Measurement of differential cross sections and C_x
and C_z for $\gamma p \rightarrow K^+ \Lambda$ and $\gamma p \rightarrow K^+ \Sigma^0$ using
CLAS at Jefferson Lab

by

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Abstract

This work presents several observables for the reactions $\gamma p \rightarrow K^+ \Lambda$ and $\gamma p \rightarrow K^+ \Sigma^0$. In addition to measuring differential cross sections, we have made first measurements of the double polarization observables C_x and C_z . C_x and C_z characterize the transfer of polarization from the incident photon to the produced hyperons.

Data were obtained at Jefferson Lab using a circularly polarized photon beam at endpoint energies of 2.4, 2.9, and 3.1 GeV. Events were detected with the CLAS spectrometer.

In the Λ channel, the cross sections support the recent observation of new resonant structure at $W = 1900$ MeV. Studies of the invariant cross section, $\frac{d\sigma}{dt}$ show scaling behavior suggesting that the production mechanism becomes t -channel dominated near threshold at forward kaon angles. The double polarization observables show that the recoiling Λ is almost maximally polarized along the direction of the incident photon from mid to forward kaon angles. While Σ^0 differential cross sections are of the same magnitude as the Λ differential cross sections, there is evidence of different physics dominating the production mechanism. The Σ^0 invariant cross sections do not show the same t -scaling behavior present in the Λ results. The double polarization observables indicate that the Σ^0 is not polarized as strongly as the Λ . They also fail to identify one preferred polarization axis.

Complete interpretation of these results will rely on model calculations. Currently available isobar models obtain varying degrees of success while attempting to predict the double polarization observables. While the models are in better agreement with the differential cross sections, discrepancies with our cross sections indicate that they must be re-optimized in light of the new data. While the data suggest that a Regge model would provide a good description of $K^+ \Lambda$ over most of the range in W , the available Regge calculation overstates the strength of the cross section and does not predict C_x and C_z correctly.

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Chapter 1

Introduction and Overview

Quantum Chromo-Dynamics, or QCD, is the currently accepted theory of the strong interaction. QCD attempts to explain a dizzying array of subatomic particles in terms of an underlying “quark” and “gluon” structure. Experimental evidence suggests that there are six flavors of quarks.

The strong interaction is weaker and easier to describe at high energies. In this regime, the quarks within a particle are seen close together. Being asymptotically close, quarks behave as if they were non-interacting (with respect to the strong interaction). This “asymptotic freedom” leads to simplifications in the underlying math of the theory. One can use perturbative techniques to produce very good first-principles solutions to QCD in high energy reactions.

QCD also simplifies for non-relativistic heavy quark states. Quarks in particles such as the Υ (a $b\bar{b}$ state), are slow moving, with respect to the center of mass frame, and can be well described using non-relativistic potential models. Newer heavy quark effective theories have also had success describing the spectrum and decays of bound states composed of both a heavy and lighter quarks, such as the B^0 meson (a $d\bar{b}$ state).

At medium energies (typically a few GeV), the strong interaction remains an enigmatic force. Here, meson and baryon degrees of freedom dominate the physics, and there is no means of simplifying the QCD equations. While progress has been made toward direct solutions of QCD using lattice methods, these calculations remain computationally intensive. There is currently no economical first-principles solution to QCD at medium energies. It is in this regime that we have studied

$$\gamma p \rightarrow K^+ \Lambda \quad (1.1)$$

and

$$\gamma p \rightarrow K^+ \Sigma^0. \quad (1.2)$$

This chapter will explain our motivation for studying $K^+ \Lambda$ and $K^+ \Sigma^0$ photoproduction from threshold up to photon energies of 3.1 GeV. We will first give a short introduction to the Λ and Σ^0 hyperons. We will discuss model calculations available to help interpret our results in light of the overlying physics issues we hope to address - the missing baryon problem and the strangeness production mechanism. Next, we will present an overview of prior experimental work on $K^+ \Lambda$ and $K^+ \Sigma^0$. We will discuss of the observables that we have measured and explain any conventions used in our study. The chapter will conclude with a brief narrative describing our activities during the past three years as we have worked on this analysis.

1.1 An introduction to the Λ and Σ^0 Hyperons

The Λ and Σ^0 hyperons are both strangeness -1 baryons. They have the same valence quark structure of (uds). The Λ is an isoscalar (isospin =0) and has a mass of 1115.6 MeV. The Σ^0 is an isovector

	Λ	Σ^0
Mass (GeV)	1115.68	1189.37
Isospin	0	1
Spin	$\frac{1}{2}$	$\frac{1}{2}$
Parity	+	+
Mean life	2.63×10^{-10} s	7.4×10^{-20}

Table 1.1: Various physical properties of the Λ and Σ^0 hyperons. Data was taken from [66].

with a mass of 1189.4 MeV. Both particles are spin 1/2 and come from the same baryon octet as the proton and neutron. More physical characteristics of these particles are summarized in Table 1.1.

The Λ has two main decay channels. The first decay is

$$\Lambda \rightarrow p\pi^- \quad (1.3)$$

and has a branching ratio of 63.9%, while the other major decay is

$$\Lambda \rightarrow n\pi^0, \quad (1.4)$$

having a branching ratio of 35.8%. The Σ^0 has one major decay,

$$\Sigma^0 \rightarrow \gamma\Lambda \quad (1.5)$$

with a branching ratio of 99.9%. The γ in the Σ^0 decay has an energy of approximately 75 MeV. This analysis will study events involving decay of the Λ to $p\pi^-$.

1.2 Interpreting Results: What We Hope to Learn

One of the main physics motivations for constructing the CLAS detector was to investigate the “missing baryon” problem. There are currently many more baryonic states predicted to exist than have been observed. In the photoproduction reactions we are studying, the photon and proton can combine and then propagate temporarily as a short-lived nucleon resonance, before decaying to a K^+ and either a Λ or Σ^0 . Which previously-observed resonances contribute to the production of our final states is currently an open question and another topic that may be addressed by our work. There are also models predicting the existence of “missing” non-strange states which decay to $K^+\Lambda$ or $K^+\Sigma^0$ [19]. Hence, the $K^+\Lambda$ and $K^+\Sigma^0$ production mechanisms may be fruitful places to search for missing resonances. Working with a dataset unprecedented in its sensitivity, this analysis hopes to ultimately shed light on these intermediate resonances, both to establish which well-known states contribute to strangeness photoproduction and also contribute to the dialog about missing resonances.

Because there is no readily accessible first-principles description of non-perturbative QCD, the interpretation of our measurements will be complicated and will ultimately rely heavily on available model calculations. Although there are numerous models available, this section will focus on three. First, we will discuss two isobar models, the Kaon-MAID model [3, 4], and the Janssen-Rykebusch model [6]. Finally, we will discuss a Regge calculation, the Guidal-Laget-Vanderhaeghen model [7].

1.2.1 Isobar Calculations

While there are a number of isobar models available, they largely take a similar approach to modeling kaon photoproduction. The basis of these calculations is an effective Lagrangian constructed around

Figure 1.1: Typical Feynman diagrams used in isobar calculations. The left-most diagram corresponds to s -channel nucleon resonance exchange. The second diagram typifies u -channel hyperon and excited hyperon exchange, while the third diagram represents t -channel meson exchange. The final diagram is a “contact” diagram required to maintain gauge invariance. Image source: [3]. The unconventional vertex labels in the figure are not used in this thesis and are explained in [3].

a selection of Feynman diagrams. Typical diagrams are shown in Figure 1.1. The models typically group their diagrams into two classes, the background and resonant diagrams. The main contribution to the background is a set of three diagrams known as the Born terms, consisting of ground-state nucleon, hyperon, and K meson exchange. By themselves, the Born terms would produce observables that wildly overshoot the measured data as one goes to higher photon energies. Reducing the strength of the Born terms then becomes an important consideration in each of these models. The strength stems from the fact that the raw models do not consider the underlying hadronic structure of the particles being exchanged. To account for this, the amplitudes are multiplied by a form factor. The form factors, in turn, require the use of various contact diagrams in order to restore gauge symmetry.

Aside from the Born terms, the models may also incorporate a selection of t - and u -channel diagrams. While all isobar models include the Born terms, the inclusion of these other background diagrams is model-dependent.

The resonant diagrams consist of s -channel nucleon resonances, N^* 's and Δ 's. The two models we will discuss here began with amplitudes suggested by multi-channel analyses, and then each model had its own criteria for the inclusion of additional diagrams. The selection of particular s -channel diagrams is important for us as this is where missing resonances may be found.

One of the main criticisms of isobar calculations is the large number of adjustable parameters in the models. The coupling constants, describing the strength of interactions at each vertex in the Feynman diagrams, are not well established quantities. The models typically extract these g_{NKY} couplings by fitting to previously published data. Other parameters, such as form factor cut-off masses are also set in these fits. For our reactions, the previously published data are largely cross sections, differential cross sections, and sparse data on hyperon recoil polarizations. Hence, the sensitivity for selecting between models is strongest for previously unmeasured observables, such as C_x and C_z .

In these next two sections, we will present more specific details of the Kaon-MAID and Janssen-Ryckebusch models.

Kaon-MAID

Kaon-MAID is maintained largely by the Center for Nuclear Studies at George Washington University.

The Kaon-MAID group based their initial selection of amplitudes on the recommendations of

Resonance	Kaon-MAID		Janssen-Ryckebusch	
	$K^+\Lambda$	$K^+\Sigma^0$	$K^+\Lambda$	$K^+\Sigma^0$
<i>s</i> -channel diagrams				
$S_{11}(1650)$	X	X	X	X
$P_{11}(1710)$	X	X	X	X
$P_{13}(1720)$	X	X	X	X
$D_{13}(1895)$	X		X	
$S_{31}(1900)$		X		X
$P_{31}(1910)$		X		X
<i>u</i> -channel diagrams				
$S_{01}(1800)$			X	X
$P_{01}(1810)$			X	X
<i>t</i> -channel diagrams				
$K^*(893)$	X	X	X	X
$K_1(1270)$	X	X	X	X

Table 1.2: This table shows the diagrams included in the two isobar models considered in this work.

numerous analyses, attempting to provide an economical description of kaon photoproduction based on the selection of a minimal number of diagrams. The amplitudes selected for inclusion in their model are listed in Table 1.2. Except for the $D_{13}(1895)$, these amplitudes were documented to contribute strongly to kaon photoproduction by published analyses. The $D_{13}(1895)$ was a later addition. It was first proposed by Capstick and Roberts [19] and included in the model to account for new structure in data recently published by the SAPHIR collaboration [4].

While attempting to minimize free parameters by utilizing SU(3) values for the Born term couplings, couplings for resonance terms were extracted by fitting to existing data. The MAID model does use form factors to reduce the strength of the Born terms at higher energies. A form factor prescribed by Habermehl [5] was adopted,

$$\hat{F} = \alpha_s F_s(\Lambda) + \alpha_t F_t(\Lambda) + \alpha_u F_u(\Lambda) \quad (1.6)$$

where the coefficients, α , were to satisfy $\alpha_s + \alpha_u + \alpha_t = 1$. The functional dependence of the form factor was chosen to be

$$F(\Lambda, q^2) = \frac{\Lambda^4}{\Lambda^4 + (q^2 - m^2)^2} \quad (1.7)$$

where m was the mass of the exchange particle; q was the invariant momentum transfer given by the square-root of the appropriate Mandelstam variable, $\sqrt{s}$, $\sqrt{-u}$, or $\sqrt{-t}$; and Λ was the form-factor cutoff mass. Use of these form factors added an additional four free parameters to be determined through fitting.

Sample differential cross section curves for $K^+\Lambda$ are shown in Figure 1.2 while differential cross sections for $K^+\Sigma^0$ are shown in Figure 1.3. The curves in these figures do not include a contribution from the $D_{13}(1895)$ resonance.

More details are available in [3].

Janssen-Ryckebusch

The Janssen-Ryckebusch model is an isobar calculation developed by Jan Ryckebusch of the University of Ghent and his student Stijn Janssen.

While choosing amplitudes for inclusion in their calculation, the Janssen group began with recommendations from multiple-channel analyses, and then varied their selection to produce the best

Figure 1.2: These plots show sample Kaon-MAID differential cross sections for $K^+\Lambda$ in bins of constant W . The solid line shows the full Kaon-MAID model, while the dashed line shows the contribution due to the Born terms and t -channel diagrams. These curves do not include contributions from the $D_{13}(1895)$. The solid squares are SAPHIR data from 1998, while the open circles are a compilation of [12] and the older world's data. The numbers on each plot indicate the midpoint of the W bin. Image source: [3].

Figure 1.3: These plots show sample Kaon-MAID differential cross sections for $K^+\Sigma^0$ in bins of constant W . The solid line shows the full Kaon-MAID model, while the dashed line shows the contribution due to the Born terms and t -channel diagrams. These curves do not include contributions from the $D_{13}(1895)$. The solid squares are SAPHIR data from 1998, while the open circles are a compilation of [12] and the older world's data. The numbers on each plot indicate the midpoint of the W bin. Image source: [3].

Figure 1.4: Total cross sections for $K^+\Lambda$. ω_{lab} is the photon energy as measured in the lab frame. The Janssen group experimented with various techniques for decreasing the effect of the Born terms at higher photon energies. In “Model A”, no u -channel diagrams were used and the form factor cutoff masses were allowed to vary unrestrained in the fitting. While this model produced a fair description of the available data, the group disfavored it because the form factors became the dominant contribution to the model behavior across a wide range of kinematics. “Model B” is the one we describe in the text. It uses form factors in conjunction with interference from u -channel diagrams to reduce the strength of the Born terms. To produce the solid curve, the $D_{13}(1895)$ was included in the calculation. The dashed line was produced without the $D_{13}(1895)$. Data are from [14]. Image source: [6].

description of previously published data (determined by minimizing a χ^2 per degree of freedom). The final amplitudes selected are summarized in Table 1.2. Although form factors were employed, the u -channel diagrams were included because they destructively interfered with the Born terms, reducing their contribution at higher energy. The inclusion of these diagrams decreased the model’s reliance on form factors. This was important as the form factors could dominate the model behavior across a wide range of kinematics if the cutoff masses were too low. While the cutoff masses were ultimately determined by fits, inclusion of the u -channel diagrams allowed lower limits to be placed on the cutoff masses.

Janssen and Ryckebusch criticized the form factors used in the Kaon-MAID model as being applicable only in the “soft photon limit,” the limit in which the photon momentum approaches 0. They opted for an alternative prescription given by

$$\hat{F} = F_s(\Lambda) + F_t(\Lambda) - F_s(\Lambda)F_t(\Lambda) \quad (1.8)$$

with the functional form of $F_x(\Lambda)$ defined by Equation 1.7.

Calculation of the total cross section for $K^+\Lambda$ is shown in Figure 1.4 and the differential cross section for $K^+\Sigma^0$ is shown in Figure 1.5. More details of the model are available in [6].

1.2.2 Guidal-Laget-Vanderhaeghen Regge Model

While retaining some similarities to the previously mentioned isobar models, the main feature of Regge calculations is t -channel exchange. Somewhere above the resonance region, the kaon production mechanism becomes dominated by t -channel meson exchange. Regge models, then are designed

Figure 1.5: Differential cross sections for $K^+\Sigma^0$. The solid line corresponds to “Model A”, as described in Figure 1.4. “Model B” is the dashed line and is the model described in the text. “Model C” removed constraints applied to coupling constants and allowed them to vary unstrained in the fits. This model is indicated by the dashed line. ω_{lab} is the photon energy as measured in the lab frame. Data are from [14]. Image source: [6].

Figure 1.6: These K and K^* trajectories contribute to the Guidal-Laget-Vanderhaeghen model. Image source: [7].

to replicate this t -channel dominance.

Although Regge models are an effective Lagrangian approach, the Lagrangian is not based on a selection of s -, u -, and t -channel Feynman diagrams. Instead, the standard propagators in the Lagrangian are replaced Regge propagators. The Regge propagators feature Regge trajectories, parameterizations of an entire families of particles which are exchanged in the t -channel. Multiple trajectories may be incorporated into a model, with the trajectories being allowed to interfere against each other.

Regge models have long been used at energies well above the resonance region where t -channel dominance is most evident. Our data do not exactly fit into this regime. However, it is felt that the transition from a production mechanism dominated by s -channel resonances to one dominated by t -channel exchanges occurs at a center of mass energy of $W=2.2$ - 2.5 GeV [3]. Our data span this transition region up to $W=2.6$ GeV. Guidal, Laget, and Vanderhaeghen claim that their model is useful above $E_\gamma=4$ GeV. We employ the model in this work, not expecting it to exactly replicate our data, but to guide the interpretation of our data in terms of the t -channel.

The Guidal-Laget-Vanderhaeghen model that will be used in this work is based on two Regge trajectories, a K and K^* trajectory. The trajectories are shown in Figure 1.6. Diagrams for s -channel nucleon exchange are also included in the model to maintain gauge invariance.

Differential cross section computed with this model are shown in Figures 1.7 and 1.8. The $K^+\Lambda$ cross sections are shown in Figure 1.7, while the $K^+\Sigma^0$ cross sections are shown in Figure 1.8. Further information about the model is available in [7].

1.3 Past Experimental Results in the $K^+\Lambda$ and $K^+\Sigma^0$ Channels

While $K^+\Lambda$ and $K^+\Sigma^0$ photoproduction have been studied for more than 40 years, new accelerator and detector technologies have revolutionized the quality of the world's dataset for these reactions. The SAPHIR collaboration conducted the first modern study of $K^+\Lambda$ and $K^+\Sigma^0$ using an electromagnetic probe and a large acceptance spectrometer. There were three results published by the SAPHIR group, one in 1994 [13], a second in 1998 [14] and the final analysis in 2003 [15]. The

Figure 1.7: $K^+\Lambda$ differential cross sections. The solid lines correspond to the full Guidal-Laget-Vanderhaeghen model, while the dashed curves show the contribution from the K^* trajectory. Data are from [11] and were taken at photon energies of $E_\gamma = 5, 8, 11, 16 \text{ GeV}$ (with upper curve corresponding to lower photon energy), which is well above the energy range of our data. Image source: [7].

Figure 1.8: $K^+\Sigma^0$ differential cross sections. The solid lines correspond to the full Guidal-Laget-Vanderhaeghen model, while the dashed curves show the contribution from the K^* trajectory. Data are from [11] and were taken at photon energies of $E_\gamma = 5, 8, 11, 16 \text{ GeV}$ (with upper curve corresponding to lower photon energy), which is well above the energy range of our data. Image source: [7].

1994 data was re-analyzed and published a second time in the 1998 paper. First studies of $K^+\Lambda$ and $K^+\Sigma^0$ with the CLAS detector were the thesis work of John McNabb and Rob Feuerbach. John McNabb analyzed photoproduction data, publishing differential cross sections and hyperon recoil polarizations [20]. Rob Feuerbach measured electroproduction response functions extracted from the differential cross sections [21]. CLAS has also measured the transferred polarization in $K^+\Lambda$ electroproduction [67]. Despite being an electroproduction measurement, this last result should mimic our C_x and C_z results in low- Q^2 limit. This section will begin by summarizing pre-SAPHIR data, and then will discuss the 1998 and 2003 SAPHIR results individually. The CLAS work of John McNabb will be summarized and then this section will end with a discussion of the CLAS $K^+\Lambda$ polarization transfer measurements.

1.3.1 Pre-SAPHIR

$K^+\Lambda$ and $K^+\Sigma^0$ photoproduction were studied by several groups during the 1960's. A number of these experiments were conducted with small-acceptance magnetic spectrometers. Such experiments detected the K^+ , and then identified the hyperons from missing mass. Photon tagging was not available at the time, so the groups relied on various techniques, such as strong collimation or the bremsstrahlung endpoint method, to determine the initial photon energy or work around it. While such experiments were best suited to measuring differential cross sections, attempts were made to integrate these results and produce a total cross section. These experiments were conducted at numerous facilities: Low energy data (from threshold and several hundred MeV beyond) were taken at Cornell [8] and CalTech [9]; data from MIT (Cambridge) [10] were taken with photon energies of 3-4.0 GeV; and high energy data ($E_\gamma = 5 - 16$ GeV) were recorded at SLAC [11].

A particularly interesting result from Stanford is shown in Figure 1.9. Here, the quantity $(s - M^2)^2 \frac{d\sigma}{dt}$, where M is the proton mass, has been plotted as a function of $\sqrt{-t}$ for $K^+\Lambda$. Although the data plotted were taken at four different photon energies, the curves all lie on top of each other. This behavior is a signature for t -channel dominance in the production mechanism. From their work, the group pointed out that the data could not be interpreted in terms of only one Regge trajectory.

A second technique, and the one used by the ABBHHM collaboration [12], was to use a hydrogen bubble chamber. Because the bubble chamber was capable of detecting the K^+ and all charged particles in a hyperon decay, this experiment did not need to measure the incident photon energy. Working at DESY, the ABBHHM collaboration measured differential and total cross sections. A sampling of their results is shown in Figure 1.10.

By modern standards, these earlier efforts were low statistics experiments. Even the ABBHHM results, which were the most statistically precise, were only based on a few hundred events. In short, the previous results consisted of a handful of data-points. Coverage was incomplete, and the data were coarsely binned.

1.3.2 SAPHIR, 1998

The SAPHIR detector (see Figure 1.11) was a multi-particle spectrometer that took data at the 3.5 GeV electron stretcher ring at Bonn, Germany. The detector was equipped with a photon tagging system that spanned 53% to 90% of the electron endpoint energy. Particles were initially tracked by a system of drift chambers which immediately surrounded the target. The drift chambers provided full angular coverage, even at extreme forward and backward angles. A normal-conducting c-shaped magnet was used to provide momentum resolution. The drift chambers were surrounded on three sides by scintillator hodoscopes used for time-of-flight measurements. In the forward direction, an electromagnetic shower calorimeter was used for photon detection. A beam veto counter, also in the forward direction, kept the detector from triggering on photons not interacting with the target. More details are available in [18].

Figure 1.9: $K^+\Lambda$ differential cross sections obtained at SLAC. Despite having been taken at differing energies, the data lie along identical curves when scaled by $(s - M^2)^2$, where M is the proton mass. Image source: [11].

Figure 1.10: These plots show data from the ABBHHM study of strange particle photoproduction. (a) shows the $K^+\Lambda$ and $K^+\Sigma^0$ total cross sections. (b) shows the $K^+\Lambda$ differential cross sections while (c) shows $K^+\Sigma^0$ differential cross sections. Image source: [12].

Figure 1.11: Schematic diagram of the SAPHIR detector.

For the 1998 analysis, data was taken at electron endpoint energies of 1.6, 1.7, and 2.2 GeV. The trigger required of a scattered electron in the tagger with no signal from the veto counter and at least two charged particles striking the scintillator hodoscopes. The final state detected, for both channels, was $K^+p\pi^-$. Events satisfying a kinematic fit and vertex cuts were selected for the analysis.

The published results include total cross sections, differential cross sections, and hyperon polarizations. The differential cross section results for $K^+\Lambda$ are shown in Figure 1.12, while the $K^+\Sigma^0$ are shown in Figure 1.13.

The 1998 results were a large improvement over the previously available world's data. The results were unprecedented in sensitivity and kinematic coverage. They were soon taken up by modelers, and isobar calculations were re-tuned to reflect the new data. The most interesting interpretation of the SAPHIR data came from the Kaon-MAID group. They focused on the structure at $W = 1900$ MeV seen in the $K^+\Lambda$ total cross section, shown in Figure 1.14. Previous data were insensitive to this structure, and initial versions of Kaon-MAID failed to reproduce the new trend. After incorporating the new SAPHIR results into their database, the Kaon-MAID group claimed that they required an additional resonance, the $D_{13}(1895)$, to recreate the bump [4]. While the $D_{13}(1895)$ had been predicted to exist by Capstick and Roberts [19], it was a previously unobserved, or “missing” baryon. The claim has been disputed by other theorists, but the Janssen-Ryckebusch group also claims their model favors the $D_{13}(1895)$ [6]. This was the first hint of some new baryonic structure hiding in the $K^+\Lambda$ production mechanism.

1.3.3 SAPHIR, 2003

Aside from publishing initial results in 1998, the SAPHIR collaboration redoubled their efforts and took additional data. For this run, the photon tagging system of their detector was reworked to drop the lower limit on their tagging sensitivity from $.53E_e$ to $.32E_e$. They also added additional downstream drift chambers to improve track reconstruction in the forward direction and worked to improve the drift chamber simulation for their acceptance calculation. The data were taken with an endpoint energy of 2.6 GeV.

The analysis procedure was similar to that used on the 1998 data. Events were analyzed having a $K^+p\pi^-$ final state. Events were required to satisfy a kinematic fit and number of vertex cuts. New in the 2003 analysis were additional cuts placed on the $p(\gamma, K^+)Y$ missing mass and the $p\pi^-$ invariant mass.

This most recent dataset was a factor of 5 larger than the data taken to produce the 1998 publication. They not only extended their kinematic coverage to higher photon energies, but also increased the statistical sensitivity of their measurements over all kinematics. The total cross section for $K^+\Lambda$ is shown in Figure 1.15 while the cross section for $K^+\Sigma^0$ is shown in Figure 1.16.

In the years from 1998 to 2004, the supposedly observed $D_{13}(1895)$ resonance was a controversial topic. Groups had found alternate methods for explaining the bump in the earlier data [17, 16]. As shown in Figure 1.15, this structure persisted at $E_\gamma = 1.45$ in the 2003 result. With the new result, the collaboration claimed they also saw a rise at backward kaon angles at this same photon energy. They claimed that this rise was also attributed to the $D_{13}(1895)$ by the Kaon-MAID group.

1.3.4 CLAS Initial Analysis of $K^+\Lambda$ and $K^+\Sigma^0$ Photoproduction

A first analysis of $K^+\Lambda$ and $K^+\Sigma^0$ photoproduction using the CLAS detector was the thesis work of John McNabb [57, 20]. McNabb analyzed photoproduction data taken with an endpoint energy of 2.4 GeV. His results consisted of differential cross sections and hyperon polarizations. While paralleling the SAPHIR results, the CLAS dataset was much larger. This enabled the resonant structure interpreted as the $D_{13}(1895)$ to be observed for the first time in the differential cross section, as shown in Figure 1.17.

Figure 1.12: $K^+\Lambda$ differential cross section results from SAPHIR published in 1998. Bands on the bottom of the plot represent systematic errors. The solid curves are Legendre polynomial fits to the data. Image source: [14]

Figure 1.13: $K^+\Sigma^0$ differential cross section results from SAPHIR published in 1998. Bands on the bottom of the plot represent systematic errors. The solid curves are Legendre polynomial fits to the data. Image source: [14]

Figure 1.14: $K^+\Lambda$ total cross section from SAPHIR published in 1998. The superimposed curves are from the Kaon-MAID model. The dashed line is the model without the $D_{13}(1895)$ while the solid line includes the $D_{13}(1895)$. The black squares are the new SAPHIR data taken from [14]. The empty circles are a compilation of older data primarily based on [12]. Image source: [4]

Figure 1.15: $K^+ \Lambda$ total cross section results from SAPHIR published in 2004. Image source: [15]

Figure 1.16: $K^+\Sigma^0$ differential cross section results from SAPHIR published in 2004. Image source: [15]

Figure 1.17: CLAS $K^+\Lambda$ differential cross section from the McNabb analysis. The main feature of this plot is the structure near $W = 1950$ MeV. The SAPHIR result from 1998 [14] is systematically lower than the CLAS result at this kaon angle. Image source: [57].

Figure 1.18: CLAS $K^+\Lambda$ differential cross section as a function of kaon angle from the McNabb analysis. The CLAS [57] and SAPHIR [14] results agree well at backward angles, but diverge in the forward direction. Image source [57].

There were also important discrepancies between the CLAS and SAPHIR result. For certain kinematic configurations, the CLAS cross sections were higher than SAPHIR's, as shown in Figure 1.18. This effect is most prevalent when the McNabb results are compared to the SAPHIR's 1998 data. The improvements to the SAPHIR program undertaken between 1998 and 2003 seem to have increased the strength of the SAPHIR cross sections in the later result. The agreement between the CLAS and SAPHIR 2003 results is an improvement, but there are still large discrepancies which can affect the interpretation of the differential cross sections. This is particularly important in the forward direction, where the data are critical for establishing the role of the t -channel in the production mechanism.

The present work will analyze more than twice the amount of data covered by the McNabb analysis. We will extend the differential cross sections to higher values in photon energy (3.1 GeV), and measure the double polarization observables C_x and C_z .

1.3.5 CLAS $K^+\Lambda$ Electroproduction

Although electroproduction is described with a different formalism, a few recent results from CLAS suggest interesting parallels between photoproduction and electroproduction of $K^+\Lambda$.

The first analysis was done by Robert Feuerbach while a graduate student at Carnegie Mellon University [21]. He analyzed electroproduction response functions extracted from the differential cross sections according to:

$$\frac{d\sigma_v}{d\Omega_K} = \sigma_T + \epsilon\sigma_L + \epsilon\sigma_{TT}\cos 2\phi_K + \sqrt{2\epsilon(\epsilon+1)}\sigma_{LT}\cos\phi_K \quad (1.9)$$

where the T and L subscripts refer to the polarization state of the virtual photon, and ϕ is the angle between the scattering plane and the reaction plane as defined in Figure 1.19. ϵ is the polarization

Figure 1.19: Electroproduction axis conventions as used in the Feuerbach analysis. ϕ_K is the angle between the scattering plane and the reaction plane. Image source [21].

of the virtual photon and is defined by:

$$\epsilon = \left(1 + 2 \frac{|\mathbf{q}|^2}{Q^2} \tan^2 \left(\frac{\theta_e^{lab}}{2} \right) \right)^{-1} \quad (1.10)$$

where $|\mathbf{q}|$ is the magnitude of the virtual photon's three-momentum, Q^2 is the square of the virtual photon's four-momentum, and θ_e^{lab} is the scattering angle of the electron in the lab frame. Feuerbach extracted the three response functions, $\sigma_T + \epsilon\sigma_L$, $\epsilon\sigma_{TT}$, and $\sqrt{2}\epsilon(\epsilon + 1)\sigma_{LT}$ by fitting the $\cos \phi_K$ behavior of the cross section.

A sample of the Feuerbach results is given in Figure 1.20. This figure shows the three response functions plotted as a function of W for one kaon angle bin. The “dip bump” near $W=1.9$ GeV in the $\sigma_T + \epsilon\sigma_L$ was previously unobserved. This structure occurs at the same value of W as the new bump in the SAPHIR $K^+\Lambda$ total cross section result that was interpreted as evidence for the “missing” $D_{13}(1895)$.

Led by Dan Carman, the CLAS collaboration has also published the first measurement of the transferred polarization, P'_x and P'_z , in $K^+\Lambda$ electroproduction [67]. These observables quantify the polarization transfer from the incident electron to the recoiling hyperon.

The accelerator delivered a polarized electron beam at an energy of $E_e = 2.567$ GeV. Λ hyperons were identified in the $p(e, e'K^+)X$ missing mass. The transferred polarizations were extracted by using the beam helicity asymmetry

$$A_\zeta = \alpha\eta P_\zeta \cos(\theta_{pY}) \quad (1.11)$$

where α is the Λ weak decay asymmetry parameter, η is the electron beam polarization, and θ_{pY} is the angle of the decay proton in the hyperon rest frame. ζ indicates the choice of axis used to reference the proton angle, and may be either $\hat{x}$ or $\hat{z}$. This analysis technique for extracting the transferred polarizations is nearly identical to the one we have used to extract C_x and C_z , as shown in in Chapter 5.

The Carman result is shown in Figure 1.21. This Figure shows the result plotted for two different axis conventions. On the left, P'_x and P'_z are for the z -axis aligned along the meson momentum in the center of mass frame. On the right, P'_x and P'_z are for the z -axis lying along the direction of the virtual photon that mediated the reaction. P'_z is strong, almost maximally polarized. Having the z -axis lie along the virtual photon momentum provides a more natural set of axes to describe the reaction.

These new observables may be compared to isobar calculations describing $K^+\Lambda$ electroproduction. However, interpretation in terms of missing resonances will have to wait until the models are re-tuned to reflect the new observables.

Figure 1.20: Virtual photoproduction response functions as a function of W from the Feuerbach analysis. The black squares are the Feuerbach data [21], while the curves are model calculations: dot-dashed magenta - Janssen [6], solid red - KAON-MAID [3]. Two Regge calculations using the Guidal-Laget-Vanderhaeghen model [22] are shown in blue: dotted - using only K exchange; dashed - using both K and K^* exchange. Image source [21].

Figure 1.21: CLAS measurements for transferred polarization in K^+A electroproduction. On the left, P'_y and P'_x are the polarization measurements for $\hat{z}$ along the meson momentum. The results on the right, P'_z and P'_x , are for $\hat{z}$ along the virtual photon momentum. The high value of P'_z , accompanied by a near-zero P'_x suggests that this is the more natural axis convention. The curves on the plots correspond to various isobar models: dotted - Williams, Gi, and Cotanch; dashed - Kaon-MAID (98); solid - Kaon-MAID (02) [3]; dot-dashed - Janssen-Ryckebusch [6]. See [67] for references to the earlier models. Image source: [67].

The Carman results plotted in Figure 1.21 are integrated over all Q^2 and kaon angles. The lowest Q^2 measured was $Q^2 = 0.3$ GeV. Extrapolating these results to predict the behavior of C_x and C_z would be clearer if the data were binned in Q^2 , however we would expect our data to mimic the Carman result, showing maximum polarization along the incident photon momentum.

1.4 Measurement Conventions of this Study

The axis conventions that we adopted for our study of photoproduction of these two hyperons are outlined in Figure 1.22.

Figure 1.22(a) shows the center-of-mass system (CMS). After the γp interaction, we have a K^+ and neutral hyperon, Y , traveling back-to-back with equal and opposite momenta. This reaction takes place in a single plane, which we call the production plane, defined by the photon and K^+ momenta. The angle between the γ and the kaon momenta is an important quantity in this analysis and will be referred to as θ_{KCM} .

In the CMS, there are two axis conventions common in the literature [1, 2, 6]. The first, which we will call the unprimed axes, has $\hat{z}$ lying along the photon momentum. The second set, the primed axes, has $\hat{z}$ lying along the K^+ momentum. Once $\hat{z}$ is assigned, the definitions for the $\hat{y}$ and $\hat{x}$, in either frame, easily follow:

$$\hat{y} = \hat{p}_\gamma \times \hat{p}_K, \quad (1.12)$$

where $\hat{p}_\gamma$ is the direction of the photon momentum and $\hat{p}_K$ is the direction of the kaon momentum. Note that $\hat{y}$ is the same direction, using primed or unprimed axes. Finally, $\hat{x}$ is in the production plane normal to $\hat{z}$,

$$\hat{x} = \hat{y} \times \hat{z}. \quad (1.13)$$

These axes are important in the extraction of C_x and C_z . While either convention could be used, we preferred the unprimed axes, with $\hat{z}$ along the photon momentum, as suggested by [67].

One final angular quantity that we measured is depicted in Figure 1.22(b). The polar angle of the final state proton's momentum was measured in the rest frame of either the Λ or Σ^0 hyperon. This angle will be referred to as θ_{pY} . Depending on the observable being measured, this angle will be referenced to either the $\hat{x}$ of $\hat{z}$ axis as defined in the center-of-mass frame.

1.5 Observables in Hyperon Photoproduction

Hyperon photoproduction is conventionally described by four complex amplitudes. These amplitudes, in turn, are sufficient to define a total of sixteen observables. The observables are listed in Table 1.3. In the reactions we are studying, there are three particles that may be polarized - the incident photon (the beam), the proton (or target), and the recoiling hyperon. As shown in the Table, these observables are divided into groups of four, largely based on polarization. The first group consists of the differential cross section $\frac{d\sigma}{d\Omega}$, and three single polarization observables - the hyperon recoil polarization, P ; the linearly polarized photon asymmetry, Σ ; and the polarized target asymmetry, T . The other three groupings are double polarization observables and require knowledge of two polarizations - beam and target, beam and hyperon, or target and hyperon.

It is not necessary to measure all sixteen observables in order to obtain complete experimental information about a given reaction. Eight carefully chosen observables will enable a unique determination of the underlying complex amplitudes. The conventional prescription is to measure $\frac{d\sigma}{d\Omega}$, the three single polarization observables (T, P, Σ), and an additional 4 double polarization observables, with no more than three double polarization observables coming from the same set [23].

This analysis has measured the differential cross sections and completed the first measurements of C_x and C_z for $K^+\Lambda$ and $K^+\Sigma^0$. C_x and C_z are double polarization observables tracing the transfer of polarization from the incident circularly polarized photon to the recoiling hyperon. While these

Figure 1.22: Axes used in this analysis. (a) shows the axes defined in the CMS system. Two conventions are prevalent in the literature [1, 2]. The unprimed system has the z -axis along the photon momentum, while the primed has the z -axis along the K^+ momentum. The angle between the photon momentum and the kaon momentum is referred to as θ_{KCM} . (b) shows the hyperon rest frame. The proton direction, referenced from either the z - or x -axis, is referred to as θ_{pY} .

Observable	Required Polarization		
	Beam	Target	Hyperon
Single Polarization			
$\frac{d\sigma}{d\Omega}$	-	-	-
Σ	linear	-	-
T	-	along y'	-
P	-	-	along y'
Beam and Target Polarization			
G	linear	along z	-
H	linear	along x	-
E	circular	along z	-
F	circular	along x	-
Beam and Hyperon Polarization			
$O_{x'}$	linear	-	along x'
$O_{z'}$	linear	-	along z'
$C_{x'}$	circular	-	along x'
$C_{z'}$	circular	-	along z'
Target and Hyperon Polarization			
$T_{x'}$	-	along x	along x'
$T_{z'}$	-	along x	along z'
$L_{x'}$	-	along z	along x'
$L_{z'}$	-	along z	along z'

Table 1.3: Groupings of polarization observables. Table adapted from [1].

observables are conventionally measured with respect to the primed axes shown in Figure 1.22(a), this analysis has adopted the unprimed axis convention. When this analysis began, we were using the primed convention. However, we tried the unprimed axes after seeing the results from Carman *et al.* (see [67] and Section 7). They permit a more natural description of the polarization transfer. Most of the theoretical papers developing the photoproduction formalism have adopted the primed axes and use the names $C_{x'}$ and $C_{z'}$. To be clear about our choice of axes, we use the names C_x and C_z .

These double polarization observables are measured with respect to axes that lie in the production plane, $\hat{x}$ and $\hat{z}$. Hence, C_z measures the polarization transfer along the photon momentum, and C_x measures the same transfer along the orthogonal unit vector. For an unpolarized photon beam, parity only allows the hyperon to be polarized normal to the production plane, in the $\hat{y}$ direction. However, with a circularly polarized photon beam, parity no longer forbids hyperon polarization in the production plane, allowing C_x and C_z to be non-zero.

1.6 Overview of 3 Years' Work

This thesis represents the combined efforts of many people, so I have opted to write in first person plural for the most part. However, this section is to be a brief description of my particular research activities, so I will write in first person singular.

I began work on $K^+\Lambda$ and $K^+\Sigma^0$ in the January of 2002. The G1C dataset was still being calibrated then, and I spent 6 months working closely with Luminita Todor to verify the quality of the calibrations. For each data run, I reviewed a suite of diagnostic histograms and reported. At the time, the photon normalization was still an issue, so I assisted with some studies of the normalization and helped process the data with an initial version of the G-flux code. Finally, I also filtered the dataset for the first time.

My code development really began in the summer of 2002. Much of the next year was spent working on the analysis software and fitting routines that handled yield extraction. During the code development, I became dissatisfied with the performance of the standard CLAS particle identification routines. In particular, I felt that less restrictive criteria would allow the identification of more kaons. As a result, I wrote my own particle identification scheme at this time.

By the spring of 2003, I had produced initial measurements of all observables. The Medium Energy Group at CMU had established the QCDcluster and I wrote scripts to run all of my analysis and acceptance calculations on these computers. I spent the next six months taking a second look at the observables. I studied all of the analysis cuts and worked to optimize background rejection while minimizing the loss of actual $K^+\Lambda$ and $K^+\Sigma^0$ yield. At this time, I also studied the binning. Initially, I used the same binning for both hyperons. However, in an attempt to improve the Σ^0 double polarization observables, I implemented a second binning scheme that was unique to that hyperon.

2004 was spent studying the cross section results. During much of my last year at CMU, we worked on resolving differences between my differential cross sections and the earlier results of John McNabb. Realizing that John and I had used the incorrect version of the CLAS offline software in our acceptance calculations, I produced new acceptance calculations for this analysis, and John McNabb's cross section analyses, which included $K^+\Lambda$, $K^+\Sigma^0$, and π^+n . The new acceptance was used in a revised version of John's cross sections. When we realized that the filtered version of the G1C dataset I was using had been corrupted by software bugs, I re-filtered the entire dataset.

The fall of 2004 and early winter of 2005 was spent writing this document.

1.7 Summary

The reactions $\gamma p \rightarrow K^+\Lambda$ and $\gamma p \rightarrow K^+\Sigma^0$ are receiving renewed interest after not having been studied since the 1960's. Large acceptance detectors, such as CLAS, SAPHIR, GRAAL, and SPRING-8, are measuring cross sections with unprecedented sensitivity and precision. In addition, polarized beams are permitting the first measurements of additional observables, such as C_x and C_z , pushing us toward complete experimental information about these reactions.

While the complicated math of non-perturbative QCD keep us from having rigorous theoretical explanations of the available data, the use of Regge and isobar calculations has provided hints about which resonant states contribute to $K^+\Lambda$ and $K^+\Sigma^0$. Interpreting the newer SAPHIR cross sections and polarization data with isobar models has hinted that the $S_{11}(1650)$, $P_{11}(1710)$, and $P_{13}(1720)$ make strong contributions in the s -channel. While structure appearing for the first time in SAPHIR's measurement of the $K^+\Lambda$ total cross section has been interpreted as possible evidence for a "missing" $D_{13}(1895)$ resonance, this existence of this state remains controversial.

This work will contribute significantly to the debate on the $K^+\Lambda$ and $K^+\Sigma^0$ production mechanisms by measuring differential cross sections and making first measurement of the double polarization observables C_x and C_z .

Chapter 2

Jefferson Lab, CEBAF, and the CLAS Detector

The data analyzed were taken as part of the G1C run period during the fall of 1999 at the Thomas Jefferson National Accelerator Facility, in Newport News, Virginia. G1C simultaneously collected data for a handful of hadron spectroscopy experiments which could be conducted under similar running conditions. This analysis concerns experiment E-98-004, “Electromagnetic Production of Hyperons” [24].

General running conditions called for a photon beam incident on a proton target. Photon beams were a joint venture of the CEBAF accelerator and Hall B photon tagging system. CEBAF provided electron beams that were used to produce the photon beams using a bremsstrahlung technique. Because bremsstrahlung photons are not mono-energetic, the photon tagger was used to determine the energy of photons interacting in the target. For G1C, data was taken at three different endpoint energies of the electron accelerator, 2.445, 2.897, and 3.115 GeV. The beam was circularly polarized for the 2.4 and 2.9 GeV datasets.

The detector used was the CEBAF Large Acceptance Spectrometer (CLAS), also housed in Hall B. CLAS provided a large acceptance spectrometer optimized for the detection of multi-particle final states over approximately 80% of the 4π solid angle. The combination of the continuous nature of the CEBAF accelerator and the acceptance of CLAS has produced the world’s largest dataset permitting study of $K^+\Lambda$ and $K^+\Sigma^0$ over an unprecedented range of kinematics.

This chapter provides details of the experimental setup including the accelerator, Hall B beamline and photon tagger, and the CLAS detector itself.

2.1 The Continuous Electron Beam Accelerator Facility (CEBAF)

The Continuous Electron Beam Accelerator Facility (CEBAF) began delivering beam for physics experiments in 1996 and is the heart of Jefferson Lab. Electromagnetic probes had been used in the 1960’s at such facilities as SLAC, Illinois, Cambridge and DESY. However, these were low-duty factor machines. As the early electron accelerators were decommissioned, hadron accelerators became the dominant type of accelerator for the next few decades. It was not until the 1980’s that particle physicists again took an interest in electromagnetic probes. Although the electromagnetic interaction would not produce desired events as copiously as the strong interaction, new technology used in Jefferson Lab’s CEBAF partially offset the lower interaction rates.

The main new technology employed at CEBAF was the superconducting radio frequency (RF) cavity used to provide the accelerating gradient. Traditional copper RF cavities are resistive and

Figure 2.1: Pair of typical CEBAF superconducting RF cavities. The cavities, shown here with associated support hardware and beam pipe, were marked by the elliptical cavities perpendicular to the beam pipe. Once completely assembled, the cavities were immersed in liquid helium inside a cryomodule. The liquid helium chilled the cavities -271°C , a temperature at which the niobium cavities were superconducting. The accelerator consisted of 338 such superconducting cavities [29].

require a significant time to cool between beam spills. The superconducting cavities at CEBAF are non-resistive, resulting in an accelerator that achieves a duty factor of 100%. Constant delivery electrons results in the acquisition of high statistics datasets quickly, even at relatively low currents. This makes CEBAF the ideal accelerator for running coincidence experiments, which are complicated by higher currents.

Polarized beam production at CEBAF began at the injector. The injector consisted of a photo-emission electron gun, an RF accelerating cavity, and a chopper. The CEBAF electron gun actually used three diode lasers, one for each experimental end-station. The three-laser arrangement permitted each experimental hall to have independent control of its current and beam polarization. The lasers were independently pulsed at 499 MHz, 120° out of phase. The laser pulses were fixed to give the accelerator an overall frequency of 1497 MHz, with a frequency of 499 MHz to any one experimental station [26]. To users in a specific experimental hall, this meant that they received bunches of electrons once every 2 ns. Laser pulses were temporally 60-80 ps, FWHM [27]. The combined laser pulses were then used to illuminate a GaAs photocathode, which produced the bunches of electrons. The resulting electron bunches were accelerated to 45 MeV [28] by two superconducting radio-frequency cavities and packaged by an optical chopper before being sent to the recirculating linacs of CEBAF.

The heart of the CEBAF accelerator was the superconducting RF cavity. A picture of a typical RF cavity assembly is shown in Figure 2.1. These cavities were constructed of niobium and chilled to -271°C , a temperature at which they were superconducting [29]. Klystrons were used to set up radio frequency standing waves in these cavities, providing the accelerating gradient for the electron beam. The RF waves in the cavity had a frequency of 1497 MHz and were in phase with the beam's electron bunches so that there was always a positive electric force on an electron bunch as it crossed an RF cavity. A diagram showing how this worked is given in Figure 2.2. Each RF cavity had its own klystron and control package to allow optimal tuning of phase and accelerating gradient [28].

CEBAF's recirculating linacs were each composed of 168 RF cavities. There were two linacs laid out in parallel along the "straightaways" of CEBAF's 7/8 mile racetrack course [29]. At the time the G1C dataset was accumulated, each linac was capable of 400 MeV acceleration. The linear accelerators were connected by nine recirculation arcs, allowing the beam to make a total of five passes through both linacs, for a maximum energy of 4.045 GeV [28]. Subsequent improvements to the accelerator have since increased the maximum beam energy to 6 GeV today (2005). A graphic

Figure 2.2: Microwave radiation supplied from klystrons was fed into the RF cavities to establish a standing wave. The frequency and phase of the waves were set so that there was always a positive electric force on an electric force on an electron bunch as it propagated through an RF cavity [29].

presenting an overview of the major accelerator components is given in Figure 2.3.

Beam for the experimental halls was extracted by RF separator cavities. All three halls could run at the maximum accelerator energy, or individual halls could choose to have their beam extracted after fewer passes through the accelerator. This gave each hall control over its beam energy; any hall could specify an energy that was equal to an integral number of passes through the accelerator plus the initial injector acceleration. It should be noted that two halls could run lower than the maximum energy, but they could not run at the same energy because the separators only extracted beam for one hall on any given pass. Any number of halls could run at maximum energy [28]. Extracted beam was then directed toward the individual experimental halls, Hall A, B, or C.

Establishing polarized beam of well-defined helicity states to the three halls was a difficult task. Electron spins would precess in the magnetic fields used to bend and steer the beam. The beam magnets had to be well mapped and understood so that the spin precession of the beam could be accounted for in the delivery. The injector had to be properly tuned, and only specific combinations of beam energies would allow simultaneous delivery of polarized beam having a well-determined helicity state to the three halls [30].

2.2 Hall B and the CLAS Detector

Hall B is the smallest of the three experimental end-stations at Jefferson Lab. Although the experimental hall has housed other detectors, the main tenant of Hall B is the CEBAF Large Acceptance Spectrometer, or CLAS detector. Aside from the detector and its associated electronics, the hall also contains the photon tagger, beamline, and a suite of beam diagnostic tools.

Upon entering the experimental hall, the electron beam was directed toward the photon tagger. The photon tagger used the electron beam to produce a beam of bremsstrahlung photons. This beam went on to interact with the liquid hydrogen in the CLAS cryotarget. Products resulting from interactions were tracked and studied by CLAS.

This section will provide an overview of the photon tagger, CLAS detector, and the beamline devices.

HOW CEBAF WORKS

Figure 2.3: Beam starts at the injector before making an integral number of passes through the recirculating linear accelerators. Beam of the desired energy is extracted independently for each experimental hall. Graphic taken from [25].

Figure 2.4: Layout of the Hall B photon tagging system. The main components of the system include the radiator, magnetic spectrometer, and collimators. Image source: [32].

2.2.1 The Photon Tagger

Production and energy determination of the photon beam was handled by the Hall B photon tagging system. The tagging system was comprised of a radiator and a large magnetic spectrometer, and a series of collimators. A schematic diagram of the tagging system is shown in Figure 2.4.

Radiator

The tagging system had an array of seven different radiators available. All radiators were gold foils, ranging in thickness from 1×10^{-6} to 1×10^{-4} radiation lengths. G1C production data was taken with the thickest radiator, 1×10^{-4} radiation lengths, while lower intensity “normalization” runs were taken with a radiator of 2×10^{-5} radiation lengths [33].

Tagger Spectrometer

After striking the radiator, the beam was a mix of electrons which did not interact in the radiator, recoiling electrons, and photons. The tagger magnet swept electrons out of the beam, allowing photons to continue toward the CLAS cryotarget. The tagger magnet was a normal-conducting dipole that produced a maximum field of 1.75 T. The magnet was designed to provide momentum resolution of 2×10^{-4} , although the overall tagger e^- momentum resolution was ultimately limited to be $.001 \times E_\gamma$ by the hodoscope planes. The magnet was tuned to direct full-energy electrons (those which did not interact with the radiator) toward a beam dump, while lower-energy recoiling electrons were bent at greater angles toward the two hodoscope planes of the spectrometer.

The two hodoscope planes were similar in construction, but differed in purpose. Both planes were composed of arrays of scintillator paddles, arranged like the slats in a venetian blind. The scintillators were positioned so that their working surfaces were normal to the local trajectory of a recoiling electron. The first scintillator plane was the “E-plane” and was used for momentum

Figure 2.5: Diagram of the photon tagging system, showing the relative position of the radiator and tagger spectrometer. Note the trajectories for electrons of varying fractional recoil energy. The geometry and segmentation of the T- and E-counters are also accurately depicted in the two hodoscope planes. Image source: [32]

determination of the recoiling particles. It contained 384 individual scintillator paddles that were 20 cm long, 4 mm thick, and from 6 to 18 mm wide. Because the trajectory of a recoiling electron in the magnetic field was a function of the electron's momentum, different regions in space along the hodoscope plane corresponded to differing electron energies. Hence, the passage of an electron through a given scintillator paddle provided a measure of the particle's momentum. By overlapping the momentum regions subtended by sequential scintillator paddles, the E-plane had 767 logical paddles, providing energy resolution of 0.1% of the incident electron energy. The function of the second plane, or "T-plane" was to take accurate timing measurements of the recoiling electrons. The T-plane had 61 plastic scintillator paddles 2 cm thick and from 9 to 20 cm wide. The widths of these paddles were varied so that counting rate in each paddle was uniform, despite the $1/E_\gamma$ drop-off of the energy spectrum of bremsstrahlung photons. The timing resolution of the tagger spectrometer was 110 ps. The spectrometer was capable of tagging photons of 20% to 95% of the incident electron beam energy. A diagram of the tagger, showing trajectories for recoiling electrons of various fractional energies is given in Figure 2.5.

Signals from the scintillator paddles were readout by photomultiplier tubes. The t-counter PMT signals were forwarded to a Phillips 715 constant fraction discriminator. Signals satisfying the discriminator were then fed to the "Master OR" (MOR) and an array of FASTBUS TDC's. The Master OR was a large "OR" gate accepting input from all 61 t-counters. The MOR was one of the main inputs of the G1C trigger and will be discussed later in Section 2.2.4. The TDC array was used to count the total number of hits registering in the tagger for purposes of computing the photon normalization. Timing information provided by the T-counters was also used to associate the correct photon with an event, as multiple photons per event were typically written to tape during readout. The E-counter signals were discriminated by a Phillips 6816 amplifier discriminator unit and then forwarded to a multi-hit TDC. The timing signals from the E- and T-counters were recorded during event readout and used during offline data analysis to establish coincidence between the signals. A schematic diagram of the tagger front-end electronics is given in Figure 2.6.

While the energy of the recoiling electron gave a measure of photon energy, the tagger timing

Figure 2.6: Diagram of the photon tagging system readout electronics. Both T- and E-counter signals were discriminated and analyzed by TDCs. The “E to T counter Mapping Logic Module” was used to establish coincidence between E- and T-counter hits as an input to the CLAS trigger. This coincidence was not used during the G1C run period. The prescaling gate was used to effectively turn off regions of the tagger during the 2.9 and 3.1 GeV data taking. Image source: [32]

information was used during offline analysis to produce an accurate determination of the event start time. The tagger time signal was used to correctly identify the beam bucket to which a given event corresponded; the 110 ps resolution of the tagger was adequate to uniquely identify a beam bucket. The accelerator RF signal was the most accurate time signal in the experimental setup, so the “RF time” was recorded by a TDC within Hall B for each beam bucket. Once an event had been correlated with its proper beam bucket, the RF time was propagated temporally to the event’s interaction vertex to yield the event’s “vertex time”.

During data collection, the low-energy portion of the tagger was temporarily disabled on a periodic basis. This was done to increase readout of events with higher-energy photons. While this tagger “prescaling” was not done with the 2.4 GeV dataset, it was implemented on groups of runs in the 2.9 and 3.1 GeV datasets.

More detail about the tagging system and spectrometer can be obtained from [32].

Collimators

The photon beam passed through a pair of collimators (see Figure 2.4) on its way to the CLAS target. Between the first and second collimator, the beamline was equipped with sweeping magnets to remove charged particles created in the first collimator as photons interacted with the collimator walls. During G1C, the first collimator was 8.61 mm in diameter and was positioned 5.8 m from the radiator. The second collimator was 17.3 mm in diameter and was positioned 8.84 m from the radiator [57]. The collimators were used to trim beam halo.

2.2.2 The CLAS Detector

The CLAS detector was used to track and detect reaction products. To accomplish this, the detector utilized several subsystems. There was an inner start counter, three layers of drift chambers, an outer scintillator shell for time-of-flight measurements, and a Cherenkov detector and two electromagnetic calorimeter packages in the forward direction. A superconducting toroidal magnet enabled measurements of track momentum. Additionally, the physics target was also found at the center of CLAS.

CLAS has been used for a wide spectrum of experiments, and not all of them use every detector subsystem. For example, photon experiments make use of a start counter to provide a fast timing measurements as charged particles leave the target. During electroproduction experiments, this device is removed from CLAS altogether. The Cherenkov detector is largely used for electron-pion separation during electroproduction experiments. The analysis being discussed here made use of the start counter, drift chambers, and outer scintillator shell, while ignoring the Cherenkov detector and calorimeters. The discussion in this section will be limited to the CLAS target, toroidal magnet, and the aforementioned detector subsystems employed by this analysis. Information about the Cherenkov detector and calorimeters can be readily obtained from other documents [31, 34, 35, 36] and will not be given here.

The CLAS Cryotarget

A variety of liquid and solid target materials have been used with CLAS since it began taking data. G1C’s target material was liquid hydrogen. The target cell consisted of a cylindrically shaped cell made of kapton that was designed and fabricated by CLAS technician Steve Christo. To keep the hydrogen in its liquid state, the target made use of a cryogenic system built by collaborators from Saclay, France. A picture and diagram of the target cell are shown in Figure 2.7.

For our analysis, we were required to know the length of the target cell and the density of the liquid hydrogen. The target cell dimensions were surveyed by Steve Christo after construction and the length was taken to be 17.85 cm. We conducted a study of the target density based on temperature and pressure readings for the target recorded in the CLAS online database. The final

Figure 2.7: Diagram of the g1 target cell. Cell design and construction was done by Steve Christo. Image source: [37].

Dataset	Density ($\frac{g}{cm^3}$)
2.4 GeV	$(7.11 \pm 0.01) \times 10^{-2}$
2.9 GeV	$(7.078 \pm 0.008) \times 10^{-2}$
3.1 GeV	$(7.07 \pm 0.02) \times 10^{-2}$

Table 2.1: Density of liquid hydrogen in the CLAS cryotarget for the various G1C endpoint energies.

density measurements for each G1C dataset are shown in Table 2.1. Details of the study are given in [38].

The Start Counter

Event timing in CLAS was best determined by the RF signal of the accelerator. Timing information from the tagger T-counters was correlated with timing measurements from the RF TDC to identify which beam bucket was responsible for producing a photon. This RF time was then propagated temporally to the center of the CLAS target to produce the “tagger vertex time”. The tagger vertex time was calculated after data acquisition during offline analysis. Triggering in photon runs required prompt information about an event’s start time; the start counter was designed to provide this signal. The start counter consisted of three pairs of scintillator “coupled-paddle” detectors that surrounded the CLAS target. Within each sector, the start counter covered an angular range of $7^\circ < \theta < 145^\circ$ and $-29^\circ < \phi < 29^\circ$ [39]. The “coupled-paddle” design was unique to CLAS and was implemented to improve the detector’s acceptance in the forward direction. Typical scintillation detectors are instrumented with two PMT’s per paddle, one at each end of the scintillator. Such a design in the CLAS start counter would have required six PMT’s downstream of the target, significantly obscuring the forward angle acceptance of the overall detector. The “coupled-paddles” then actually linked the scintillator paddles for two adjacent sectors through the use of a “nose” in the far forward direction. The coupled paddles were then instrumented with two PMT’s, but only upstream of the target, in the shadow of the cryostats for the toroidal magnet. A schematic drawing of the CLAS start counter is shown in Figure 2.8

As with any scintillation detector, timing differences in the two PMT signals were used to calculate a position of the track along the length of the coupled paddles.

The Superconducting Toroidal Magnet

The superconducting toroidal magnet was one of the most important systems in the spectrometer, both structurally and scientifically. The magnetic field, combined with the tracking system, was used for momentum determination of charged particles traversing CLAS. The toroid was also the single most important element in the detector geometry. A picture of the bare torus coils is shown in Figure 2.9.

The magnet was comprised of six kidney-shaped superconducting coils, separated azimuthally by 60° . The magnet had a peak current of 3861 A and produced a peak field of 3.5 T. The magnetic field pointed in the azimuthal direction around the beam. The default or “normal field” configuration was to run the field such that negatively charged particles were deflected toward the beam pipe while positively charged particles are bent away from the beampipe. By reversing the current direction, the opposite field configuration was achievable, and is referred to as “reverse field”. The magnet is cooled to an operating temperature of 4.4 K using helium supplied by the central CEBAF helium refrigerator.

The torus coils themselves were some of the most important structural elements in the detector. The drift chambers were mounted directly to the cryostats, and in some cases (Region 2) bore the stress of the wire tension. The torus cryostats also regulated the geometry of the fiducial region of the

START COUNTER COUPLED-PADDLE

Figure 2.8: CLAS start counter with cut-away to show coupled scintillator paddle and PMT. Image source: [39].

detector. The coils determined the sector boundaries; electronics and other non-sensing components of other detector systems were constrained to fit in the shadow regions created by the torus cryostats.

During G1C, the torus was run in “normal field” mode with a nominal current of 1920 A.

More details of the torus are given in [40].

Drift Chambers

Tracking of charged particles in the fiducial region radially outward from the start counter was provided by three layers, or “Regions” of drift chambers. Region 1 was the inner-most chamber and was positioned radially below the torus cryostats in a region of low magnetic field. Region 2 was mounted directly to the cryostats and sat in the region of high magnetic field. Region 3 was the furthest radially from the target and was again in a region of low magnetic field. Figure 2.10 gives a horizontal profile of CLAS showing the positions of the drift chambers relative to the torus cryostats. Each region was divided into two “superlayers”, one superlayer with the wires oriented axially with respect to the magnetic field direction, and the second superlayer having the wires tilted at a 6° stereo angle. In Region 1, the stereo superlayer was closer to the beam, while Regions 2 and 3 had the axial layers closer. Within each superlayer, there were typically six layers of drift cells, with neighboring layers being offset by half a cell width.

Each sector contained 5,858 individually-instrumented hexagonal drift cells. The sense wires were made of 20 μm gold-coated tungsten and were located at the center of the hexagonal cells. Six field wires, made of 140 μm gold-plated aluminum alloy wire, surrounded each sense wire. The field wires were held at negative high voltage while the sense wires were maintained at a positive potential. The drift gas was a 90%/10% Argon-CO₂ mixture, chosen because it was non-flammable.

Signals from the sense wires were first fed to preamplifiers, located on the chambers, and then to

Figure 2.9: The bare coils for the CLAS toroidal magnet in place on the steel carriages that hold the detector. None of the other detector systems have been installed in this picture. The cross members were actually thick carbon-fiber posts. Protective aluminum covers, in place at the time this picture was taken, make these cross members appear artificially large. Image source: [41].

Figure 2.10: Cut-away diagram of CLAS showing the positions of the various detector packages. Structures labeled “Region 1”, “Region 2”, and “Region 3” are the drift chambers. The “TOF” is the outer scintillator time-of-flight detector. In the forward direction, the “CC” is the Cherenkov counter, while the “EC” is the electromagnetic calorimeter. The kidney-shaped structures sketched with dashed lines represent projections of magnet’s cryostats. Image source: [42].

amplifier discriminator boards (ADB), located on the CLAS support frame. Discriminated signals were then channeled to the timing electronics, comprised mainly of LeCroy 1877 TDCs.

More information about the construction and performance of the drift chambers is given in [42, 43, 44, 45].

Time of Flight Scintillator Shell

The outer layer of the CLAS “onion” was a segmented scintillator shell that was roughly four meters from the cryotarget. Each sector had 57 scintillator bars mounted in four panels as shown in Figure 2.11. The scintillators in the most forward direction, where counting rates were the greatest, were 15 cm wide, while counters corresponding to a scattering angle greater than 45° were 22 cm wide. The bars varied in length from 32 to 445 cm and were mounted so that their lengths projected perpendicularly onto the beamline. All bars were 2 inches thick in order to provide 100% detection of minimum-ionizing particles.

The scintillators were each instrumented with two photo-multiplier tubes, one on each end. The PMT’s were mounted in the shadow of the magnet’s cryostats, to keep them out of the fiducial region of the detector. The PMT’s interface the scintillator bars with the help of short lightguides made of lucite. Although most of the scintillator paddles were individually instrumented, the last eighteen in the backward direction were instrumented in pairs; two scintillators per pair of PMT’s.

The timing resolution of the scintillator shell was from 80 to 160 ps and was a function of the counter lengths; longer counters had poorer resolution. More details on the construction and performance of the TOF system may be found in [46].

The time-of-flight shell provided a vital timing measurement for each track as it left the CLAS detector. Due to the nano-second scale speed at which signals from scintillators may be collected, the time-of-flight shell was a key input of the CLAS photon trigger. Offline, the TOF signal was a key component of the particle identification that we have implemented in this analysis.

2.2.3 Beamline Devices

Aside from the main CLAS detector, the physics program in Hall B required the use of numerous beamline devices. Upstream from CLAS, beam position monitors, harps and current measuring devices were used to monitor beam quality. Downstream, the total absorption shower counter (TASC), pair spectrometer (PS), and pair converter (PC) were used to measure photon flux.

Beam Position Monitors

The pickup for the beam position monitors (BPM’s) was a normal-conducting RF cavity operating at 1497 MHz. The beam position monitors provided an x and y position measurement with a resolution of less than 0.1 mm and a current measurement. The BPM’s were capable of monitoring beam over a current range from 1 to 100 nA. The BPM’s reported at a rate of 1Hz [47]. Signals from the BPM’s were used in continuous feedback loops to constantly ensure acceptable beam positions during data acquisition.

Three BPM’s are installed on the beamline, at 36.0, 24.6, and 8.2 m upstream from the target. During photon experiments, only the first two BPM’s were functional [31].

Harps

Harps provided a means of studying the beam profile. The harps in Hall B consisted of a pair of wires oriented to scan the beam profile in orthogonal directions. Electrons scattered by the harp wires could be detected by just about any detector element in the Hall, but the standard device was an array of PMT detectors located downstream from the harps. The wires in the harp were made of both tungsten and iron. Three harps were located at 36.7, 22.1 and 15.5 m and the PMT array

Figure 2.11: Scintillator shell for one CLAS sector. The scintillator rods were mounted in four panels that cover scattering polar angles from 8° in the forward direction to 142° . The PMT's shown lie in the shadow of the cryostats for the toroidal magnet. In the forward direction and extreme backward direction, smaller PMT's and straight lightguides were used. Everywhere else, the light guides were bent 90° to accommodate larger PMT's. Image source: [46].

Dataset	e^- Beam Polarization
2.4 GeV	0.654 ± 0.013
2.9 GeV	0.641 ± 0.012
3.1 GeV	No reliable measurements

Table 2.2: e^- beam polarization measurements. The polarization was measured three times for the 2.4 GeV dataset, so the number shown is the weighted mean of all three measurements and the standard deviation is reported as the error. Only one measurement was made for the 2.9 GeV dataset. Individual measurements were retrieved from the Hall B Electronic Logbook [50].

was placed at 6.8 m, all upstream from the target. Harp scans would disrupt the beam and could only be performed while the data acquisition system was not running [31].

Møller Polarimeter

In order to provide a measurement of beam polarization close to the CLAS cryotarget, Hall B was equipped with a Møller polarimeter. The polarimeter itself consisted of a permendur target, two normal-conducting quadrupole magnets, and an array of scintillators instrumented with photomultiplier tubes. A diagram of the system and photographs are given in Figure 2.12.

The polarimeter exploited the helicity dependence of Møller scattering to determine the beam polarization. The target material was polarized with a Helmholtz coil producing a magnetic field of approximately 100 gauss. The polarimeter then measured the rate of elastic $e^- + e^- \rightarrow e^- + e^-$ events. Scattered electrons were collected by two quadrupole magnets, and both electrons were detected by the scintillator arrays. The beam helicity asymmetry, A , was then used to determine the beam polarization according to

$$A = \frac{N_+ - N_-}{N_+ + N_-} = A_z P_B^z P_T^z \quad (2.1)$$

where $N_{\pm}$ are the helicity-dependent yields, $A_z = 0.7826 \pm 0.0079$ is the analyzing power of the polarimeter target, and $P_T^z = .08$ is the polarization of the target material [48].

The Møller polarimeter played a key role in this analysis. Although the polarimeter could not directly measure the polarization of the photon beam used during the G1C run period, the polarization of the electron beam was used to calculate the photon beam polarization (see section 5.3). Use of the polarimeter was invasive and disrupted the beam; data acquisition was suspended during a Møller measurement. The measurements were made by Arne Freyberger and recorded in the Hall B Online Logbook [50]. During the 3.1 GeV run period, we were unable to obtain accurate measurements of the electron beam polarization due to problems with the data acquisition system that interfaced with the Hall B Møller polarimeter. This dataset was excluded from the double polarization measurements (C_z and C_x). We do have measurements for the 2.9 GeV and 2.4 GeV run periods which are shown in Table 2.2.

Total Absorption Shower Counter

The total absorption shower counter (TASC) consisted of four lead glass blocks assumed to have perfect detection efficiency for photons. The glass was made of 55% PbO and 45% SiO₂ and had a radiation length of 2.36 cm. The blocks were each $10 \times 10 \times 40$ cm and were mounted in a 2×2 array with the longest dimension positioned parallel to the beam. Each block was individually instrumented with a Philips XP4312B phototube.

Although the TASC was used to obtain an absolute measure of the photon flux, it could only be used at beam currents lower than 100 pA. During production data taking, the TASC was removed from the beamline. It was inserted periodically during lower-intensity “normalization” runs.

Figure 2.12: Figure 2.12(a) shows a schematic diagram of the polarimeter as it looked from above. The pictures in 2.12(b) show both ends of the Møller polarimeter. The top image shows the polarimeter target and first quadrupole magnet from an upstream observation point. The lower image shows the scintillation detectors and downstream quadrupole magnet from a downstream vantage. Image source: [49].

More details about the TASC can be found in [32] and [31].

Pair Spectrometer

The pair spectrometer (PS) consisted of a large aperture dipole magnet, an aluminum converter and an array of eight scintillator paddles. The converter resided within the field of the dipole magnet. As photons struck the converter, they produced e^+e^- pairs, which the magnetic field swept out of the beamline and directed toward the scintillator paddles. Two converters were made of aluminum and had thicknesses of 1% or 2% radiation lengths. The scintillators were positioned so that the PS would detect e^+e^- pairs over the full energy range of the tagger spectrometer. The segmentation of the counters gives the spectrometer a degree of energy discrimination.

The pair spectrometer was used to measure the photon flux at higher beam intensities than was possible with the TASC. The PS was cross calibrated against the TASC during low-intensity runs, but then remained in the beamline during higher intensity runs of several nano-amperes.

Pair Counter

The pair counter was another device which remained in the beamline when nano-amp beam was being delivered to the Hall. The counter consists of a 1.5% converter positioned in the beam upstream of four scintillator paddles. The scintillator paddles were paired in groups of two with each paddle overlapping its partner. One pair of scintillators was positioned horizontally producing a vertical stripe of overlapping scintillator. The second pair of paddles was vertically oriented to produce a horizontal band of overlapping scintillator. The scintillators were fixed in position with respect to each other, but the whole assembly could be swept through the beam by the use of a stepper motor. The pair counter was equipped with a veto to keep the system from counting charged particles not originating in the converter. The pair counter did not play a role in establishing the photon flux; it was primarily used to study the beam profile and position near the beam dump.

2.2.4 Triggering and Data Acquisition

The previous sections mentioned the first level of readout electronics applied to each detector system; each system had its unique package of electronics to monitor active components, discriminate, and collect signals. Above this level of electronics, the detector was controlled by the trigger and data acquisition system. The trigger looked at preliminary signals from the faster detector elements to decide which events should be recorded. Events passing the trigger were then packaged and written to magnetic tape by the data acquisition system.

This section will discuss the function of the trigger electronics and the data acquisition system. Significant differences exist in detector triggering between electron and photon experiments; discussion of this section will be limited to photon running. An overview of the conditions for electron experiments is given in [31].

The Level I trigger provided an initial gate of the readout electronics based on prompt signals from the tagger, start counter, and time-of-flight scintillators. For G1C, the Level I trigger required at least one charged track through CLAS. Tracks were identified by comparing signals from the detectors to pre-defined bit patterns. The trigger required three memory lookups. The first two lookups correlated information from the start counter and the time-of-flight scintillators within a single sector (all 6 sectors being processed in parallel). The third memory lookup then attempted to correlate a possible event with a hit in the tagger and further information from all six sectors. The average time it took to process an event with the Level I trigger was 90 ns.

The data acquisition and readout is shown schematically in Figure 2.13. Once an event satisfied the Level I trigger, the data acquisition was gated and began to read out the event. Signals from the individual detector elements within CLAS were digitized and then read out by 24 VME readout controllers (ROC's). Data tables from the various systems were then sent to the CLAS online

Figure 2.13: Signals from the detector subsystems were assembled by readout controllers (ROC's) and arranged into fragments. These fragments are packaged into an event by the Event Builder (EB). Event Transport (ET1) makes the events accessible to a variety of online subprocesses and monitors (managed by ET2 and ET3) from a bank of shared memory. The Event Recorder (ER) is responsible for writing the data to tape. Image source: [31].

acquisition computer in the control room. The Event Builder (EB) running on the acquisition computer collected the data tables. The EB associated the tables into banks, and packaged the event into its final form before depositing it in a shared memory bank on the online computer. The Event Transport (ET) system managed the shared memory and made events available to a number of online monitoring processes. It is also from this shared memory that the Event Recorder took delivery of events and wrote them to magnetic tape on the Jefferson Lab tape silo system [31].

At the time G1C was acquired, the data acquisition system was capable of running at a maximum rate of approximately 2.5 KHz. At the time, the limiting factor was the VME readout electronics. Subsequent improvement in readout electronics have since made the data acquisition capable of running at 4.5 KHz, with the limit now being set by the maximum 25 MByte/s rate at which data can be written to disk.

Events were assembled into “runs” and individual events within a run were tagged with a unique event number. Although run sizes varied greatly, a typical run contained roughly 3 million events. Ideally, the length of a data run was determined by the shift workers in the control room, however runs were often ended prematurely due to unforeseen troubles, such as the DAQ system crashing. Once written to tape, runs were saved as a collection of sequentially-numbered 2 GB files, a typical run comprising roughly 10 files. A 2 GB file contained roughly 300,000 events.

Assuming perfect running conditions would be naive. Systems were bound to fail during data acquisition, and the shift workers were expected to monitor and correct such problems. At all times, the control room was staffed by two workers. Workers were expected to maintain an online logbook, noting unforeseen troubles and detailing their solutions. Workers also were given the opportunity to record comments at the beginning and end of a run. Finally, a more informal method of collecting pertinent information was the “run progress file”. The run progress file was a simple text file maintained by the shift workers containing basic information about each run, such as the number of triggers in the run or the beam current at the time the run was taken. The progress file may often contain informative notes marking trouble with running conditions or the DAQ system [51].

2.3 Summary

This analysis required the production and observation of a sample of $K^+\Lambda$ and $K^+\Sigma^0$ events. The production employed the CEBAF accelerator to indirectly produce a beam of polarized photons that interacted with the CLAS cryotarget. The observation of those events was handled by the drift chambers and scintillators of the CLAS detector. Additional pieces of information about the total photon flux incident on the target and the incident e^- beam polarization was provided by the beamline devices. After data acquisition, all the information required to produce final results was sitting in data files at Jefferson Lab. The pieces of the puzzle were sitting in an unopened box, waiting to be arranged into their proper positions. The offline data analysis, detailed in the next three chapters, became the process of solving this puzzle.

Chapter 3

Data Reduction and Yield Extraction

The G1C dataset was collected in the fall of 1999 by the CLAS collaboration. The dataset comprised 7.5 terabytes of disk space and consisted of 4.5 billion triggers. Although the collaboration carefully monitored the data as it was collected, much remained to be done before the data could be used for analysis. The next step, called “cooking”, was a round of offline analysis in which the data were put into a usable form. During cooking, the various detector subsystems, including the drift chambers, time-of-flight system, and RF, were calibrated. Events were reconstructed, tracks were identified, four-vectors were calculated, and a first round of particle identification was implemented. G1C took two months to collect, but two years to cook properly. The cooking was handled by Luminita Todor, a CMU post-doctoral researcher stationed at Jefferson Lab. It was after the cooking had been completed that our physics analysis began.

This chapter will describe our data reduction and event selection procedures. We will begin by explaining the filter we used to reduce the datasets to a more manageable size. Each step of the event selection will then be documented, from particle identification all the way to yield extraction. Although this analysis measured three different observables, there were only minimal differences in the determination of particle yields for each measurement. Differences will be noted throughout the chapter and then summarized again at the end. This chapter will not go beyond particle yield extraction; discussion of the final steps required to complete a particular measurement will be reserved for Chapters 4 and 5. The cooking process has been documented elsewhere, [52, 54], and will not be detailed here.

3.1 Excluded Files

Run numbers defining each dataset within G1C are given in Table 3.1.

Dataset	First Run	Last Run
2.4 GeV	21763	21982
2.9 GeV	21427	21611
3.1 GeV	20926	21359

Table 3.1: Runs in this table were included in our analysis, excluding files listed in Table 3.2. Data from CLAS were grouped into “runs”. Runs usually consisted of several million events.

Before any data analysis began, a summary of the data quality was made to determine if any part of the data should be excluded from this analysis. Grounds for ignoring a data file included corruption of a file after acquisition, failure of a major detector system during data acquisition, or a file was taken as a diagnostic and was not intended for physics analysis. We investigated particle yields as a function of tagger T-counter looking for problematic yield fluctuations. Detector operator comments in the online log and progress files were also searched to identify problems that may affect the quality of specific files. Finally, a data file was required to have an associated normalization vector before being admitted into this analysis. A list of excluded files is given in Table 3.2. Every other data file falling within the ranges of run numbers specified in Table 3.1 was used in the analysis.

3.2 Event Filter

The G1C dataset was taken with the intention of analyzing more than $K^+\Lambda/\Sigma$ photo-production. The run period simultaneously took data for several proposed analyses; the trigger simply accepted every event that had one potential charged track. Hence, $K^+\Lambda/\Sigma^0$ events constitute only a small fraction of G1C. In addition, the data were stored in a total of 6497 files written to data tapes in the Jefferson Lab tape silo. Simply retrieving this many files from the Jefferson Lab mass storage system, independent of any time required to do analysis, would typically take at least two weeks to one month. Use of a filtered dataset, then, greatly simplified analyzing $K^+\Lambda/\Sigma$ events in the following ways:

- Realized savings in processor time required to analyze the data.
- Permitted concatenation of dataset into a smaller number of files. Fewer files made the dataset easier to handle.
- Further simplified the mechanics of the analysis process by allowing storage of data locally at CMU. The data could have been processed at Jefferson Lab, but we would have had to compete with a large user community for computing resources. At CMU, we had adequate CPU power that was much more available. In addition, the locally managed facilities proved more reliable than those at JLab.

To this end, an event filter was authored for this analysis. This section will discuss the filter event selection criteria and performance.

3.2.1 Basis of Filter

The filter selected events based on two physical criteria:

1. First, the event had to contain a potential positive kaon.
2. Second, the event had to show evidence of a Λ or Σ hyperon in the $p(\gamma, K^+)Y$ missing mass.

Possible kaons were identified through a timing cut. The timing quantity of interest was a particle's "time-of-flight", the time it took a particle to travel from its production vertex to the scintillator layer at the outer edge of the CLAS detector. The filter compared two approaches to determine a track's time-of-flight. The first method was to directly measure the time-of-flight using times measured with CLAS. The second method used an assumed mass in conjunction with a track's measured momentum and flight-path to calculate a hypothetical time-of-flight. If the two times-of-flight were in good agreement, then the particle's identification was consistent with the mass hypothesis from the second method.

In the first method, the time-of-flight, tof_1 , was directly measured by subtracting the tagger vertex time of the event from the time at which the track struck the CLAS time-of-flight scintillator layer. The particle's speed, β_1 , and measured mass, m_1 , derived from this time-of-flight and

Dataset	Run	File
2.4 GeV	21786	6
	21832	8
	21836	8
	21839	9
	21862	0
	21867	9
	21882	6
	21905-21908	all
	21941	all
	21966	all
2.9 GeV	21446	9-12
	21447	0-1
	21449	all
	21523	0
	21524-21535	all
	21548	all
	21563-21567	all
	21614-21615	all
3.1 GeV	20933	all
	20947	all
	21031	4
	21045	0
	21057	all
	21063	12
	21066-21071	all
	21120	10
	21139	2
	21140	12
	21151	3
	21172	12
	21210	10
	21215	10
	21218	2-3
	21224	0
	21233	3
	21239	3
	21256	6
	21260	0
	21261	all
	21326	all
	21339	9

Table 3.2: Files and runs excluded from data processing. Runs were subdivided into two-gigabyte files that were sequentially numbered.

momentum will be useful in this discussion. The length of the particle's flight path, d , through the detector was determined from the track fitting procedure and combined with this tof_1 to measure the track's speed,

$$c\beta_1 = \frac{d}{tof_1}. \quad (3.1)$$

Here, β_1 is the canonical ratio of the particle's speed to the speed of light, c . We calculated a measure of the particle's mass, m_1 , using β_1 and the particle's momentum, p ,

$$m_1 = \frac{p}{\beta_1 \gamma c}. \quad (3.2)$$

Note that m_1 is a function of tof_1 and d through β_1 .

A second prediction of time-of-flight was based on the assumption that the particle had a given mass, m_2 . For purposes of identifying a particle, m_2 was typically taken to be the known mass of a proton, pion, or kaon. In the context of this filter, m_2 was the charged kaon mass, 493.68 MeV/c². We use the track's momentum, p , and path length through CLAS, d , to calculate a time-of-flight as

$$tof_2 = \frac{d}{\beta_2 c}. \quad (3.3)$$

We then substituted relations for the particle's computed speed, β_2 , and d , the measured path length. β_2 was given as a function of the particle's measured momentum, p , and mass as

$$\beta_2 = \frac{p}{\sqrt{(m_2 c)^2 + p^2}} \quad (3.4)$$

The assumed mass, m_2 , entered the calculation at this step. d was related to tof_1 and p through Equation 3.1:

$$d = tof_1 \beta_1 c = tof_1 \frac{pc}{\sqrt{(m_1 c)^2 + p^2}}. \quad (3.5)$$

Substituting Equations 3.4 and 3.5 into Equation 3.3, a second expression for the time-of-flight was given by

$$tof_2 = \frac{d}{\beta_2 c} = \frac{d \sqrt{(m_2 c)^2 + p^2}}{pc} = tof_1 \sqrt{\frac{(m_2 c)^2 + p^2}{(m_1 c)^2 + p^2}}. \quad (3.6)$$

When the difference in tof_1 and tof_2 is small, a particle's identity is revealed by the mass hypothesis, m_2 . We expressed this difference in times of flight as

$$\Delta tof = tof_1 \left(1 - \sqrt{\frac{(m_2 c)^2 + p^2}{(m_1 c)^2 + p^2}} \right). \quad (3.7)$$

A particle was selected to be a candidate kaon when the absolute value of Δtof was less than 1 ns for m_2 equal to the kaon mass. An example of the time-of-flight difference spectrum as a function of momentum is shown in Figure 3.1.

The second selection criterion of the filter was then to look at the missing mass recoiling against the potential kaon. Once a potential kaon was selected, its momentum four-vector was corrected for energy lost as it passed through the target, target wall, carbon beam pipe, and the air gap between the target and Region 1 drift chambers. This correction employed the "e-loss" package written by Eugene Pasyuk from Arizona State University [53]. The missing mass recoiling against the kaon was then calculated with the energy-loss corrected kaon momentum vector. If this missing mass lay between 0.90 GeV/c² and 1.35/c² GeV, then the event was likely a $K^+ \Lambda / \Sigma$ event. These events

Figure 3.1: K^+ particles were identified by a ± 1 ns cut on the Δtof parameter when a kaon mass hypothesis was used in the calculation. Using this technique, actual kaons should have had a Δtof close to 0, producing the kaon band that lies along the $\Delta tof = 0$ line. The white lines illustrate this cut. The Δtof parameter was calculated with a kaon mass hypothesis for any positive particle, producing the p and π^+ bands shown in the figure. The cut was generous and did not exclude a number of higher momentum π^+ ; these particles were removed later in the analysis. The fainter unlabeled vertical band on the left in the figure is due to a bad tagger element. Note that the z -scale of the above plot is logarithmic in order to show the kaon band. The above plot contains data from one unfiltered data file.

Figure 3.2: $p(\gamma, K^+)Y$ missing mass from the filtered 2.4 GeV dataset. Data in this are the subset of filtered events containing a proton in the final state. This is the subset of filtered events that will be treated in this analysis. Aside from the proton stipulation, no other analysis cuts have been applied. The background is largely due to mis-identified pions.

Dataset	Pre-skim	Post-skim
Size (GB)	7570	177
Number of Files	6497	401

Table 3.3: Size of the G1C dataset and number of datafiles before and after skimming.

were written to an output file. A typical $p(\gamma, K^+)Y$ missing mass spectrum for a filtered dataset is shown in Figure 3.2.

As discussed in Section 2.2.1, there were typically several photons associated with an event. Although only one of these photons was actually responsible for the event, the filter did not attempt to determine which was the proper photon. Because the best start time for an event came from the tagger vertex time, and each photon had different timing information, the filter simply looped through all photons and accepted an event if any particle-photon combination satisfied the two above criteria. Further handling of multiple photons associated with an event is discussed in Section 3.3.1.

3.2.2 Filter Performance

The filter resulted in a significantly more manageable dataset. As shown in Table 3.3, the filtered dataset was 43 times smaller than the original unfiltered set. Running independently of the Jefferson Lab scientific computing facilities, the entire filtered dataset could be analyzed in approximately 12 hours using one 1.4 GHz processor, or in 3-4 hours using the CMU analysis cluster. The unfiltered data took one month to analyze using Jefferson Lab computing resources.

3.3 Event Selection

The filtered dataset was then subjected to a more selective analysis. This analysis was a multi-step process designed to identify $K^+\Lambda$ and $K^+\Sigma^0$ events and eliminate background. The first step was to identify the photon likely to have produced the event. We then identified potential kaons and protons by cutting on the time-of-flight for each track. As misidentification of pions as kaons was the major source of our background, we verified our kaon identification with a simple algorithm designed to detect and reject misidentified pions. At this stage, we applied fiducial cuts and knocked out problematic time-of-flight counters in the cross section analysis. Having performed the particle identification on individual tracks, the final cut looked for a pion (from the Λ decays) in the $\gamma(p, K^+p)X$ missing mass. In what follows, the analysis cuts and particle identifications are detailed.

3.3.1 Photon Selection

For photo-production experiments, two differing methods could be used to determine the time at which an event took place. The first method was to use the tagger vertex time. The tagger T-counters were used to determine which beam-bucket produced a given photon. The RF time at which this beam bucket arrived at the tagger was then propagated to calculate the time at which the resultant photon arrived at the center of the CLAS target. The final step in determining the tagger vertex time was a small correction to propagate the photon time from the center of the target to the interaction vertex. The tagger vertex time was the most correct determination of an event's start time, provided that the correct photon had been associated with an event.

An alternative determination of an event's start time was to use the vertex time provided by the start counter. The start counter was the first detector system that a charged particle would trigger after it left the target. Timing information from the start counter could be propagated backward temporally to the moment that the event took place by using a track's momentum and vertex position.

One would expect a high degree of agreement between the tagger vertex time and the start counter vertex time if the correct photon had been selected. The data fulfilled this expectation, as shown in Figure 3.3. Counts in the large central peak in Figure 3.3 showed good start time coincidence; the photon involved was likely the one that triggered the event being considered. Photons having a "status word" 7 or 15 in the TAGR bank and satisfying a ± 1 ns cut on the timing difference between the tagger vertex time and the start counter vertex time of any track in the event were selected.

It was possible that multiple photons from any given event could pass the tagger/start counter selection cut. The effect was studied by monitoring the number of multiple photon events during data processing. From a random sampling of runs from each dataset, it was estimated that approximately 2.32% of all events had multiple "good" photons. While we could have made an attempt to find the one correct photon for an event, we felt that later steps in the analysis would likely filter out incorrect photon choices. The tagger T-counters only triggered on one particle until they were reset. Hence, for two photons to have similar timing information, they must have come from different T-counters corresponding to different groups of e-counters, and therefore must have different energies. An incorrect photon may have passed the γ selection timing cut, but it is unlikely that it would yield a missing mass lying under the Λ or Σ^0 peak. Thus, both photons were "kept", causing an event to be analyzed twice. However, it is unlikely that the event was counted twice in the extracted yields.

3.3.2 Minimum Momentum Cut

Before attempting any particle identification, we placed a cut on the minimum momentum of a track that we would consider in our particle identification routines. This minimum, for all particle types, was set at 250 MeV/c.

Figure 3.3: Tagger vertex time subtracted from the start counter vertex time is plotted above. The large peak centered at 0 demonstrates a good tagger/start counter coincidence; photons in this peak are consistent with production of the track that generated the corresponding start counter vertex time. A cut of ± 1 ns, shown by the vertical lines, was used to select these photons. The 2 ns structure of the beam bunches from the accelerator is evident here; the smaller peaks not centered at 0 occur at every 2 ns. Counts in these peaks demonstrate photons which were in the wrong beam bucket to produce the event being considered and are, thus, out of time by a multiple of 2 ns.

3.3.3 Initial Kaon and Proton Identification

Having selected a likely photon, we then identified probable kaons and protons. The basis of the particle identification was the timing cut discussed in Section 3.2.1. For each positive track associated with an event, we calculate two Δtof parameters, one for a kaon mass hypothesis and the second for a proton mass hypothesis. The time of flight for each track was measured by subtracting the tagger vertex time for the current photon from the scintillator time for each track. Again, probable kaons were identified using a ± 1 ns cut on the Δtof for the kaon mass hypothesis. An example of the time-of-flight difference as a function of particle momentum using the kaon mass hypothesis is shown in Figure 3.1.

A time-of-flight difference spectrum as a function of track momentum for all particles using a proton mass hypothesis is shown in Figure 3.4. As shown in the figure, there are two tails in the proton band at lower momentum. These tails are due to energy loss, which is a large effect in the low momentum protons. Although energy loss corrections were used in this analysis, they could not be used in the timing-based particle identification to correct the tails. To avoid cutting a large number of these lower-momentum protons, we used a momentum-dependent timing cut to identify protons. This cut was defined by

$$T_p = 30e^{\left(\frac{-p}{0.4\sqrt{p}}\right)} + 0.75, \quad (3.8)$$

where p was the momentum of the track being considered. T_p is given in nanoseconds. When the absolute value of Δtof was less than T_p , then the track was marked as a possible proton.

3.3.4 Rejection of Mis-Identified Particles

As seen in Figure 3.1, there were a number of higher-momentum pions that satisfied the ± 1 ns timing cut used to identify probable kaons. In fact, above 1.25 GeV/c, the entire pion band was within the limits of the cut. Because pions were produced much more liberally than kaons, a small amount of pion leakage could overwhelm the kaon yield under the right kinematic conditions. This was one of the difficulties with John McNabb's thesis work [57].

To avoid this difficulty, we incorporated a simple algorithm that rejected likely mis-identified pions. For every track satisfying the K^+ identification timing cut, the algorithm calculated Δtof for both a pion and a kaon mass hypothesis. If Δtof was minimized for a pion mass hypothesis, then the track was rejected from further analysis.

While this may seem overly simple, the algorithm actually started out being much more complex. In its first version, the algorithm was configured to verify both kaon and proton identification as well as beam-bucket assignment. The algorithm calculated a goodness of fit parameter for the event based on the Δtof parameter for both the kaon and proton using the timing information for the current photon selection. This was compared to similar parameters calculated using different mass hypothesis for the two particles. Finally, to check the beam-bucket assignments, offsets of ± 2 or 4 ns were added to the times-of-flight measured by CLAS; a χ^2 was calculated to characterize the particle identification under each scenario (45 particle identification scenarios in all). Initially, only events minimizing the χ^2 for kaon and proton mass hypotheses with no time-of-flight offset were used in the analysis.

The earlier version of the algorithm was certainly much more rigorous and may appear to be more correct. However, when we looked at what was rejected by the earlier algorithm, we noticed that we were losing a significant number of actual $K^+\Lambda$ and $K^+\Sigma^0$ events. After an extensive study of the algorithm, it was scaled back to its present form, simply comparing the kaon and pion hypotheses of the potential kaon track. The $p(\gamma, K^+)Y$ missing mass for potential kaons rejected by the final algorithm is shown in Figure 3.5. This spectrum is smooth, without enhancement at either the Λ or Σ^0 mass. The absence of hyperon peaks leads us to conclude that the simplified algorithm

Figure 3.4: The above figure shows the Δtof parameter, based on the proton mass hypothesis, versus momentum for all positively charged particles. The white curve show the cuts that were used to select potential protons. A low-momentum cut first removed protons with a momentum less than 0.25 GeV/c. The other two curves represent a momentum-dependent timing cut. The two tails on the low-momentum end of the proton band are due to energy loss in the detector, which is strongest for low-momentum tracks. Bands of particles representing kaons and pions are labeled. Because the kaons and pions will move faster than protons of the same momentum, we expected these two bands to show up in the $\Delta\text{tof} < 0$ region of the plot.

Figure 3.5: This plot shows the $p(\gamma, K^+)Y$ missing mass where the K^+ was labeled as a misidentified pion by the timing algorithm. That there is no enhancement at the Λ or Σ^0 mass testifies that the algorithm is loose enough to not reject a measurable number of actual K^+ tracks.

has rejected a large number of mis-identified pions, without rejecting a significant percentage of our actual yield.

3.3.5 Additional Cuts Applied for Extracting $\frac{d\sigma}{d\Omega}$

Because the cross sections relied on an acceptance calculation, two additional cuts were applied to ensure an accurate acceptance calculation. First, fiducial cuts were applied to remove tracks striking regions near the torus coils where the acceptance calculation was not well understood. The second cut was the rejection of tracks striking inefficient scintillator paddles that could not be accurately modeled in the acceptance Monte-Carlo.

The fiducial cuts were based on the “pseudo-spa” function [56]. The CLAS acceptance near the boundaries of each sector was not well understood; the magnetic field varied rapidly close to the torus coils. Pseudo-spa simply rejected tracks as a function of laboratory angles and particle momentum and torus current. The effects of pseudo-spa are demonstrated in Figure 3.6. These cuts are most dramatic in the forward direction, where the torus coils occupy more of the available solid angle.

The second set of cross section specific cuts involved removing or “knocking out” problematic time-of-flight counters. A number of time-of-flight scintillators showing unexpected behavior were “turned off” in the analysis. The scintillator and sector number for each track was available in the data files; tracks striking bad paddles were simply not involved further in the analysis. To identify weak counters, we independently examined the distribution of K^+ and protons as a function of scintillator and momentum for each sector. These distributions were based on particles included in our final yields; they had passed all cuts previously described. The paddle occupancies in all six sectors were compared, and all scintillator occupancies were individually normalized against the paddle having the highest occupancy. In this way, we were able to visually identify inefficient or “hot” paddles.

The normalized occupancy distributions are shown in Figures 3.7 and 3.8. Paddles operating close to maximum efficiency are green, while blue indicates a lower efficiency. Examining the figures, we identified three distinct kinds of problematic paddles:

1. Hot paddles: Hot paddles had occupancies that were much higher than those in the other sectors. An example is shown in sector 4, paddle 25 shown in Figure 3.8. Here, the whole paddle is bright green over a large range of momentum. The fact that this paddle’s occupancy

Figure 3.6: Figure 3.6(a) shows the angular distribution of tracks in each sector before fiducial cuts were applied. Figure 3.6(b) shows the same spectrum, after fiducial cuts were implemented. The effects are most apparent at the sector boundaries and in the forward lab direction (small φ), where the torus coils occupy much of the available solid angle.

is anomalously high is proven by the fact that there is a deep blue stripe along paddle 25 in every other sector. This stripe is a reflection of paddle 25 in sector 4 which was used to normalize all the other sectors. A blue stripe in 5 sectors was indicative of hot paddle in the 6th sector, not 5 inefficient counters.

2. Inefficient paddles: Paddles that were weak or inefficient are noted by a blue stripe which remains localized to one scintillator paddle, and is not reflected in multiple sectors. Sector 3 in Figure 3.8 shows such a paddle at scintillators 17 and 18.
3. Drift chamber holes: Some depletions in Figures 3.7 and 3.8 were actually not due to inefficient scintillator paddles, but were caused by dead wires in the drift chambers. Large holes in the DC lead to localized inefficiencies in the overall tracking. The signature of a DC hole is that the depletion actually maps to several adjoining TOF paddles. An example can be seen in Sector 5 of Figure 3.7. Here, the depletion begins at higher momentum in paddle 11. The depletion is most noticeable in paddle 12, but also crosses into paddles 13 and 14 at lower momentum. We might have solved this problem by implementing some kind of a dead wire map in the acceptance calculation, but knocking out the corresponding time-of-flight paddles was more straightforward. The code was set up to handle the knockouts, and the G1C dataset was large enough to overcome the additional loss of statistics due to this method.

After finding negligible differences in the TOF behavior for both datasets, we decided to knock out the same paddles in the 2.4 and 3.1 datasets. Because knockouts were only used for the differential cross section, they were never applied to the 2.9 GeV dataset, which was only used for the double polarization analysis. The final list of unused paddles is given in Table 3.4.

3.3.6 Additional Cut Used in Extraction of C_x and C_z

Because the double polarization observables required information about the beam helicity state, we rejected events having a problem in the beam helicity reporting.

Momentum vs. SCID; 3.1 GeV dataset

Figure 3.7: Momentum vs. scintillator number for proton tracks from events included in the final yield. Figures based on the 3.1 GeV dataset.

Sector	Paddles
3	17,18
4	21,25
5	11-14
6	32

Table 3.4: This table lists time-of-flight paddles excluded from analysis.

Momentum vs. SCID; 3.1 GeV dataset

Figure 3.8: Momentum vs. scintillator number for kaon tracks from events included in the final yields. Figures based on the 3.1 GeV dataset.

During data acquisition, the beam helicity was flipped at 30 Hz. Two bits related to the beam helicity state were reported with each event. The first bit, the helicity bit, related the current beam helicity state. The second bit was called the sync bit. The beam helicity was changed in a pseudo-random fashion, meaning that it was not changed at regular intervals. Instead, the sync bit was flipped between 0 and 1 at regular intervals. There were two types of sync bit transitions, which we will call obligatory and nonobligatory transitions. During obligatory sync transitions, the beam helicity state was required to flip, while the helicity was flipped randomly at nonobligatory sync transitions. Every obligatory sync transition was followed by a non-obligatory one. We studied the helicity and sync bit transitions in the data to verify that the system was working as expected. In particular, we verified that:

- Any changes in the helicity bit occurred at a sync bit transition.
- The beam helicity bit actually changed at all obligatory sync transitions.

Runs of events containing problematic helicity information were identified and excluded from the analysis.

3.3.7 Energy-loss Corrections

Momentum vectors for the proton and kaon were corrected for energy lost as the particles passed through the target material (liquid hydrogen), target walls, beam pipe, and the air gap between the target and Region 1 drift chambers. These corrections were handled by the “e-loss” package, a CLAS software routine written by Eugene Pasyuk [53]. Energy loss corrections were implemented before any missing mass calculations made.

3.3.8 $p(\gamma, K^+p)\pi^-$ Missing Mass Cut

A further means of ensuring that a kaon and proton corresponded to an actual $K^+\Lambda/\Sigma^0$ event was to look for the mass of a π^- in the $p(\gamma, K^+p)X$ missing mass spectrum. The cut was actually applied to the missing mass squared, stipulating that it be between -0.25 and 1.0 $(\text{GeV}/c)^2$. While the cut is wide, we initially started with a much narrower cut, but widened it to minimize rejection of actual $K^+\Lambda$ and $K^+\Sigma^0$ events. By widening the cut, we clearly let through more background. However, we felt that our yield extraction methods would be able to properly model the background and produce a reliable, clean yield.

A plot of the $p(\gamma, K^+p)X$ missing mass squared spectrum is shown for each dataset in Figure 3.9(a) and 3.9(c). The figures show a strong π^- peak with a long tail on the lower mass side of each plot. The effect of the cut is to remove the tail.

Figure 3.9(b) and 3.9(d) shows the $p(\gamma, K^+)Y$ spectrum for events rejected by this cut. There are Λ and Σ^0 peaks visible in these plots, demonstrating that a number of “good” events were rejected by this cut. Fits were used to extract the actual number of Λ and Σ^0 events in Figure 3.9(b) and 3.9(d). The percentage of missing yield is shown in Table 3.5.

While it appears that a number of good $K^+\Lambda$ and $K^+\Sigma^0$ events were rejected by this cut, these are events that we do not want to retain in the analysis. The $p(\gamma, K^+p)X$ missing mass squared cut is very wide. For an event to be rejected by this cut, something had to be very wrong with the event. The fact that these events had a reasonable $p(\gamma, K^+)Y$ missing mass but a $p(\gamma, K^+p)X$ missing mass squared so far away from the pion mass suggests that these events had a properly identified kaon but a poorly identified proton. We identified two sources for such events:

1. Events where the proton momentum was poorly determined due to multiple scattering or other energy-loss or resolution issues.

Figure 3.9: Plots on the left show the $p(\gamma, K^+p)X$ missing mass squared, while plots on the right show the $p(\gamma, K^+)Y$ missing mass squared for events rejected by the cut. (a) and (b) are for the 2.4 GeV dataset, while (c) and (d) are for the 3.1 GeV dataset.

Dataset	Hyperon	Lost Events	Kept Events	Ratio
2.4 GeV	Λ	3520	236260	1.48%
	Σ^0	2256	169796	1.32%
3.1 GeV	Λ	30096	325792	9.24%
	Σ^0	20224	269216	7.51%

Table 3.5: Percentage of events missing from yield due to pion missing mass cut. The number of “lost events” was determined by the fits in Figure 3.9(b) and 3.9(d). The “Kept Events” column lists the number of events that were actually used to measure the cross sections. The “Ratio” is the percentage of yield rejected by the pion selection criteria.

2. Events containing an “accidental” proton. Accidental tracks correspond to particles from events that did not satisfy the CLAS trigger. Because our analysis looped through each potential kaon-proton combination, we could have a significant amount of combinatoric background in the $p(\gamma, K^+p)X$ missing mass squared spectrum.

The fact that much more of the 3.1 GeV yield was rejected by the cut than the 2.4 GeV yield could be explained by either effect. The momentum resolution was poorer in the 3.1 GeV dataset. Higher energy tracks curved less in the magnetic field, leading to larger errors in the momentum resolution. There were also more accidental tracks in the 3.1 GeV dataset. During select runs, the tagger was “prescaled” while taking the 3.1 GeV dataset. During “prescaled” runs, sections of the tagger recording lower energy photons were turned off. This was done to record more data at higher photon energies. To compensate for the lower data rates during prescaled runs, the beam current was also increased.

The lost yield is compensated by the acceptance calculation. The $p(\gamma, K^+p)X$ missing mass squared spectra for Monte-Carlo events used in the acceptance calculation are shown in Figure 3.10(a) and 3.10(b). The Monte-Carlo events also show the tail below the π^- peak. As in the data, a larger percentage of the 3.1 GeV Monte-Carlo events were rejected than the 2.4 GeV Monte-Carlo events. 0.89% of Monte-Carlo event used in conjunction with the 2.4 GeV dataset were rejected by this cut, while 6.00% of MC events used in conjunction with the 3.1 GeV dataset were rejected. While the rejection of MC events is smaller than the rejection of actual data events, the simulation was a physics Monte-Carlo, so the MC did not contain background events. The absence of background events would lead to very little combinatorial background in the simulated data.

It is reasonable to expect a few (2-3%) of the events to have an accidental proton. A few percent of the total data would resolve the discrepancies between the rejection of actual data and the rejection of MC events by this cut. Any uncertainty between the data and MC would be a small effect (1-2%) and well within the systematic error estimates detailed in Chapter 6.

The agreement between our cross section results and John McNabb’s results, as discussed in Chapter 6 further supports our results. In his analysis, John McNabb did not detect the proton from the Λ decay. The McNabb results, then, did not reflect any discrepancies between data and simulation due to a $p(\gamma, K^+p)X$ missing mass cut. If there were a significant mismatch between our data and simulation due to this cut, our cross sections would have been lower than the McNabb results.

3.4 Binning and Yield Extraction

Yield extraction involved the final determination of the number of $K^+\Lambda$ and $K^+\Sigma^0$ events in each kinematic bin. This section includes a description of the final yield extraction, including binning, and a discussion of the logic used to determine the yields.

3.4.1 Binning of Kinematic Variables

Binning was determined by a number of factors. First, the observables themselves determined the actual kinematic quantities considered when structuring the bins. For example, the polarization observables required angular information about the proton from the lambda decays. Hence, we were obliged to bin the data in $\cos(\theta_{pY})$ for C_x and C_z . Second, the actual number of bins in each quantity was a balance between maximizing the number of bins while maintaining reasonable statistics in each bin. More bins allowed the resulting measurements to have greater sensitivity to narrow structures. However, too many bins would make the yield extraction difficult across regions of our kinematics where the yields were relatively low.

The bin definitions for the differential cross sections are shown in Table 3.6, while the bins for the double polarization observables are defined in Table 3.7. The differential cross sections only required

Figure 3.10: $p(\gamma, K^+p)X$ missing mass for Monte-Carlo events. (a) is for MC used with the 2.4 GeV dataset while (b) is for MC used with the the 3.1 GeV dataset.

Hyperon	E_γ (GeV)			$\cos(\theta_{KCM})$		
	Low	High	Δ	Low	High	Δ
Λ	0.9125	2.9875	0.025	-0.85	0.95	0.1
Σ°	1.0625	2.9875	0.025	-0.85	0.95	0.1

Table 3.6: Data binning for the $\frac{d\sigma}{d\Omega}$ measurements. Here, the difference in the binning for the two hyperons was caused solely by the higher threshold for the Σ° . The Λ had a total of 1494 kinematic bins, while the Σ° used 1386. The “low” and “high” of each kinematic variable is the edge of our kinematic coverage, and do not correspond to bin centers.

Hyperon	E_γ (GeV)			$\cos(\theta_{KCM})$			$\cos(\theta_{pY})$			Helicity
	Low	High	Δ	Low	High	Δ	Low	High	Δ	# of bins
Λ	0.9375	2.7375	0.1	-0.85	0.95	0.2	-1.0	1.0	0.2	2
Σ°	1.1375	2.7375	0.1	-0.85	0.95	0.3	-1.0	1.0	0.4	2

Table 3.7: Binning for C_x and C_z . Coarser binning was used for the Σ° observables because the results, and errors, had to be scaled by the dilution factor, ν . $K^+\Lambda$ observables used a total of 3420 bins, while the $K^+\Sigma^\circ$ observables had 1020. The “low” and “high” of each kinematic variable in the table are the edges of our kinematic coverage, and do not correspond to bin centers.

binning in E_γ and $\cos(\theta_{KCM})$. Because the double polarization observables required additional information about beam helicity, and the proton angle distribution, they typically employed many more bins than the cross sections. All events passing the yield selection cuts outlined in the previous sections of this chapter were assigned to bins and involved in the yield extraction.

3.4.2 Yield Extraction

By yield extraction we mean the determination of the number of actual $K^+\Lambda$ and $K^+\Sigma^\circ$ events within each kinematic bin. Yield extraction was performed independently within each bin. As the number of counts and background varied greatly over the kinematics, a total of 4 yield extractions methods were employed. First, three different fits were performed. For all fits, Gaussian curves were fit to the hyperon peaks in the $p(\gamma, K^+)Y$ missing mass spectrum. Background was modeled with either a constant, linear, or quadratic polynomial. The fits were the preferred method of extracting the yield, but there were bins where fitting proved unreliable. In these cases, a simple sideband subtraction was performed, assuming a constant background under the hyperons. Each of these yield extraction methods will be detailed here. We will begin with the sideband-subtraction methods. Whether the cross sections or double polarization observables were being studied, the implementation of this routine did not change. Because there were differences in the fitting and yield selection for the double polarization observables and the cross sections, the last two sections of the chapter will then be specific to each type of observable. The fitting and yield selection for the cross section will first be detailed followed by the logic used to fit and select the final yield for C_x and C_z .

Sideband Subtraction

In this routine, five ranges in the missing mass spectra were defined within each bin - two ranges defining actual K^+Y events, and three sidebands used to characterize the background. The ranges are shown in Figure 3.11. Three sidebands were defined, as shown in Figure 3.11. The yields were calculated by subtracting off an estimated background from the total counts in the Λ or Σ° bands.

The estimated background under a given hyperon peak was given by

$$b(Y) = \frac{N_{bcount} N_{ybins}}{N_{bbins}}, \quad (3.9)$$

where N_{bcount} was the total number of counts in all three sidebands and $N_{bbins} = 62$ was the number of histogram bins in the sidebands. N_{ybins} was the number of histogram bins in the Λ or Σ^0 band and was equal to 37 for Λ or 35 for Σ^0 . The statistical error on the final yield was

$$\sigma_Y = \sqrt{N_Y + N_{bcount} \left(\frac{N_{ybins}}{N_{bbins}} \right)^2} \quad (3.10)$$

where N_Y was the number of counts in the hyperon band. Equation 3.10 was based on standard error propagation and the assumption that the errors on N_Y and N_{bcount} were purely statistical and uncorrelated. N_{ybins} and N_{bbins} were assumed to have no error.

Yields for $\frac{d\sigma}{d\Omega}$ Determined by Fitting

In our experience, the most important factor in producing reliable yields from the fits was the careful selection of initial parameters supplied to our fitting routine. The yield fits for the cross section then were handled in two passes. The first pass was a quicker initial fitting of the data to extract parameters that could be used to initialize the second pass fits. During the first pass fits, the data were only binned in E_γ (i.e., we initially summed the data over all $\cos(\theta_{KCM})$ and $\cos(\theta_{pY})$). Because of this, we only had to fit a maximum of 83 histograms per dataset. Having fewer histograms, we then closely monitored the fitting of each one, altering initial fit parameters or constraints until the fits were a good match to the data. These fits were 7-9 parameter fits, depending on the background model employed. A Poisson statistics fitting algorithm was used.

Once satisfied with the first pass fitting, we ran the second pass fits. For the second pass, the data was additionally binned in $\cos(\theta_{KCM})$. The fit employing the constant background model ran first. This fit was initialized with the final parameters from the corresponding fit of the first pass. The Gaussian positions and widths were unaltered, but the number of events under the peaks and the constant background term were scaled by 1/18 because each first pass E_γ bin had been further divided into 18 $\cos(\theta_{KCM})$ slices. The linear fit was then initialized with the final Gaussian parameters from the constant fit, and “1” was used for both background parameters. Similarly, the quadratic fit used Gaussian parameters from the linear fit. All parameters were allowed to vary in these fits.

A selection of second-pass fits is shown in Figures 3.12-3.14. As shown in the figures, the smallest yields were typically at lower photon energies and backward angles. The yields peaked at mid-forward angles ($\cos(\theta_{KCM})=0.5-0.6$) and then began to drop more in the extreme forward direction. The background was small over most of the kinematic range, but increased in the forward direction at higher energies when mis-identified pions leaked into the kaon yield. At higher photon energies, the momentum resolution of CLAS worsened, so the width of the hyperon peaks broadened significantly, as seen in Figure 3.14. Aside from a few isolated bins that proved difficult to fit, the fitting procedure produced robust fits over most of the kinematics. Because of the Poisson statistics fitting algorithm, values of χ^2 per degree of freedom fell typically between 0.8 and 2.0.

C_x and C_z fits

A 2-pass scheme was also employed to fit the double polarization observables. In this case, the first pass fits were binned in E_γ , $\cos(\theta_{KCM})$, and beam helicity. The first pass, consisting of 5-10 times fewer fits than the second pass and was verified manually as the fitting macro ran. We checked each bin to ensure that the fits actually followed the data and gave a reasonable χ^2 per degree of

Figure 3.11: Events lying in the bands labeled “Left”, “Middle”, and “Right” were considered background. The total number of events in the three bands was normalized to the number of histogram bins to calculate an average background in a histogram bin. This number, multiplied by the number of histogram bins in either the Λ or Σ bands, was used to estimate the background under the respective hyperon peaks. These estimated backgrounds were subtracted from the total counts in the hyperon bands to the sideband-subtracted yields.

Figure 3.12: Typical fits in a bin of lower photon energy, at backward, (a); mid, (b); and forward, (c), kaon angles. The exact value of each angle is printed on each plot. The curves are three fits performed in each bin, and their interpretation is given by the key on each plot.

Figure 3.13: These plots show typical fits in a bin of mid photon energy, at backward, (a); mid, (b); and forward, (c), kaon angles. The exact value of each angle is printed on each plot. The curves are three fits performed in each bin, and their interpretation is given by the key on each plot.

Figure 3.14: These plots show typical fits in a bin of higher photon energy, at backward, (a); mid, (b); and forward, (c) kaon angles. The exact value of each angle is printed on each plot. The curves are three fits performed in each bin, and their interpretation is given by the key on each plot.

freedom. The macro prompted the user for feedback in each kinematic bin and allowed for changes in fit parameters and constraints. Again, all fit parameters were allowed to vary in the first pass. A Poisson statistics fitting algorithm was used for both the first- and second-pass fits.

During the second pass fitting, the data was additionally binned in $\cos(\theta_{pY})$. The binning required for the double polarization observables produced a number of bins with low-statistics yields, particularly at backward kaon angles and low photon energies. These bins could not support a 7-9 parameter fit. To solve this problem, the hyperon peak centroids and widths were used from the first pass fittings. The only fit parameters allowed to vary in the second pass were the number of events in the hyperon peaks, and the terms describing the background. The number of events under each Gaussian was initialized to 1/10 the value of the corresponding parameter from the first pass fits.

Yield Extraction

The yield selection algorithms were nearly identical for the two types of observables. In general, the fits were the preferred method of yield determination because they had the most flexibility in describing the background. The fit with the lowest χ^2 per degree of freedom falling below some maximum value was used. For the double polarization observables, this maximum was set at $\chi^2 < 2.0$. This stipulation was employed for the cross sections below $E_\gamma=1.325$ GeV, but the upper limit was raised to $\chi^2 < 10$ at higher photon energies to permit the use of a few apparently stable fits with slightly higher values of χ^2 . If no acceptable fit was found, the algorithm attempted to use the side-band subtracted yield. If this yield determination was less than 0, which was possible in bins with poor signal-to-noise, then the sideband-subtracted yield was deemed unsuitable. For bins where both the fits and sideband-subtraction failed, no yield was extracted. Yields in such bins was set to 0.

Aside from the maximum χ^2 criteria, the only other difference in the yield selection for the two observable types involved an extra stipulation placed on the differential cross sections. Above $E_\gamma=2.3$ GeV, the cross section fits were not allowed to employ fits using a quadratic background model. Before this stipulation was put in place, we noticed an abrupt 20% drop in the cross sections at higher photon energies in the forward-most kaon angle bin. When studied, it appeared that this drop was due to the fact that the yield selection algorithm was predominantly using yields extracted with quadratic fits in this region. Several versions of the yield extraction were studied at these kinematics, and the only version showing a drop in the cross section involved the quadratic fits. Cross sections based on the other fits or the sideband-subtracted yields did not show this drop. Because the other yield determinations were consistent with each other and appeared to better follow the trend of the data, the quadratic fits were turned off in this kinematic region.

While the exact reason for this behavior in the quadratic fits remained unknown, it does seem to correlate with two effects prominent at these kinematics. At higher photon energies and forward kaon angles, the CLAS momentum resolution dropped, broadening the hyperon peaks in the missing mass spectrum. At the same time, there is more background at these kinematics due to mis-identified pions. Wider tails on the hyperon peaks may have been fit as background with the quadratic model, effectively decreasing the extracted yields.

3.5 Summary

This chapter has described the initial processing done on the cooked data to produce extracted yields. The size of the G1C dataset has allowed us to extract strong Λ and Σ^0 signals over a small background with very fine binning.

Overall, the steps taken to produce $\frac{d\sigma}{d\Omega}$ yields were largely similar to those taken to produce the yields required for C_x and C_z . The differences were:

1. Fiducial cuts and knockout of inefficient time-of-flight scintillator paddles in the cross section analysis.
2. Data for the double polarization observables was binned in two additional quantities - beam helicity and $\cos(\theta_{pY})$.
3. Small differences in the fitting procedures and yield determination algorithms, as described in Section 3.4.

Chapter 4

Acceptance and Photon Normalization for Differential Cross Sections

At this point, it is helpful to recall the formula for the differential cross section:

$$\frac{d\sigma(E_\gamma, \theta_{KCM})}{d\cos(\theta_{KCM})} = \frac{M_{MOL}}{N_p N_A \rho L} \frac{Y(E_\gamma, \theta_{KCM})}{\Delta\cos(\theta_{KCM}) A(E_\gamma, \theta_{KCM}) N_\gamma(E_\gamma)} \quad (4.1)$$

To an experimentalist, the measurement of the differential cross section largely involves extracting the detected yield, $Y(E_\gamma, \theta_{KCM})$; correcting this yield for the efficiency and acceptance of the detector, $A(E_\gamma, \theta_{KCM})$; and normalizing the yield by $N_\gamma(E_\gamma)$, the number of particles incident on the target. These three factors are what Reinhard calls the “legs upon which the cross section rests” and constitute most of the work involved in the extraction. $\Delta\cos(\theta_{KCM})$ corresponds to the size of the differential bin. The remaining factors are largely related to the target material. M_{MOL} is the molar mass for liquid hydrogen, N_p is the number of protons per molecule of liquid hydrogen, N_A is Avogadro’s number, L is the target length, and ρ is the density of hydrogen in the target. These last factors require some thought, but are readily available.

Accordingly, this chapter will focus on two “legs” of the cross section. The yield extraction has been discussed previously, in Chapter 3, and will not be covered here. This chapter will begin at the point of having extracted yields and largely discuss the normalization and acceptance calculations. Two smaller sections will discuss the target factors and any corrections to the extracted yield. As the 2.9 GeV dataset was not used to make a differential cross section measurement, this chapter will only discuss treatment of the 2.4 and 3.1 GeV datasets. This chapter will conclude with a comparison of the differential cross sections for the 2.4 and 3.1 GeV datasets.

It should be noted that we expressed the cross sections as $\frac{d\sigma}{d(\cos\theta)}$ instead of $\frac{d\sigma}{d\Omega}$. Because the differential cross sections are azimuthally symmetric, it was easy to integrate over all ϕ angles. The integration simply resulted in an extra factor of 2π according to

$$\frac{d\sigma}{d(\cos\theta)} = 2\pi \frac{d\sigma}{d\Omega} \quad (4.2)$$

The benefit of doing this was a convenient scale for the results. The integration and subsequent factor of 2π allowed us to express the results in units of whole μbarns , while $\frac{d\sigma}{d\Omega}$ would have been in fractional $\mu\text{barns/steradian}$.

4.1 Acceptance and Efficiency

The basis of the acceptance calculation for this analysis was the CLAS GSIM simulation package. GSIM is a GEANT-based simulation of the CLAS detector and is the collaboration's standard simulation package [58]. We ran an acceptance calculation independently for each G1C dataset, throwing a total of 40 million events, 10 million for each hyperon within each dataset. Events were thrown using the "strange.gen" [59] phase-space event generator. The events were thrown flat in photon energy and the cosine of the kaon angle to ensure sufficient statistics in all kinematic bins. In particular, strange.gen provided the incident photon energy, and momentum vectors and a vertex position for one K^+ and one hyperon in each event. The events, initially written to a text file, were then processed by "txt2part", an intermediate routine used to transform the text file into a form usable by GSIM.

Once generated, the events were processed by GSIM, which propagated the particle tracks from their vertex positions through the CLAS detector and generated a simulated set of detector signals for the tracks. GSIM included the effects of particle decays, multiple scattering, and scattering from structures within CLAS. Output from GSIM was packaged in the standard CLAS "bosbank" data file.

The GSIM output was then processed with a code called "GPP". GSIM assumes that CLAS has perfect timing resolution, so another software package, GPP, was used to "smear" timing in the Monte-Carlo (MC) events to more accurately reflect the actual CLAS time-of-flight and DC timing resolution. In particular, GPP smeared the scintillator time signals as a function of the scintillator length. DC smearing was a function of the distance of closest approach (DOCA) of a track to the DC wires. GPP nominally used scintillator and DC resolutions based on residuals measured during the data calibration. The code permitted the user to scale these widths in order to make the Monte-Carlo more accurately resemble the actual data. In our case, we employed scale factors suggested by John McNabb [57]: The time-of-flight resolutions were scaled by 1.0, while the DC timing resolutions were scaled by 2.0 for the Region 1 drift chambers, 2.5 for Region 2, and 3.0 for Region 3.

Monte-Carlo events processed by GSIM and GPP were the equivalent of actual "raw" data read from the detector and immediately written to tape. The Monte-Carlo still needed to be "cooked" and treated by all of the code normally used in the offline data processing. The cooking was handled by the code "a1c". To ensure that the acceptance calculations accurately reflected any software bugs affecting the data, we were careful to use the same versions of the CLAS software on the Monte-Carlo simulation that had been used during the cooking of the G1C data. These software versions were tagged as "g1c-2445" for the 2.4 GeV dataset and "g1c-3115" for the 3.1 GeV dataset in the CLAS CVS repository [52]. a1c required use of calibration constants, so the constants for a representative run from each dataset were used in the Monte-Carlo processing. For the 2.4 GeV data, the representative run was 21785, while run 20960 was used for the 3.1 GeV dataset.

After being "cooked", the Monte-Carlo data were processed by the analysis code and post-processing routines required to complete a yield extraction, as outlined in Chapter 3. The yields were extracted in kinematic bins identical to those employed in the actual data. From here, the acceptance was calculated by taking the ratio of the extracted yield to the number of MC events thrown in each kinematic bin.

Detector efficiency was accounted for simultaneously through the same simulation. Sources of inefficiency were tracking, time-of-flight paddle knockouts, as well as bugs in software used to process the data.

The final four acceptance calculations are shown in Figure 4.1. The acceptance tends to be largest at mid to forward kaon angles and at higher photon energies. The maximum acceptance is about 20% for $K^+\Lambda$ and 23% for $K^+\Sigma^0$.

Figure 4.1: The final acceptance calculations for each reaction in both datasets. Plots 4.1(a) and 4.1(c) show the acceptance applied to the $K^+\Lambda$ differential cross sections in the 2.4 and 3.1 GeV datasets, respectively. Similarly, plots 4.1(b) and 4.1(d) show the results for the $K^+\Sigma^0$ differential cross sections.

4.2 Normalization

Having discussed the yield extraction and the acceptance calculation, the remaining leg of the differential cross section is the determination of the total photon flux incident on the target within each E_γ bin. This measurement of the photon flux is referred to as the normalization.

For the G1C dataset, the standard normalization technique was known as the “G-flux” method [57, 60]. G-flux was developed by James Ball and Eugene Pasyuk of Arizona State University.

4.2.1 Basics of G-flux

Although the main premise of G-flux is actually very simple, there are several steps required to put it into effect. The main idea behind G-flux can be expressed in a simple “rate-times-time” formula:

$$N_\gamma^i = R^i \cdot \Delta T_{run}. \quad (4.3)$$

Here, N_γ^i was the total photon flux within a tagger T-bin, R^i is the rate of hits in that bin, and ΔT_{run} is the time over which data was taken. This looks simple, but determining R^i and ΔT_{run} involves several additional steps.

The single-hit nature of the tagger TDC’s was central to G-flux’s determination of the rate, R^i . G-flux considered all T-counter hits occurring 30 ns to 180 ns after the hit satisfying the CLAS Level I trigger to be out-of-time. Due to the single-hit nature of the TDC’s, each counter only recorded the first hit that occurred during the active timing period. Using Poisson statistics, the probability for multiple out-of-time hits in the same T-counter is given by:

$$P_{\geq 1} = 1 - e^{-R^i \Delta T_{out}}, \quad (4.4)$$

where $\Delta T_{out} = 150$ ns is the width of the timing window. Now, $P_{\geq 1}$ can be used to calculate the measured number of out-of-time hits for a given T-counter, N_{out}^i ,

$$N_{out}^i = P_{\geq 1} N_{trig}^i = \left(1 - e^{-R^i \Delta T_{out}}\right) N_{trig}^i, \quad (4.5)$$

where N_{trig}^i is the total number of random hits in the out-of-time window that could have hit the i^{th} counter. This can be solved for the rate of hits in a single TDC, R^i ,

$$R^i = \frac{-1}{\Delta T_{out}} \ln \left(1 - \frac{N_{out}^i}{N_{trig}^i}\right). \quad (4.6)$$

N_{trig}^i could have been estimated by counting the total number of hits in the entire tagger, N_{tot} . This estimate would have been valid if each TDC was active throughout the entire out-of-time window. Due to the single-hit nature of the TDC’s, there was a chance that a T-counter may not have been active at all during out-of-time window if it had recorded a hit before the out-of-time window opened at 30 ns. To compensate, N_{trig}^i is defined as

$$N_{trig}^i = N_{tot} - N_{early}^i \quad (4.7)$$

where N_{early}^i is the number of early hits in the i^{th} T-counter.

As we have calculated it, the rate, R^i was the rate at which photons were tagged at the i^{th} element of the tagger. The differential cross section is concerned with the number of photons that actually hit the target, so we have to account for any loss of tagged photons between the tagger and the target. This was measured with the help of the pair spectrometer (PS - see Section 2.2.3). Although the pair spectrometer could not individually detect each photon, its efficiency was cross calibrated to that of the total absorption shower counter (TASC) during lower intensity

“normalization” runs. A plot showing the efficiency of the tagger as a function of T-counter number for various normalization runs is shown in Figure 4.2. The PS was able to remain in the beamline during normal data-taking and gave an accurate measurement of the photon flux downstream of the tagger. Discrepancies between this measurement and the flux measured at the photon tagger are indicative of photon loss along the beamline between the tagger and the PS. Because the TASC and pair spectrometer sit about 15 meters downstream of the target, the beamloss correction is actually overestimated due to additional loss along the beamline between the target and downstream devices. This additional loss was calculated to be $\eta=0.039 \pm 0.002$ [61], independent of T-counter. The final correction for beamloss in a given t-bin, ϵ^i , is expressed as

$$\epsilon^i = \left(\frac{N_{coin}}{N_{tag}} \right) \cdot (1 + \eta) \quad (4.8)$$

where N_{tag}^i is the number of hits in a given T-counter, and N_{coin}^i is the subset of N_{tag}^i also registering a coincident hit in the TASC.

The final step needed to calculate the normalization was a measure of the run time ΔT_{run} . This is given by

$$\Delta T_{run} = \Delta T_{clock} L_t \quad (4.9)$$

where ΔT_{clock} is the run-gated clock time. L_t is the livetime fraction. Because the detector systems shut off during event readout, we are constrained to correct for this in our determination of ΔT_{run} . L_t is a measure of the fraction of T_{clock} that the detector systems are actually active and is given by

$$L_t = \frac{N_{tot}}{N_{scal}} \quad (4.10)$$

where N_{tot} is again the total number of hits registered in the tagger, and N_{scal} is the total number of hits counted by scalers with no deadtime during event readout.

Putting things together, then the photon normalization became

$$N_{\gamma}^i = R^i \Delta T_{run} \epsilon^i. \quad (4.11)$$

with the rate, R^i given by

$$R^i = \frac{-1}{\Delta T_{out}} \ln \left(1 - \frac{N_{out}^i}{N_{tot} - N_{early}^i} \right) \quad (4.12)$$

and the livetime,

$$\Delta T_{run} = \Delta T_{clock} \frac{N_{tot}}{N_{scal}}, \quad (4.13)$$

and the beamloss correction is given by Equation 4.8.

The tagger T- or E-counter boundaries might have provided a natural photon energy binning for the data, especially in light of the G-flux code. However, our choice to work with 25 MeV wide bins was guided by the size of the dataset. The E-counter binning would have been too fine. We would not have had enough events within each bin to perform a reliable yield extraction. T-counter binning, on the other hand, would have been too coarse. 25 MeV wide bins provided reasonably fine binning without spreading the data too thin. The normalization then was mapped from the T- and E-counter binning to our 25 MeV wide bins within the G-flux code. This was a feature added by Eugene Pasyuk at our request. We took care to make certain that our bin boundaries coincide with those used by G-flux.

Figure 4.2: The “tagging ratio” is the probability that the tagger will detect a photon within the energy range subtended by each T-counter. The plot is basically the ratio of T-counter hits to hits in the TASC during a lower-intensity normalization run. The horizontal axis is the T-counter number. Each different colored band of data-points corresponds to a unique normalization run taken with the 2.4 GeV dataset. The plot shows that the efficiency was stable during the data taking, with variations being limited to roughly 1.5%.

4.2.2 Implementation of G-flux

While it may seem like a straightforward matter to process all of the data with the G-flux code and implement the resulting normalization in our analysis, there are a few technicalities worth noting. There were multiple versions of the normalization available on the JLab Farm; we had to study each one and decide which we believed. In addition, we must mention the role of “trip” files, which must be used in an analysis involving G-flux.

Version of G-flux Results

It was most convenient to process the uncooked data files with the G-flux code at the time of cooking; this was done by Luminita Todor [52]. After further study and revision, a newer version of the code was released by Eugene Pasyuk, and he handled a second processing of the data. Because the file locations of the two results are not properly documented anywhere, we will provide that information here. The 2.4 GeV normalization files were held in `/work/clas/production/g1c/pass1.2400/`. The Todor files were held in the “gflux.out” subdirectory, while the Pasyuk files were held in the “gflux_new” subdirectory. Both versions of the 3.1 GeV normalization were held in similarly named subdirectories in `/work/clas/production/g1c/pass1.3115/`.

The earlier G-flux result (produced by Todor) appears to have seriously over-counted the photon flux for the 3.1 GeV dataset. This came to our attention when we noticed large discrepancies in our differential cross section results for the 2.4 and 3.1 GeV datasets. The 2.4 GeV results were higher than the 3.1 results by 10 to 15%. After some investigation, we found the error while comparing ratios of the newer G-flux result to the older in each dataset. These ratios are shown in Figure 4.3. Figure 4.3(a) shows the ratio of G-flux results for the 2.4 GeV dataset; it is flat and essentially equal to unity (within 1%). The fact that the 3.1 GeV ratio is significantly less than 1 suggests that the older G-flux results (in the denominator) over-counted the number of photons incident on the target.

When brought to Eugene Pasyuk’s attention, he explained that the older version of G-flux did not properly handle events that had been rejected by the cooking software, *a1c* [62]. Every 1000 events, the scalars within CLAS were read and written to the output datafile. During the cooking process, *a1c* ran simple checks against the scalar information, such as verifying that there were only 1000 events between scalar dumps. If there was a problem, then *a1c* skipped the events in troublesome scalar intervals. These events were not written to the cooked output file, and the beginning and ending event numbers of the skipped events were written to a text file. The earlier version of G-flux that Todor used did not properly handle these skipped events. G-flux had to be run on the “raw” data files, so the executable had access to the skipped events and included them in its calculation of the photon flux, causing an overestimation. We have not further researched the problem to see if we could locate what would cause this to become such a large problem in the 3.1 GeV dataset. The 3.1 GeV dataset was the first data taken during the G1C run period. While the data quality is strong, it is not unreasonable to expect such behavior during the first part of an experiment. Once the skipped intervals were correctly handled, the normalization of the 3.1 GeV dataset was of sufficient quality to permit the extraction of the differential cross section.

Trip Files

The G-flux code was unable to properly calculate the normalization for groups of events occurring immediately before and after beam trips (momentary lapses in beam delivery to the experimental hall). These groupings of events are listed in “trip” files, which are available at Jefferson Lab. The events listed in the trip files were excluded from our analysis.

Data files not having a corresponding trip file were not included in the analysis to avoid difficulties with the normalization. A list of these files may be found in Table 3.2.

Figure 4.3: These two figures show the ratio of the two versions of the G-flux results, the more recent version (prepared by Eugene Pasyuk) over the older (prepared by Luminita Todor). On the left, (a) shows the ratio for the 2.4 GeV dataset. This ratio is flat and essentially one. On the right, (b) shows the same ratio for the 3.1 GeV dataset. The fact that the 3.1 GeV ratio is less than one indicates that the older version had a significantly higher photon count. The over-counting is attributed to G-flux’s inability to properly handle events not written to the “cooked” data files by the reconstruction software. The bug was fixed in a later version of the code.

Data Files not having an Associated Normalization

There were a number of individual data files not having an associated normalization vector among the results stored at Jefferson Lab. Rather than attempting to recreate the G-flux vectors for these files, we simply excluded the data files from our analysis. The fraction of data files affected was small enough that the excluded files did not have a significant impact on the statistical precision of the results. A list of these files may be found in Table 3.2.

4.3 Target Factors

Having the extracted yields, an acceptance calculation, and the photon normalization, we have in place the three legs on which the differential cross section rests. As discussed at the beginning of this chapter, we must scale the acceptance-corrected normalized yield by certain factors related to the CLAS target to produce the final measurement. The CLAS target and many of these factors are discussed in Chapter 2. For convenience, we list the factors in Table 4.1.

4.4 Corrections

The general procedure followed to measure the differential cross section has been outlined in this chapter and in Chapter 3. If the world were ideal, this would be enough to measure the cross section perfectly. However, there were two occasions where an explicit corrections were required. The first effect concerns tagger inefficiencies that made the normalized yields artificially low. The second effect concerns loss of “good” events due to the photon selection cut discussed in Section 3.3.1. In both cases, these were effects that could not be modeled by our acceptance calculation.

Factor	Description	Value	Reference
M_{MOL}	Molar mass of atomic hydrogen	$1.00794 \frac{g}{mol}$	[64]
N_p	Number of protons per LH2 molecule	2	
L	Target length	17.85 ± 0.05 cm	[37]
N_A	Avogadro's number	6.02×10^{23}	-
$\Delta(\cos(\theta_{KCM}))$	$\cos(\theta_{KCM})$ bin width	.1	-
ρ	LH2 density	$(7.11 \pm .01) \times 10^{-2} \frac{g}{cm^3}$ (2.4 GeV dataset) $(7.07 \pm .02) \times 10^{-2} \frac{g}{cm^3}$ (3.1 GeV dataset)	[38]

Table 4.1: Constant factors required to complete the differential cross section. These factors are applied multiplicatively to the acceptance corrected normalized yields, as shown in Equation 7.1.

4.4.1 Tagger Inefficiency Corrections

In the tagger electronics, signals from the T-counters were sent to two places. The first copy went to the trigger via an array of “or” gates (the “Master OR” discussed in Section 2.2.1). The second copy was sent to an array of TDC’s used to calculate the normalization. If both copies of the signals were not handled correctly, then the normalized yield in a small range of E_γ would be incorrect. For example, a “hot” TDC could over estimate a photon count, making the yield look low. Similarly, a trigger inefficiency coupled with a properly functioning scaler could also make the normalized yield artificially low. On the other hand, an inefficient TDC could make the normalized yield appear high. Nothing in the acceptance could account for this tagger behavior, so we were forced to apply an explicit correction.

Figure 4.4 shows a plot of the normalized yields for both the 2.4 and 3.1 GeV datasets. The two datasets should overlap from threshold up to $E_\gamma = 2.325$ GeV. The normalized yields for the two datasets should be nearly identical over the range plotted. The points labeled “a”, “b”, and “c” in the figure denote regions where there is a localized discrepancy in the normalized yields. While (d) lies above the overlap of the two dataset, it too appears to be an anomaly due to some hardware problem, perhaps a “hot” counter.

The basis of the correction was that the photon energy mapping of the detector elements was unique for each dataset. Hence, an E_γ bin covered by a weak T-counter in the 2.4 GeV dataset, mapped to a different, more-efficient counter in the 3.1 GeV dataset. We assumed that the higher normalized yield between the two datasets was always the correct one. The correction was made by taking the ratio of normalized yields for the two datasets as shown in Figure 4.5. In this figure, data-points above 1.0 indicate regions where the 3.1 GeV normalized yield was greater than the 2.4 GeV normalized yield. The 3.1 GeV cross sections were scaled bin-by-bin by ratios lying above 1.0 in Figure 4.5, while the 2.4 GeV results were scaled by the inverse of ratios lying below 1.0. The dataset having the higher normalized yield in an E_γ bin was scaled by 1.0 at that point. The points (a), (b), and (c) in Figure 4.5 correspond to the identical points indicated in Figure 4.4. Because it lies above the overlap region of the 2.4 and 3.1 GeV dataset, point (d) could not be corrected by this method. The normalization at point (d) is obviously unreliable, so we were unable to calculate a cross section at this point. Two photon energy bins, at $E_\gamma = 2.375$ GeV and $E_\gamma = 2.40$ GeV were removed from the analysis.

Many of these discrepancies between the two sets of normalized yields are due to the same faulty T-counters manifesting themselves at different energies in the two datasets. For example, point (a) and (c) are actually due to the same counter. The counters responsible for structure (b) in the 3.1 GeV dataset were actually operating below the Λ threshold in the 2.4 GeV dataset. These counters may have been inefficient in the 2.4 GeV dataset, but we cannot tell from the data being studied. The cause of structure (d) appears to have been unique to the 3.1 GeV dataset. The 3.1 GeV dataset was taken first, and the online logbook mentions that a tagger TDC (with one bad channel) was

Figure 4.4: Normalized yields for the 2.4 GeV and 3.1 GeV over the full range of photon energy. Ideally, the normalized yields for the two datasets should be identical. However, there are large discrepancies, as noted by (a), (b), and (c). The excess at (d) is also notable. While (d) lies just above the overlap of the two datasets, it does not follow the trend of neighboring counters and appears to be an artificial excess.

Figure 4.5: This figure shows the ratio of the 2.4 GeV normalized yields to the 3.1 GeV normalized yields as a function of photon energy. This ratio was used to scale upward regions of lower yield in either dataset. Points below 1.0 represent deficiencies in the 2.4 GeV normalized yield and were used as correction factors applied to this dataset. Similarly, points above 1.0 were used to correct the 3.1 GeV dataset.

replaced at the end of the 3.1 GeV dataset [63].

4.4.2 Events Rejected by Photon Selection Cut

Multiple photons were often correlated with an event and recorded with the data. Although only one photon could actually be responsible for a given event, several photons may have registered in the tagger during the timing window for an event. It is left up to those performing a particular analysis to determine criteria for identifying the correct photon.

Our photon selection criteria were discussed in Section 3.3.1. In short, we used a timing cut that stipulated that the coincidence between the tagger vertex time and start counter vertex times had to be less than 1.0 ns. This value of 1.0 ns was chosen to be much wider than the timing resolution of both the tagger and the start counter, yet tight enough to reject significant amounts of background.

There is one scenario where this cut could possibly reject a “good” event. In CLAS, “accidentals” are tracks resulting from events not caused by tagged photons. There are a number of sources of accidentals, such as cosmic rays or events due to photons of energies outside the tagger’s sensitivity

Dataset	Hyperon	Lost Events	Kept Events	Ratio
2.4 GeV	Λ	4524	236260	1.92%
	Σ^0	3332	169796	1.94%
3.1 GeV	Λ	1180	325792	0.36%
	Σ^0	1428	269216	0.53%

Table 4.2: Percentage of events missing from yield due to photon selection criteria. The number of “lost events” was determined by the fits in Figure 4.6. The “Kept Events” column lists the number of events that were actually used to measure the cross sections. The “Ratio” is the percentage of yield rejected by the photon selection criteria.

limits. Because the start counter employed single-hit TDC’s, it is possible that an accidental track could have triggered the start counter early during its window of sensitivity, causing failure to record accurate times for a small number of otherwise good events. Such events would likely be rejected by our photon selection cut.

To study this effect, we relaxed the photon selection timing cut, and re-analyzed the data for the 2.4 and 3.1 GeV datasets. We then compared the integrated yields generated with the cut to those generated without the cut. The difference in these two yields, plotted as a function of the $p(\gamma, K^+)X$ missing mass, is shown in Figure 4.6. While many of the events in the plots are background, there are clear Λ and Σ^0 peaks visible.

Fits were used to extract the total number of Λ and Σ^0 events in each spectrum. The results are summarized in Table 4.2. By taking the ratio of the rejected events to the total number of events in our final yield, we were able to calculate the percentage of yield rejected by the cut. This effect was much stronger in the 2.4 GeV dataset than in the 3.1 GeV dataset.

While we could have made a correction for each dataset, we opted to calculate one correction that could be applied equally to both datasets. The tagger inefficiency corrections outlined in the previous section effectively normalized the 2.4 and 3.1 GeV datasets to each other. In light of this, the correct thing to do was to apply the same correction to both datasets. Because the final result was to be the weighted mean of the differential cross section measurements from the two datasets, the correction should be a simple average of the corrections for both datasets. In the end, our correction was determined to be:

$$X = \frac{R_{2.4} + R_{3.1}}{N_{2.4} + N_{3.1}} \quad (4.14)$$

where $R_{2.4}$ and $R_{3.1}$ are the number of valid Λ or Σ^0 events rejected by the photon selection criteria in each dataset and $N_{2.4}$ and $N_{3.1}$ are the integrated yield in each dataset (These numbers are available in Table 4.2.) The individual cross sections were scaled multiplicatively upward by factors of $1 + X$. The final corrections are given in Table 4.3.

While one may argue that this correction is overly simple, the procedure seems to yield a correction of the proper strength. More than half of the events in the final cross sections come from the 3.1 GeV dataset. Hence, the correction should reflect the strength of this effect in the 3.1 GeV dataset more than the 2.4 GeV dataset. A correction on the order of 1 % is appropriate. One could argue that there are more correct procedures for determining this correction. However, any changes in the value of the correction will be much less than 1% and this is a quite small compared to other sources of systematic error outlined in Chapter 6.

4.5 Near-final Results

At this point, we have discussed everything done to complete the differential cross section measurement within each dataset. To produce what we will call the “final results” will require taking the

Figure 4.6: “Good” events rejected by the photon selection criteria are shown in (a) for the 2.4 GeV dataset and in (b) for the 3.1 GeV dataset. Events in these two plots were rejected from our analysis by the photon selection criteria discussed in Section 3.3.1. The spectra here were generated by taking the difference in the $p(\gamma, K^+)X$ missing mass spectrum generated with the photon selection cut turned on and the same spectrum generated with the cut turned off. While most of the events are background, there are visible Λ and Σ^0 peaks. The number of events in the peaks was extracted by the fits shown. For reference, the final total yields used to measure the cross sections are shown in (c) and (d). Events in these two plots were passed not only the photon identification timing cut, but all other analysis cuts as well.

Hyperon	Correction Factor
Λ	1.01%
Σ^0	1.08%

Table 4.3: The final cross sections in both datasets were scaled by this amount to account for yield loss due to the photon selection criteria.

weighted mean of the measurements over the kinematic regions where the datasets overlap. This will be presented in Chapter 7. Because it is instructive to compare the results from both datasets in the region where they overlap, we will present them in this section.

The completed $K^+\Lambda$ differential cross section measurements for each dataset are shown in Figures 4.7-4.9 while the $K^+\Sigma^0$ results are shown in Figure 4.10-4.12. In these figures, the differential cross sections are expressed as functions of $\cos(\theta_{KCM})$ in bins of constant E_γ .

As can be seen in the figures, the two results are in good agreement across all kinematic bins where the datasets overlap. There appear to be no overall systematic offsets; what discrepancies do exist are localized and largely explainable.

- While the cross sections are within statistical precision of each other, the error bars of the 3.1 GeV dataset are uncharacteristically large at $E_\gamma=1.025$ GeV. Upon investigation, there was a definite Λ signal in this bin, but the number of events here was anomalously low. The signals appeared to be extractable; the fits and yield extractions in the 3.1 GeV dataset were in order. There was simply an inefficiency here that was properly modeled by the acceptance (perhaps a poor calibration), that has been corrected in the 2.4 GeV dataset.
- The 3.1 GeV dataset could not produce a measurement at $E_\gamma=1.425$ GeV for either hyperon. Although the data was fine in this bin, the normalization returned a null result at this photon energy. G-flux simply returned a “0”. Having an invalid photon normalization in this bin, we could not produce a result.
- At $E_\gamma=1.875$ GeV in the 2.4 GeV dataset, a collection of weak E-counters in the tagger led to low yields in this bin. Unlike bin $E_\gamma=1.025$ GeV, the signal here was weak enough that the yield extraction became problematic, producing a measurement of poor quality. This problem persisted in the 3.1 GeV dataset, but showed up at higher energies because the e-counter mapping is dependent on the endpoint energy of the incident electron beam. In the 3.1 GeV dataset, these troublesome counters appeared in two bins - $E_\gamma=2.375$ GeV and $E_\gamma=2.4$ GeV.

The consistency between the two measurements strongly validates these results and the analysis procedure used. The corrections to the normalized yields discussed in Section 4.4.1 basically force the angle integrated cross sections to agree in magnitude. However, nothing constrained the cross sections to agree once they were binned in $\cos(\theta_{KCM})$. We expect them to have the same overall scale, but the fact that they have the same shape across the angular range is nontrivial. The hardware failures, such as new holes in the drift chambers, in the detector could easily have introduced angle-dependent tracking inefficiencies. If the problematic scintillator paddles, as discussed in Section 3.3.5 had not been handled properly, we might have also have had angle-dependent discrepancies. Because different versions of the CLAS software were used in the cooking of the datasets, the agreement confirms that the acceptance calculations properly accounted for any software bugs.

Additionally, the agreement also supports the quality of the yield extraction. A bad fit in one $\cos(\theta_{KCM})$ bin could have produced an artificially low or high yield within that kinematic bin. These are typically manifested by discrepancies in the two datasets that are more than a few standard deviations, often resulting in missing data-points from yields that were 0 or off scale. We do not see this behavior in the cross sections, either.

4.6 Summary

This chapter details the acceptance calculations and photon normalization for the differential cross section. The acceptance was based on a GEANT simulation using a total of 40 million Monte-Carlo events. The normalization was based on the G-flux code which used out-of-time tagger hits to estimate the rate of photons incident on the target. Multiplying this rate by the total time the beam was incident on the target produced an estimate of the total photon flux.

Figure 4.7: The 2.4 GeV (blue circles) and 3.1 GeV (black triangles) differential cross sections as a function of $\cos(\theta_{KCM})$ in bins of constant E_γ

Figure 4.8: The 2.4 GeV (blue circles) and 3.1 GeV (black triangles) differential cross sections as a function of $\cos(\theta_{KCM})$ in bins of constant E_γ

Figure 4.9: The 2.4 GeV (blue circles) and 3.1 GeV (black triangles) differential cross sections as a function of $\cos(\theta_{KCM})$ in bins of constant E_γ

Figure 4.10: The 2.4 GeV (blue circles) and 3.1 GeV (black triangles) differential cross sections as a function of $\cos(\theta_{KCM})$ in bins of constant E_γ

Figure 4.11: The 2.4 GeV (blue circles) and 3.1 GeV (black triangles) differential cross sections as a function of $\cos(\theta_{KCM})$ in bins of constant E_γ

Figure 4.12: The 2.4 GeV (blue circles) and 3.1 GeV (black triangles) differential cross sections as a function of $\cos(\theta_{KCM})$ in bins of constant E_γ

The final cross sections for the 2.4 and 3.1 GeV datasets were presented at the end of the chapter. Strong agreement between the two results helps validate the analysis procedures detailed in these last two chapters.

Chapter 5

Double Polarization Observables: C_x and C_z

Our analysis strategy for extracting C_x and C_z relied on the beam helicity asymmetry distribution:

$$A(\cos(\theta_{pY})) = \nu\alpha\eta C_{x/z} \cos(\theta_{pY}) \quad (5.1)$$

where A is the asymmetry, η is the polarization of the incident photon beam, and $\cos(\theta_{pY})$ is the proton angle in the hyperon rest frame. α is the Λ weak decay asymmetry, $0.642 \pm .013$ [66]. ν is what we called the dilution factor. The dilution factor played a role in the Σ^0 analysis and was required because we studied the Σ^0 polarization through its decay to $\gamma\Lambda$. $\nu = -0.256$ for the $K^+\Sigma^0$ analysis, but $\nu = 1.0$ for the $K^+\Lambda$ analysis.

Equation 5.1 states that the beam helicity asymmetry is a linear function of $\cos(\theta_{pY})$. The slope of this linear function should be directly proportional to the double polarization observables. Our analysis then consisted of calculating beam helicity asymmetry within each kinematic bin, plotting it against $\cos(\theta_{pY})$, extracting the slope of the distribution, and then dividing out α , η , and ν .

Having discussed the yield extraction in Section 3.4, this chapter will discuss the remaining steps required to measure C_x and C_z . We will cover calculation of the beam helicity asymmetries, extraction of the asymmetry's slope, and measurement of the photon beam polarization. The steps outlined in this chapter will apply equally well to either observable. Once we had selected the axis used to reference the proton angle, the remaining analysis of both C_x and C_z was identical. A section of the chapter will be devoted to special considerations required for the $K^+\Sigma$ events. The individual results from each beam energy dataset will be presented and compared at the end of the chapter. The final results, which will be the weighted mean of measurements from both datasets, will be presented in Chapter 7.

The analysis of these observables required a circularly polarized photon beam. During acquisition of the 3.1 GeV dataset, data acquisition for the Møller polarimeter in Hall B was not working properly. Because we have no polarization measurements for the 3.1 GeV dataset, only the 2.4 and 2.9 GeV datasets were used to measure C_x and C_z .

5.1 Beam Helicity Asymmetry

The beam helicity asymmetry was defined by

$$A = \frac{N_+ - N_-}{N_+ + N_-} \quad (5.2)$$

where $N_{\pm}$ is the helicity-dependent hyperon yield in a given kinematic bin in E_{γ} , $\cos(\theta_{KCM})$, and $\cos(\theta_{pY})$. One attractive feature of this asymmetry is that the yields need not be acceptance corrected. Because the detector performance could not depend on the helicity state of the incident beam, any acceptance corrections we could have calculated would have factored and divided out of the asymmetry.

The error on the asymmetry was calculated using the standard error propagation formula:

$$\sigma_A = \sqrt{\sigma_{N_+}^2 \left(\frac{dA}{dN_+} \right)^2 + \sigma_{N_-}^2 \left(\frac{dA}{dN_-} \right)^2} \quad (5.3)$$

where $\sigma_{N_{\pm}}$ was the uncertainty on the specified helicity-dependent yield. Because we employed various methods to determine the yield in each kinematic bin, $\sigma_{N_{\pm}}$ was dependent on the method used. In most cases, the yield was extracted with a fit, so $\sigma_{N_{\pm}}$ was the error on the appropriate fit parameter. The uncertainties for the various yield extraction methods are discussed in Section 3.4. The partials were given by

$$\frac{\partial A}{\partial N_{\pm}} = \pm \frac{2N_{\mp}}{(N_+ + N_-)^2}. \quad (5.4)$$

Substituting the partials from Equation 5.4 into Equation 5.3, the final form of the error then became

$$\sigma_A = \frac{2}{(N_+ + N_-)^2} \sqrt{N_-^2 \sigma_{N_+}^2 + N_+^2 \sigma_{N_-}^2}. \quad (5.5)$$

The asymmetries were calculated twice in each kinematic bin. In the first case, the asymmetries were based on the full yield extraction, as discussed in Section 3.4. For this iteration, the yield selection algorithm was allowed to choose the yield from the fitted yields or the sideband-subtracted yield. This determination of the yields was largely based on the fits, so this calculation of the asymmetries will be named the ‘‘Fit-Based Asymmetries’’ (FBA). A second calculation of the asymmetries was based solely on the sideband-subtracted yields. This second calculation of the asymmetries will be called the ‘‘sideband-subtracted asymmetries’’ (SBA). Calculating two versions of the asymmetries allowed us to study how the yield extraction method affected the results. This will be discussed more in the following sections.

For either method, the asymmetry was assigned a value of 100 ± 99 in the few bins where the yields could not be extracted (for either helicity state). The large error bar assigned to this value guaranteed that problematic bins would not have any influence on the linear fits used to extract the slope of the asymmetry distributions (as outlined in the following section).

5.2 Extraction of Asymmetry Distribution Slope

Having calculated the beam helicity asymmetry in each kinematic bin, the asymmetries were then plotted as a function of $\cos(\theta_{pY})$ for fixed kaon angle and photon energy. We then performed a 2-parameter linear fit to the asymmetry distributions and extracted the slope. Fits were made for both the FBA and SBA asymmetry calculations.

Sixteen sets of these fits had to be performed, two for each observable for each hyperon in each dataset and each beam helicity. Due to the number of fits, we will not show all the plots here. However, sample fits used to extract C_z for $K^+\Lambda$ in the 2.4 GeV dataset are shown in Figures 5.1 through 5.4. Figures 5.1 and 5.2 are based on the FBA, while the SBA are plotted in Figures 5.3 and 5.4.

The data quality was poorer at backward angles and at lower energies. This trend is noticeable in Figures 5.1 and 5.3 at $E_{\gamma}=0.9375$ GeV across all angles. In this photon energy bin, it was not obvious that many of the asymmetry distributions were not linear. The fits typically had higher values of χ^2 per degree of freedom and the slope changed rapidly from one bin to the next. In

Asymmetry distributions for $K^+\Lambda$

Figure 5.1: Asymmetry distributions plotted as a function of $\cos(\theta_{p\gamma})$ for the FBA. The rows are bins of constant photon energy, while the columns are bins of constant $\cos(\theta_{KCM})$. Plotted against $\cos(\theta_{p\gamma})$, the asymmetry distributions should be linear, passing through the origin, according to Equation 5.1. The linear fit to each distribution is plotted in blue. The χ^2 per degree of freedom of the fit is printed in blue at the bottom of each panel.

Asymmetry distributions for $K^+\Lambda$

Figure 5.2: Asymmetry distributions plotted as a function of $\cos(\theta_{p\gamma})$ for the FBA. The rows are bins of constant photon energy, while the columns are bins of constant $\cos(\theta_{KCM})$. Plotted against $\cos(\theta_{p\gamma})$, the asymmetry distributions should be linear, passing through the origin, according to Equation 5.1. The linear fit to each distribution is plotted in blue. The χ^2 per degree of freedom of the fit is printed in blue at the bottom of each panel.

Asymmetry distributions for $K^+\Lambda$

Figure 5.3: Asymmetry distributions plotted as a function of $\cos(\theta_{pY})$ for the SBA. The rows are bins of constant photon energy, while the columns are bins of constant $\cos(\theta_{KCM})$. Plotted against $\cos(\theta_{pY})$, the asymmetry distributions should be linear, passing through the origin, according to Equation 5.1. The linear fit to each distribution is plotted in blue. The χ^2 per degree of freedom of the fit is printed in blue at the bottom of each panel.

Figure 5.4: Asymmetry distributions plotted as a function of $\cos(\theta_{pY})$ for the SBA. The rows are bins of constant photon energy, while the columns are bins of constant $\cos(\theta_{KCM})$. Plotted against $\cos(\theta_{pY})$, the asymmetry distributions should be linear, passing through the origin, according to Equation 5.1. The linear fit to each distribution is plotted in blue. The χ^2 per degree of freedom of the fit is printed in blue at the bottom of each panel.

Hyperon	E_γ (GeV)	$\cos(\theta_{KCM})$
Λ	0.9375	all
	1.0375	-0.75
	1.1375	-0.75
Σ°	1.1375	all
	1.2375	-0.7
	1.3375	-0.7

Table 5.1: Data-points rejected from the double polarization analysis. The values for E_γ and $\cos(\theta_{KCM})$ are bin centers. For both hyperons, the lowest photon energy bin was turned off. Two additional bins, at the back-most kaon angle, were also rejected from further analysis.

this kinematic region, the yields used to calculate the asymmetries were very low, producing erratic asymmetry distributions. Because any measurements based on such data would be unreliable, we removed these points from further analysis. A list of the rejected bins is presented in Table 5.1.

We ensured the quality of these linear fits by visually inspecting the fits and studying the distribution of χ^2 per degree-of-freedom for each set of fits. As shown in Figures 5.1-5.4, the asymmetry distributions really were linear when plotted against $\cos(\theta_{pY})$, so the linear fits were of the correct functional form. It can be noted that the slope of the distributions does not appear to change rapidly with the proton energy or kaon angle. Plots of the distribution of χ^2 per degree of freedom for the linear fits are shown in Figures 5.5-5.8. Distributions for the $K^+\Lambda$ observables are shown in Figure 5.5 for the 2.4 GeV dataset, and in Figure 5.7 for the 2.9 GeV dataset. Similarly, $K^+\Sigma^\circ$ observables are shown in Figures 5.6 and 5.8. The solid curve on each plot is the expected χ^2 per degree-of-freedom based on the χ^2 probability density function. A few observations should be made about these plots:

1. Distributions from the $K^+\Lambda$ analysis have a different shape than the distributions for the $K^+\Sigma^\circ$ analysis. This was expected, though. Because there were differences in the kinematic binning used for the different hyperons, we had fewer degrees of freedom when fitting the $K^+\Sigma^\circ$ asymmetries. The $K^+\Lambda$ distributions had 8 degrees-of-freedom, while the $K^+\Sigma^\circ$ had only 3.
2. Overall, there is good agreement between the curve for the expected χ^2 per degree-of-freedom and the actual distribution from the fits. The Λ distributions peak at 1, as they should, while the Σ° are peaked closer to 0.
3. There are not significant differences overall between the χ^2 distributions for the FBA fits and the SBA fits.

Overall, there was good agreement between the fit-based and sideband-subtraction based asymmetries. A few bins are highlighted in Figure 5.9. For the most part, the data resembled Figure 5.9(a). Here, the FBA and SBA were identical, to within errors, across the entire range of proton angles. Fits to both asymmetry calculations are shown in the Figure, and one can see that there is a high degree of agreement between the slope of the two fits. Within the whole analysis, however, there were a few anomalous bins where the agreement between the two asymmetry calculations was poor. One such bin is shown in Figure 5.9(b). In this bin, the FBA calculation was flatter than the SBA calculation. We inspected the quality of the fits used to extract the yields upon which the FBA was based, but found nothing wrong. We had two measurements that were inconsistent, but appeared to be equally valid.

To correctly handle bins such as the one plotted in Figure 5.9(b), we had to choose between the FBA slope and the SBA slope. To accomplish this, we based the results on the asymmetry calculation

Figure 5.5: Distributions of χ^2 per degree-of-freedom for the linear fits to the asymmetry distributions. These plots pertain specifically to $K^+\Lambda$ events in the 2.4 GeV dataset. On the left, the plots are for fits used to extract C_x , while the plots on the right are for fits used to extract C_z . Plots on the top are for fits to FBA distributions, while plots on the bottom are for fits to SBA distributions. The solid curve shows the expected distribution of χ^2 per degree of freedom.

Figure 5.6: Distributions of χ^2 per degree-of-freedom for the linear fits to the asymmetry distributions. These plots pertain specifically to $K^+\Sigma^0$ events in the 2.4 GeV dataset. On the left, the plots are for fits used to extract C_x , while the plots on the right are for fits used to extract C_z . Plots on the top are for fits to FBA distributions, while plots on the bottom are for fits to SBA distributions. The solid curve shows the expected distribution of χ^2 per degree of freedom.

Figure 5.7: Distributions of χ^2 per degree-of-freedom for the linear fits to the asymmetry distributions. These plots pertain specifically to $K^+\Lambda$ events in the 2.9 GeV dataset. On the left, the plots are for fits used to extract C_x , while the plots on the right are for fits used to extract C_z . Plots on the top are for fits to FBA distributions, while plots on the bottom are for fits to SBA distributions. The solid curve shows the expected distribution of χ^2 per degree of freedom.

Figure 5.8: Distributions of χ^2 per degree-of-freedom for the linear fits to the asymmetry distributions. These plots pertain specifically to $K^+\Sigma^0$ events in the 2.9 GeV dataset. On the left, the plots are for fits used to extract C_x , while the plots on the right are for fits used to extract C_z . Plots on the top are for fits to FBA distributions, while plots on the bottom are for fits to SBA distributions. The solid curve shows the expected distribution of χ^2 per degree of freedom.

Figure 5.9: These plots demonstrate how the method of calculating the asymmetries may affect the slope of the final distribution. In both plots, the data and fit corresponding to the FBA are in black, while the SBA data and fit are in blue. Each figure shows one kinematic bin from the 2.9 GeV dataset. Most kinematic bins resemble plot (a). In this plot, both the FBA and SBA are in good agreement across the full range of $\cos(\theta_{pY})$. As a result, the slopes from each distribution are also in good agreement. (b) shows a bin in which the two distributions do not agree. Here, the SBA appear to be much flatter than the FBA. Fitting a line to the FBA yields a slope of 0.017 and a χ^2 per degree of freedom of 1.03. A linear fit to the SBA has a slope of 0.26 and χ^2 per degree of freedom equal to .98.

Dataset	Polarization
2.4 GeV	$65.4 \pm 1.3 \%$
2.9 GeV	$64.1 \pm 1.2\%$

Table 5.2: e^- beam polarization measurements for 2.4 and 2.9 GeV datasets. Three measurements were made for the 2.4 GeV dataset, so the number reported is the weighted mean of the three measurements, with the standard deviation being taken as the error. Only one measurement was made for the 2.9 GeV dataset. Polarization measurements were retrieved from the CLAS Electronic Logbook [50].

that resulted in a better linear fit. The better fit was determined to be the one producing a lower χ^2 per degree of freedom. We felt this was justifiable in light of Equation 5.1. While we could have opted to take the average or weighted mean of the two slopes, we felt that this χ^2 selection produced the most honest measurement. As shown in Figures 5.1 through 5.4, the slopes of the asymmetry distributions were very stable and did not vary rapidly with E_γ or $\cos(\theta_{KCM})$. The slope of the FBA in Figure 5.9(b) was a large departure from the slope of surrounding bins, while the slope of the SBA was not. To use the FBA would have introduced structure in the final result that was of questionable validity. While an average or weighted mean would have reduced the strength of such a structure, it would have still been present.

The error on the slope measurement was taken to be

$$\sigma_{slope} = \sqrt{\sigma_{fit}^2 + \sigma_{ye}^2} \quad (5.6)$$

where σ_{fit} is the error on the appropriate fit parameter. σ_{ye} characterized the systematic dependence of the slope on the method of yield extraction and was the difference between the FBA and SBA slopes. The systematic contribution was small over most of the dataset, but dominated the error in bins such as the one shown in Figure 5.9(b).

5.3 Photon Polarization

Although Hall B had devices to measure the polarization of an electron beam, the Hall had no means to directly measure the polarization of a photon beam. Our strategy, then, was to use the electron beam polarization as input to a model that allowed us to calculate the photon beam polarization. This section will detail our analysis of the beam polarization.

Electron beam polarization was measured using the Møller polarimeter located upstream from CLAS. The polarization was studied during special “Møller runs” in which the tagger and data acquisition were turned off. The Møller runs were analyzed by Arne Freyberger, and he posted the results in the CLAS on-line logbook. We do have electron beam polarization measurements for the 2.4 and 2.9 GeV datasets. There was one successful polarization measurement taken for the 2.9 GeV dataset. This measurement, with its associated error is shown in Table 5.2. Three polarization measurements were made for the 2.4 GeV dataset. The weighted mean of these measurements was used to produce one determination of the beam polarization, as given in Table 5.2. The error on the polarization for the 2.4 GeV dataset was taken to be the standard deviation of the three individual measurements.

The polarization of the photon beam was calculated using the Maximon and Olson relation [65]

$$\eta = \frac{k(\epsilon_1 + \frac{1}{3}\epsilon_2)\zeta}{\epsilon_1^2 + \epsilon_2^2 - \frac{2}{3}\epsilon_1\epsilon_2} \quad (5.7)$$

Figure 5.10: This plot shows the functional form of the Maximon and Olsen relation [65]. The vertical axis shows the relative photon polarization; the curve needs to be scaled by the polarization of the incident electrons to yield the photon polarization. The horizontal axis is the ratio of photon energy to incident electron energy.

where ζ is the polarization of the incident electron beam (see Table 5.2), ϵ_1 is the energy of the incident e^- , ϵ_2 is the energy of the recoiling e^- , and k is the energy of the resultant γ . The midpoint of each E_γ bin was used when choosing values for k , ϵ_1 and ϵ_2 .

A beam of bremsstrahlung photons is non-mono-energetic, and Equation 5.7 states that the polarization of such a photon beam is a function of the energy of the resultant photon. A plot of the functional form of Equation 5.7 is given in Figure 5.10. From the plot, it can be seen that the photon polarization drops as the ratio of photon energy to incident electron energy falls. The polarization transfer is maximal at full energy transfer and falls off in a monotonic fashion.

There is some error that may enter into the final results for C_x and C_z due to this method of calculating the photon polarization. A number of effects can be considered. First, there was some error inherently associated with the formula that must be considered. Second, the electron beam polarization measurements from the Møller polarimeter were not perfect and have their associated error as shown in Table 5.2. Finally, there was some error associated with the fact that we calculated the polarization at the midpoint of photon energy bins that were 100 MeV wide. The polarization

varied across the entire bin width, so there was some error associated with our approximation. These sources of error are all systematic in nature and will be discussed in Section 6.4.4. They will not contribute to the propagated error.

5.4 Final Constants

After the slope of asymmetry distributions was divided by the beam polarization, there were a few final constants to be applied to complete the extraction of C_x and C_z .

First, we had to divide the extracted slopes by α , the Λ weak decay asymmetry. This number had previously been measured in other experiments and has a published value of $\alpha = 0.642 \pm 0.013$ [66]. The error on the weak decay asymmetry parameter was considered to be a systematic error. Hence it was not propagated with the statistical errors and will be discussed in Chapter 6.

Next, we had to divide out the dilution factor, ν . The dilution factor only applied to the $K^+\Sigma^0$ analysis. Because we studied the Σ^0 through its Λ decay product, the proper way to perform the Σ^0 analysis would have been to measure the proton distribution in the rest frame of the decay Λ . In this case, we would have used $\nu = \frac{-1}{3}$ to account for dilution of the Σ^0 polarization due to the hyperon decay. However, we did not have the means to recreate the rest frame of the decay Λ . To do this, we would have either had to detect the γ from the Σ^0 decay, or the π^- from the Λ decay. The CLAS acceptance for either particle would have been low enough to prohibit us from measuring these observables for the Σ^0 channel. Our solution, then, was to measure the proton in the Σ^0 rest frame. We studied the effect of measuring the proton distribution in the improper frame and applied a correction to the analysis.

The effect of measuring the proton distribution in the Σ^0 rest frame was studied with a simulation, and the result is shown in Figure 5.11. As shown in the figure, the distribution measured in the Σ^0 rest frame has a smaller slope than the distribution would have in the rest frame of the decay Λ . The correct value of ν was determined by using the ratio of the slopes in the figure. Hence, for the $K^+\Sigma^0$ analysis, we used $\nu = -0.256$, a number which accounts for the dilution of the Σ^0 polarization due to its decay, as well as the frame dependence of the slope of the proton distribution. For the Λ analysis, $\nu = 1.0$.

Finally, we had to scale the 2.4 GeV dataset by a factor of -1 to account for a change in the interpretation of the beam helicity reporting. Any information recorded in the data about the beam helicity state was supplied by the CEBAF accelerator division and recorded by the Hall B data acquisition system. We received a one-bit signal flagging the beam helicity state. This signal was not an absolute determination of the helicity as the interpretation of the flag's numerical value changed with the accelerator configuration [30]. During acquisition of the individual datasets, the interpretation stayed constant. However, there was a change in the flag's interpretation between the 2.4 and 2.9 GeV datasets. This change in the helicity bit's interpretation created an overall sign discrepancy between the results of the two datasets. As a result, a scale factor of -1 was applied to the 2.4 GeV dataset to give the two datasets a consistent overall sign.

This action was not inconsequential; this constant settled our assignment of the absolute helicity interpretation. Although we were without a direct means of interpreting the helicity information recorded with the data, our action is not without reason. Our assignment was made so that our results concurred with those of Carman *et al.* in their measurement of transferred polarization in $K^+\Lambda$ electro-production [67]. In their work, the Carman group was able to correctly determine the overall electron polarization by referencing the fifth structure function in the $\Delta(1232)$ resonance region [69]. The overall sign of this function is known to be positive in this region, permitting one to verify an interpretation of the data-stream helicity flag. Expecting our measurements to approach the Carman low q^2 result, we established our sign convention accordingly.

Figure 5.11: Effect of measuring proton angle in Σ^0 rest frame. The solid line shows the proton distribution as we measured it, in the Σ^0 rest frame. The dashed line shows the same distribution measured in the rest frame of the decay Λ . Image source: [68].

5.5 Comparison of 2.4 GeV and 2.9 GeV Result

Once the final analysis was completed for each dataset, the results were plotted and compared on the same set of axes. The results plotted against W in bins of constant $\cos(\theta_{KCM})$ for $K^+\Lambda$ are shown in Figures 5.12 through 5.20. The corresponding results for $K^+\Sigma^0$ are given in Figures 5.21 through 5.26. The fact that the two results agree to within the calculated error bars is an initial qualitative systematic check of the analysis; the two datasets should agree within identical kinematic bins.

A few additional points about the comparison are worth mentioning:

1. The 2.4 GeV dataset was initially much larger than the 2.9 GeV dataset, and was spread over a smaller kinematic range. We expect the statistical error of the 2.4 GeV results to be much better than the 2.9 GeV results.
2. The value of either observable should be capped at ± 1.0 . While there are a few data-points that exceed these limits, such points have typically large error bars. Because the final result will be the weighted mean of these two datasets, these errant points will have little influence on the final result.
3. There are occasional jumps in error bar size within a single dataset. An obvious example appears in Figure 5.19 around $W=2.15$ GeV in both C_z and C_x . In both cases, error bars on neighboring points are much smaller. Such a jump is not statistical and due to poor yields within a kinematic bin. These increases result from a large systematic contribution to the error. These sudden large error bars testify that the result is significantly dependent on the yield extraction method, as explained in Section 5.2.

5.6 Summary

This chapter discussed analysis performed on the extracted yields in order to produce the measurements of C_x and C_z . Because the method used relied on initially calculating the beam helicity asymmetry in each kinematic bin, no acceptance correction was required for these observables. We simply extracted the slope of the beam helicity asymmetry distribution as a function of $\cos(\theta_{pY})$, and then divided out the photon beam polarization and the Λ weak decay asymmetry parameter.

Figure 5.12: These are the final observable measurements for both datasets plotted on the same axes for purposes of comparison. These data are for a constant K^+ angle bin of $\cos(\theta_{KCM}) = -0.75$. The data are plotted as a function of W . The dotted line on the plot of C_z has been drawn to show how close this observable comes to its maximum allowed value.

Figure 5.13: These are the final observable measurements for both datasets plotted on the same axes for purposes of comparison. These data are for a constant K^+ angle bin of $\cos(\theta_{KCM}) = -0.55$. The data are plotted as a function of W . The dotted line on the plot of C_z has been drawn to show how close this observable comes to its maximum allowed value.

Figure 5.14: These are the final observable measurements for both datasets plotted on the same axes for purposes of comparison. These data are for a constant K^+ angle bin of $\cos(\theta_{KCM}) = -0.35$. The data are plotted as a function of W . The dotted line on the plot of C_z has been drawn to show how close this observable comes to its maximum allowed value.

Figure 5.15: These are the final observable measurements for both datasets plotted on the same axes for purposes of comparison. These data are for a constant K^+ angle bin of $\cos(\theta_{KCM}) = -0.15$. The data are plotted as a function of W . The dotted line on the plot of C_z has been drawn to show how close this observable comes to its maximum allowed value.

Figure 5.16: These are the final observable measurements for both datasets plotted on the same axes for purposes of comparison. These data are for a constant K^+ angle bin of $\cos(\theta_{KCM}) = 0.05$. The data are plotted as a function of W . The dotted line on the plot of C_z has been drawn to show how close this observable comes to its maximum allowed value.

Figure 5.17: These are the final observable measurements for both datasets plotted on the same axes for purposes of comparison. These data are for a constant K^+ angle bin of $\cos(\theta_{KCM}) = 0.25$. The data are plotted as a function of W . The dotted line on the plot of C_z has been drawn to show how close this observable comes to its maximum allowed value.

Figure 5.18: These are the final observable measurements for both datasets plotted on the same axes for purposes of comparison. These data are for a constant K^+ angle bin of $\cos(\theta_{KCM}) = 0.45$. The data are plotted as a function of W . The dotted line on the plot of C_z has been drawn to show how close this observable comes to its maximum allowed value.

Figure 5.19: These are the final observable measurements for both datasets plotted on the same axes for purposes of comparison. These data are for a constant K^+ angle bin of $\cos(\theta_{KCM}) = 0.65$. The data are plotted as a function of W . The dotted line on the plot of C_z has been drawn to show how close this observable comes to its maximum allowed value.

Figure 5.20: These are the final observable measurements for both datasets plotted on the same axes for purposes of comparison. These data are for a constant K^+ angle bin of $\cos(\theta_{KCM}) = 0.85$. The data are plotted as a function of W . The dotted line on the plot of C_z has been drawn to show how close this observable comes to its maximum allowed value.

Figure 5.21: These are the final observable measurements for both datasets plotted on the same axes for purposes of comparison. These data are for a constant K^+ angle bin of $\cos(\theta_{KCM}) = -0.70$. The data are plotted as a function of W .

Figure 5.22: These are the final observable measurements for both datasets plotted on the same axes for purposes of comparison. These data are for a constant K^+ angle bin of $\cos(\theta_{KCM}) = -0.40$. The data are plotted as a function of W .

Figure 5.23: These are the final observable measurements for both datasets plotted on the same axes for purposes of comparison. These data are for a constant K^+ angle bin of $\cos(\theta_{KM}) = -0.10$. The data are plotted as a function of W .

Figure 5.24: These are the final observable measurements for both datasets plotted on the same axes for purposes of comparison. These data are for a constant K^+ angle bin of $\cos(\theta_{KCM}) = 0.20$. The data are plotted as a function of W .

Figure 5.25: These are the final observable measurements for both datasets plotted on the same axes for purposes of comparison. These data are for a constant K^+ angle bin of $\cos(\theta_{KCM}) = 0.50$. The data are plotted as a function of W .

Figure 5.26: These are the final observable measurements for both datasets plotted on the same axes for purposes of comparison. These data are for a constant K^+ angle bin of $\cos(\theta_{KM}) = 0.80$. The data are plotted as a function of W .

Chapter 6

Systematic Uncertainties

Statistical errors, in our case, quantify how our measurements could have changed had we used a larger sample of events. In the past three chapters, we have detailed the analysis steps required to produce final measurements from the unanalyzed cooked events. The error bars shown in the previous chapters have been dominated by statistical error.

Systematic uncertainties are of a different nature from statistical. They are independent of the size of the dataset, and are more concerned with effects that could introduce an artificial bias into a result. Systematic errors are more difficult to detect, and required careful study on our part.

This chapter begins by discussing the presentation of our final measurements. Previous chapters have presented measurements made within individual datasets. For example, differential cross sections were measured from both the 2.4 GeV and 3.1 GeV datasets. The two results were presented side-by-side at the end of Chapter 4. What we call the final results will be the weighted mean of the results from the individual datasets. While the formal presentation and discussion of the final results will be done in Chapter 7, this chapter will show a few final results and discuss them in the context of systematic errors. The first section of this chapter, then will discuss how we calculated the weighted mean of two individual measurements, as well as any corrections made to the final results after the weighted mean was calculated.

The remainder of the chapter discusses our efforts to detect and characterize systematic errors in our analysis. The second section of this chapter will discuss an extensive study that we undertook comparing our differential cross section results to an earlier measurement made by John McNabb. John measured differential cross sections for $K^+\Lambda$ and $K^+\Sigma^0$ using the 2.4 GeV dataset for his thesis research, completed in 2002. This study took most of a year and resulted in significant changes for both results. In addition, this study produced much of what we know about the systematic errors on the differential cross section. The remaining two sections of this chapter will summarize the systematic errors on the differential cross section and double polarization observables. The resulting numbers will be presented in a table and the criteria for determining the error estimates will be detailed.

6.1 Final Results and One Last Correction

Each observable that has been measured has involved the analysis of two independent datasets. Up to this point, the two datasets have been treated independently. One of the most extensive studies that we made which effected our understanding of the systematic errors was the comparison of our cross section results to those of John McNabb. This study will be discussed in the following section, and our final results will be compared to John McNabb's. Before showing these results, this section will detail how we calculated the weighted mean of our individual results and a final correction made to the bin centers used to display our final results.

6.1.1 Calculation of the Weighted Mean

As previously mentioned, two datasets were analyzed independently while measuring all observables. The differential cross sections were extracted from the 2.4 and 3.1 GeV datasets, while the double polarization observables were extracted from the 2.4 and 2.9 GeV datasets. Comparisons of the individual results have been an important check of our analysis procedures and data quality. However, in the end, we wanted one result based on the statistical power of both datasets. In order to combine the two individual results for each observable, we used the weighted mean.

The weighted mean of an observable, O , is defined by:

$$O = \frac{\sum_i \frac{O_i}{\sigma_i^2}}{\sum_j \frac{1}{\sigma_j^2}} \quad (6.1)$$

where O_i is the value of the observable for one dataset in one kinematic bin, σ_i is the corresponding error. The sums run over both datasets producing a measurement of the observable. In this case, the errors are given by

$$\sigma_O = \sqrt{\frac{1}{\sum_j \frac{1}{\sigma_j^2}}}. \quad (6.2)$$

where the sum again runs over the datasets. This technique weights the final results by the errors of the individual measurements. In the end, the most precise measurement (having the smallest error) will have the most influence on the final result.

6.1.2 Bin Centering Correction

Mike Williams and Curtis Meyer, at Carnegie Mellon University, developed the first successful kinematic fitter for use with CLAS photoproduction data late in 2003 [70]. They then used this kinematic fitter to study the accuracy of CLAS momentum and energy measurements [71]. The completion of this study in the summer of 2004 revealed systematic errors in the photon energies determined by the tagger. The tagger was designed by Dan Sober and Hall Crannell at Catholic University. They determined that the errors were due to some previously undetected mechanical sag in the tagger hodoscopes. A plot showing the the correction as a function of E_γ (as reported by the tagger) is shown in Figure 6.1. Because the mapping of tagger detector elements to photon energy changed with the endpoint energy of the electron beam, the corrections differ for each G1C dataset.

The obvious way to correct for this error was to correct the photon energy of our data-points, which also amounted to restating the center of our kinematic bins. Because the final results are the weighted mean of two datasets, we averaged the correct bin centers for the two datasets and reported that as the E_γ coordinate for the final results. The exact numbers of the bin centers for each G1C datasets, as well as the bin centers used for the weighted mean of our measured observables are reported in Appendix A.

One could argue that the correction should have been applied before the weighted mean of the observables was calculated. However, any uncertainty in the bin centroids of the final results is small. We studied this effect by calculating the corrected bin centers for the 2.4 and 3.1 GeV datasets. We then took the difference between the corrected bin centers for the two datasets. This difference should estimate twice the uncertainty in the bin centroids reported for the final results. The largest differences were approximately 4 MeV, resulting in a bin centering uncertainty of 2 MeV in a 25-MeV-wide bin. We will quote an error of ± 2 MeV on our reported bin centers.

Further evidence in support of our bin centering corrections comes from the agreement between results from the individual datasets. Individual cross section results were shown in Chapter 4. Differential cross sections from the 2.4 GeV and 3.1 GeV datasets were plotted side-by-side in bins of constant E_γ . There were no corrections made to the photon energies reported by the tagger in these plots. Hence, the two results were actually from slightly different ranges in photon energy.

Figure 6.1: Corrections to tagger photon energy vs. the tagger photon energy. The scale of both axes is GeV. The corrections on the vertical axis were determined by Mike Williams and Curtis Meyer using a kinematic fitter. The errors in the reported energy were due to previously undetected mechanical sag in the tagger hodoscopes. These corrections pertain to the 3.1 GeV dataset. Image source: [71].

Despite the systematic shifts, the two results are in strong agreement. Clearly, the cross sections do not change fast enough in E_γ for any error in the reported photon energy to introduce large errors in the result. The agreement is strong enough that we feel justified taking the weighted mean of the two results and simply reporting the corrected bin centers. Similar conclusions could be made about the double polarization observables.

6.2 McNabb Differential Cross Sections Revisited

During our analysis of the differential cross section, we spent large amounts of time resolving differences between our preliminary results and those of an earlier analysis completed by John McNabb. John McNabb was a graduate student at Carnegie Mellon from 1995 to 2002. He was the first graduate student to study $K^+\Lambda$ and $K^+\Sigma^0$ in the G1C dataset, measuring $\frac{d\sigma}{d\Omega}$ and the hyperon recoil polarization, P .

The McNabb differential cross section analysis differed significantly from ours in its yield extraction and acceptance. The McNabb yield extraction relied on explicit detection of only the kaon, and used a cut on the $p(\gamma, K^+)Y$ missing mass to identify Λ and Σ^0 events. The acceptance calculation was based on a parametric Monte-Carlo. Finally, the McNabb normalization was based on the G-flux code, although it used an earlier version than the one employed in our cross sections.

Initially, we noted two types of discrepancies when comparing our results to those of John McNabb. First, the McNabb differential cross sections were systematically higher than ours by approximately 10%. Second, we also noticed some apparent angle-dependent discrepancies that became more pronounced in the forward direction. Trying to understand the discrepancies led us on a study that lasted approximately one year, and resulted in significant changes for both results. For us, the study revealed problems with our filtered dataset and normalization. For both analyses, the study resulted in a revised and improved acceptance calculation.

6.2.1 Improved Filters and Normalization

Since our preliminary cross sections were low compared to the McNabb results, the first step was to double-check our analysis, looking for anything that would artificially lower our result. In the process, we found two effects that were largely responsible for the discrepancy.

First, we found software bugs that artificially decreased the yield in our results. We ran our analysis code on one filtered run, and then on the cooked datafiles for the same run. The resulting yields should have been identical, but the results from the cooked file contained significantly more events than the filtered result. A closer examination of the filter code revealed bugs that were randomly rejecting “good” events that otherwise should have been included in the filter output. At the same time, we altered the filter to include Eugene Pasyuk’s energy-loss package, a software function that corrected the momentum vector of a track for energy lost in the target and other material located between the interaction vertex and the CLAS time-of-flight system. The effect of the improved filter was an overall 5.24% increase in the total yield. This effort resulted in a refiltering of all datasets, requiring about two months of work.

Second, we also found problems with the photon flux normalization. We checked the stability of the normalized yields as a function of run number, which should be stable across a dataset. However, we found that the normalized yields were low in roughly 10% of the runs in the 2.4 GeV dataset, resulting in a normalization that was artificially high by an overall 5%. Looking into the matter further, we found that the G-flux results for a number of files excluded from the filtering were included in the overall normalization.

The correction of these two errors resolved much of the systematic offset between our differential cross section and the McNabb differential cross section.

6.2.2 Acceptance

Because some of the discrepancies appeared to be angle-dependent, we spent time studying the acceptance calculation for both results. The McNabb results were based on a parametric Monte-Carlo, tuned to concur with GSIM results. At the time John McNabb was finishing his thesis, the parametric Monte-Carlo ran much more quickly on the CMU computer facilities than GSIM did. McNabb generated an acceptance based on two million GSIM events and used this to guide the construction of the parametric Monte-Carlo. Once the parametric Monte-Carlo had been properly tuned, he relied on its speed to generate a statistically precise acceptance.

Of further interest was the fact that McNabb scaled his final measurement globally upward by approximately 8%. This scale factor was based on comparisons of pion data to the SAID database. In order to resolve controversy surrounding the photon normalization, McNabb analyzed $\gamma p \rightarrow \pi^+ n$ differential cross sections using the G1C dataset. His results appeared globally low by 8% when compared to the SAID parametrization of the world's data. The plot used to justify the scale factor is shown in Figure 6.2. Because the ratio was low, yet flat as a function of $\cos(\theta_{\pi^+})$, McNabb felt that a global scale factor was an appropriate correction to the problem. Finding nothing that would keep the kaon data from also being globally low, the McNabb $K^+ \Lambda$ and $K^+ \Sigma^0$ differential cross sections were scaled upward by the same factor.

The strategy for our acceptance study was to generate a high-statistics GSIM based acceptance for the McNabb differential cross sections. We would compare the GSIM acceptance to the parametric acceptance used in McNabb analysis and see how things changed. We ran the McNabb analysis code on the 20 million $K^+ \Lambda$ and $K^+ \Sigma^0$ events that we had previously generated. In the course of the study, it became evident that both analyses had used an incorrect version of a1c, the code used to process "raw" data into a "cooked" form suitable for physics analysis. When generating an acceptance, one must use the same version of a1c that was used to process the data - any bugs or calibration differences affecting the actual data must have an identical effect on the MC for the acceptance to be valid. Although McNabb based his main acceptance on a parametric MC, he employed a1c to cook his 2 million GSIM events used to tune the parametric Monte-Carlo. Implementing the correct version of a1c resulted in an overall 3% lower acceptance than that used in the McNabb thesis. Correspondingly, the differential cross sections scaled upward by the same amount. A sample acceptance ratio comparing an acceptance using the proper a1c with the McNabb thesis acceptance is shown in Figure 6.3.

So, due to the 8% scale factor applied to the McNabb cross section, we were obliged to generate a new acceptance for the $\pi^+ n$ cross sections and repeat the comparison. We generated 10 million $\pi^+ n$ events and ran the McNabb pion analysis code on them to produce a new acceptance, which was used to produce new $\pi^+ n$ differential cross sections. The new cross sections were compared to the SAID parametrization, and the ratios are shown in Figure 6.4. As shown in the figure, the new acceptance scaled the $\pi^+ n$ cross sections upward, so that the McNabb results were only 6.56% low compared to the SAID curves. In addition, because the ratio was no longer flat as a function of $\cos(\theta_{\pi^+})$, we felt such a correction was no longer valid. Instead of renormalizing all cross sections, we opted to state that there was a 6.56% systematic uncertainty in the global scale of these measurements. Groups have argued that this number could be lower, however we feel that it accurately reflects the uncertainty in the SAID parametrization and McNabb $\pi^+ n$ analysis.

6.2.3 Comparison to McNabb Results

The final results of both analyses are shown in Figures 6.5 to 6.8 for the Λ differential cross sections and in Figures 6.9 to 6.12 for the Σ^0 . The data are plotted as a function of $\cos(\theta_{KCM})$ in bins of constant photon energy. Our binning in photon energy is identical to the McNabb binning, 25 MeV-wide bins with a lower limit of .9125 GeV. However, our binning in $\cos(\theta_{KCM})$ differs; while both analyses have 18 bins, .1 wide, the McNabb bins are offset from ours by .05. They cover from -.9 to .9 in $\cos(\theta_{KCM})$, while our bins cover from -.85 to .95. For that reason, the results are only

Figure 6.2: This plot shows the ratio of the McNabb $\gamma p \rightarrow \pi^+ n$ differential cross section to the SAID parametrization of the world's data. A constant was fit to the ratio, and the result of .9198 is printed on the figure. The McNabb analysis attributed the low value of the ratio to a trigger inefficiency in the CLAS data, and used the result of the fit to justify scaling all $K^+ Y$ cross sections by 1.087. Image source: [57]

2004/04/27 18.40

Figure 6.3: These plots show the ratio of two acceptance calculations used in the McNabb $p(\gamma, K^+) \Lambda$ analysis. In the numerator is an acceptance based on 1M GSIM events generated by John McNabb and processed with the correct version of `alc`. The denominator is John's thesis acceptance. The numbers on the horizontal axis in both plots correspond to bin numbers. The bins in the upper plot are arranged from lower to higher E_γ , while the bins in the lower plot are arranged according to kaon angle, from backward to forward. The blue line just below 1.0 in each plot is a constant that was fit to the ratio. In both cases, the fit reveals that the newer acceptance is roughly 3% lower than the thesis acceptance.

$$\gamma p \rightarrow \pi^+ n, \text{fit}$$

2004/11/16 17.52

Figure 6.4: This plot shows the ratio of the revised McNabb $\gamma p \rightarrow \pi^+ n$ differential cross section to the SAID parametrization of the world's data. A constant was fit to the ratio, and the result of .9494 is printed on the figure. This ratio has improved due to the implementation of the correct version of a1c. Also of note is the fact that the ratio is no longer flat across the angular range. Due to these changes, both our results and the McNabb results were no longer scaled by the 8% global correction.

shown as a function of $\cos(\Theta_{KCM})$. Our results shown are the weighted mean of the 2.4 and 3.1 GeV datasets. Photon energies printed on the figures are our corrected bin centers.

Quantitatively, we have more data than McNabb. In terms of photon energy, our result extends up to $E_\gamma = 2.9125$ GeV, while McNabb's results end at 2.3375 GeV. In the region where the results overlap, the differences in coverage were closely related to the number of particles detected. Our analysis placed more stipulations on each event, especially requiring the explicit detection of the proton. These extra requirements resulted in lower yields, which were particularly difficult to extract at lower photon energies and backward kaon angles, where the CLAS acceptance was weakest. For this reason, McNabb has data at $E_\gamma = 0.925$ GeV for the $K^+\Lambda$ while we do not. On the other hand, because we detected two particles, we had other means of removing background that were not available to McNabb. For this reason, his yields were frequently overwhelmed by mis-identified pions. This effect is particularly strong at forward angles and higher photon energies where his yield extraction became unreliable. This effect begins to show up at $E_\gamma = 1.925$ GeV, where the McNabb result starts to lose data-points in the forward direction.

Other quantitative differences in the two results are resolved by the fact that we analyzed both the 3.1 and 2.4 GeV datasets. While proton detection gave our analysis an overall lower efficiency for detecting $K^+\Lambda/\Sigma^0$ events than McNabb's analysis, the statistical accuracy of the two measurements is comparable because we analyzed roughly twice as many events. Our analysis of both datasets accounts for two rather isolated discrepancies between the size of our error bars and those of the McNabb analysis:

- At $E_\gamma = 1.119$ GeV, the yields are low in the 2.4 GeV dataset. The yields are extractable, but the statistical precision is low. This is the reason why McNabb's error bars are so much larger than ours. Our error bars in this bin are reduced greatly by the 3.1 GeV dataset, which has much higher yields at this photon energy.
- A collection of weak tagger E-counters kept McNabb from making reliable measurements in the $E_\gamma = 1.875$ GeV bin. The 3.1 GeV dataset allows our measurement to cover this bin.

Above the region in which the two measurements overlap, we had no means of cross-checking bins where there were problems in the 3.1 GeV dataset. As a result, we were unable to make verifiable measurements in three photon energy bins. The weak E-counters showing up at $E_\gamma = 1.875$ GeV in the 2.4 GeV dataset appeared at $E_\gamma = 2.375$ and 2.400 GeV in the 3.1 GeV dataset. The measurements made in these bins were of very poor quality, so we do not include them in our final result. Additionally, the result in the highest energy bin, $E_\gamma = 2.375$ GeV, was also of poor quality and is not included here.

Qualitatively, both results are in strong agreement. The fact that both analyses agree so well is a strong systematic check on the final results. Although both analyses used the 2.4 GeV dataset and some of the same MC events were used in the acceptance calculation, the yield extraction methods were unique to each effort. While the normalization in both analyses was based on G-flux, two differing versions of the G-flux analysis were employed. Across all kinematics, the shape of the data is well reproduced. There are no "new" structures appearing in our results that do not appear in McNabb's. In most cases, the two measurements are within error-bars of each other.

There are a number of bins where our cross section is slightly higher than the McNabb result, at $E_\gamma = 1.521$ or 1.621 GeV, for example. This discrepancy persists over most of the angular coverage within these bins. The next higher and lower photon energy bins show good agreement, so this appears to be a systematic effect, dependent on photon energy. Because of this energy dependence, the photon normalization is likely to be the cause of the discrepancy. As noted earlier, McNabb's analysis employed a different version of the G-flux normalization than we did. While these versions were equivalent for the 2.4 GeV dataset, there were known to be significant discrepancies between the two versions for the 3.1 GeV dataset, as discussed in section 4.2.2. Although McNabb's analysis does not cover the 3.1 GeV dataset, he did use it to make corrections to his photon normalization,

Figure 6.5: Our final (black triangles) and the McNabb revised (blue circles) differential cross sections for $K^+\Lambda$ as a function of $\cos(\theta_{KCM})$ in bins of constant E_γ . Photon energies printed on the plots are at the corrected bin centers, and are given in GeV.

much as we did in Section 4.4.1. The procedure McNabb employed to calculate these corrections differed from our in the following ways:

1. McNabb based his corrections on the all positive charged particle yield for single track events. We based ours on the sum of our $K^+\Lambda$ and $K^+\Sigma^0$ yields.
2. While we used the entire 3.1 GeV dataset, McNabb used only a subset of runs.
3. McNabb used the older G-flux version to normalize his 3.1 GeV yields.

Due to the different methods, discrepancies in the final cross sections attributable to the normalization corrections are not surprising. However, both results are better with the corrections in place. Instead of further studying the issue, we note that the McNabb π^+n analysis also had to employ these normalization corrections. This π^+n analysis was used to estimate the overall systematic error on the normalization in both analyses. Hence, the systematic error we quote on the normalization should already reflect this E_γ -dependent error manifest in this comparison of the two cross section results.

Figure 6.6: Our final (black triangles) and the McNabb revised (blue circles) differential cross sections for $K^+\Lambda$ as a function of $\cos(\theta_{KCM})$ in bins of constant E_γ . Photon energies printed on the plots are at the corrected bin centers, and are given in GeV.

Figure 6.7: Our final (black triangles) and the McNabb revised (blue circles) differential cross sections for $K^+\Lambda$ as a function of $\cos(\theta_{KCM})$ in bins of constant E_γ . Photon energies printed on the plots are at the corrected bin centers, and are given in GeV.

Figure 6.8: Our final (black triangles) differential cross sections for $K^+\Lambda$ as a function of $\cos(\theta_{KCM})$ in bins of constant E_γ . Photon energies printed on the plots are at the corrected bin centers (in GeV).

Figure 6.9: Our final (black triangles) and the McNabb revised (blue circles) differential cross sections for $K^+\Sigma^0$ as a function of $\cos(\theta_{KCM})$ in bins of constant E_γ . Photon energies printed on the plots are at the corrected bin centers. (in GeV).

Figure 6.10: Our final (black triangles) and the McNabb revised (blue circles) differential cross sections for $K^+\Sigma^0$ as a function of $\cos(\theta_{KCM})$ in bins of constant E_γ . Photon energies printed on the plots are at the corrected bin centers. (in GeV)

Figure 6.11: Our final (black triangles) and the McNabb revised (blue circles) differential cross sections for $K^+\Sigma^0$ as a function of $\cos(\theta_{KCM})$ in bins of constant E_γ . Photon energies printed on the plots are at the corrected bin centers. (in GeV).

Figure 6.12: Our final (black triangles) differential cross sections for $K^+\Sigma^0$ as a function of $\cos(\theta_{KCM})$ in bins of constant E_γ . Photon energies printed on the plots are at the corrected bin centers. (in GeV).

Source	Uncertainty
Yield	
Yield extraction	5.4%
Normalization	
Overall normalization (CLAS vs. SAID, π^+n)	6.6%
Photon attenuation	0.20%
Acceptance	
Acceptance	2.7%
Target Factors	
H_2 density	0.14%
Target length	0.28%
Total	8.9%

Table 6.1: Sources of systematic uncertainty and their estimated strength. Note that the differential cross section results will also have an uncertainty of ± 2 MeV on the centering of bins in E_γ or W .

6.3 Differential Cross Section Systematic Uncertainties

The total systematic error on our differential cross section measurements has been estimated at 8.9%. This number applies equally to $K^+\Lambda$ as well as to $K^+\Sigma^0$. Although we cite one number as the overall systematic error, we studied many individual effects before arriving at this estimate. The individual contributions to the overall error are summarized in Table 6.1.

The remainder of this section will discuss the individual sources of the systematic uncertainties and explain the reasoning behind them.

6.3.1 Yield Extraction

The yield extraction was studied by varying the yield extraction algorithm and seeing how it affected our final cross sections. As discussed in Section 3.4, we employed 4 unique methods of determining the yield within each bin - three different fits and a simple sideband subtraction. We used an algorithm to select the best determination of the yield. Without repeating the details previously given in Chapter 3, this algorithm largely selected the fit with the lowest χ^2 per degree of freedom. For this study, we had the algorithm select the second best fit (next lowest χ^2 per degree of freedom). The ratio of the two cross sections was calculated at each data-point, and the distribution of this ratio for both hyperons is plotted in Figure 6.13. Gaussians were fitted to each distribution. We used the width of the Gaussian to estimate the uncertainty due to the yield extraction at 5.4%. The same number for both hyperons will be reported due to the similarity in the Gaussian widths.

6.3.2 Acceptance

Our knowledge of the systematic error due to the acceptance comes largely from our study of the McNabb cross section results, detailed in Section 6.2.3. In this study, our acceptance calculations shifted by an overall 2.7% once we implemented the correct version of `alc` in the acceptance calculation. This was a systematic error that we corrected, and also serves as our estimate of any residual systematic error due to the acceptance calculation.

6.3.3 Normalization

Two factors related to the normalization contributed to the systematic error.

Figure 6.13: Fractional difference on the differential cross section between the final results (based on the full yield extraction algorithm) and a version of the yield extraction selecting the second-best fit. The Gaussian curves (in blue) were used to characterize the width of the distribution.

First, John McNabb's comparison of the π^+n differential cross sections to the SAID parameterization of the world's data was systematically low by 6.6%. The pion analysis was also based on the GIC dataset, and used the same normalization as employed in his thesis work. If the discrepancy shows up in the pion channel, there is no reason to believe that it will not affect the kaon channels as well. John attributed this scale factor to an unidentified trigger inefficiency in the CLAS dataset. We quote 6.6% as the uncertainty in the overall normalization.

Second, the photon attenuation is a global correction, of 1.039, applied to the normalization to account for photon loss in the beamline between the tagger and the pair spectrometer. This correction was calculated by Reinhard Schumacher and has been discussed in Section 4.2. The same number scales the normalization in each E_γ bin, so any uncertainty in the calculation can be interpreted as a systematic uncertainty on the final cross section. The error on the correction is given as 0.20% [61].

6.4 Double Polarization Observables

In terms of systematic uncertainty, the double polarization observables were fundamentally different from the differential cross sections. The differential cross section required a photon normalization, an acceptance correction, and extracted yields. On the other hand, the double polarization observables required a yield extraction and good knowledge of the photon beam polarization. Because of these basic differences, systematic errors of C_x and C_z merit an independent discussion.

Systematic errors on the double polarization observables C_x and C_z are summarized in Table 6.2. While the Λ weak decay asymmetry parameter makes a small contribution to the overall systematic error, the main contributions are due to the beam polarization and the stipulation that C_y should be 0. This section will discuss each factor contributing to the systematic error on the double polarization observables.

In addition to the items listed in Table 6.2, we will also discuss possible contributions from the yield extraction method and a potential beam charge asymmetry.

Source	Uncertainty	
	Λ	Σ°
Photon polarization		
Determination of e^- polarization	± 0.022	
Maximon and Olson relation	Assumed perfect	
Constants		
Λ weak decay asymmetry parameter	± 0.020	
Overall scale		
$C_y=0$	$0.00 \text{ (} \cos(\theta_{KCM}) < 0.55 \text{)}$	$0.00 \text{ (} \cos(\theta_{KCM}) < 0.35 \text{)}$
	$\pm 0.08 \text{ (} \cos(\theta_{KCM}) > 0.55 \text{)}$	$0.17 \text{ (} \cos(\theta_{KCM}) > 0.35 \text{)}$
Total	$\pm 0.03 \text{ (} \cos(\theta_{KCM}) < 0.55 \text{)}$	$\pm 0.03 \text{ (} \cos(\theta_{KCM}) < 0.35 \text{)}$
	$\pm 0.09 \text{ (} \cos(\theta_{KCM}) > 0.55 \text{)}$	$\pm 0.17 \text{ (} \cos(\theta_{KCM}) > 0.35 \text{)}$

Table 6.2: Sources of systematic errors on C_x and C_z . Note that final results will also have a ± 2 MeV uncertainty on the centroid of bins in E_γ or W .

6.4.1 Yield Extraction Criteria

Systematic uncertainties due to the yield extraction method have already been considered and discussed in Section 5.1. This error was characterized by calculating two versions of the beam helicity asymmetry distributions based on differing yield extraction criteria. The slope of both distributions was extracted with a linear fit, and the standard deviation of both slopes was taken as a point-by-point systematic error. This standard deviation was added in quadrature with the statistical error and will contribute to the error bars shown with the final results in Chapter 7. Because the contribution was propagated with the statistical errors, no explicit contribution will be added to Table 6.2.

6.4.2 Beam Charge Asymmetry

If the accelerator preferentially delivered photons of one helicity state, then this would lead to a false asymmetry in our data. We call this asymmetry the “beam charge asymmetry, and it is defined by

$$A = \frac{Q^+ - Q^-}{Q^+ + Q^-} \quad (6.3)$$

where $Q^\pm$ is the total flux of photons in one helicity state, integrated over all E_γ for the 2.4 or 3.1 GeV dataset. This differs from the beam helicity asymmetry discussed in Section 5.1. The beam helicity asymmetry was a helicity-dependent asymmetry in the extracted yield for each kinematic bin. The beam charge asymmetry we discuss here is also a helicity dependent asymmetry, but it deals with photon flux incident on target, and is not concerned with particle yields. This beam charge asymmetry is a beam quality parameter used to characterize any bias in the photon beam toward one helicity state.

The beam charge asymmetry was initially monitored during data acquisition by Arne Freyberger. He used Møller runs to monitor both the polarization as well as the beam charge asymmetry for the e^- beam. These measurements were posted in the CLAS online logbook. While these measurements were taken on the e^- beam, any significant charge asymmetry would have carried over to the photon beam. We have calculated the weighted mean of beam charge asymmetry measurements taken by Arne and they are displayed in Table 6.3. Our values for C_x and C_z are on the order of 0.1, roughly two orders of magnitude larger than Arne’s measurements.

Dataset	Beam Charge Asymmetry
2.4 GeV	$(4.26 \pm 0.08) \times 10^{-3}$
2.9 GeV	$(6.2 \pm 0.6) \times 10^{-3}$

Table 6.3: Beam charge asymmetry measurements. The numbers in this table are the weighted mean of all beam charge asymmetry measurements for each dataset. Individual measurements were retrieved from the Hall B Electronic Logbook [50].

Because of our analysis method, we claim that our results are not sensitive to the beam charge asymmetry, regardless of its magnitude. Any beam charge asymmetry would introduce artificial strength in our beam helicity asymmetries. However, our analysis was immune because we need only the slope of the beam helicity asymmetry distribution. As discussed earlier, we fit the beam helicity asymmetries as a function of $\cos(\theta_{PY})$ in bins of constant E_γ and $\cos(\theta_{KCM})$. One could imagine that the beam charge asymmetry may have some energy dependence, but it should be constant over the kaon and proton angles. As a result, the beam charge asymmetry may not influence the slope of the beam helicity asymmetry distributions.

To extract the slope of the beam helicity asymmetries, we used a two-parameter linear fit. Following arguments in the last paragraph, the constant parameter in the fit should be indicative of any beam charge asymmetry. These constant terms are shown in Figure 6.14. While there is some spread to the distributions in the figure, the mean value of each distribution is statistically consistent with 0.

In summary, we have studied the beam charge asymmetry. It is a very small effect in our dataset, but should not have any influence on our double polarization results. We will not quote a systematic error due to this effect.

6.4.3 Λ Weak Decay Asymmetry Parameter

This analysis used a value of the Λ weak decay asymmetry parameter, $\alpha = .642 \pm .013$, measured by other experiments and published in the Particle Data Book [66]. The uncertainty on the measurement figures into our analysis as a systematic error.

The systematic error was estimated using the partial derivative of C_x and C_z with respect to α

$$\frac{\delta C_{x/z}}{\delta \alpha} = \frac{-1}{\alpha} C_{x/z}. \quad (6.4)$$

To make the estimates conservative, we let the value of $C_{x/z} = 1$. Evaluating the above expression yields a systematic contribution due to the uncertainty on α of ± 0.020 .

6.4.4 Beam Polarization

C_x and C_z also depended on the photon beam polarization, η . There was some uncertainty associated with this quantity, and it is also considered to be a systematic error.

We actually used a well-known model [65] to calculate the photon beam polarization, as explained in Section 5.3. As input, the model required the polarization of the incident electron beam. The model calculation was such that η was linear in the electron polarization, ζ , as shown below

$$\eta = \zeta F \quad (6.5)$$

where F was calculated by our model.

While both ζ and the model should contribute to the systematic error, we are unable to estimate the contribution from the model calculation. We conducted a literature search looking for information that might provide clues as to the accuracy of the model. We looked for comparisons to data

Figure 6.14: A linear fit was used to extract the slope of the beam helicity distribution in each kinematic bin. These plots show the distributions of the y-intercepts from these fits for C_x and C_z for both hyperons. A Gaussian has been fit to each distribution and the fit parameters are displayed.

or other calculations, but failed to find either. The literature search showed evidence of the model being used recently by other collaborations, [72], so our use of it is not unwarranted. However, we have no means of quantifying the accuracy of the model, and will not venture a guess.

The photon beam polarization was measured by Arne Freyberger with the Hall B Møller polarimeter. He provided uncertainties with his measurements, which were posted in the online logbook [50]. Arne provided one measurement with the 2.9 GeV dataset, and three with the 2.4 GeV dataset. For the 2.9 GeV dataset, we were obliged to use Arne's measurement and its associated error. For the 2.4 GeV dataset, we took the weighted mean of the three measurements and used their standard deviation, 0.015, as the error.

Because η is linear in the electron polarization, we can estimate its contribution to the overall systematic error using the partial derivative, much as we did with the lambda weak decay asymmetry parameter

$$|\delta C_{x/z}| = \left| \frac{\delta \zeta}{\zeta} C_{x/z} \right|, \quad (6.6)$$

where, again, we assume $C_{x/z} = 1$. Following this prescription, the contribution to the systematic error due to the polarization calculation was ± 0.022 .

6.4.5 C_y

Just as parity arguments allow a nonzero C_x and C_z in the production plane, they may also be used to argue that C_y must be zero within when the incident beam is circularly polarized. As a systematic check, we measured C_y for both Λ and Σ^0 . The process of extracting this observable was identical to that followed while measuring C_x and C_z , the only difference being that the proton angle was measured with respect to the $\hat{y}$ axis. C_y was plotted as a function of W , and constants were fit to the distributions. The plots are shown in Figures 6.15 through 6.19.

For both hyperons, C_y was found to be small across the entire range of kaon angles. At backward and mid-forward angles, the results were consistent with zero. At forward-most kaon angles, the deviation became statistically significant. Hence, we have reported an angle-dependent systematic error. The numbers reported in Table 6.2 for the forward kaon angles are the average magnitude of C_y (average of the constant fits) over the kaon angle range indicated.

Interpretation of nonzero- C_y in light of C_x and C_z would require an extensive Monte-Carlo simulation, that we will not conduct. In other studies that we have conducted, the only effect that shared a similar angular correlation was leakage of mis-identified pions. Fast-moving π^+ were most prevalent at forward kaon angles, complicating the yield extraction. Systematic uncertainties have been calculated on a point-by-point basis and are already accounted for by the error bars shown in the results. The error due to yield extraction method was small (smaller than statistical error on most data-points), and would be inconsistent with the strength of C_y . One may also attempt to claim that a nonzero C_y could result from a beam charge asymmetry. However, the beam charge asymmetry should not display an angular dependence, and other studies of this effect conclude that it is not large enough to account for the strength of C_y in the forward direction.

The one possible explanation that we have not been able to rule out is error in the assignment of the unit vectors used to reference $\cos(\theta_{PY})$. The $\hat{y}$ unit vector was defined by taking the cross product of the kaon momentum and the direction of the beamline. For forward-going kaons, these kaon momentum and beamline direction were nearly parallel. If there was a systematic uncertainty in the measurement of the cross product, then this would have lead to errors in the determination of the $\hat{y}$ unit vector. Polarization in the $\hat{z}$ direction was so strong that even small mixing between the $\hat{y}$ and $\hat{z}$ directions would have contributed significantly to a nonzero C_y . In this sense, then, the C_y measurements may be interpreted as a systematic uncertainty due to poor determination of $\hat{y}$.

Figure 6.15: C_y for $K^+\Lambda$ as a function of W , for bins of constant kaon angle. The plots cover kaon angles from $\cos(\theta_{KCM}) = -0.75$ to $\cos(\theta_{KCM}) = -0.35$. The blue dots show the final result, a weighted mean over the 2.4 and 2.9 GeV datasets. The dashed line is a constant fit to each distribution.

Figure 6.16: C_y for $K^+\Lambda$ as a function of W , for bins of constant kaon angle. The plots cover kaon angles from $\cos(\theta_{KCM}) = -0.15$ to $\cos(\theta_{KCM}) = 0.25$. The blue dots show the final result, a weighted mean over the 2.4 and 2.9 GeV datasets. The dashed line is a constant fit to each distribution.

Figure 6.17: C_y for $K^+\Lambda$ as a function of W , for bins of constant kaon angle. The plots cover kaon angles from $\cos(\theta_{KCM}) = 0.45$ to $\cos(\theta_{KCM}) = 0.85$. The blue dots show the final result, a weighted mean over the 2.4 and 2.9 GeV datasets. The red line is a constant fit to each distribution.

Figure 6.18: C_y for $K^+\Sigma^0$ as a function of W , for bins of constant kaon angle. The plots cover kaon angles from $\cos(\theta_{KCM}) = -0.7$ to $\cos(\theta_{KCM}) = 0.1$. The blue dots show the final result, a weighted mean over the 2.4 and 2.9 GeV datasets. The dashed line is a constant fit to each distribution.

Figure 6.19: C_y for $K^+\Sigma^0$ as a function of W , for bins of constant kaon angle. The plots cover kaon angles from $\cos(\theta_{KCM}) = 0.2$ to $\cos(\theta_{KCM}) = 0.8$. The blue dots show the final result, a weighted mean over the 2.4 and 2.9 GeV datasets. The dashed line is a constant fit to each distribution.

6.5 Summary

In this chapter, we have discussed sources of systematic error for both the differential cross sections as well as C_x and C_z . The systematic error on the differential cross sections was estimated to be 8.9%. The cross section error was largely dominated by uncertainty in the overall scale of the result, stemming from John McNabb's π^+n analysis. The largest contribution to the systematic error on the double polarization observables was due to a nonzero C_y . This error was most significant at forward kaon angles, introducing an angle-dependence in the systematic error reporting. For all observables, the systematic error was found to be small compared to the magnitude of the final results. Results reported as a function of photon energy or, W , have a ± 2 MeV on the centroid of the energy bin.

Chapter 7

Final Results and Discussion

Previously, we have discussed the yield extraction (Chapter 3) and analysis of the selected events (Chapters 4 and 5). Systematic uncertainties have also been detailed (Chapter 6). Every step in the analysis has been described; all that remains is to display the final results and discuss the implications of the measurements.

In this chapter, the final measurements for the differential cross section and double polarization observables will be presented. For those not interested in reading the previous chapters, a brief summary will be given before the presentation of each observable. The differential cross sections will be presented first followed by C_x and C_z . Results will also include curves from the Kaon-MAID, Janssen-Rykebusch, and Guidal-Laget-Vanderhaeghen models. After each result is presented, we will discuss the measurement in light of the models and relevant physics.

7.1 Differential Cross Section

The differential cross section is the acceptance corrected yield normalized to the flux of incident particles within a defined kinematic bin. At any given photon energy, E_γ , and center of mass kaon angle, θ_{KCM} , it is defined by the equation

$$\frac{d\sigma(E_\gamma, \theta_{KCM})}{d\cos(\theta_{KCM})} = \frac{M_{MOL}}{N_A \rho L} \frac{Y(E_\gamma, \theta_{KCM})}{\Delta \cos(\theta_{KCM}) A(E_\gamma, \theta_{KCM}) N_\gamma(E_\gamma)} \quad (7.1)$$

where $Y(E_\gamma, \theta_{KCM})$ is the detected yield, $A(E_\gamma, \theta_{KCM})$ is the acceptance correction, and $N_\gamma(E_\gamma)$ is the photon normalization. $\Delta \cos(\theta_{KCM})$ defines to the size of the differential bin. The remaining factors are largely related to the target material. M_{MOL} is the molar mass of the target material, N_A is Avogadro's number, L is the target length, and ρ is the density of hydrogen in the target.

The yields came from an analysis of the CLAS G1C run period. Two datasets with differing endpoint energies, 2.4 and 3.1 GeV, were analyzed. The analysis required explicit detection of a K^+ and p in each event and then recreated the Λ and Σ^0 hyperons from missing mass. The photon normalization was calculated with G-flux code, which used out-of-time hits in the photon tagger to determine the total photon flux. Finally, the acceptance calculation was based on a collection of 40 million MC events (20 million for each hyperon). The events were processed with the GSIM code, a full GEANT simulation of the CLAS detector.

The differential cross sections for $K^+\Lambda$ are shown in Figures 7.1 through 7.5. Corresponding results for $K^+\Sigma^0$ are shown in Figures 7.6 through 7.10. These figures show our results (black circles) plotted alongside two measurements from SAPHIR (1998 [14] - magenta triangles, 2003 [15] - red stars). Model curves are also shown: Kaon-maid [3] (solid red line), Janssen [6] (dashed black line), and the Guidal-Laget-Vanderhaeghen [7] Regge calculation (dashed blue line).

Figure 7.1: Comparison of the CLAS $K^+\Lambda$ differential cross section (black circles) with SAPHIR data (1998 [14] - magenta triangles, 2004 [15] - red stars). The solid red line is calculated from KAON-MAID [3], the blue dash-dotted line is calculated from the Guidal/Laget/Vanderhaeghen Regge model [7], and the black dashed line is the Janssen model [6]. Note that the SAPHIR angle bins are offset by 0.05 in $\cos(\theta_{KCM})$. All model curves also have this same offset.

Figure 7.2: Comparison of the CLAS $K^+\Lambda$ differential cross section (black circles) with SAPHIR data (1998 [14] - magenta triangles, 2004 [15] - red stars). The solid red line is calculated from KAON-MAID [3], the blue dash-dotted line is calculated from the Guidal/Laget/Vanderhaeghen Regge model [7], and the black dashed line is the Janssen model [6]. Note that the SAPHIR angle bins are offset by 0.05 in $\cos(\theta_{KCM})$. All model curves also have this same offset.

Figure 7.3: Comparison of the CLAS $K^*\Lambda$ differential cross section (black circles) with SAPHIR data (1998 [14] - magenta triangles, 2004 [15] - red stars). The solid red line is calculated from KAON-MAID [3], the blue dash-dotted line is calculated from the Guidal/Laget/Vanderhaeghen Regge model [7], and the black dashed line is the Janssen model [6]. Note that the SAPHIR angle bins are offset by 0.05 in $\cos(\theta_{KCM})$. All model curves also have this same offset.

Figure 7.4: Comparison of the CLAS $K^*\Lambda$ differential cross section (black points) for a few representative energy bins. Some of the SAPHIR data (1998 [14] - magenta triangles, 2004 [15] - red stars) are shown. The solid red line is calculated from KAON-MAID [3], the blue dash-dotted line is calculated from the Guidal/Laget/Vanderhaeghen Regge model [7], and the black dashed line is the Janssen model [6].

Figure 7.5: Comparison of the CLAS $K^+\Lambda$ differential cross section (black points) for a few representative energy bins. Some of the SAPHIR data (1998 [14] - magenta triangles, 2004 [15] - red stars) are shown. The solid red line is calculated from KAON-MAID [3], the blue dash-dotted line is calculated from the Guidal/Laget/Vanderhaeghen Regge model [7], and the black dashed line is the Janssen model [6].

Figure 7.6: Comparison of the CLAS $K^+\Sigma^0$ differential cross section (black circles) with SAPHIR data (1998 [14] - magenta triangles, 2004 [15] - red stars). The solid red line is calculated from KAON-MAID [3], the blue dash-dotted line is calculated from the Guidal-Laget Regge model [7], and the black dashed line is the Janssen model [6]. Note that the SAPHIR angle bins are offset by 0.05 in $\cos(\theta_{KCM})$. All model curves also have this same offset.

Figure 7.7: Comparison of the CLAS $K^+\Sigma^0$ differential cross section (black circles) with SAPHIR data (1998 [14] - magenta triangles, 2004 [15] - red stars). The solid red line is calculated from KAON-MAID [3], the blue dash-dotted line is calculated from the Guidal-Laget Regge model [7], and the black dashed line is the Janssen model [6]. Note that the SAPHIR angle bins are offset by 0.05 in $\cos(\theta_{KCM})$. All model curves also have this same offset.

Figure 7.8: Comparison of the CLAS $K^+\Sigma^0$ differential cross section (black circles) with SAPHIR data (1998 [14] - magenta triangles, 2004 [15] - red stars). The solid red line is calculated from KAON-MAID [3], the blue dash-dotted line is calculated from the Guidal-Laget Regge model [7], and the black dashed line is the Janssen model [6]. Note that the SAPHIR angle bins are offset by 0.05 in $\cos(\theta_{KCM})$. All model curves also have this same offset.

Figure 7.9: Comparison of the CLAS differential cross section (black points) for a few representative energy bins. Some SAPHIR data (1998 [14] - magenta triangles, 2004 [15] - red stars) are shown. The solid red line is calculated from KAON-MAID[3], the blue dash-dotted line is calculated from the Guidal-Laget Regge model [7], and the black dashed line is the Janssen model [6].

Figure 7.10: Comparison of the CLAS differential cross section (black points) for a few representative energy bins. Some SAPHIR data (1998 [14] - magenta triangles, 2004 [14] - red stars) are shown. The solid red line is calculated from KAON-MAID[3], the blue dash-dotted line is calculated from the Guidal-Laget Regge model[7], and the black dashed line is the Janssen model [6].

7.1.1 Discussion of $\frac{d\sigma}{d(\cos\theta_{KCM})}$ for $K^+\Lambda$

Three features are accentuated in our data that are not as clear in the SAPHIR results. First, we have a prominent forward peaking in our data when plotted as a function of $\cos(\theta_{KCM})$. Our data appear to rise monotonically through our last angular bin, while SAPHIR's data seem to round off in the most forward direction. Above $W = 2.2$ GeV, the cross section becomes rather unchanging and its main feature is this forward peak. This behavior is typically indicative of a strong t -channel contribution.

A second feature that is apparent in our measurements is a strong backward-peaking of the cross section. This structure is not as prevalent as the forward peaking, but it is present above $W = 1.9$ GeV and begins to die away around $W = 2.15$ GeV. The backward peaking is typically a signature of a strong u -channel contribution to the reaction mechanism.

The third feature is the structure around $W = 1.9$ GeV, particularly at forward and backward kaon angles. While there is a bump in the SAPHIR data at this value of W , it is most noticeable in the total cross section, as shown in Figure 1.14. This structure has been interpreted in light of the Kaon-MAID and Janssen-Ryckebusch groups as evidence for a missing $D_{13}(1900)$ resonance. The statistics of our dataset are strong enough to show this bump prominently in the differential cross section measurement for the first time. Looking at the cross section plotted in bins of constant kaon angle, this bump is apparent at most angles. The shape appears to evolve as the kaon angle changes. It is present at the backward-going kaon angles, disappears around $\cos(\theta_{KCM})=0.3$, and then reappears around $\cos(\theta_{KCM})=0.6$, making its most prominent showing at $\cos(\theta_{KCM})=0.8$. The changes in this structure suggest that it is due to the interference of multiple amplitudes in the production mechanism.

While the isobar model curves appear to do a good job following the trends of the cross section, that is not unexpected. These isobar models involve a number of free parameters that were fit to previously published cross section results. In the case of $K^+\Lambda$, the models have already been tuned to the SAPHIR results that were published in 1998. As a result, conclusions that could be made by comparing to the models will closely parallel the comparison to the SAPHIR results - the models may not match so well at the extreme kaon angles and are systematically low in various bins of constant W . The Kaon-MAID calculation does a better job than the Janssen calculation at backward direction, but does roll-over in the forward direction (similar to the SAPHIR result). The Janssen-Ryckebusch calculation does a better job recreating the forward peaking of the cross sections.

The Guidal-Laget-Vanderhaeghen Regge calculation does some things right, but over-predicts the strength of the cross section. The shape of the curves is approximately right. While the Regge model cannot replicate the lower-energy structure of the cross section (in the resonance region), it does follow the forward peaking of the higher energy data. We expect this because the Regge model's strength is t -channel exchange. The Regge calculation is systematically higher than the data, by a factor of 2, over most of the kinematics. The systematic offset of the curves suggests that there is some simple modification to the model that would improve its performance.

7.1.2 Discussion of $\frac{d\sigma}{d(\cos\theta_{KCM})}$ for $K^+\Sigma^0$

It is interesting to contrast the Σ^0 results to the Λ . The two results are comparable in magnitude. They both display structure in the resonance region. While the Λ cross sections have a prominent forward peaking above the resonant region, the Σ^0 results seem to roll over at the extreme forward angles. This roll over in the forward direction would suggest that the Σ^0 is less t -channel dominated than the Λ .

Having been tuned to the older SAPHIR data, the isobar models do a reasonable job of following the data. They both are able to replicate the major structures in the Σ^0 cross section. The Kaon-MAID calculation stays closer to the SAPHIR result, and the Janssen calculation seems to favor

our data. At backward kaon angles, the Janssen model replicates the increased strength of the cross section at $W = 1.8 - 2.0$ GeV. While our results agree well with the SAPHIR data at $W = 1.85$ GeV in the forward kaon angles, the Kaon-MAID calculation rises higher than the data. However, the Janssen calculation maintains good agreement. The Janssen calculation appears to have trouble above $W = 2.0$ GeV. At backward kaon angles, it over-shoots our data, while it under-shoots in forward kaon angle bins.

Overall, our $K^+\Sigma^0$ results were in better agreement with the SAPHIR results than our $K^+\Lambda$ results were. Aside from the fact that our result is higher around $W = 1.8 - 2.0$ GeV, the agreement is strong across all kinematics. Even at the extreme kaon angles, the two results seem to follow each other very well.

7.1.3 Discussion of $\frac{d\sigma}{d\Omega}$ Results in Relation to Past Measurements

Up until the CLAS measurements, the SAPHIR group had produced the world's most complete differential cross section measurements for these two reactions. In our new result, we have smaller error bars, and were able to maintain finer binning over the entire kinematic range. The SAPHIR group does have slightly better angular coverage than CLAS, especially at the extreme forward and backward kaon angles. A hole for the beam pipe limited CLAS's forward angle coverage. In addition, the sectors converged in the forward direction, so sector boundaries occupied much of the available solid angle. The sector boundaries were hard to model in the acceptance, so our fiducial cuts had a strong effect in the forward direction. Backward coverage was limited at CLAS by the magnet's cryostats and mounting hardware.

There are two main discrepancies between the SAPHIR and CLAS measurements. First, our data are systematically higher than SAPHIR's across all kaon angles from $W = 1.8$ GeV to about $W = 2.0$ GeV. It can be seen as a bump around $W = 1.9$ GeV when the cross section is plotted versus W , and appears to be a constant fractional offset when plotted against $\cos(\theta_{pY})$. Second, our results are also systematically higher at forward kaon angles in the $K^+\Lambda$ cross sections. This is not a feature of the $K^+\Sigma^0$ results. These discrepancies are much larger than our statistical error bars, in most cases. Due to this W dependence, one might think that the normalization is at fault. The discrepancy at $W = 1.8 - 2.0$ GeV appears to match up with the largest corrections that we made to the photon normalization, as explained in Section 4.4.1. Structures "b" and "c" in Figure 4.5 lie within this W range. However, because these inefficiencies were only present in the 3.1 GeV dataset, it seems unlikely that a poor photon normalization within this W range was to blame. In the end, the 3.1 and 2.4 GeV datasets were in good agreement here.

An instructive result is shown in Figure 7.9. The plot of $W = 2.09$ GeV is the only figure where we have SAPHIR results from 1998 and 2003 across the entire angular range. One can see that the red stars, indicating the 2003 SAPHIR results are in much better agreement with our data than the older 1998 results. Both experiments have completed two analyses of these channels. The first CLAS analysis was completed by John McNabb in 2002. After resolving discrepancies discussed in Section 6.2, this analysis and John McNabb's analysis are in very good agreement. Revisions made to the acceptance systematically lowered our cross sections by approximately 3%, but two distinct analyses of the CLAS data show a high degree of consistency. As shown in this plot, the SAPHIR results increased by a factor of 2 between 1998 and 2003. Consistency of the CLAS results over time and the fact that the newer SAPHIR results are in closer agreement with this analysis lends credibility to the CLAS cross sections.

Further arguments in favor of our results stem from John McNabb's π^+n analysis. He measured preliminary differential cross sections for π^+n while studying his normalization for $K^+\Lambda$ and $K^+\Sigma^0$. In comparing his pion cross sections to the SAID parametrization, there was an overall discrepancy of 6.6% [57]. The angular dependence of the discrepancy is shown in Figure 6.4. This figure would suggest that that CLAS results could be low in the forward direction. If our results are low in the forward direction, then the SAPHIR results should be higher than ours to be more correct. It

appears that the SAPHIR results are even further from the world's data than ours. In light of this, we suspect that there are some misunderstood forward acceptance issues in the SAPHIR analysis.

We have identified no source of error in our analysis that can correctly account for the discrepancies with the SAPHIR results. We echo John McNabb's conclusion from two years ago that these differences "can not be attributed to any known or suspected peculiarities in CLAS or this analysis" [57].

7.1.4 Invariant Cross Sections

Comparison of the Λ and Σ^0 cross sections is further facilitated by studying the Lorentz invariant differential cross sections, $\frac{d\sigma}{dt}$. Here, t is the Mandelstam variable representing the four-momentum transfer from the photon to K^+ meson in a typical t -channel diagram and is defined by

$$t = (p_\gamma - p_K)^2 \quad (7.2)$$

where $p_\gamma = (E_\gamma, 0, 0, E_\gamma)$ is the four-momentum for the photon and $p_K = (E_K, \vec{p}_K)$ is the four-momentum for the K^+ . Simplifying t in terms of these two four vectors yields

$$t = 2E_\gamma (|\vec{p}_K| \cos(\theta_{KCM}) - E_K) - m_K^2 \quad (7.3)$$

where $|\vec{p}_K|$ is the magnitude of the kaon 3-momentum, and m_K is the kaon mass. A simple Jacobian allows us to relate $\frac{d\sigma}{d(\cos\theta_{KCM})}$ to $\frac{d\sigma}{dt}$:

$$\frac{d\sigma}{dt} = \frac{d\sigma}{d(\cos\theta_{KCM})} \frac{d(\cos\theta_{KCM})}{dt}. \quad (7.4)$$

Plots of $\frac{d\sigma}{dt}$ for $K^+\Lambda$ and $K^+\Sigma^0$ are shown in Figure 7.11. To simplify the figure, results from eight E_γ bins were averaged, producing eleven curves, each spanning a strip of data 200 MeV wide in photon energy. There is some apparent spread in the curves. For $K^+\Lambda$ this spread is approximately an order of magnitude at low $-t$, and for $K^+\Sigma^0$, the spread is roughly a factor of 5.

According to Perkins [73], a cross section dominated by t -channel exchanges may be expressed as

$$\frac{d\sigma}{dt} = D(t) \left(\frac{s}{s_0} \right)^{2\alpha(t)-2} \quad (7.5)$$

where $D(t)$ is some function of t and $\alpha(t)$ is a typical "Regge" trajectory. s_0 is a reference parameter with dimensions of GeV^2 . The spread of the curves in Figure 7.11 is due to this s -dependence. For the real data, $\alpha(t)$ is typically less than 1, so the s -dependence largely determined by the -2 in the exponent. If we multiply the invariant cross sections by s^2 , we should be able to remove much of the spread in the curves, as long as t -channel dominance is a good description of the cross sections.

Plots of $s^2 \frac{d\sigma}{dt}$ are shown in Figure 7.12. Figure 7.12(a) shows that the Λ cross section is well described by the Regge theory. In the plot, the rescaled curves appear to be much closer; the spread here has decreased to a factor of 2. The remaining spread can likely be accounted for by the residual s -dependence, $\left(\frac{s}{s_0} \right)^{2\alpha(t)}$. Each curve in the plot appears to have a value of $-t$ at which it begins to deviate from the nominal curve. The appearance of these tails hints that the pure Regge description of the cross section begins to fail. Because the tails show up at lower values of $-t$ in the lower energy data, there must be significant contributions from something other than t -channel exchanges at lower E_γ . The lower energy data is in the resonance region, and is likely influenced by the exchange of s -channel nucleon resonances. As discussed earlier, the lower energy data has a pronounced backward peaking, which is suggestive of a u -channel contribution. Perhaps the appearance of the tails in the lower energy data could be used to define kinematic conditions under which the cross sections transition to a t -channel dominance and further refine the models discussed in this work.

(a)

(b)

Figure 7.11: Figure 7.11(a) shows $\frac{d\sigma}{dt}$ for $K^+\Lambda$. Forward kaon angles appear at lower $-t$, while backward kaon angles are at higher $-t$. Figure 7.11(b) shows the same cross for $K^+\Sigma^0$.

The Σ^0 scaling results are not as striking. While the Σ^0 curves are closer together, there are significant differences in the shape of the lower-energy data. These differences suggest that something other than the t -channel is dominating the $K^+\Sigma^0$ production. The Σ^0 is an isospin 1 state, allowing the Δ states to contribute. The s -channel could be the difference here. Thus, even though the $K^+\Lambda$ and $K^+\Sigma^0$ cross sections are of similar magnitude, we have evidence here for quite different underlying production mechanisms.

7.2 Double Polarization Observables

C_x and C_z were extracted using the beam helicity asymmetry according to:

$$A(\cos(\theta_{pY})) = \nu\alpha\eta C_{x'/z'} \cos(\theta_{pY}). \quad (7.6)$$

According to Equation 7.6, the beam helicity asymmetry, A , should be linear when plotted against the $\cos(\theta_{pY})$ (the cosine of the proton angle in the hyperon rest frame). The slope of this distribution was then proportional to the desired double polarization observable. To complete the extraction, we divided out the Λ weak decay asymmetry parameter, α , and photon beam polarization, η , and the dilution factor, ν .

Yields for these observables were taken from the 2.4 and 2.9 GeV datasets of the CLAS G1C run period. The yield extraction was similar to that performed for the differential cross sections; we required all events studied to include a K^+ and a p track. The beam helicity asymmetries were calculated, and these were plotted against $\cos(\theta_{pY})$. A two-parameter fit was used to extract the slope of this distribution. The photon beam polarization was calculated using the Maximon and Olson relation, as detailed in Section 5.3.

7.2.1 Double Polarization Results

C_x and C_z for $K^+\Lambda$ are shown in Figures 7.13 through 7.21. The observables for $K^+\Sigma^0$ are plotted in Figures 7.22 through 7.27.

At first glance, the errors on the last three data points appear systematically large. This is a correct observation; the 2.4 GeV dataset does not extend to these last three points. Measurements at energies above 2.7375 GeV are limited to the statistics of the 2.9 GeV dataset. The 2.9 GeV dataset is smaller than the 2.4 GeV dataset, and the statistics are spread out over a wider kinematic range.

Discussion of C_x and C_z for $K^+\Lambda$

The most striking feature about the Λ results is the fact that C_z is nearly +1 in the forward hemisphere. While there is what appears to be resonant structure at backward angles, C_z remains strongly positive. Moving toward forward angles, the structure in the observable begins to disappear, beginning around $\cos(\theta_{KCM}) = 0.05$, and C_z stays flat and fixed around 1.0.

In C_x there is also resonance-like behavior at backward kaon angles. The amplitude of this observables dies away to zero when moving to more forward kaon angles while C_z approaches 1.0.

The Janssen-Ryckebusch model is the most successful isobar calculation. This model does a good job of following the data for both hyperons. It does fail to recreate some resonance-like structure around $W = 2.1$ GeV in C_x for the $K^+\Lambda$ data at backward angles. Generally, this model predicts the correct shape, sign and magnitude of the observables.

The Kaon-MAID model does not fare as well. For C_x , the model is almost as good as the Janssen-Ryckebusch model; the two curves track each other, and the data, rather well. The fundamental flaw in the Kaon-MAID model is evident when looking at C_z . For both hyperons, Kaon-MAID appears to incorrectly predict the sign of the data. This is particularly striking for the $K^+\Lambda$ results. Kaon-MAID predicts $C_z = -1.0$ at forward kaon angles.

Figure 7.12: Figure 7.12(a) shows $s^2 \frac{d\sigma}{dt}$ for $K^+ \Lambda$ while the Σ^0 results are plotted in Figure 7.12(b). Aside from tails appearing at higher $-t$, the Λ data appear to lie on one curve. This scaling behavior is typical of t -channel processes, suggesting a strong t -channel contribution to the $K^+ \Lambda$ production mechanism. The lack of this behavior in the Σ^0 results indicates that the production mechanism has strong s - or u -channel contributions.

Figure 7.13: Final CLAS results constructed as the weighted mean of measurements from both the 2.4 GeV and 2.9 GeV datasets. These data are for a constant K^+ angle bin of $\cos(\theta_{KCM}) = -0.75$. Error bars are combined statistical and point-to-point systematic. The curves are for the Janssen ([6] - dashed blue curve) and Kaon-MAID ([3] - solid red curve) isobar models. The Kaon-MAID curve corresponds to a kaon angle of $\cos(\theta_{KCM}) = -0.766$.

Figure 7.14: Final CLAS results constructed as the weighted mean of measurements from both the 2.4 GeV and 2.9 GeV datasets. These data are for a constant K^+ angle bin of $\cos(\theta_{KCM}) = -0.55$. The curves are for the Janssen ([6] - dashed blue curve) and Kaon-MAID ([3] - solid red curve) isobar models. The Kaon-MAID curve corresponds to a kaon angle of $\cos(\theta_{KCM}) = -0.574$.

Figure 7.15: Final CLAS results constructed as the weighted mean of measurements from both the 2.4 GeV and 2.9 GeV datasets. These data are for a instant K^+ angle bin of $\cos(\theta_{KCM}) = -0.35$. The curves are for the Janssen ([6] - dashed blue curve) and Kaon-MAID ([3] - solid red curve) isobar models. The Kaon-MAID curve corresponds to a kaon angle of $\cos(\theta_{KCM}) = -0.342$.

Figure 7.16: Final CLAS results constructed as the weighted mean of measurements from both the 2.4 GeV and 2.9 GeV datasets. These data are for a constant K^+ angle bin of $\cos(\theta_{KCM}) = -0.15$. The curves are for the Janssen ([6] - dashed blue curve) and Kaon-MAID ([3] - solid red curve) isobar models. The Kaon-MAID curve corresponds to a kaon angle of $\cos(\theta_{KCM}) = -0.174$.

Figure 7.17: Final CLAS results constructed as the weighted mean of measurements from both the 2.4 GeV and 2.9 GeV datasets. These data are for a constant K^+ angle bin of $\cos(\theta_{KCM}) = 0.05$. The curves are for the Janssen ([6] - dashed blue curve) and Kaon-MAID ([3] - solid red curve) isobar models. The Kaon-MAID curve corresponds to a kaon angle of $\cos(\theta_{KCM}) = 0.087$.

Figure 7.18: Final CLAS results constructed as the weighted mean of measurements from both the 2.4 GeV and 2.9 GeV datasets. These data are for a constant K^+ angle bin of $\cos(\theta_{KCM}) = 0.25$. The curves are for the Janssen ([6] - dashed blue curve) and Kaon-MAID ([3] - solid red curve) isobar models. The Kaon-MAID curve corresponds to a kaon angle of $\cos(\theta_{KCM}) = 0.259$.

Figure 7.19: Final CLAS results constructed as the weighted mean of measurements from both the 2.4 GeV and 2.9 GeV datasets. These data are for a constant K^+ angle bin of $\cos(\theta_{KCM}) = 0.45$. The curves are for the Janssen ([6] - dashed blue curve) and Kaon-MAID ([3] - solid red curve) isobar models. The Kaon-MAID curve corresponds to a kaon angle of $\cos(\theta_{KCM}) = 0.423$.

Figure 7.20: Final CLAS results constructed as the weighted mean of measurements from both the 2.4 GeV and 2.9 GeV datasets. These data are for a constant K^+ angle bin of $\cos(\theta_{KCM}) = 0.65$. The curves are for the Janssen ([6] - dashed blue curve) and Kaon-MAID ([3] - solid red curve) isobar models. The Kaon-MAID curve corresponds to a kaon angle of $\cos(\theta_{KCM}) = 0.643$.

Figure 7.21: Final CLAS results constructed as the weighted mean of measurements from both the 2.4 GeV and 2.9 GeV datasets. These data are for a constant K^+ angle bin of $\cos(\theta_{KCM}) = 0.85$. The curves are for the Janssen ([6] - dashed blue curve) and Kaon-MAID ([3] - solid red curve) isobar models. The Kaon-MAID curve corresponds to a kaon angle of $\cos(\theta_{KCM}) = 0.866$.

Figure 7.22: Final CLAS results constructed as the weighted mean of measurements from both the 2.4 GeV and 2.9 GeV datasets. These data are for a constant K^+ angle bin of $\cos(\theta_{KCM}) = -0.70$. The curves are for the Janssen ([6] - dashed blue curve) and Kaon-MAID ([3] - solid red curve) isobar models. The Kaon-MAID curve corresponds to a kaon angle of $\cos(\theta_{KCM}) = -0.707$.

Figure 7.23: Final CLAS results constructed as the weighted mean of measurements from both the 2.4 GeV and 2.9 GeV datasets. These data are for a constant K^+ angle bin of $\cos(\theta_{KCM}) = -0.40$. The curves are for the Janssen ([6] - dashed blue curve) and Kaon-MAID ([3] - solid red curve) isobar models. The Kaon-MAID curve corresponds to a kaon angle of $\cos(\theta_{KCM}) = -0.423$.

Figure 7.24: Final CLAS results constructed as the weighted mean of measurements from both the 2.4 GeV and 2.9 GeV datasets. These data are for a constant K^+ angle bin of $\cos(\theta_{KCM}) = -0.10$. The curves are for the Janssen ([6] - dashed blue curve) and Kaon-MAID ([3] - solid red curve) isobar models. The Kaon-MAID curve corresponds to a kaon angle of $\cos(\theta_{KCM}) = -0.087$.

Figure 7.25: Final CLAS results constructed as the weighted mean of measurements from both the 2.4 GeV and 2.9 GeV datasets. These data are for a constant K^+ angle bin of $\cos(\theta_{KCM}) = 0.20$. The curves are for the Janssen ([6] - dashed blue curve) and Kaon-MAID ([3] - solid red curve) isobar models. The Kaon-MAID curve corresponds to a kaon angle of $\cos(\theta_{KCM}) = 0.174$.

Figure 7.26: Final CLAS results constructed as the weighted mean of measurements from both the 2.4 GeV and 2.9 GeV datasets. These data are for a constant K^+ angle bin of $\cos(\theta_{KCM}) = 0.50$. The curves are for the Janssen ([6] - dashed blue curve) and Kaon-MAID ([3] - solid red curve) isobar models. The Kaon-MAID curve corresponds to a kaon angle of $\cos(\theta_{KCM}) = 0.50$.

Figure 7.27: Final CLAS results constructed as the weighted mean of measurements from both the 2.4 GeV and 2.9 GeV datasets. These data are for a constant K^+ angle bin of $\cos(\theta_{KCM}) = 0.80$. The curves are for the Janssen ([6] - dashed blue curve) and Kaon-MAID ([3] - solid red curve) isobar models. The Kaon-MAID curve corresponds to a kaon angle of $\cos(\theta_{KCM}) = 0.819$.

The comments we have made here about the isobar calculations are qualitative in nature, and are little more than a summary of how well the curves match the data. It is worth recalling that C_x and C_z are previously unmeasured observables. The isobar models will have more to say about these reaction channels once they have been tuned to reflect the new data. Statements these models might make about whether these data show evidence for additional missing resonances will have to wait until the models have been fit to our results.

While interpretation of the double polarization observables in terms of missing resonances will have to wait until the available models are applied to our data, one can make qualitative statements about the meaning of the saturated C_z in light of few simple quark-level arguments. Vector meson dominance allows for the incoming photon to hadronize into a ϕ meson, an $s\bar{s}$ state having the same quantum numbers as the photon. The K^+ meson is then formed by a u -quark from the target proton, and the $\bar{s}$ from the ϕ . The remaining s quark from the ϕ and the ud from the proton combine to form the Λ . Now, the K^+ is a spin=0 particle, so all of the photon spin polarization is carried away by the s quark to the Λ . Note that the ud quarks in the Λ have their spins anti-aligned in the valence quark model and the s quark is responsible for the Λ spin. Helicity was assumed to be conserved, in other words.

While this simple picture offers an interpretation of the C_z saturation, it is far from a satisfying explanation. Despite the shortcomings of the isobar models, they were able to follow the cross section data and will probably be able to match the double polarization observables better once re-tuned. A successful isobar match would then cloud the VMD explanation; the isobar models are based on single particle exchanges and do not include diagrams that mimic our explanation. In light of the t -channel contribution to the differential cross section, any viable explanation should be able to explore whether the strong C_z saturation is due to the t -channel dominance.

7.2.2 Discussion of C_x and C_z for $K^+\Sigma^0$

Discussing these observables for $K^+\Sigma^0$ is more complicated than for $K^+\Lambda$. The data are of poorer quality because the results had to be scaled by the dilution factor, ν . Like the Λ results, there does appear to be more resonant structure at backward angles. Moving to more forward kaon angles, both C_x and C_z seem to approach 0. Comparison of the isobar curves to the Σ^0 results is similar to the comparison with the Λ results. The Janssen model appears to do the better job following the data. It still struggles with some structures at mid to forward kaon angles, but it does appear to have the magnitude and shape of the data over much of the kinematics. Kaon-MAID performs best predicting C_x below $W = 2.1$ GeV. It is rather close to the Janssen curve and the data at these kinematics. As with the Λ results, the MAID calculation does a poor job predicting C_z .

Being an isospin one particle, the production mechanism for the Σ^0 is much more complicated than that of the Λ . More resonances are allowed to contribute. It is easy to assume that the difference behavior of C_x and C_z for the two hyperons is due to some resonant state which contributes to the Σ^0 but not to the Λ . However, a better answer will have to be provided by the models. The VMD arguments used to explain the the Λ polarization are not as insightful here.

7.3 Conclusions and Suggestions for Future Work

While this chapter presents the data and includes some discussion of them in light of the available model calculations, this discussion is by no means exhaustive. The interpretation of these data has only just begun in this chapter; the model-builders themselves will provide further insight as their models are refined to reflect the new data.

The Kaon-MAID and Janssen-Ryckebusch isobar models should be further constrained by the new data. The presence of the resonant structure at $W = 1.9$ GeV in the $K^+\Lambda$ differential cross section may provide further evidence for the $D_{13}(1900)$ missing resonance. C_x and C_z should yield

new information about the production mechanism. While the Janssen model does a good job following the data over a large range of the kinematics, there are structures that the model misses. In this light, both the Kaon-MAID and Janssen-Ryckebusch models should be further refined by the new measurements.

The t -dependence of the $K^+\Lambda$ cross sections suggests that the production mechanism for this reaction may best be understood in a Regge picture. However, the available Guidal-Laget-Vanderhaeghen model overestimated the strength of the Λ cross section while understating the strength of the Σ° cross section. The Regge calculation will still have trouble matching the data in the resonance region because it does not incorporate s -channel exchanges. Further analysis, however, should provide information about when t -channel dominance is onset in $K^+\Lambda$ photoproduction.

Aside from needed input from the theoretical models, much work remains to be done in $K^+\Lambda$ and $K^+\Sigma^\circ$ photoproduction. We are still in the early stages of establishing which resonances contribute to the production of these two reactions. While the cross sections could be measured with increasing precision, this question would be best studied by the partial wave analysis of a high statistics dataset taken at a large acceptance detector, such as CLAS. There should be agreement between such an analysis and the input to the isobar models.

The measurements of C_x and C_z are only the first double polarization observables measured for these hyperons. As discussed in Chapter 1, experimentalists must measure nine observables before we have complete experimental information about these reactions. For both of these reactions, only four observables have been measured (differential cross sections, hyperon recoil polarization, C_x , and C_z). There is much more information to be gained from polarization studies. The proposed polarized target program at CLAS should be online within a few years, giving Jefferson Lab the capacity to complete the studies of Λ and Σ° . Data will be available from CLAS within 2-4 years.

While producing new information about $K^+\Lambda$ and $K^+\Sigma^\circ$, this work has produced no final answers and will only result in more unanswered questions. While my career is taking me away from hadronic physics, I hope others pick up the questions produced from this analysis and continue the effort.

Bibliography

- [1] J.S. Barker, A. Donnachie, and J.K. Storrow. *Complete experiments in pseudoscalar photoproduction*. Nucl Phys B 95, 347 (1975).
- [2] G. Knöchlein, D. Drechsel, and L. Tiator. *Photo- and electroproduction of eta mesons*. Z Phys A 352, 327 (1995).
- [3] F.X. Lee, T. Mart, C. Bennhold, H. Haberzettl, and L.E. Wright. *Quasifree kaon photoproduction on nuclei*. Nucl Phys A 695, 237 (2001). Results can be downloaded from the Kaon-MAID web page: <http://www.kph.uni-mainz.de/MAID/kaon/kaonmaid.html>
- [4] T. Mart and C. Bennhold. *Evidence for a missing nucleon resonance in kaon photoproduction*. Phys Rev C 61, 012201 (2000). Preprint available at: arXiv: nucl-th/9906096 v1.
- [5] H. Haberzettl. *Preserving the gauge invariance of meson production currents in the presence of explicit final-state interactions*. Phys Rev C 62, 034605 (2000).
- [6] S. Janssen. *Strangeness production on the nucleon*. Ph.D. thesis, University of Gent, 2002.
- [7] M. Guidal, J.-M. Laget, and M. Vanderhaeghen. *Pion and kaon photoproduction at high energies: forward and intermediate angles*. Nucl Phys A 627, 645 (1997).
- [8] R.L. Anderson, E. Gabathuler, D. Jones, B.D. McDaniel, and A.J. Sadoff. *Photoproduction of K^+ mesons in hydrogen*. Phys Rev Lett 9, 131 (1962).
- [9] C.W. Peck. *$K^+\Lambda$ Photoproduction from Hydrogen at 1200 MeV*. Phys Rev 135, B830 (1964).
- [10] V.B. Elings, *et al.* *Photoproduction cross sections for π^+ and K^+ mesons at 3.4 to 4.0 GeV and their comparison with $SU(3)$* . Phys Rev Lett 16, 474 (1966).
- [11] A.M. Boyarski, *et al.* *Photoproduction of $K^+\Lambda$ and $K^+\Sigma^0$ from hydrogen from 5 to 16 GeV*. Phys Rev Lett 22, 1131 (1969).
- [12] R. Erbe, *et al.* *Multipion and strange-particle photoproduction on protons at energies up to 5.8 GeV*. Phys Rev 188, 2060 (1969).
- [13] M. Bockhorst, *et al.* *Measurement of $K^+\Lambda$ and $K^+\Sigma^0$ at photon energies up to 1.47 GeV*. Z Phys C 63, 37 (1994).
- [14] M.Q. Tran, *et al.* *Measurement of $\gamma p \rightarrow K^+\Lambda$ and $\gamma p \rightarrow K^+\Sigma^0$ at photon energies up to 2 GeV*. Phys Lett B 445, 20 (1998).
- [15] K.-H. Glander, *et al.* *Measurement of $\gamma p \rightarrow K^+\Lambda$ and $\gamma p \rightarrow K^+\Sigma^0$ at photon energies up to 2.6 GeV*. Eur Phys J A 19, 247 (2004).
- [16] B. Saghai. *From known to undiscovered resonances*. arXiv:nucl-th/0105001 v1.

- [17] G. Penner and U. Mosel. *Vector meson production and nucleon resonance analysis in a coupled-channel approach for energies $m_N < \sqrt{s} < 2$ GeV. II. Photon-induced results.* Phys Rev C 66 055212 (2002).
- [18] The SAPHIR detector is documented online at: <http://lisa12.physik.uni-bonn.de/saphir/system/system.html>
- [19] S. Capstick and W. Roberts. *Strange decays of nonstrange baryons.* Phys Rev D 58, 074011 (1998).
- [20] J. McNabb, *et al.* *Hyperon photoproduction in the nucleon resonance region.* Phys Rev C 69, 042201(R) (2004).
- [21] R. Feuerbach. *Measurement of the Unpolarized $K^+\Lambda$ and $K^+\Sigma^0$ Electroproduction Cross sections and Interference Terms from the Proton with the CLAS Detector.* Ph.D. thesis, Carnegie Mellon University, 2002.
- [22] M. Guidal, J.M. Laget, and M. Vanderhaeghen. *Electroproduction of strangeness above the resonance region.* Phys Rev C 61, 025204 (2000).
- [23] W. Chiang and F. Tabakin. *Completeness rules for spin observables in pseudoscalar meson photoproduction.* Phys Rev C 55, 55 (1997).
- [24] R. Schumacher. *Electromagnetic Production of Hyperons.* Experiment proposal available online at: <http://www.jlab.org/exp-prog/generated/apphallb.html>
- [25] Posted online at <http://www.jlab.org/news/facts/works.html>
- [26] M. Crofford, C. Hovater, G. Lahti, C. Piller, and M. Poelker. *The RF system for the CEBAF polarized photoinjector.* Thomas Jefferson National Accelerator Facility, 1993. Posted online at: http://www.jlab.org/accel/inj_group/docs/TU4067.pdf
- [27] C. Sinclair. *Polarized Electrons at Jefferson Laboratory.* JLAB-ACT-97-11. Thomas Jefferson National Accelerator Facility, 1997.
- [28] B.M. Dumham. *Jefferson Lab, a status report* Thomas Jefferson National Accelerator Facility, 1997. Posted online at: http://www.jlab.org/accel/inj_group/pdf/Paper.pdf
- [29] S. Gagnon. *Jefferson Lab Guided Tour* <http://education.jlab.org/sitetour/guidedt05.html>. Thomas Jefferson National Accelerator Facility, Newport News, VA.
- [30] C.K. Sinclair. *Beam energy combinations which provide simultaneous longitudinal electron polarization in two experimental halls.* Jefferson Lab Tech Notes, 97-021, (1997).
- [31] B. Mecking, *et al.* *The CEBAF Large Acceptance Spectrometer (CLAS),* Nucl Inst Meth A 503, 513 (2003).
- [32] D.I. Sober, *et al.* *The bremsstrahlung tagged photon beam in Hall B at JLab,* Nucl Inst Meth A 440, 263 (2000).
- [33] This information came from two sources. The radiator in the beamline during a datarun is held in the CLAS Online Database. The interpretation of the information held in the Online Database is given in the Hall B Online Logbook, entry 5783, by Arne P. Freyberger.
- [34] G. Adams, *et al.* *The CLAS Cerenkov detector,* Nucl Inst Meth A 465, 414 (2001).
- [35] M. Amarian, *et al.* *The CLAS forward electromagnetic calorimeter,* Nucl Inst Meth A 460, 239 (2001).

- [36] M. Anghinolfi, *et al.* *Response to cosmic rays of the large-angle electromagnetic shower calorimeter of the CLAS detector*, Nucl Inst Meth A 447, 424 (2000).
- [37] S. Christo. “g1 Target Cell”. Posted online at: <http://www.jlab.org/christo/g1%20target.html>.
- [38] R. Bradford and R. Schumacher. “Liquid H_2 density in the G1C CLAS cryotarget.” Thomas Jefferson National Laboratory, Newport News, VA (2002). CLAS Note: 2002003. Available online at: <http://www.jlab.org/HallB/notes/clas.notes02.html>
- [39] S. Taylor, *et al.* *The CLAS Start Counter*, Nucl Inst Meth A 462, 484 (2001).
- [40] Alan J. Street, *et al.* *Final site assembly and testing of the superconducting toroidal magnet for the CEBAF Large Acceptance Spectrometer (CLAS)* IEEE Trans. Mag. Vol. 32, No. 4, 2074 (1996).
- [41] David S. Armstrong. *CLAS Magnet*. Posted online at: <http://www.physics.wm.edu/armd/clas.photo.html>.
- [42] M.D. Mestayer, *et al.* *The CLAS drift chamber system*, Nucl Inst Meth A 449, 81 (2000).
- [43] D.S. Carman, *et al.* *The Region One drift chamber for the CLAS spectrometer*, Nucl Inst Meth A 419, 315 (1998).
- [44] L.M. Qin, *et al.* *Prototype studies and design considerations for the CLAS Region Two drift chambers*, Nucl Inst Meth A 367, 316 (1995).
- [45] F.J. Barbosa, *et al.* *A drift chamber system for a toroidal detector*, Nucl Inst Meth A 323, 19 (1992).
- [46] E. Smith, *et al.* *The time-of-flight system for CLAS*, Nucl Inst Meth A 432, 265 (1999).
- [47] Rok Ursic, Roger Flood, Chip Piller, Edward Strong, and Larry Turlington. *1 nA beam position monitoring system*. Proceedings of the 1997 Particle Accelerator Conference, (1998) 2131.
- [48] Daniel S. Carman and Brian A. Raue. *Hyperon electroproduction at CLAS $p(e, e'K^+)Y$ analysis* CLAS Analysis Note: 02-107, Thomas Jefferson National Accelerator Facility, Newport News, VA (2002).
- [49] Rakhsha Nasseripour, *et al.* *Polarization Measurements and Systematic Studies for the Hall B Moeller Polarimeter*. This is a talk presented at the 2000 APS Division of Nuclear Physics Meeting in Williamsburg, VA, in October 2000. Brian Raue pointed me to an online posting of his slides in a private communication. The slides are available at “<http://www.fiu.edu/barraue/research/moeller/dnp2000.html>”, and there is an abstract for the talk available in the Bulletin of the American Physical Society 45, 91 (2000).
- [50] Electronic Logbook entries listing e^- beam polarization and beam charge asymmetry measurements were: 6865, 6943, 6964, 7034, 7133, and 7147. Measurements made by Arne P. Freyberger, Thomas Jefferson National Accelerator Facility, Newport News, VA (1999).
- [51] The G1C run progress file was compiled at run time by the shift workers staffing the controll room. It has been posted online at “<http://clasweb.jlab.org/rungroups/g1c/oct99.html>”.
- [52] L. Todor. *G1C data calibration and cooking: Procedures, characteristics, information*. CLAS-NOTE 2002-017, Thomas Jefferson National Accelerator Facility, 2002.
- [53] The “e-loss” package was written by Eugene Pasyuk of Arizona State University. There is no written documentation, but the code is available in the CLAS CVS repository under “/clas/packages/utilities/eloss”.

- [54] J.J. Manak, E.S. Smith, S. McAleer, and S. Barrow. *e1, g1, and g6 data Processing Procedures*. CLAS-NOTE 1999-016, Thomas Jefferson National Accelerator Facility, 1999.
- [55] No documentation for the G-flux code currently exists. It was written by Eugene Pasyuk, with the first version being released in 2002. G-flux is available under the CLAS CVS system at: `/clas/packages/utilities/gflux`.
- [56] Pseudo-spa is another CLAS software package with no documentation. It was written by Volker Burkert, and is available in the CLAS CVS repository under: `/clas/packages/pid/pseudo.spa.f`
- [57] J. McNabb. *Photoproduction of Λ and Σ^0 Hyperons off Protons in the Nucleon Resonance Region using CLAS at Jefferson Lab*. Ph.D. thesis, Carnegie Mellon University, 2002.
- [58] GSim is largely maintained by Maurik Holtrop of the University of New Hampshire. He documents the code with a web page: <http://www.physics.unh.edu/maurik/gsim.info.shtml>
- [59] J. McNabb wrote strange_gen while a graduate student at Carnegie Mellon. While there is no documentation, copies of the source code are available from the author - mcnabb@gravity.psu.edu.
- [60] Eugene Pasyuk and James Ball wrote the G-flux code. As far as I can tell, there is no official document written by the authors explaining the ideas behind G-flux. The only written explanation I have found of G-flux is in John McNabb's thesis. The source code is available under the CLAS CVS system (`/packages/utilities/gflux`).
- [61] R. Schumacher. "Photon Attenuation in the CLAS Beam Line." Thomas Jefferson National Laboratory, Newport News, VA (2001). CLAS Note: 01010. Available online at: <http://www.jlab.org/HallB/notes/clas.notes01.html>
- [62] E. Pasyuk. Private communication.
- [63] This information is available in the CLAS electronic logbook. The entry is number 6734 and was made by Eugene Pasyuk.
- [64] R.D. McCartney, J. Hord, and H.M. Roder, *Selected Properties of Hydrogen (Engineering Design Data)*. National Bureau of Standards Monograph 168, U.S. Government Printing Office, 1981.
- [65] L.C. Maximon and H. Olsen. *Photon and electron polarization in high-energy bremsstrahlung and pair-production with screening*. Phys Rev 114, 887 (1959).
- [66] D.E. Groom, *et al.*, *Review of Particle Physics*. The European Physical Journal C15, 1 (2002).
- [67] D.S. Carman, *et al.* *First Measurement of Transferred Polarization in the Exclusive $ep \rightarrow K^+\Lambda$ Reaction*. Phys Rev Lett 90, 131804 (2003).
- [68] R. Schumacher, G. Franklin, B. Quinn, and M. Williams. *Proton Angular Distribution in Σ^0 Decay Rest Frame*. Thomas Jefferson National Accelerator Facility, Newport News, VA (2005). New CLAS Note written while thesis was being revised. Should be available on the web at: <http://www.jlab.org/Hall-B/notes/clas.notes05.html>
- [69] D.S. Carman. Private communication.
- [70] M. Williams and C.A. Meyer. *Kinematic Fitting in CLAS*. CLAS note: 03-017 (2003). Available online at: <http://www.jlab.org/Hall-B/notes/clas.notes03.html>.
- [71] M. Williams, C.A. Meyer, and D. Applegate. *Determining momentum and energy corrections for g1c using the kinematic fitter*. CLAS note: 04-017 (2003). Available online at: <http://www.jlab.org/Hall-B/notes/clas.notes04.html>.

- [72] P. Anthony, *et al.* *Letter of Intent to submit a 2-stage proposal to test production of polarized positrons with the SLAC 50 GeV beam in FFTB* (2002). Posted on the web at: <http://www-project.slac.stanford.edu/lc/local/PolarizedPositrons/internal/doc/2002/2002-08-27-LOIv5.pdf>.
- [73] D.H. Perkins. *Introduction to High energy Physics*, 2nd edition (1982), Addison-Wesley, Reading, MA.

Appendix A

Bin Centering Correction Table

The table in this appendix is here to give more detail about the bin centering correction. The bin centering correction was detailed in Section 6.1.2. For simplicity, I show only the table used to correct the differential cross section bin centers. The cross sections were based on the 2.4 and 3.1 GeV datasets. While the correction was applied to the double polarization observables, the 2.4 and 2.9 GeV datasets are closer in energy, so the effect was not as strong for C_x and C_z .

The tables in this appendix contain eight columns, which may be interpreted as follows:

1. The nominal bin center (GeV).
2. Corrected bin center reported with final results (GeV).
3. Correction to photon energy of 2.4 GeV dataset (MeV).
4. Correction to photon energy of 3.1 GeV dataset (MeV).
5. Half the difference between the individual corrections.
6. Nominal value of W (GeV)
7. Corrected value of W (GeV)
8. Shift in W (MeV).

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
0.92500	0.91861	-4.834	-7.946	1.556	1.61745	1.61374	-3.711
0.95000	0.94378	-4.754	-7.692	1.469	1.63189	1.62831	-3.582
0.97500	0.96892	-4.696	-7.455	1.380	1.64620	1.64274	-3.466
1.00000	0.99405	-4.659	-7.236	1.288	1.66039	1.65703	-3.364
1.02500	1.01916	-4.644	-7.033	1.194	1.67446	1.67118	-3.275
1.05000	1.04425	-4.651	-6.847	1.098	1.68841	1.68521	-3.198
1.07500	1.06932	-4.679	-6.678	0.999	1.70225	1.69911	-3.133
1.10000	1.09437	-4.729	-6.526	0.898	1.71597	1.71289	-3.080
1.12500	1.11940	-4.800	-6.390	0.795	1.72959	1.72655	-3.038
1.15000	1.14442	-4.893	-6.272	0.690	1.74309	1.74009	-3.008
1.17500	1.16941	-5.007	-6.171	0.582	1.75650	1.75351	-2.988
1.20000	1.19439	-5.143	-6.087	0.472	1.76980	1.76683	-2.979
1.22500	1.21934	-5.301	-6.019	0.359	1.78301	1.78003	-2.981
1.25000	1.24422	-5.600	-5.969	0.184	1.79612	1.79309	-3.024
1.27500	1.26916	-5.751	-5.935	0.092	1.80913	1.80610	-3.033
1.30000	1.29444	-5.199	-5.918	0.360	1.82205	1.81918	-2.865
1.32500	1.31971	-4.668	-5.919	0.625	1.83488	1.83217	-2.709
1.35000	1.34495	-4.158	-5.936	0.889	1.84762	1.84505	-2.565
1.37500	1.37018	-3.668	-5.970	1.151	1.86027	1.85784	-2.432
1.40000	1.39539	-3.200	-6.021	1.411	1.87284	1.87053	-2.311

1.42500	1.42058	-2.752	-6.089	1.669	1.88532	1.88312	-2.201
1.45000	1.44575	-2.325	-6.174	1.925	1.89772	1.89562	-2.102
1.47500	1.47090	-1.919	-6.276	2.178	1.91004	1.90803	-2.014
1.50000	1.49604	-1.533	-6.394	2.431	1.92228	1.92035	-1.936
1.52500	1.52115	-1.168	-6.530	2.681	1.93445	1.93258	-1.868
1.55000	1.54625	-0.824	-6.683	2.929	1.94653	1.94472	-1.810
1.57500	1.57132	-0.501	-6.852	3.175	1.95855	1.95679	-1.762
1.60000	1.59596	-0.199	-7.883	3.842	1.97049	1.96856	-1.925
1.62500	1.62138	0.083	-7.313	3.698	1.98236	1.98064	-1.712
1.65000	1.64679	0.343	-6.759	3.551	1.99415	1.99264	-1.510
1.67500	1.67218	0.583	-6.222	3.403	2.00598	2.00456	-1.319
1.70000	1.69755	0.803	-5.701	3.252	2.01754	2.01640	-1.139
1.72500	1.72290	1.001	-5.196	3.099	2.02914	2.02817	-0.970
1.75000	1.74824	1.179	-4.708	2.943	2.04066	2.03985	-0.812
1.77500	1.77355	1.336	-4.236	2.786	2.05213	2.05146	-0.663
1.80000	1.79885	1.472	-3.780	2.626	2.06352	2.06300	-0.525
1.82500	1.82412	1.587	-3.341	2.464	2.07486	2.07446	-0.397
1.85000	1.84938	1.681	-2.918	2.300	2.08614	2.08586	-0.278
1.87500	1.87462	1.755	-2.511	2.133	2.09735	2.09718	-0.169
1.90000	1.89984	1.808	-2.120	1.964	2.10850	2.10843	-0.070
1.92500	1.92505	1.840	-1.746	1.793	2.11960	2.11962	0.021
1.95000	1.95023	1.852	-1.388	1.620	2.13064	2.13074	0.102
1.97500	1.97540	1.842	-1.047	1.445	2.14162	2.14179	0.174
2.00000	2.00055	1.812	-0.722	1.267	2.15254	2.15278	0.237
2.02500	2.02567	1.761	-0.413	1.087	2.16341	2.16371	0.293
2.05000	2.05078	1.689	-0.120	0.905	2.17423	2.17457	0.339
2.07500	2.07588	1.597	0.156	0.720	2.18499	2.18537	0.376
2.10000	2.10128	2.147	0.416	0.865	2.19570	2.19625	0.548
2.12500	2.12592	1.188	0.660	0.264	2.20636	2.20675	0.393
2.15000	2.15130	1.711	0.887	0.412	2.21696	2.21751	0.550
2.17500	2.17665	2.198	1.098	0.550	2.22752	2.22821	0.694
2.20000	2.20197	2.650	1.293	0.678	2.23802	2.23885	0.826
2.22500	2.22727	3.066	1.471	0.797	2.24848	2.24943	0.946
2.25000	2.25254	3.446	1.633	0.906	2.25889	2.25994	1.055
2.27500	2.27778	3.791	1.779	1.006	2.26925	2.27040	1.151
2.30000	2.30300	4.100	1.908	1.096	2.27956	2.28080	1.236
2.32500	2.32820	4.374	2.021	1.176	2.28983	2.29114	1.310
2.35000	2.35336	4.611	2.118	1.247	2.30005	2.30142	1.372
2.37500	2.37851	4.814	2.199	1.307	2.31023	2.31165	1.424
2.40000	2.40498	4.981	4.981	0.000	2.32036	2.32237	2.013
2.42500	2.43011	5.111	5.111	0.000	2.33044	2.33250	2.067
2.45000	2.45521	5.207	5.207	0.000	2.34049	2.34258	2.086
2.47500	2.48027	5.267	5.267	0.000	2.35049	2.35259	2.102
2.50000	2.50529	5.291	5.291	0.000	2.36045	2.36255	2.102
2.52500	2.53028	5.280	5.280	0.000	2.37036	2.37245	2.089
2.55000	2.55523	5.233	5.233	0.000	2.38024	2.38230	2.062
2.57500	2.58015	5.150	5.150	0.000	2.39007	2.39210	2.021
2.60000	2.60503	5.032	5.032	0.000	2.39987	2.40183	1.966
2.62500	2.62988	4.878	4.878	0.000	2.40962	2.41162	1.899
2.65000	2.65469	4.689	4.689	0.000	2.41934	2.42116	1.818
2.67500	2.67946	4.464	4.464	0.000	2.42901	2.43074	1.724
2.70000	2.70420	4.203	4.203	0.000	2.43865	2.44027	1.616
2.72500	2.72891	3.907	3.907	0.000	2.44825	2.44975	1.497
2.75000	2.75357	3.575	3.575	0.000	2.45781	2.45918	1.364
2.77500	2.77821	3.207	3.207	0.000	2.46734	2.46856	1.219
2.80000	2.80280	2.804	2.804	0.000	2.47683	2.47789	1.062
2.82500	2.82737	2.365	2.365	0.000	2.48628	2.48717	0.892
2.85000	2.85189	1.891	1.891	0.000	2.49570	2.49641	0.711
2.87500	2.87638	1.381	1.381	0.000	2.50508	2.50560	0.517
2.90000	2.90084	0.835	0.835	0.000	2.51442	2.51474	0.312
2.92500	2.92525	0.254	0.254	0.000	2.52374	2.52383	0.094
2.95000	2.94964	-0.363	-0.363	0.000	2.53301	2.53288	-0.134

Appendix B

Data Table: $K^+\Lambda$ Differential Cross Section

This appendix contains tables of numerical values for the $K^+\Lambda$ differential cross section. The table consist of thirteen columns, which are interpreted as follows:

1. Column 1: Lower limit of E_γ bin (GeV)
2. Column 2: Nominal midpoint of E_γ bin (GeV)
3. Column 3: Corrected midpoint of E_γ bin (GeV)
4. Column 4: Upper limit of E_γ bin (GeV)
5. Column 5: Lower limit of W bin (GeV)
6. Column 6: Nominal idpoint of W bin (GeV)
7. Column 7: Corrected midpoint of W bin (GeV)
8. Column 8: Upper limit of W bin (GeV)
9. Column 9: Lower limit of $\cos(\theta_{KCM})$ bin
10. Column 10: Midpoint of $\cos(\theta_{KCM})$ bin
11. Column 11: Lower limit of $\cos(\theta_{KCM})$ bin
12. Column 12: $\frac{d\sigma}{d(\cos\theta_{KCM})}$ in $\mu barns$.
13. Column 13: Error on datapoint. Expressed in $\mu barns$.

B.1 Data Table

0.9375	0.9500	0.9438	0.9625	1.6247	1.6319	1.6283	1.6391	-0.85	-0.80	-0.75	0.000	0.000
0.9375	0.9500	0.9438	0.9625	1.6247	1.6319	1.6283	1.6391	-0.75	-0.70	-0.65	0.000	0.000
0.9375	0.9500	0.9438	0.9625	1.6247	1.6319	1.6283	1.6391	-0.65	-0.60	-0.55	0.000	0.000
0.9375	0.9500	0.9438	0.9625	1.6247	1.6319	1.6283	1.6391	-0.55	-0.50	-0.45	0.000	0.000
0.9375	0.9500	0.9438	0.9625	1.6247	1.6319	1.6283	1.6391	-0.45	-0.40	-0.35	0.000	0.000
0.9375	0.9500	0.9438	0.9625	1.6247	1.6319	1.6283	1.6391	-0.35	-0.30	-0.25	0.000	0.000
0.9375	0.9500	0.9438	0.9625	1.6247	1.6319	1.6283	1.6391	-0.25	-0.20	-0.15	0.544	0.147
0.9375	0.9500	0.9438	0.9625	1.6247	1.6319	1.6283	1.6391	-0.15	-0.10	-0.05	0.348	0.101
0.9375	0.9500	0.9438	0.9625	1.6247	1.6319	1.6283	1.6391	-0.05	0.00	0.05	0.320	0.093

0.9375	0.9500	0.9438	0.9625	1.6247	1.6319	1.6283	1.6391	0.05	0.10	0.15	0.393	0.097
0.9375	0.9500	0.9438	0.9625	1.6247	1.6319	1.6283	1.6391	0.15	0.20	0.25	0.636	0.144
0.9375	0.9500	0.9438	0.9625	1.6247	1.6319	1.6283	1.6391	0.25	0.30	0.35	0.547	0.130
0.9375	0.9500	0.9438	0.9625	1.6247	1.6319	1.6283	1.6391	0.35	0.40	0.45	0.532	0.134
0.9375	0.9500	0.9438	0.9625	1.6247	1.6319	1.6283	1.6391	0.45	0.50	0.55	0.593	0.137
0.9375	0.9500	0.9438	0.9625	1.6247	1.6319	1.6283	1.6391	0.55	0.60	0.65	0.406	0.101
0.9375	0.9500	0.9438	0.9625	1.6247	1.6319	1.6283	1.6391	0.65	0.70	0.75	0.364	0.107
0.9375	0.9500	0.9438	0.9625	1.6247	1.6319	1.6283	1.6391	0.75	0.80	0.85	0.000	0.000
0.9375	0.9500	0.9438	0.9625	1.6247	1.6319	1.6283	1.6391	0.85	0.90	0.95	0.000	0.000
0.9625	0.9750	0.9689	0.9875	1.6391	1.6462	1.6427	1.6533	-0.85	-0.80	-0.75	0.000	0.000
0.9625	0.9750	0.9689	0.9875	1.6391	1.6462	1.6427	1.6533	-0.75	-0.70	-0.65	0.000	0.000
0.9625	0.9750	0.9689	0.9875	1.6391	1.6462	1.6427	1.6533	-0.65	-0.60	-0.55	0.000	0.000
0.9625	0.9750	0.9689	0.9875	1.6391	1.6462	1.6427	1.6533	-0.55	-0.50	-0.45	0.000	0.000
0.9625	0.9750	0.9689	0.9875	1.6391	1.6462	1.6427	1.6533	-0.45	-0.40	-0.35	0.000	0.000
0.9625	0.9750	0.9689	0.9875	1.6391	1.6462	1.6427	1.6533	-0.35	-0.30	-0.25	0.460	0.096
0.9625	0.9750	0.9689	0.9875	1.6391	1.6462	1.6427	1.6533	-0.25	-0.20	-0.15	0.818	0.124
0.9625	0.9750	0.9689	0.9875	1.6391	1.6462	1.6427	1.6533	-0.15	-0.10	-0.05	0.596	0.105
0.9625	0.9750	0.9689	0.9875	1.6391	1.6462	1.6427	1.6533	-0.05	0.00	0.05	0.582	0.088
0.9625	0.9750	0.9689	0.9875	1.6391	1.6462	1.6427	1.6533	0.05	0.10	0.15	0.608	0.100
0.9625	0.9750	0.9689	0.9875	1.6391	1.6462	1.6427	1.6533	0.15	0.20	0.25	0.797	0.122
0.9625	0.9750	0.9689	0.9875	1.6391	1.6462	1.6427	1.6533	0.25	0.30	0.35	0.688	0.162
0.9625	0.9750	0.9689	0.9875	1.6391	1.6462	1.6427	1.6533	0.35	0.40	0.45	0.721	0.093
0.9625	0.9750	0.9689	0.9875	1.6391	1.6462	1.6427	1.6533	0.45	0.50	0.55	0.692	0.093
0.9625	0.9750	0.9689	0.9875	1.6391	1.6462	1.6427	1.6533	0.55	0.60	0.65	0.728	0.097
0.9625	0.9750	0.9689	0.9875	1.6391	1.6462	1.6427	1.6533	0.65	0.70	0.75	0.555	0.079
0.9625	0.9750	0.9689	0.9875	1.6391	1.6462	1.6427	1.6533	0.75	0.80	0.85	0.775	0.105
0.9625	0.9750	0.9689	0.9875	1.6391	1.6462	1.6427	1.6533	0.85	0.90	0.95	0.000	0.000
0.9875	1.0000	0.9941	1.0125	1.6533	1.6604	1.6570	1.6674	-0.85	-0.80	-0.75	0.000	0.000
0.9875	1.0000	0.9941	1.0125	1.6533	1.6604	1.6570	1.6674	-0.75	-0.70	-0.65	0.000	0.000
0.9875	1.0000	0.9941	1.0125	1.6533	1.6604	1.6570	1.6674	-0.65	-0.60	-0.55	0.000	0.000
0.9875	1.0000	0.9941	1.0125	1.6533	1.6604	1.6570	1.6674	-0.55	-0.50	-0.45	0.000	0.000
0.9875	1.0000	0.9941	1.0125	1.6533	1.6604	1.6570	1.6674	-0.45	-0.40	-0.35	0.990	0.173
0.9875	1.0000	0.9941	1.0125	1.6533	1.6604	1.6570	1.6674	-0.35	-0.30	-0.25	0.675	0.096
0.9875	1.0000	0.9941	1.0125	1.6533	1.6604	1.6570	1.6674	-0.25	-0.20	-0.15	0.879	0.114
0.9875	1.0000	0.9941	1.0125	1.6533	1.6604	1.6570	1.6674	-0.15	-0.10	-0.05	0.857	0.104
0.9875	1.0000	0.9941	1.0125	1.6533	1.6604	1.6570	1.6674	-0.05	0.00	0.05	0.561	0.073
0.9875	1.0000	0.9941	1.0125	1.6533	1.6604	1.6570	1.6674	0.05	0.10	0.15	0.966	0.118
0.9875	1.0000	0.9941	1.0125	1.6533	1.6604	1.6570	1.6674	0.15	0.20	0.25	0.882	0.114
0.9875	1.0000	0.9941	1.0125	1.6533	1.6604	1.6570	1.6674	0.25	0.30	0.35	1.057	0.106
0.9875	1.0000	0.9941	1.0125	1.6533	1.6604	1.6570	1.6674	0.35	0.40	0.45	0.804	0.084
0.9875	1.0000	0.9941	1.0125	1.6533	1.6604	1.6570	1.6674	0.45	0.50	0.55	0.909	0.098
0.9875	1.0000	0.9941	1.0125	1.6533	1.6604	1.6570	1.6674	0.55	0.60	0.65	1.071	0.116
0.9875	1.0000	0.9941	1.0125	1.6533	1.6604	1.6570	1.6674	0.65	0.70	0.75	1.091	0.106
0.9875	1.0000	0.9941	1.0125	1.6533	1.6604	1.6570	1.6674	0.75	0.80	0.85	0.974	0.104
0.9875	1.0000	0.9941	1.0125	1.6533	1.6604	1.6570	1.6674	0.85	0.90	0.95	0.000	0.000
1.0125	1.0250	1.0192	1.0375	1.6674	1.6745	1.6712	1.6814	-0.85	-0.80	-0.75	0.000	0.000
1.0125	1.0250	1.0192	1.0375	1.6674	1.6745	1.6712	1.6814	-0.75	-0.70	-0.65	0.000	0.000
1.0125	1.0250	1.0192	1.0375	1.6674	1.6745	1.6712	1.6814	-0.65	-0.60	-0.55	0.000	0.000
1.0125	1.0250	1.0192	1.0375	1.6674	1.6745	1.6712	1.6814	-0.55	-0.50	-0.45	0.000	0.000
1.0125	1.0250	1.0192	1.0375	1.6674	1.6745	1.6712	1.6814	-0.45	-0.40	-0.35	0.819	0.148
1.0125	1.0250	1.0192	1.0375	1.6674	1.6745	1.6712	1.6814	-0.35	-0.30	-0.25	0.818	0.135
1.0125	1.0250	1.0192	1.0375	1.6674	1.6745	1.6712	1.6814	-0.25	-0.20	-0.15	1.079	0.141
1.0125	1.0250	1.0192	1.0375	1.6674	1.6745	1.6712	1.6814	-0.15	-0.10	-0.05	0.880	0.115
1.0125	1.0250	1.0192	1.0375	1.6674	1.6745	1.6712	1.6814	-0.05	0.00	0.05	0.879	0.109
1.0125	1.0250	1.0192	1.0375	1.6674	1.6745	1.6712	1.6814	0.05	0.10	0.15	1.032	0.128
1.0125	1.0250	1.0192	1.0375	1.6674	1.6745	1.6712	1.6814	0.15	0.20	0.25	1.106	0.138
1.0125	1.0250	1.0192	1.0375	1.6674	1.6745	1.6712	1.6814	0.25	0.30	0.35	1.074	0.113
1.0125	1.0250	1.0192	1.0375	1.6674	1.6745	1.6712	1.6814	0.35	0.40	0.45	0.945	0.105
1.0125	1.0250	1.0192	1.0375	1.6674	1.6745	1.6712	1.6814	0.45	0.50	0.55	1.037	0.121
1.0125	1.0250	1.0192	1.0375	1.6674	1.6745	1.6712	1.6814	0.55	0.60	0.65	1.295	0.134
1.0125	1.0250	1.0192	1.0375	1.6674	1.6745	1.6712	1.6814	0.65	0.70	0.75	1.155	0.122
1.0125	1.0250	1.0192	1.0375	1.6674	1.6745	1.6712	1.6814	0.75	0.80	0.85	1.232	0.143
1.0125	1.0250	1.0192	1.0375	1.6674	1.6745	1.6712	1.6814	0.85	0.90	0.95	1.495	0.318
1.0375	1.0500	1.0443	1.0625	1.6814	1.6884	1.6852	1.6953	-0.85	-0.80	-0.75	0.000	0.000

1.0375	1.0500	1.0443	1.0625	1.6814	1.6884	1.6852	1.6953	-0.75	-0.70	-0.65	0.000	0.000
1.0375	1.0500	1.0443	1.0625	1.6814	1.6884	1.6852	1.6953	-0.65	-0.60	-0.55	0.000	0.000
1.0375	1.0500	1.0443	1.0625	1.6814	1.6884	1.6852	1.6953	-0.55	-0.50	-0.45	0.941	0.158
1.0375	1.0500	1.0443	1.0625	1.6814	1.6884	1.6852	1.6953	-0.45	-0.40	-0.35	0.789	0.101
1.0375	1.0500	1.0443	1.0625	1.6814	1.6884	1.6852	1.6953	-0.35	-0.30	-0.25	0.860	0.092
1.0375	1.0500	1.0443	1.0625	1.6814	1.6884	1.6852	1.6953	-0.25	-0.20	-0.15	0.846	0.085
1.0375	1.0500	1.0443	1.0625	1.6814	1.6884	1.6852	1.6953	-0.15	-0.10	-0.05	0.971	0.086
1.0375	1.0500	1.0443	1.0625	1.6814	1.6884	1.6852	1.6953	-0.05	0.00	0.05	0.843	0.076
1.0375	1.0500	1.0443	1.0625	1.6814	1.6884	1.6852	1.6953	0.05	0.10	0.15	1.099	0.095
1.0375	1.0500	1.0443	1.0625	1.6814	1.6884	1.6852	1.6953	0.15	0.20	0.25	1.093	0.093
1.0375	1.0500	1.0443	1.0625	1.6814	1.6884	1.6852	1.6953	0.25	0.30	0.35	1.269	0.092
1.0375	1.0500	1.0443	1.0625	1.6814	1.6884	1.6852	1.6953	0.35	0.40	0.45	1.245	0.095
1.0375	1.0500	1.0443	1.0625	1.6814	1.6884	1.6852	1.6953	0.45	0.50	0.55	1.470	0.109
1.0375	1.0500	1.0443	1.0625	1.6814	1.6884	1.6852	1.6953	0.55	0.60	0.65	1.396	0.105
1.0375	1.0500	1.0443	1.0625	1.6814	1.6884	1.6852	1.6953	0.65	0.70	0.75	1.429	0.111
1.0375	1.0500	1.0443	1.0625	1.6814	1.6884	1.6852	1.6953	0.75	0.80	0.85	1.501	0.130
1.0375	1.0500	1.0443	1.0625	1.6814	1.6884	1.6852	1.6953	0.85	0.90	0.95	1.822	0.214
1.0625	1.0750	1.0693	1.0875	1.6953	1.7022	1.6991	1.7091	-0.85	-0.80	-0.75	0.000	0.000
1.0625	1.0750	1.0693	1.0875	1.6953	1.7022	1.6991	1.7091	-0.75	-0.70	-0.65	0.000	0.000
1.0625	1.0750	1.0693	1.0875	1.6953	1.7022	1.6991	1.7091	-0.65	-0.60	-0.55	0.000	0.000
1.0625	1.0750	1.0693	1.0875	1.6953	1.7022	1.6991	1.7091	-0.55	-0.50	-0.45	0.670	0.108
1.0625	1.0750	1.0693	1.0875	1.6953	1.7022	1.6991	1.7091	-0.45	-0.40	-0.35	0.780	0.100
1.0625	1.0750	1.0693	1.0875	1.6953	1.7022	1.6991	1.7091	-0.35	-0.30	-0.25	0.798	0.092
1.0625	1.0750	1.0693	1.0875	1.6953	1.7022	1.6991	1.7091	-0.25	-0.20	-0.15	0.973	0.088
1.0625	1.0750	1.0693	1.0875	1.6953	1.7022	1.6991	1.7091	-0.15	-0.10	-0.05	1.074	0.089
1.0625	1.0750	1.0693	1.0875	1.6953	1.7022	1.6991	1.7091	-0.05	0.00	0.05	0.961	0.079
1.0625	1.0750	1.0693	1.0875	1.6953	1.7022	1.6991	1.7091	0.05	0.10	0.15	1.158	0.098
1.0625	1.0750	1.0693	1.0875	1.6953	1.7022	1.6991	1.7091	0.15	0.20	0.25	1.256	0.098
1.0625	1.0750	1.0693	1.0875	1.6953	1.7022	1.6991	1.7091	0.25	0.30	0.35	1.278	0.094
1.0625	1.0750	1.0693	1.0875	1.6953	1.7022	1.6991	1.7091	0.35	0.40	0.45	1.427	0.103
1.0625	1.0750	1.0693	1.0875	1.6953	1.7022	1.6991	1.7091	0.45	0.50	0.55	1.372	0.098
1.0625	1.0750	1.0693	1.0875	1.6953	1.7022	1.6991	1.7091	0.55	0.60	0.65	1.620	0.114
1.0625	1.0750	1.0693	1.0875	1.6953	1.7022	1.6991	1.7091	0.65	0.70	0.75	1.556	0.126
1.0625	1.0750	1.0693	1.0875	1.6953	1.7022	1.6991	1.7091	0.75	0.80	0.85	1.772	0.138
1.0625	1.0750	1.0693	1.0875	1.6953	1.7022	1.6991	1.7091	0.85	0.90	0.95	1.879	0.219
1.0875	1.1000	1.0944	1.1125	1.7091	1.7160	1.7129	1.7228	-0.85	-0.80	-0.75	0.000	0.000
1.0875	1.1000	1.0944	1.1125	1.7091	1.7160	1.7129	1.7228	-0.75	-0.70	-0.65	0.000	0.000
1.0875	1.1000	1.0944	1.1125	1.7091	1.7160	1.7129	1.7228	-0.65	-0.60	-0.55	0.635	0.159
1.0875	1.1000	1.0944	1.1125	1.7091	1.7160	1.7129	1.7228	-0.55	-0.50	-0.45	0.697	0.090
1.0875	1.1000	1.0944	1.1125	1.7091	1.7160	1.7129	1.7228	-0.45	-0.40	-0.35	0.857	0.090
1.0875	1.1000	1.0944	1.1125	1.7091	1.7160	1.7129	1.7228	-0.35	-0.30	-0.25	0.936	0.082
1.0875	1.1000	1.0944	1.1125	1.7091	1.7160	1.7129	1.7228	-0.25	-0.20	-0.15	0.982	0.078
1.0875	1.1000	1.0944	1.1125	1.7091	1.7160	1.7129	1.7228	-0.15	-0.10	-0.05	0.821	0.066
1.0875	1.1000	1.0944	1.1125	1.7091	1.7160	1.7129	1.7228	-0.05	0.00	0.05	0.936	0.068
1.0875	1.1000	1.0944	1.1125	1.7091	1.7160	1.7129	1.7228	0.05	0.10	0.15	1.164	0.086
1.0875	1.1000	1.0944	1.1125	1.7091	1.7160	1.7129	1.7228	0.15	0.20	0.25	1.237	0.086
1.0875	1.1000	1.0944	1.1125	1.7091	1.7160	1.7129	1.7228	0.25	0.30	0.35	1.416	0.088
1.0875	1.1000	1.0944	1.1125	1.7091	1.7160	1.7129	1.7228	0.35	0.40	0.45	1.410	0.088
1.0875	1.1000	1.0944	1.1125	1.7091	1.7160	1.7129	1.7228	0.45	0.50	0.55	1.497	0.089
1.0875	1.1000	1.0944	1.1125	1.7091	1.7160	1.7129	1.7228	0.55	0.60	0.65	1.641	0.100
1.0875	1.1000	1.0944	1.1125	1.7091	1.7160	1.7129	1.7228	0.65	0.70	0.75	1.653	0.108
1.0875	1.1000	1.0944	1.1125	1.7091	1.7160	1.7129	1.7228	0.75	0.80	0.85	1.889	0.127
1.0875	1.1000	1.0944	1.1125	1.7091	1.7160	1.7129	1.7228	0.85	0.90	0.95	1.652	0.177
1.1125	1.1250	1.1194	1.1375	1.7228	1.7296	1.7265	1.7364	-0.85	-0.80	-0.75	0.000	0.000
1.1125	1.1250	1.1194	1.1375	1.7228	1.7296	1.7265	1.7364	-0.75	-0.70	-0.65	0.000	0.000
1.1125	1.1250	1.1194	1.1375	1.7228	1.7296	1.7265	1.7364	-0.65	-0.60	-0.55	0.539	0.138
1.1125	1.1250	1.1194	1.1375	1.7228	1.7296	1.7265	1.7364	-0.55	-0.50	-0.45	0.550	0.098
1.1125	1.1250	1.1194	1.1375	1.7228	1.7296	1.7265	1.7364	-0.45	-0.40	-0.35	0.716	0.091
1.1125	1.1250	1.1194	1.1375	1.7228	1.7296	1.7265	1.7364	-0.35	-0.30	-0.25	0.795	0.084
1.1125	1.1250	1.1194	1.1375	1.7228	1.7296	1.7265	1.7364	-0.25	-0.20	-0.15	0.794	0.082
1.1125	1.1250	1.1194	1.1375	1.7228	1.7296	1.7265	1.7364	-0.15	-0.10	-0.05	0.904	0.085
1.1125	1.1250	1.1194	1.1375	1.7228	1.7296	1.7265	1.7364	-0.05	0.00	0.05	1.054	0.089
1.1125	1.1250	1.1194	1.1375	1.7228	1.7296	1.7265	1.7364	0.05	0.10	0.15	0.999	0.089
1.1125	1.1250	1.1194	1.1375	1.7228	1.7296	1.7265	1.7364	0.15	0.20	0.25	1.209	0.099

1.1125	1.1250	1.1194	1.1375	1.7228	1.7296	1.7265	1.7364	0.25	0.30	0.35	1.313	0.096
1.1125	1.1250	1.1194	1.1375	1.7228	1.7296	1.7265	1.7364	0.35	0.40	0.45	1.419	0.104
1.1125	1.1250	1.1194	1.1375	1.7228	1.7296	1.7265	1.7364	0.45	0.50	0.55	1.594	0.106
1.1125	1.1250	1.1194	1.1375	1.7228	1.7296	1.7265	1.7364	0.55	0.60	0.65	1.598	0.113
1.1125	1.1250	1.1194	1.1375	1.7228	1.7296	1.7265	1.7364	0.65	0.70	0.75	1.983	0.147
1.1125	1.1250	1.1194	1.1375	1.7228	1.7296	1.7265	1.7364	0.75	0.80	0.85	2.205	0.159
1.1125	1.1250	1.1194	1.1375	1.7228	1.7296	1.7265	1.7364	0.85	0.90	0.95	2.154	0.248
1.1375	1.1500	1.1444	1.1625	1.7364	1.7431	1.7401	1.7498	-0.85	-0.80	-0.75	0.000	0.000
1.1375	1.1500	1.1444	1.1625	1.7364	1.7431	1.7401	1.7498	-0.75	-0.70	-0.65	0.000	0.000
1.1375	1.1500	1.1444	1.1625	1.7364	1.7431	1.7401	1.7498	-0.65	-0.60	-0.55	0.618	0.091
1.1375	1.1500	1.1444	1.1625	1.7364	1.7431	1.7401	1.7498	-0.55	-0.50	-0.45	0.680	0.080
1.1375	1.1500	1.1444	1.1625	1.7364	1.7431	1.7401	1.7498	-0.45	-0.40	-0.35	0.675	0.061
1.1375	1.1500	1.1444	1.1625	1.7364	1.7431	1.7401	1.7498	-0.35	-0.30	-0.25	0.681	0.057
1.1375	1.1500	1.1444	1.1625	1.7364	1.7431	1.7401	1.7498	-0.25	-0.20	-0.15	0.850	0.060
1.1375	1.1500	1.1444	1.1625	1.7364	1.7431	1.7401	1.7498	-0.15	-0.10	-0.05	0.957	0.063
1.1375	1.1500	1.1444	1.1625	1.7364	1.7431	1.7401	1.7498	-0.05	0.00	0.05	1.068	0.066
1.1375	1.1500	1.1444	1.1625	1.7364	1.7431	1.7401	1.7498	0.05	0.10	0.15	1.070	0.068
1.1375	1.1500	1.1444	1.1625	1.7364	1.7431	1.7401	1.7498	0.15	0.20	0.25	1.336	0.076
1.1375	1.1500	1.1444	1.1625	1.7364	1.7431	1.7401	1.7498	0.25	0.30	0.35	1.327	0.073
1.1375	1.1500	1.1444	1.1625	1.7364	1.7431	1.7401	1.7498	0.35	0.40	0.45	1.659	0.085
1.1375	1.1500	1.1444	1.1625	1.7364	1.7431	1.7401	1.7498	0.45	0.50	0.55	1.664	0.083
1.1375	1.1500	1.1444	1.1625	1.7364	1.7431	1.7401	1.7498	0.55	0.60	0.65	1.674	0.091
1.1375	1.1500	1.1444	1.1625	1.7364	1.7431	1.7401	1.7498	0.65	0.70	0.75	1.654	0.092
1.1375	1.1500	1.1444	1.1625	1.7364	1.7431	1.7401	1.7498	0.75	0.80	0.85	1.913	0.110
1.1375	1.1500	1.1444	1.1625	1.7364	1.7431	1.7401	1.7498	0.85	0.90	0.95	1.971	0.179
1.1625	1.1750	1.1694	1.1875	1.7498	1.7565	1.7535	1.7632	-0.85	-0.80	-0.75	0.000	0.000
1.1625	1.1750	1.1694	1.1875	1.7498	1.7565	1.7535	1.7632	-0.75	-0.70	-0.65	0.000	0.000
1.1625	1.1750	1.1694	1.1875	1.7498	1.7565	1.7535	1.7632	-0.65	-0.60	-0.55	0.395	0.071
1.1625	1.1750	1.1694	1.1875	1.7498	1.7565	1.7535	1.7632	-0.55	-0.50	-0.45	0.426	0.061
1.1625	1.1750	1.1694	1.1875	1.7498	1.7565	1.7535	1.7632	-0.45	-0.40	-0.35	0.504	0.060
1.1625	1.1750	1.1694	1.1875	1.7498	1.7565	1.7535	1.7632	-0.35	-0.30	-0.25	0.683	0.065
1.1625	1.1750	1.1694	1.1875	1.7498	1.7565	1.7535	1.7632	-0.25	-0.20	-0.15	0.789	0.062
1.1625	1.1750	1.1694	1.1875	1.7498	1.7565	1.7535	1.7632	-0.15	-0.10	-0.05	0.913	0.063
1.1625	1.1750	1.1694	1.1875	1.7498	1.7565	1.7535	1.7632	-0.05	0.00	0.05	0.938	0.063
1.1625	1.1750	1.1694	1.1875	1.7498	1.7565	1.7535	1.7632	0.05	0.10	0.15	1.066	0.076
1.1625	1.1750	1.1694	1.1875	1.7498	1.7565	1.7535	1.7632	0.15	0.20	0.25	1.137	0.074
1.1625	1.1750	1.1694	1.1875	1.7498	1.7565	1.7535	1.7632	0.25	0.30	0.35	1.295	0.075
1.1625	1.1750	1.1694	1.1875	1.7498	1.7565	1.7535	1.7632	0.35	0.40	0.45	1.599	0.089
1.1625	1.1750	1.1694	1.1875	1.7498	1.7565	1.7535	1.7632	0.45	0.50	0.55	1.618	0.086
1.1625	1.1750	1.1694	1.1875	1.7498	1.7565	1.7535	1.7632	0.55	0.60	0.65	1.755	0.098
1.1625	1.1750	1.1694	1.1875	1.7498	1.7565	1.7535	1.7632	0.65	0.70	0.75	1.753	0.099
1.1625	1.1750	1.1694	1.1875	1.7498	1.7565	1.7535	1.7632	0.75	0.80	0.85	1.703	0.108
1.1625	1.1750	1.1694	1.1875	1.7498	1.7565	1.7535	1.7632	0.85	0.90	0.95	1.662	0.175
1.1875	1.2000	1.1944	1.2125	1.7632	1.7698	1.7668	1.7764	-0.85	-0.80	-0.75	0.000	0.000
1.1875	1.2000	1.1944	1.2125	1.7632	1.7698	1.7668	1.7764	-0.75	-0.70	-0.65	0.742	0.214
1.1875	1.2000	1.1944	1.2125	1.7632	1.7698	1.7668	1.7764	-0.65	-0.60	-0.55	0.352	0.063
1.1875	1.2000	1.1944	1.2125	1.7632	1.7698	1.7668	1.7764	-0.55	-0.50	-0.45	0.579	0.070
1.1875	1.2000	1.1944	1.2125	1.7632	1.7698	1.7668	1.7764	-0.45	-0.40	-0.35	0.630	0.064
1.1875	1.2000	1.1944	1.2125	1.7632	1.7698	1.7668	1.7764	-0.35	-0.30	-0.25	0.723	0.062
1.1875	1.2000	1.1944	1.2125	1.7632	1.7698	1.7668	1.7764	-0.25	-0.20	-0.15	0.971	0.071
1.1875	1.2000	1.1944	1.2125	1.7632	1.7698	1.7668	1.7764	-0.15	-0.10	-0.05	0.902	0.061
1.1875	1.2000	1.1944	1.2125	1.7632	1.7698	1.7668	1.7764	-0.05	0.00	0.05	1.040	0.067
1.1875	1.2000	1.1944	1.2125	1.7632	1.7698	1.7668	1.7764	0.05	0.10	0.15	1.099	0.075
1.1875	1.2000	1.1944	1.2125	1.7632	1.7698	1.7668	1.7764	0.15	0.20	0.25	1.280	0.073
1.1875	1.2000	1.1944	1.2125	1.7632	1.7698	1.7668	1.7764	0.25	0.30	0.35	1.365	0.077
1.1875	1.2000	1.1944	1.2125	1.7632	1.7698	1.7668	1.7764	0.35	0.40	0.45	1.584	0.081
1.1875	1.2000	1.1944	1.2125	1.7632	1.7698	1.7668	1.7764	0.45	0.50	0.55	1.655	0.086
1.1875	1.2000	1.1944	1.2125	1.7632	1.7698	1.7668	1.7764	0.55	0.60	0.65	1.748	0.094
1.1875	1.2000	1.1944	1.2125	1.7632	1.7698	1.7668	1.7764	0.65	0.70	0.75	1.856	0.098
1.1875	1.2000	1.1944	1.2125	1.7632	1.7698	1.7668	1.7764	0.75	0.80	0.85	1.997	0.116
1.1875	1.2000	1.1944	1.2125	1.7632	1.7698	1.7668	1.7764	0.85	0.90	0.95	1.663	0.173
1.2125	1.2250	1.2193	1.2375	1.7764	1.7830	1.7800	1.7896	-0.85	-0.80	-0.75	0.000	0.000
1.2125	1.2250	1.2193	1.2375	1.7764	1.7830	1.7800	1.7896	-0.75	-0.70	-0.65	0.276	0.086
1.2125	1.2250	1.2193	1.2375	1.7764	1.7830	1.7800	1.7896	-0.65	-0.60	-0.55	0.427	0.060

1.2125	1.2250	1.2193	1.2375	1.7764	1.7830	1.7800	1.7896	-0.55	-0.50	-0.45	0.529	0.057
1.2125	1.2250	1.2193	1.2375	1.7764	1.7830	1.7800	1.7896	-0.45	-0.40	-0.35	0.605	0.055
1.2125	1.2250	1.2193	1.2375	1.7764	1.7830	1.7800	1.7896	-0.35	-0.30	-0.25	0.664	0.051
1.2125	1.2250	1.2193	1.2375	1.7764	1.7830	1.7800	1.7896	-0.25	-0.20	-0.15	0.797	0.056
1.2125	1.2250	1.2193	1.2375	1.7764	1.7830	1.7800	1.7896	-0.15	-0.10	-0.05	0.985	0.060
1.2125	1.2250	1.2193	1.2375	1.7764	1.7830	1.7800	1.7896	-0.05	0.00	0.05	0.992	0.060
1.2125	1.2250	1.2193	1.2375	1.7764	1.7830	1.7800	1.7896	0.05	0.10	0.15	1.079	0.068
1.2125	1.2250	1.2193	1.2375	1.7764	1.7830	1.7800	1.7896	0.15	0.20	0.25	1.164	0.063
1.2125	1.2250	1.2193	1.2375	1.7764	1.7830	1.7800	1.7896	0.25	0.30	0.35	1.344	0.069
1.2125	1.2250	1.2193	1.2375	1.7764	1.7830	1.7800	1.7896	0.35	0.40	0.45	1.574	0.077
1.2125	1.2250	1.2193	1.2375	1.7764	1.7830	1.7800	1.7896	0.45	0.50	0.55	1.705	0.081
1.2125	1.2250	1.2193	1.2375	1.7764	1.7830	1.7800	1.7896	0.55	0.60	0.65	1.685	0.086
1.2125	1.2250	1.2193	1.2375	1.7764	1.7830	1.7800	1.7896	0.65	0.70	0.75	1.761	0.085
1.2125	1.2250	1.2193	1.2375	1.7764	1.7830	1.7800	1.7896	0.75	0.80	0.85	2.002	0.113
1.2125	1.2250	1.2193	1.2375	1.7764	1.7830	1.7800	1.7896	0.85	0.90	0.95	2.084	0.190
1.2375	1.2500	1.2442	1.2625	1.7896	1.7961	1.7931	1.8026	-0.85	-0.80	-0.75	0.000	0.000
1.2375	1.2500	1.2442	1.2625	1.7896	1.7961	1.7931	1.8026	-0.75	-0.70	-0.65	0.629	0.099
1.2375	1.2500	1.2442	1.2625	1.7896	1.7961	1.7931	1.8026	-0.65	-0.60	-0.55	0.429	0.053
1.2375	1.2500	1.2442	1.2625	1.7896	1.7961	1.7931	1.8026	-0.55	-0.50	-0.45	0.453	0.047
1.2375	1.2500	1.2442	1.2625	1.7896	1.7961	1.7931	1.8026	-0.45	-0.40	-0.35	0.678	0.054
1.2375	1.2500	1.2442	1.2625	1.7896	1.7961	1.7931	1.8026	-0.35	-0.30	-0.25	0.687	0.048
1.2375	1.2500	1.2442	1.2625	1.7896	1.7961	1.7931	1.8026	-0.25	-0.20	-0.15	0.715	0.047
1.2375	1.2500	1.2442	1.2625	1.7896	1.7961	1.7931	1.8026	-0.15	-0.10	-0.05	0.899	0.051
1.2375	1.2500	1.2442	1.2625	1.7896	1.7961	1.7931	1.8026	-0.05	0.00	0.05	1.020	0.057
1.2375	1.2500	1.2442	1.2625	1.7896	1.7961	1.7931	1.8026	0.05	0.10	0.15	1.090	0.062
1.2375	1.2500	1.2442	1.2625	1.7896	1.7961	1.7931	1.8026	0.15	0.20	0.25	1.243	0.061
1.2375	1.2500	1.2442	1.2625	1.7896	1.7961	1.7931	1.8026	0.25	0.30	0.35	1.377	0.068
1.2375	1.2500	1.2442	1.2625	1.7896	1.7961	1.7931	1.8026	0.35	0.40	0.45	1.621	0.071
1.2375	1.2500	1.2442	1.2625	1.7896	1.7961	1.7931	1.8026	0.45	0.50	0.55	1.672	0.076
1.2375	1.2500	1.2442	1.2625	1.7896	1.7961	1.7931	1.8026	0.55	0.60	0.65	1.704	0.077
1.2375	1.2500	1.2442	1.2625	1.7896	1.7961	1.7931	1.8026	0.65	0.70	0.75	1.939	0.087
1.2375	1.2500	1.2442	1.2625	1.7896	1.7961	1.7931	1.8026	0.75	0.80	0.85	1.993	0.106
1.2375	1.2500	1.2442	1.2625	1.7896	1.7961	1.7931	1.8026	0.85	0.90	0.95	1.861	0.161
1.2625	1.2750	1.2692	1.2875	1.8026	1.8091	1.8061	1.8156	-0.85	-0.80	-0.75	0.000	0.000
1.2625	1.2750	1.2692	1.2875	1.8026	1.8091	1.8061	1.8156	-0.75	-0.70	-0.65	0.456	0.070
1.2625	1.2750	1.2692	1.2875	1.8026	1.8091	1.8061	1.8156	-0.65	-0.60	-0.55	0.522	0.055
1.2625	1.2750	1.2692	1.2875	1.8026	1.8091	1.8061	1.8156	-0.55	-0.50	-0.45	0.529	0.047
1.2625	1.2750	1.2692	1.2875	1.8026	1.8091	1.8061	1.8156	-0.45	-0.40	-0.35	0.617	0.047
1.2625	1.2750	1.2692	1.2875	1.8026	1.8091	1.8061	1.8156	-0.35	-0.30	-0.25	0.747	0.049
1.2625	1.2750	1.2692	1.2875	1.8026	1.8091	1.8061	1.8156	-0.25	-0.20	-0.15	0.895	0.054
1.2625	1.2750	1.2692	1.2875	1.8026	1.8091	1.8061	1.8156	-0.15	-0.10	-0.05	0.927	0.050
1.2625	1.2750	1.2692	1.2875	1.8026	1.8091	1.8061	1.8156	-0.05	0.00	0.05	0.914	0.048
1.2625	1.2750	1.2692	1.2875	1.8026	1.8091	1.8061	1.8156	0.05	0.10	0.15	1.188	0.061
1.2625	1.2750	1.2692	1.2875	1.8026	1.8091	1.8061	1.8156	0.15	0.20	0.25	1.256	0.058
1.2625	1.2750	1.2692	1.2875	1.8026	1.8091	1.8061	1.8156	0.25	0.30	0.35	1.617	0.072
1.2625	1.2750	1.2692	1.2875	1.8026	1.8091	1.8061	1.8156	0.35	0.40	0.45	1.656	0.070
1.2625	1.2750	1.2692	1.2875	1.8026	1.8091	1.8061	1.8156	0.45	0.50	0.55	1.560	0.068
1.2625	1.2750	1.2692	1.2875	1.8026	1.8091	1.8061	1.8156	0.55	0.60	0.65	1.679	0.078
1.2625	1.2750	1.2692	1.2875	1.8026	1.8091	1.8061	1.8156	0.65	0.70	0.75	1.699	0.070
1.2625	1.2750	1.2692	1.2875	1.8026	1.8091	1.8061	1.8156	0.75	0.80	0.85	1.989	0.102
1.2625	1.2750	1.2692	1.2875	1.8026	1.8091	1.8061	1.8156	0.85	0.90	0.95	2.093	0.194
1.2875	1.3000	1.2944	1.3125	1.8156	1.8220	1.8192	1.8285	-0.85	-0.80	-0.75	0.000	0.000
1.2875	1.3000	1.2944	1.3125	1.8156	1.8220	1.8192	1.8285	-0.75	-0.70	-0.65	0.647	0.116
1.2875	1.3000	1.2944	1.3125	1.8156	1.8220	1.8192	1.8285	-0.65	-0.60	-0.55	0.657	0.083
1.2875	1.3000	1.2944	1.3125	1.8156	1.8220	1.8192	1.8285	-0.55	-0.50	-0.45	0.564	0.062
1.2875	1.3000	1.2944	1.3125	1.8156	1.8220	1.8192	1.8285	-0.45	-0.40	-0.35	0.717	0.069
1.2875	1.3000	1.2944	1.3125	1.8156	1.8220	1.8192	1.8285	-0.35	-0.30	-0.25	0.733	0.062
1.2875	1.3000	1.2944	1.3125	1.8156	1.8220	1.8192	1.8285	-0.25	-0.20	-0.15	0.846	0.064
1.2875	1.3000	1.2944	1.3125	1.8156	1.8220	1.8192	1.8285	-0.15	-0.10	-0.05	0.971	0.066
1.2875	1.3000	1.2944	1.3125	1.8156	1.8220	1.8192	1.8285	-0.05	0.00	0.05	1.120	0.074
1.2875	1.3000	1.2944	1.3125	1.8156	1.8220	1.8192	1.8285	0.05	0.10	0.15	1.246	0.081
1.2875	1.3000	1.2944	1.3125	1.8156	1.8220	1.8192	1.8285	0.15	0.20	0.25	1.209	0.071
1.2875	1.3000	1.2944	1.3125	1.8156	1.8220	1.8192	1.8285	0.25	0.30	0.35	1.604	0.090
1.2875	1.3000	1.2944	1.3125	1.8156	1.8220	1.8192	1.8285	0.35	0.40	0.45	1.544	0.081

1.2875	1.3000	1.2944	1.3125	1.8156	1.8220	1.8192	1.8285	0.45	0.50	0.55	1.759	0.090
1.2875	1.3000	1.2944	1.3125	1.8156	1.8220	1.8192	1.8285	0.55	0.60	0.65	1.722	0.092
1.2875	1.3000	1.2944	1.3125	1.8156	1.8220	1.8192	1.8285	0.65	0.70	0.75	1.916	0.097
1.2875	1.3000	1.2944	1.3125	1.8156	1.8220	1.8192	1.8285	0.75	0.80	0.85	1.910	0.120
1.2875	1.3000	1.2944	1.3125	1.8156	1.8220	1.8192	1.8285	0.85	0.90	0.95	1.675	0.166
1.3125	1.3250	1.3197	1.3375	1.8285	1.8349	1.8322	1.8413	-0.85	-0.80	-0.75	0.000	0.000
1.3125	1.3250	1.3197	1.3375	1.8285	1.8349	1.8322	1.8413	-0.75	-0.70	-0.65	0.521	0.086
1.3125	1.3250	1.3197	1.3375	1.8285	1.8349	1.8322	1.8413	-0.65	-0.60	-0.55	0.618	0.071
1.3125	1.3250	1.3197	1.3375	1.8285	1.8349	1.8322	1.8413	-0.55	-0.50	-0.45	0.654	0.065
1.3125	1.3250	1.3197	1.3375	1.8285	1.8349	1.8322	1.8413	-0.45	-0.40	-0.35	0.705	0.064
1.3125	1.3250	1.3197	1.3375	1.8285	1.8349	1.8322	1.8413	-0.35	-0.30	-0.25	0.722	0.056
1.3125	1.3250	1.3197	1.3375	1.8285	1.8349	1.8322	1.8413	-0.25	-0.20	-0.15	0.828	0.058
1.3125	1.3250	1.3197	1.3375	1.8285	1.8349	1.8322	1.8413	-0.15	-0.10	-0.05	0.999	0.064
1.3125	1.3250	1.3197	1.3375	1.8285	1.8349	1.8322	1.8413	-0.05	0.00	0.05	1.049	0.066
1.3125	1.3250	1.3197	1.3375	1.8285	1.8349	1.8322	1.8413	0.05	0.10	0.15	1.235	0.079
1.3125	1.3250	1.3197	1.3375	1.8285	1.8349	1.8322	1.8413	0.15	0.20	0.25	1.286	0.070
1.3125	1.3250	1.3197	1.3375	1.8285	1.8349	1.8322	1.8413	0.25	0.30	0.35	1.464	0.080
1.3125	1.3250	1.3197	1.3375	1.8285	1.8349	1.8322	1.8413	0.35	0.40	0.45	1.739	0.088
1.3125	1.3250	1.3197	1.3375	1.8285	1.8349	1.8322	1.8413	0.45	0.50	0.55	1.806	0.094
1.3125	1.3250	1.3197	1.3375	1.8285	1.8349	1.8322	1.8413	0.55	0.60	0.65	1.925	0.095
1.3125	1.3250	1.3197	1.3375	1.8285	1.8349	1.8322	1.8413	0.65	0.70	0.75	1.918	0.088
1.3125	1.3250	1.3197	1.3375	1.8285	1.8349	1.8322	1.8413	0.75	0.80	0.85	1.898	0.116
1.3125	1.3250	1.3197	1.3375	1.8285	1.8349	1.8322	1.8413	0.85	0.90	0.95	1.777	0.163
1.3375	1.3500	1.3449	1.3625	1.8413	1.8476	1.8450	1.8540	-0.85	-0.80	-0.75	0.463	0.164
1.3375	1.3500	1.3449	1.3625	1.8413	1.8476	1.8450	1.8540	-0.75	-0.70	-0.65	0.727	0.086
1.3375	1.3500	1.3449	1.3625	1.8413	1.8476	1.8450	1.8540	-0.65	-0.60	-0.55	0.601	0.059
1.3375	1.3500	1.3449	1.3625	1.8413	1.8476	1.8450	1.8540	-0.55	-0.50	-0.45	0.732	0.061
1.3375	1.3500	1.3449	1.3625	1.8413	1.8476	1.8450	1.8540	-0.45	-0.40	-0.35	0.725	0.059
1.3375	1.3500	1.3449	1.3625	1.8413	1.8476	1.8450	1.8540	-0.35	-0.30	-0.25	0.842	0.055
1.3375	1.3500	1.3449	1.3625	1.8413	1.8476	1.8450	1.8540	-0.25	-0.20	-0.15	0.853	0.055
1.3375	1.3500	1.3449	1.3625	1.8413	1.8476	1.8450	1.8540	-0.15	-0.10	-0.05	0.945	0.054
1.3375	1.3500	1.3449	1.3625	1.8413	1.8476	1.8450	1.8540	-0.05	0.00	0.05	1.054	0.058
1.3375	1.3500	1.3449	1.3625	1.8413	1.8476	1.8450	1.8540	0.05	0.10	0.15	1.072	0.063
1.3375	1.3500	1.3449	1.3625	1.8413	1.8476	1.8450	1.8540	0.15	0.20	0.25	1.327	0.064
1.3375	1.3500	1.3449	1.3625	1.8413	1.8476	1.8450	1.8540	0.25	0.30	0.35	1.381	0.067
1.3375	1.3500	1.3449	1.3625	1.8413	1.8476	1.8450	1.8540	0.35	0.40	0.45	1.431	0.065
1.3375	1.3500	1.3449	1.3625	1.8413	1.8476	1.8450	1.8540	0.45	0.50	0.55	1.696	0.078
1.3375	1.3500	1.3449	1.3625	1.8413	1.8476	1.8450	1.8540	0.55	0.60	0.65	1.807	0.080
1.3375	1.3500	1.3449	1.3625	1.8413	1.8476	1.8450	1.8540	0.65	0.70	0.75	1.849	0.083
1.3375	1.3500	1.3449	1.3625	1.8413	1.8476	1.8450	1.8540	0.75	0.80	0.85	1.742	0.094
1.3375	1.3500	1.3449	1.3625	1.8413	1.8476	1.8450	1.8540	0.85	0.90	0.95	1.694	0.142
1.3625	1.3750	1.3702	1.3875	1.8540	1.8603	1.8578	1.8666	-0.85	-0.80	-0.75	0.625	0.131
1.3625	1.3750	1.3702	1.3875	1.8540	1.8603	1.8578	1.8666	-0.75	-0.70	-0.65	0.784	0.077
1.3625	1.3750	1.3702	1.3875	1.8540	1.8603	1.8578	1.8666	-0.65	-0.60	-0.55	0.692	0.063
1.3625	1.3750	1.3702	1.3875	1.8540	1.8603	1.8578	1.8666	-0.55	-0.50	-0.45	0.677	0.050
1.3625	1.3750	1.3702	1.3875	1.8540	1.8603	1.8578	1.8666	-0.45	-0.40	-0.35	0.663	0.049
1.3625	1.3750	1.3702	1.3875	1.8540	1.8603	1.8578	1.8666	-0.35	-0.30	-0.25	0.762	0.046
1.3625	1.3750	1.3702	1.3875	1.8540	1.8603	1.8578	1.8666	-0.25	-0.20	-0.15	0.913	0.051
1.3625	1.3750	1.3702	1.3875	1.8540	1.8603	1.8578	1.8666	-0.15	-0.10	-0.05	1.063	0.055
1.3625	1.3750	1.3702	1.3875	1.8540	1.8603	1.8578	1.8666	-0.05	0.00	0.05	1.096	0.053
1.3625	1.3750	1.3702	1.3875	1.8540	1.8603	1.8578	1.8666	0.05	0.10	0.15	1.236	0.063
1.3625	1.3750	1.3702	1.3875	1.8540	1.8603	1.8578	1.8666	0.15	0.20	0.25	1.375	0.061
1.3625	1.3750	1.3702	1.3875	1.8540	1.8603	1.8578	1.8666	0.25	0.30	0.35	1.423	0.066
1.3625	1.3750	1.3702	1.3875	1.8540	1.8603	1.8578	1.8666	0.35	0.40	0.45	1.566	0.061
1.3625	1.3750	1.3702	1.3875	1.8540	1.8603	1.8578	1.8666	0.45	0.50	0.55	1.576	0.066
1.3625	1.3750	1.3702	1.3875	1.8540	1.8603	1.8578	1.8666	0.55	0.60	0.65	1.789	0.073
1.3625	1.3750	1.3702	1.3875	1.8540	1.8603	1.8578	1.8666	0.65	0.70	0.75	1.883	0.077
1.3625	1.3750	1.3702	1.3875	1.8540	1.8603	1.8578	1.8666	0.75	0.80	0.85	1.792	0.087
1.3625	1.3750	1.3702	1.3875	1.8540	1.8603	1.8578	1.8666	0.85	0.90	0.95	1.807	0.135
1.3875	1.4000	1.3954	1.4125	1.8666	1.8728	1.8705	1.8791	-0.85	-0.80	-0.75	0.728	0.122
1.3875	1.4000	1.3954	1.4125	1.8666	1.8728	1.8705	1.8791	-0.75	-0.70	-0.65	0.732	0.070
1.3875	1.4000	1.3954	1.4125	1.8666	1.8728	1.8705	1.8791	-0.65	-0.60	-0.55	0.805	0.062
1.3875	1.4000	1.3954	1.4125	1.8666	1.8728	1.8705	1.8791	-0.55	-0.50	-0.45	0.701	0.045
1.3875	1.4000	1.3954	1.4125	1.8666	1.8728	1.8705	1.8791	-0.45	-0.40	-0.35	0.754	0.047

1.3875	1.4000	1.3954	1.4125	1.8666	1.8728	1.8705	1.8791	-0.35	-0.30	-0.25	0.847	0.045
1.3875	1.4000	1.3954	1.4125	1.8666	1.8728	1.8705	1.8791	-0.25	-0.20	-0.15	0.840	0.042
1.3875	1.4000	1.3954	1.4125	1.8666	1.8728	1.8705	1.8791	-0.15	-0.10	-0.05	0.971	0.045
1.3875	1.4000	1.3954	1.4125	1.8666	1.8728	1.8705	1.8791	-0.05	0.00	0.05	1.036	0.047
1.3875	1.4000	1.3954	1.4125	1.8666	1.8728	1.8705	1.8791	0.05	0.10	0.15	1.118	0.050
1.3875	1.4000	1.3954	1.4125	1.8666	1.8728	1.8705	1.8791	0.15	0.20	0.25	1.300	0.052
1.3875	1.4000	1.3954	1.4125	1.8666	1.8728	1.8705	1.8791	0.25	0.30	0.35	1.469	0.058
1.3875	1.4000	1.3954	1.4125	1.8666	1.8728	1.8705	1.8791	0.35	0.40	0.45	1.540	0.053
1.3875	1.4000	1.3954	1.4125	1.8666	1.8728	1.8705	1.8791	0.45	0.50	0.55	1.666	0.065
1.3875	1.4000	1.3954	1.4125	1.8666	1.8728	1.8705	1.8791	0.55	0.60	0.65	1.598	0.059
1.3875	1.4000	1.3954	1.4125	1.8666	1.8728	1.8705	1.8791	0.65	0.70	0.75	1.732	0.063
1.3875	1.4000	1.3954	1.4125	1.8666	1.8728	1.8705	1.8791	0.75	0.80	0.85	1.847	0.085
1.3875	1.4000	1.3954	1.4125	1.8666	1.8728	1.8705	1.8791	0.85	0.90	0.95	1.862	0.130
1.4125	1.4250	1.4206	1.4375	1.8791	1.8853	1.8831	1.8915	-0.85	-0.80	-0.75	0.875	0.176
1.4125	1.4250	1.4206	1.4375	1.8791	1.8853	1.8831	1.8915	-0.75	-0.70	-0.65	0.993	0.113
1.4125	1.4250	1.4206	1.4375	1.8791	1.8853	1.8831	1.8915	-0.65	-0.60	-0.55	0.794	0.073
1.4125	1.4250	1.4206	1.4375	1.8791	1.8853	1.8831	1.8915	-0.55	-0.50	-0.45	0.825	0.071
1.4125	1.4250	1.4206	1.4375	1.8791	1.8853	1.8831	1.8915	-0.45	-0.40	-0.35	0.835	0.067
1.4125	1.4250	1.4206	1.4375	1.8791	1.8853	1.8831	1.8915	-0.35	-0.30	-0.25	0.789	0.057
1.4125	1.4250	1.4206	1.4375	1.8791	1.8853	1.8831	1.8915	-0.25	-0.20	-0.15	0.775	0.056
1.4125	1.4250	1.4206	1.4375	1.8791	1.8853	1.8831	1.8915	-0.15	-0.10	-0.05	1.030	0.061
1.4125	1.4250	1.4206	1.4375	1.8791	1.8853	1.8831	1.8915	-0.05	0.00	0.05	0.937	0.060
1.4125	1.4250	1.4206	1.4375	1.8791	1.8853	1.8831	1.8915	0.05	0.10	0.15	1.288	0.074
1.4125	1.4250	1.4206	1.4375	1.8791	1.8853	1.8831	1.8915	0.15	0.20	0.25	1.379	0.072
1.4125	1.4250	1.4206	1.4375	1.8791	1.8853	1.8831	1.8915	0.25	0.30	0.35	1.396	0.073
1.4125	1.4250	1.4206	1.4375	1.8791	1.8853	1.8831	1.8915	0.35	0.40	0.45	1.563	0.077
1.4125	1.4250	1.4206	1.4375	1.8791	1.8853	1.8831	1.8915	0.45	0.50	0.55	1.632	0.077
1.4125	1.4250	1.4206	1.4375	1.8791	1.8853	1.8831	1.8915	0.55	0.60	0.65	1.694	0.083
1.4125	1.4250	1.4206	1.4375	1.8791	1.8853	1.8831	1.8915	0.65	0.70	0.75	1.867	0.087
1.4125	1.4250	1.4206	1.4375	1.8791	1.8853	1.8831	1.8915	0.75	0.80	0.85	1.707	0.099
1.4125	1.4250	1.4206	1.4375	1.8791	1.8853	1.8831	1.8915	0.85	0.90	0.95	1.938	0.168
1.4375	1.4500	1.4457	1.4625	1.8915	1.8977	1.8956	1.9039	-0.85	-0.80	-0.75	0.842	0.104
1.4375	1.4500	1.4457	1.4625	1.8915	1.8977	1.8956	1.9039	-0.75	-0.70	-0.65	0.789	0.069
1.4375	1.4500	1.4457	1.4625	1.8915	1.8977	1.8956	1.9039	-0.65	-0.60	-0.55	0.887	0.062
1.4375	1.4500	1.4457	1.4625	1.8915	1.8977	1.8956	1.9039	-0.55	-0.50	-0.45	0.644	0.044
1.4375	1.4500	1.4457	1.4625	1.8915	1.8977	1.8956	1.9039	-0.45	-0.40	-0.35	0.752	0.047
1.4375	1.4500	1.4457	1.4625	1.8915	1.8977	1.8956	1.9039	-0.35	-0.30	-0.25	0.750	0.042
1.4375	1.4500	1.4457	1.4625	1.8915	1.8977	1.8956	1.9039	-0.25	-0.20	-0.15	0.797	0.042
1.4375	1.4500	1.4457	1.4625	1.8915	1.8977	1.8956	1.9039	-0.15	-0.10	-0.05	0.851	0.041
1.4375	1.4500	1.4457	1.4625	1.8915	1.8977	1.8956	1.9039	-0.05	0.00	0.05	0.934	0.045
1.4375	1.4500	1.4457	1.4625	1.8915	1.8977	1.8956	1.9039	0.05	0.10	0.15	1.117	0.053
1.4375	1.4500	1.4457	1.4625	1.8915	1.8977	1.8956	1.9039	0.15	0.20	0.25	1.115	0.047
1.4375	1.4500	1.4457	1.4625	1.8915	1.8977	1.8956	1.9039	0.25	0.30	0.35	1.308	0.053
1.4375	1.4500	1.4457	1.4625	1.8915	1.8977	1.8956	1.9039	0.35	0.40	0.45	1.461	0.057
1.4375	1.4500	1.4457	1.4625	1.8915	1.8977	1.8956	1.9039	0.45	0.50	0.55	1.670	0.061
1.4375	1.4500	1.4457	1.4625	1.8915	1.8977	1.8956	1.9039	0.55	0.60	0.65	1.678	0.062
1.4375	1.4500	1.4457	1.4625	1.8915	1.8977	1.8956	1.9039	0.65	0.70	0.75	1.834	0.072
1.4375	1.4500	1.4457	1.4625	1.8915	1.8977	1.8956	1.9039	0.75	0.80	0.85	1.953	0.083
1.4375	1.4500	1.4457	1.4625	1.8915	1.8977	1.8956	1.9039	0.85	0.90	0.95	2.105	0.137
1.4625	1.4750	1.4709	1.4875	1.9039	1.9100	1.9080	1.9162	-0.85	-0.80	-0.75	1.065	0.118
1.4625	1.4750	1.4709	1.4875	1.9039	1.9100	1.9080	1.9162	-0.75	-0.70	-0.65	0.802	0.063
1.4625	1.4750	1.4709	1.4875	1.9039	1.9100	1.9080	1.9162	-0.65	-0.60	-0.55	0.738	0.052
1.4625	1.4750	1.4709	1.4875	1.9039	1.9100	1.9080	1.9162	-0.55	-0.50	-0.45	0.699	0.045
1.4625	1.4750	1.4709	1.4875	1.9039	1.9100	1.9080	1.9162	-0.45	-0.40	-0.35	0.633	0.039
1.4625	1.4750	1.4709	1.4875	1.9039	1.9100	1.9080	1.9162	-0.35	-0.30	-0.25	0.740	0.040
1.4625	1.4750	1.4709	1.4875	1.9039	1.9100	1.9080	1.9162	-0.25	-0.20	-0.15	0.711	0.037
1.4625	1.4750	1.4709	1.4875	1.9039	1.9100	1.9080	1.9162	-0.15	-0.10	-0.05	0.761	0.037
1.4625	1.4750	1.4709	1.4875	1.9039	1.9100	1.9080	1.9162	-0.05	0.00	0.05	0.829	0.039
1.4625	1.4750	1.4709	1.4875	1.9039	1.9100	1.9080	1.9162	0.05	0.10	0.15	1.037	0.047
1.4625	1.4750	1.4709	1.4875	1.9039	1.9100	1.9080	1.9162	0.15	0.20	0.25	1.155	0.046
1.4625	1.4750	1.4709	1.4875	1.9039	1.9100	1.9080	1.9162	0.25	0.30	0.35	1.353	0.052
1.4625	1.4750	1.4709	1.4875	1.9039	1.9100	1.9080	1.9162	0.35	0.40	0.45	1.440	0.051
1.4625	1.4750	1.4709	1.4875	1.9039	1.9100	1.9080	1.9162	0.45	0.50	0.55	1.627	0.062
1.4625	1.4750	1.4709	1.4875	1.9039	1.9100	1.9080	1.9162	0.55	0.60	0.65	1.787	0.060

1.4625	1.4750	1.4709	1.4875	1.9039	1.9100	1.9080	1.9162	0.65	0.70	0.75	1.950	0.073
1.4625	1.4750	1.4709	1.4875	1.9039	1.9100	1.9080	1.9162	0.75	0.80	0.85	1.949	0.082
1.4625	1.4750	1.4709	1.4875	1.9039	1.9100	1.9080	1.9162	0.85	0.90	0.95	2.087	0.129
1.4875	1.5000	1.4960	1.5125	1.9162	1.9223	1.9203	1.9284	-0.85	-0.80	-0.75	0.808	0.098
1.4875	1.5000	1.4960	1.5125	1.9162	1.9223	1.9203	1.9284	-0.75	-0.70	-0.65	0.841	0.068
1.4875	1.5000	1.4960	1.5125	1.9162	1.9223	1.9203	1.9284	-0.65	-0.60	-0.55	0.650	0.051
1.4875	1.5000	1.4960	1.5125	1.9162	1.9223	1.9203	1.9284	-0.55	-0.50	-0.45	0.582	0.042
1.4875	1.5000	1.4960	1.5125	1.9162	1.9223	1.9203	1.9284	-0.45	-0.40	-0.35	0.714	0.046
1.4875	1.5000	1.4960	1.5125	1.9162	1.9223	1.9203	1.9284	-0.35	-0.30	-0.25	0.613	0.037
1.4875	1.5000	1.4960	1.5125	1.9162	1.9223	1.9203	1.9284	-0.25	-0.20	-0.15	0.649	0.038
1.4875	1.5000	1.4960	1.5125	1.9162	1.9223	1.9203	1.9284	-0.15	-0.10	-0.05	0.795	0.041
1.4875	1.5000	1.4960	1.5125	1.9162	1.9223	1.9203	1.9284	-0.05	0.00	0.05	0.770	0.042
1.4875	1.5000	1.4960	1.5125	1.9162	1.9223	1.9203	1.9284	0.05	0.10	0.15	1.058	0.051
1.4875	1.5000	1.4960	1.5125	1.9162	1.9223	1.9203	1.9284	0.15	0.20	0.25	1.112	0.047
1.4875	1.5000	1.4960	1.5125	1.9162	1.9223	1.9203	1.9284	0.25	0.30	0.35	1.375	0.056
1.4875	1.5000	1.4960	1.5125	1.9162	1.9223	1.9203	1.9284	0.35	0.40	0.45	1.521	0.058
1.4875	1.5000	1.4960	1.5125	1.9162	1.9223	1.9203	1.9284	0.45	0.50	0.55	1.623	0.063
1.4875	1.5000	1.4960	1.5125	1.9162	1.9223	1.9203	1.9284	0.55	0.60	0.65	1.821	0.064
1.4875	1.5000	1.4960	1.5125	1.9162	1.9223	1.9203	1.9284	0.65	0.70	0.75	1.948	0.073
1.4875	1.5000	1.4960	1.5125	1.9162	1.9223	1.9203	1.9284	0.75	0.80	0.85	2.043	0.088
1.4875	1.5000	1.4960	1.5125	1.9162	1.9223	1.9203	1.9284	0.85	0.90	0.95	1.995	0.129
1.5125	1.5250	1.5211	1.5375	1.9284	1.9344	1.9326	1.9405	-0.85	-0.80	-0.75	0.832	0.096
1.5125	1.5250	1.5211	1.5375	1.9284	1.9344	1.9326	1.9405	-0.75	-0.70	-0.65	0.852	0.067
1.5125	1.5250	1.5211	1.5375	1.9284	1.9344	1.9326	1.9405	-0.65	-0.60	-0.55	0.767	0.054
1.5125	1.5250	1.5211	1.5375	1.9284	1.9344	1.9326	1.9405	-0.55	-0.50	-0.45	0.621	0.042
1.5125	1.5250	1.5211	1.5375	1.9284	1.9344	1.9326	1.9405	-0.45	-0.40	-0.35	0.617	0.041
1.5125	1.5250	1.5211	1.5375	1.9284	1.9344	1.9326	1.9405	-0.35	-0.30	-0.25	0.583	0.035
1.5125	1.5250	1.5211	1.5375	1.9284	1.9344	1.9326	1.9405	-0.25	-0.20	-0.15	0.675	0.037
1.5125	1.5250	1.5211	1.5375	1.9284	1.9344	1.9326	1.9405	-0.15	-0.10	-0.05	0.760	0.038
1.5125	1.5250	1.5211	1.5375	1.9284	1.9344	1.9326	1.9405	-0.05	0.00	0.05	0.883	0.044
1.5125	1.5250	1.5211	1.5375	1.9284	1.9344	1.9326	1.9405	0.05	0.10	0.15	0.985	0.044
1.5125	1.5250	1.5211	1.5375	1.9284	1.9344	1.9326	1.9405	0.15	0.20	0.25	1.101	0.046
1.5125	1.5250	1.5211	1.5375	1.9284	1.9344	1.9326	1.9405	0.25	0.30	0.35	1.369	0.054
1.5125	1.5250	1.5211	1.5375	1.9284	1.9344	1.9326	1.9405	0.35	0.40	0.45	1.463	0.056
1.5125	1.5250	1.5211	1.5375	1.9284	1.9344	1.9326	1.9405	0.45	0.50	0.55	1.604	0.059
1.5125	1.5250	1.5211	1.5375	1.9284	1.9344	1.9326	1.9405	0.55	0.60	0.65	1.829	0.062
1.5125	1.5250	1.5211	1.5375	1.9284	1.9344	1.9326	1.9405	0.65	0.70	0.75	1.901	0.074
1.5125	1.5250	1.5211	1.5375	1.9284	1.9344	1.9326	1.9405	0.75	0.80	0.85	2.104	0.085
1.5125	1.5250	1.5211	1.5375	1.9284	1.9344	1.9326	1.9405	0.85	0.90	0.95	2.287	0.144
1.5375	1.5500	1.5462	1.5625	1.9405	1.9465	1.9447	1.9525	-0.85	-0.80	-0.75	0.923	0.100
1.5375	1.5500	1.5462	1.5625	1.9405	1.9465	1.9447	1.9525	-0.75	-0.70	-0.65	0.734	0.058
1.5375	1.5500	1.5462	1.5625	1.9405	1.9465	1.9447	1.9525	-0.65	-0.60	-0.55	0.634	0.049
1.5375	1.5500	1.5462	1.5625	1.9405	1.9465	1.9447	1.9525	-0.55	-0.50	-0.45	0.553	0.041
1.5375	1.5500	1.5462	1.5625	1.9405	1.9465	1.9447	1.9525	-0.45	-0.40	-0.35	0.545	0.038
1.5375	1.5500	1.5462	1.5625	1.9405	1.9465	1.9447	1.9525	-0.35	-0.30	-0.25	0.464	0.030
1.5375	1.5500	1.5462	1.5625	1.9405	1.9465	1.9447	1.9525	-0.25	-0.20	-0.15	0.586	0.033
1.5375	1.5500	1.5462	1.5625	1.9405	1.9465	1.9447	1.9525	-0.15	-0.10	-0.05	0.663	0.035
1.5375	1.5500	1.5462	1.5625	1.9405	1.9465	1.9447	1.9525	-0.05	0.00	0.05	0.753	0.039
1.5375	1.5500	1.5462	1.5625	1.9405	1.9465	1.9447	1.9525	0.05	0.10	0.15	0.846	0.041
1.5375	1.5500	1.5462	1.5625	1.9405	1.9465	1.9447	1.9525	0.15	0.20	0.25	1.085	0.047
1.5375	1.5500	1.5462	1.5625	1.9405	1.9465	1.9447	1.9525	0.25	0.30	0.35	1.266	0.051
1.5375	1.5500	1.5462	1.5625	1.9405	1.9465	1.9447	1.9525	0.35	0.40	0.45	1.409	0.051
1.5375	1.5500	1.5462	1.5625	1.9405	1.9465	1.9447	1.9525	0.45	0.50	0.55	1.489	0.055
1.5375	1.5500	1.5462	1.5625	1.9405	1.9465	1.9447	1.9525	0.55	0.60	0.65	1.688	0.060
1.5375	1.5500	1.5462	1.5625	1.9405	1.9465	1.9447	1.9525	0.65	0.70	0.75	1.789	0.069
1.5375	1.5500	1.5462	1.5625	1.9405	1.9465	1.9447	1.9525	0.75	0.80	0.85	2.040	0.084
1.5375	1.5500	1.5462	1.5625	1.9405	1.9465	1.9447	1.9525	0.85	0.90	0.95	2.022	0.121
1.5625	1.5750	1.5713	1.5875	1.9525	1.9585	1.9568	1.9645	-0.85	-0.80	-0.75	0.762	0.076
1.5625	1.5750	1.5713	1.5875	1.9525	1.9585	1.9568	1.9645	-0.75	-0.70	-0.65	0.742	0.056
1.5625	1.5750	1.5713	1.5875	1.9525	1.9585	1.9568	1.9645	-0.65	-0.60	-0.55	0.697	0.048
1.5625	1.5750	1.5713	1.5875	1.9525	1.9585	1.9568	1.9645	-0.55	-0.50	-0.45	0.512	0.036
1.5625	1.5750	1.5713	1.5875	1.9525	1.9585	1.9568	1.9645	-0.45	-0.40	-0.35	0.464	0.032
1.5625	1.5750	1.5713	1.5875	1.9525	1.9585	1.9568	1.9645	-0.35	-0.30	-0.25	0.457	0.028
1.5625	1.5750	1.5713	1.5875	1.9525	1.9585	1.9568	1.9645	-0.25	-0.20	-0.15	0.532	0.030

1.5625	1.5750	1.5713	1.5875	1.9525	1.9585	1.9568	1.9645	-0.15	-0.10	-0.05	0.613	0.032
1.5625	1.5750	1.5713	1.5875	1.9525	1.9585	1.9568	1.9645	-0.05	0.00	0.05	0.671	0.033
1.5625	1.5750	1.5713	1.5875	1.9525	1.9585	1.9568	1.9645	0.05	0.10	0.15	0.870	0.039
1.5625	1.5750	1.5713	1.5875	1.9525	1.9585	1.9568	1.9645	0.15	0.20	0.25	0.998	0.040
1.5625	1.5750	1.5713	1.5875	1.9525	1.9585	1.9568	1.9645	0.25	0.30	0.35	1.217	0.047
1.5625	1.5750	1.5713	1.5875	1.9525	1.9585	1.9568	1.9645	0.35	0.40	0.45	1.341	0.051
1.5625	1.5750	1.5713	1.5875	1.9525	1.9585	1.9568	1.9645	0.45	0.50	0.55	1.546	0.054
1.5625	1.5750	1.5713	1.5875	1.9525	1.9585	1.9568	1.9645	0.55	0.60	0.65	1.749	0.061
1.5625	1.5750	1.5713	1.5875	1.9525	1.9585	1.9568	1.9645	0.65	0.70	0.75	1.735	0.065
1.5625	1.5750	1.5713	1.5875	1.9525	1.9585	1.9568	1.9645	0.75	0.80	0.85	2.030	0.080
1.5625	1.5750	1.5713	1.5875	1.9525	1.9585	1.9568	1.9645	0.85	0.90	0.95	2.370	0.130
1.5875	1.6000	1.5960	1.6125	1.9645	1.9705	1.9686	1.9764	-0.85	-0.80	-0.75	0.674	0.070
1.5875	1.6000	1.5960	1.6125	1.9645	1.9705	1.9686	1.9764	-0.75	-0.70	-0.65	0.762	0.053
1.5875	1.6000	1.5960	1.6125	1.9645	1.9705	1.9686	1.9764	-0.65	-0.60	-0.55	0.566	0.040
1.5875	1.6000	1.5960	1.6125	1.9645	1.9705	1.9686	1.9764	-0.55	-0.50	-0.45	0.389	0.031
1.5875	1.6000	1.5960	1.6125	1.9645	1.9705	1.9686	1.9764	-0.45	-0.40	-0.35	0.381	0.028
1.5875	1.6000	1.5960	1.6125	1.9645	1.9705	1.9686	1.9764	-0.35	-0.30	-0.25	0.406	0.026
1.5875	1.6000	1.5960	1.6125	1.9645	1.9705	1.9686	1.9764	-0.25	-0.20	-0.15	0.426	0.025
1.5875	1.6000	1.5960	1.6125	1.9645	1.9705	1.9686	1.9764	-0.15	-0.10	-0.05	0.526	0.028
1.5875	1.6000	1.5960	1.6125	1.9645	1.9705	1.9686	1.9764	-0.05	0.00	0.05	0.552	0.031
1.5875	1.6000	1.5960	1.6125	1.9645	1.9705	1.9686	1.9764	0.05	0.10	0.15	0.758	0.034
1.5875	1.6000	1.5960	1.6125	1.9645	1.9705	1.9686	1.9764	0.15	0.20	0.25	0.912	0.037
1.5875	1.6000	1.5960	1.6125	1.9645	1.9705	1.9686	1.9764	0.25	0.30	0.35	1.085	0.042
1.5875	1.6000	1.5960	1.6125	1.9645	1.9705	1.9686	1.9764	0.35	0.40	0.45	1.294	0.047
1.5875	1.6000	1.5960	1.6125	1.9645	1.9705	1.9686	1.9764	0.45	0.50	0.55	1.404	0.050
1.5875	1.6000	1.5960	1.6125	1.9645	1.9705	1.9686	1.9764	0.55	0.60	0.65	1.511	0.052
1.5875	1.6000	1.5960	1.6125	1.9645	1.9705	1.9686	1.9764	0.65	0.70	0.75	1.683	0.062
1.5875	1.6000	1.5960	1.6125	1.9645	1.9705	1.9686	1.9764	0.75	0.80	0.85	1.915	0.078
1.5875	1.6000	1.5960	1.6125	1.9645	1.9705	1.9686	1.9764	0.85	0.90	0.95	1.935	0.111
1.6125	1.6250	1.6214	1.6375	1.9764	1.9824	1.9806	1.9883	-0.85	-0.80	-0.75	0.574	0.061
1.6125	1.6250	1.6214	1.6375	1.9764	1.9824	1.9806	1.9883	-0.75	-0.70	-0.65	0.617	0.045
1.6125	1.6250	1.6214	1.6375	1.9764	1.9824	1.9806	1.9883	-0.65	-0.60	-0.55	0.444	0.036
1.6125	1.6250	1.6214	1.6375	1.9764	1.9824	1.9806	1.9883	-0.55	-0.50	-0.45	0.381	0.029
1.6125	1.6250	1.6214	1.6375	1.9764	1.9824	1.9806	1.9883	-0.45	-0.40	-0.35	0.373	0.026
1.6125	1.6250	1.6214	1.6375	1.9764	1.9824	1.9806	1.9883	-0.35	-0.30	-0.25	0.352	0.023
1.6125	1.6250	1.6214	1.6375	1.9764	1.9824	1.9806	1.9883	-0.25	-0.20	-0.15	0.367	0.022
1.6125	1.6250	1.6214	1.6375	1.9764	1.9824	1.9806	1.9883	-0.15	-0.10	-0.05	0.455	0.027
1.6125	1.6250	1.6214	1.6375	1.9764	1.9824	1.9806	1.9883	-0.05	0.00	0.05	0.568	0.031
1.6125	1.6250	1.6214	1.6375	1.9764	1.9824	1.9806	1.9883	0.05	0.10	0.15	0.761	0.035
1.6125	1.6250	1.6214	1.6375	1.9764	1.9824	1.9806	1.9883	0.15	0.20	0.25	0.950	0.040
1.6125	1.6250	1.6214	1.6375	1.9764	1.9824	1.9806	1.9883	0.25	0.30	0.35	1.084	0.042
1.6125	1.6250	1.6214	1.6375	1.9764	1.9824	1.9806	1.9883	0.35	0.40	0.45	1.353	0.049
1.6125	1.6250	1.6214	1.6375	1.9764	1.9824	1.9806	1.9883	0.45	0.50	0.55	1.413	0.053
1.6125	1.6250	1.6214	1.6375	1.9764	1.9824	1.9806	1.9883	0.55	0.60	0.65	1.532	0.053
1.6125	1.6250	1.6214	1.6375	1.9764	1.9824	1.9806	1.9883	0.65	0.70	0.75	1.812	0.071
1.6125	1.6250	1.6214	1.6375	1.9764	1.9824	1.9806	1.9883	0.75	0.80	0.85	1.761	0.072
1.6125	1.6250	1.6214	1.6375	1.9764	1.9824	1.9806	1.9883	0.85	0.90	0.95	1.832	0.104
1.6375	1.6500	1.6468	1.6625	1.9883	1.9942	1.9926	2.0000	-0.85	-0.80	-0.75	0.697	0.081
1.6375	1.6500	1.6468	1.6625	1.9883	1.9942	1.9926	2.0000	-0.75	-0.70	-0.65	0.514	0.048
1.6375	1.6500	1.6468	1.6625	1.9883	1.9942	1.9926	2.0000	-0.65	-0.60	-0.55	0.470	0.041
1.6375	1.6500	1.6468	1.6625	1.9883	1.9942	1.9926	2.0000	-0.55	-0.50	-0.45	0.368	0.032
1.6375	1.6500	1.6468	1.6625	1.9883	1.9942	1.9926	2.0000	-0.45	-0.40	-0.35	0.280	0.026
1.6375	1.6500	1.6468	1.6625	1.9883	1.9942	1.9926	2.0000	-0.35	-0.30	-0.25	0.293	0.026
1.6375	1.6500	1.6468	1.6625	1.9883	1.9942	1.9926	2.0000	-0.25	-0.20	-0.15	0.334	0.025
1.6375	1.6500	1.6468	1.6625	1.9883	1.9942	1.9926	2.0000	-0.15	-0.10	-0.05	0.425	0.028
1.6375	1.6500	1.6468	1.6625	1.9883	1.9942	1.9926	2.0000	-0.05	0.00	0.05	0.470	0.035
1.6375	1.6500	1.6468	1.6625	1.9883	1.9942	1.9926	2.0000	0.05	0.10	0.15	0.650	0.036
1.6375	1.6500	1.6468	1.6625	1.9883	1.9942	1.9926	2.0000	0.15	0.20	0.25	0.926	0.044
1.6375	1.6500	1.6468	1.6625	1.9883	1.9942	1.9926	2.0000	0.25	0.30	0.35	1.063	0.047
1.6375	1.6500	1.6468	1.6625	1.9883	1.9942	1.9926	2.0000	0.35	0.40	0.45	1.231	0.053
1.6375	1.6500	1.6468	1.6625	1.9883	1.9942	1.9926	2.0000	0.45	0.50	0.55	1.417	0.058
1.6375	1.6500	1.6468	1.6625	1.9883	1.9942	1.9926	2.0000	0.55	0.60	0.65	1.494	0.058
1.6375	1.6500	1.6468	1.6625	1.9883	1.9942	1.9926	2.0000	0.65	0.70	0.75	1.704	0.072
1.6375	1.6500	1.6468	1.6625	1.9883	1.9942	1.9926	2.0000	0.75	0.80	0.85	1.737	0.075

1.6375	1.6500	1.6468	1.6625	1.9883	1.9942	1.9926	2.0000	0.85	0.90	0.95	1.905	0.116
1.6625	1.6750	1.6722	1.6875	2.0000	2.0059	2.0046	2.0117	-0.85	-0.80	-0.75	0.487	0.051
1.6625	1.6750	1.6722	1.6875	2.0000	2.0059	2.0046	2.0117	-0.75	-0.70	-0.65	0.530	0.040
1.6625	1.6750	1.6722	1.6875	2.0000	2.0059	2.0046	2.0117	-0.65	-0.60	-0.55	0.400	0.032
1.6625	1.6750	1.6722	1.6875	2.0000	2.0059	2.0046	2.0117	-0.55	-0.50	-0.45	0.313	0.025
1.6625	1.6750	1.6722	1.6875	2.0000	2.0059	2.0046	2.0117	-0.45	-0.40	-0.35	0.309	0.024
1.6625	1.6750	1.6722	1.6875	2.0000	2.0059	2.0046	2.0117	-0.35	-0.30	-0.25	0.266	0.019
1.6625	1.6750	1.6722	1.6875	2.0000	2.0059	2.0046	2.0117	-0.25	-0.20	-0.15	0.327	0.022
1.6625	1.6750	1.6722	1.6875	2.0000	2.0059	2.0046	2.0117	-0.15	-0.10	-0.05	0.402	0.023
1.6625	1.6750	1.6722	1.6875	2.0000	2.0059	2.0046	2.0117	-0.05	0.00	0.05	0.573	0.030
1.6625	1.6750	1.6722	1.6875	2.0000	2.0059	2.0046	2.0117	0.05	0.10	0.15	0.652	0.031
1.6625	1.6750	1.6722	1.6875	2.0000	2.0059	2.0046	2.0117	0.15	0.20	0.25	0.826	0.035
1.6625	1.6750	1.6722	1.6875	2.0000	2.0059	2.0046	2.0117	0.25	0.30	0.35	1.047	0.040
1.6625	1.6750	1.6722	1.6875	2.0000	2.0059	2.0046	2.0117	0.35	0.40	0.45	1.213	0.046
1.6625	1.6750	1.6722	1.6875	2.0000	2.0059	2.0046	2.0117	0.45	0.50	0.55	1.336	0.048
1.6625	1.6750	1.6722	1.6875	2.0000	2.0059	2.0046	2.0117	0.55	0.60	0.65	1.451	0.053
1.6625	1.6750	1.6722	1.6875	2.0000	2.0059	2.0046	2.0117	0.65	0.70	0.75	1.509	0.059
1.6625	1.6750	1.6722	1.6875	2.0000	2.0059	2.0046	2.0117	0.75	0.80	0.85	1.644	0.068
1.6625	1.6750	1.6722	1.6875	2.0000	2.0059	2.0046	2.0117	0.85	0.90	0.95	1.871	0.108
1.6875	1.7000	1.6976	1.7125	2.0117	2.0175	2.0164	2.0233	-0.85	-0.80	-0.75	0.573	0.041
1.6875	1.7000	1.6976	1.7125	2.0117	2.0175	2.0164	2.0233	-0.75	-0.70	-0.65	0.413	0.035
1.6875	1.7000	1.6976	1.7125	2.0117	2.0175	2.0164	2.0233	-0.65	-0.60	-0.55	0.373	0.033
1.6875	1.7000	1.6976	1.7125	2.0117	2.0175	2.0164	2.0233	-0.55	-0.50	-0.45	0.236	0.022
1.6875	1.7000	1.6976	1.7125	2.0117	2.0175	2.0164	2.0233	-0.45	-0.40	-0.35	0.252	0.022
1.6875	1.7000	1.6976	1.7125	2.0117	2.0175	2.0164	2.0233	-0.35	-0.30	-0.25	0.213	0.018
1.6875	1.7000	1.6976	1.7125	2.0117	2.0175	2.0164	2.0233	-0.25	-0.20	-0.15	0.250	0.019
1.6875	1.7000	1.6976	1.7125	2.0117	2.0175	2.0164	2.0233	-0.15	-0.10	-0.05	0.351	0.023
1.6875	1.7000	1.6976	1.7125	2.0117	2.0175	2.0164	2.0233	-0.05	0.00	0.05	0.456	0.028
1.6875	1.7000	1.6976	1.7125	2.0117	2.0175	2.0164	2.0233	0.05	0.10	0.15	0.612	0.030
1.6875	1.7000	1.6976	1.7125	2.0117	2.0175	2.0164	2.0233	0.15	0.20	0.25	0.792	0.036
1.6875	1.7000	1.6976	1.7125	2.0117	2.0175	2.0164	2.0233	0.25	0.30	0.35	0.955	0.039
1.6875	1.7000	1.6976	1.7125	2.0117	2.0175	2.0164	2.0233	0.35	0.40	0.45	1.211	0.049
1.6875	1.7000	1.6976	1.7125	2.0117	2.0175	2.0164	2.0233	0.45	0.50	0.55	1.314	0.048
1.6875	1.7000	1.6976	1.7125	2.0117	2.0175	2.0164	2.0233	0.55	0.60	0.65	1.439	0.054
1.6875	1.7000	1.6976	1.7125	2.0117	2.0175	2.0164	2.0233	0.65	0.70	0.75	1.583	0.064
1.6875	1.7000	1.6976	1.7125	2.0117	2.0175	2.0164	2.0233	0.75	0.80	0.85	1.738	0.071
1.6875	1.7000	1.6976	1.7125	2.0117	2.0175	2.0164	2.0233	0.85	0.90	0.95	1.818	0.103
1.7125	1.7250	1.7229	1.7375	2.0233	2.0291	2.0282	2.0349	-0.85	-0.80	-0.75	0.542	0.053
1.7125	1.7250	1.7229	1.7375	2.0233	2.0291	2.0282	2.0349	-0.75	-0.70	-0.65	0.483	0.043
1.7125	1.7250	1.7229	1.7375	2.0233	2.0291	2.0282	2.0349	-0.65	-0.60	-0.55	0.315	0.027
1.7125	1.7250	1.7229	1.7375	2.0233	2.0291	2.0282	2.0349	-0.55	-0.50	-0.45	0.210	0.022
1.7125	1.7250	1.7229	1.7375	2.0233	2.0291	2.0282	2.0349	-0.45	-0.40	-0.35	0.233	0.021
1.7125	1.7250	1.7229	1.7375	2.0233	2.0291	2.0282	2.0349	-0.35	-0.30	-0.25	0.179	0.016
1.7125	1.7250	1.7229	1.7375	2.0233	2.0291	2.0282	2.0349	-0.25	-0.20	-0.15	0.258	0.019
1.7125	1.7250	1.7229	1.7375	2.0233	2.0291	2.0282	2.0349	-0.15	-0.10	-0.05	0.318	0.021
1.7125	1.7250	1.7229	1.7375	2.0233	2.0291	2.0282	2.0349	-0.05	0.00	0.05	0.437	0.027
1.7125	1.7250	1.7229	1.7375	2.0233	2.0291	2.0282	2.0349	0.05	0.10	0.15	0.566	0.028
1.7125	1.7250	1.7229	1.7375	2.0233	2.0291	2.0282	2.0349	0.15	0.20	0.25	0.760	0.034
1.7125	1.7250	1.7229	1.7375	2.0233	2.0291	2.0282	2.0349	0.25	0.30	0.35	0.993	0.040
1.7125	1.7250	1.7229	1.7375	2.0233	2.0291	2.0282	2.0349	0.35	0.40	0.45	1.042	0.040
1.7125	1.7250	1.7229	1.7375	2.0233	2.0291	2.0282	2.0349	0.45	0.50	0.55	1.303	0.048
1.7125	1.7250	1.7229	1.7375	2.0233	2.0291	2.0282	2.0349	0.55	0.60	0.65	1.480	0.054
1.7125	1.7250	1.7229	1.7375	2.0233	2.0291	2.0282	2.0349	0.65	0.70	0.75	1.674	0.067
1.7125	1.7250	1.7229	1.7375	2.0233	2.0291	2.0282	2.0349	0.75	0.80	0.85	1.807	0.073
1.7125	1.7250	1.7229	1.7375	2.0233	2.0291	2.0282	2.0349	0.85	0.90	0.95	1.617	0.097
1.7375	1.7500	1.7482	1.7625	2.0349	2.0407	2.0398	2.0464	-0.85	-0.80	-0.75	0.529	0.055
1.7375	1.7500	1.7482	1.7625	2.0349	2.0407	2.0398	2.0464	-0.75	-0.70	-0.65	0.477	0.038
1.7375	1.7500	1.7482	1.7625	2.0349	2.0407	2.0398	2.0464	-0.65	-0.60	-0.55	0.314	0.029
1.7375	1.7500	1.7482	1.7625	2.0349	2.0407	2.0398	2.0464	-0.55	-0.50	-0.45	0.239	0.023
1.7375	1.7500	1.7482	1.7625	2.0349	2.0407	2.0398	2.0464	-0.45	-0.40	-0.35	0.166	0.018
1.7375	1.7500	1.7482	1.7625	2.0349	2.0407	2.0398	2.0464	-0.35	-0.30	-0.25	0.167	0.017
1.7375	1.7500	1.7482	1.7625	2.0349	2.0407	2.0398	2.0464	-0.25	-0.20	-0.15	0.243	0.019
1.7375	1.7500	1.7482	1.7625	2.0349	2.0407	2.0398	2.0464	-0.15	-0.10	-0.05	0.296	0.022
1.7375	1.7500	1.7482	1.7625	2.0349	2.0407	2.0398	2.0464	-0.05	0.00	0.05	0.377	0.026

1.7375	1.7500	1.7482	1.7625	2.0349	2.0407	2.0398	2.0464	0.05	0.10	0.15	0.572	0.029
1.7375	1.7500	1.7482	1.7625	2.0349	2.0407	2.0398	2.0464	0.15	0.20	0.25	0.745	0.033
1.7375	1.7500	1.7482	1.7625	2.0349	2.0407	2.0398	2.0464	0.25	0.30	0.35	1.005	0.041
1.7375	1.7500	1.7482	1.7625	2.0349	2.0407	2.0398	2.0464	0.35	0.40	0.45	1.116	0.047
1.7375	1.7500	1.7482	1.7625	2.0349	2.0407	2.0398	2.0464	0.45	0.50	0.55	1.295	0.047
1.7375	1.7500	1.7482	1.7625	2.0349	2.0407	2.0398	2.0464	0.55	0.60	0.65	1.497	0.056
1.7375	1.7500	1.7482	1.7625	2.0349	2.0407	2.0398	2.0464	0.65	0.70	0.75	1.610	0.065
1.7375	1.7500	1.7482	1.7625	2.0349	2.0407	2.0398	2.0464	0.75	0.80	0.85	1.693	0.071
1.7375	1.7500	1.7482	1.7625	2.0349	2.0407	2.0398	2.0464	0.85	0.90	0.95	1.917	0.108
1.7625	1.7750	1.7736	1.7875	2.0464	2.0521	2.0515	2.0578	-0.85	-0.80	-0.75	0.455	0.046
1.7625	1.7750	1.7736	1.7875	2.0464	2.0521	2.0515	2.0578	-0.75	-0.70	-0.65	0.358	0.030
1.7625	1.7750	1.7736	1.7875	2.0464	2.0521	2.0515	2.0578	-0.65	-0.60	-0.55	0.262	0.026
1.7625	1.7750	1.7736	1.7875	2.0464	2.0521	2.0515	2.0578	-0.55	-0.50	-0.45	0.155	0.022
1.7625	1.7750	1.7736	1.7875	2.0464	2.0521	2.0515	2.0578	-0.45	-0.40	-0.35	0.194	0.020
1.7625	1.7750	1.7736	1.7875	2.0464	2.0521	2.0515	2.0578	-0.35	-0.30	-0.25	0.170	0.015
1.7625	1.7750	1.7736	1.7875	2.0464	2.0521	2.0515	2.0578	-0.25	-0.20	-0.15	0.166	0.015
1.7625	1.7750	1.7736	1.7875	2.0464	2.0521	2.0515	2.0578	-0.15	-0.10	-0.05	0.296	0.022
1.7625	1.7750	1.7736	1.7875	2.0464	2.0521	2.0515	2.0578	-0.05	0.00	0.05	0.391	0.026
1.7625	1.7750	1.7736	1.7875	2.0464	2.0521	2.0515	2.0578	0.05	0.10	0.15	0.543	0.028
1.7625	1.7750	1.7736	1.7875	2.0464	2.0521	2.0515	2.0578	0.15	0.20	0.25	0.737	0.034
1.7625	1.7750	1.7736	1.7875	2.0464	2.0521	2.0515	2.0578	0.25	0.30	0.35	0.922	0.039
1.7625	1.7750	1.7736	1.7875	2.0464	2.0521	2.0515	2.0578	0.35	0.40	0.45	1.188	0.049
1.7625	1.7750	1.7736	1.7875	2.0464	2.0521	2.0515	2.0578	0.45	0.50	0.55	1.310	0.051
1.7625	1.7750	1.7736	1.7875	2.0464	2.0521	2.0515	2.0578	0.55	0.60	0.65	1.507	0.056
1.7625	1.7750	1.7736	1.7875	2.0464	2.0521	2.0515	2.0578	0.65	0.70	0.75	1.685	0.068
1.7625	1.7750	1.7736	1.7875	2.0464	2.0521	2.0515	2.0578	0.75	0.80	0.85	1.720	0.070
1.7625	1.7750	1.7736	1.7875	2.0464	2.0521	2.0515	2.0578	0.85	0.90	0.95	1.921	0.106
1.7875	1.8000	1.7989	1.8125	2.0578	2.0635	2.0630	2.0692	-0.85	-0.80	-0.75	0.351	0.045
1.7875	1.8000	1.7989	1.8125	2.0578	2.0635	2.0630	2.0692	-0.75	-0.70	-0.65	0.284	0.035
1.7875	1.8000	1.7989	1.8125	2.0578	2.0635	2.0630	2.0692	-0.65	-0.60	-0.55	0.217	0.025
1.7875	1.8000	1.7989	1.8125	2.0578	2.0635	2.0630	2.0692	-0.55	-0.50	-0.45	0.154	0.021
1.7875	1.8000	1.7989	1.8125	2.0578	2.0635	2.0630	2.0692	-0.45	-0.40	-0.35	0.100	0.013
1.7875	1.8000	1.7989	1.8125	2.0578	2.0635	2.0630	2.0692	-0.35	-0.30	-0.25	0.187	0.017
1.7875	1.8000	1.7989	1.8125	2.0578	2.0635	2.0630	2.0692	-0.25	-0.20	-0.15	0.184	0.017
1.7875	1.8000	1.7989	1.8125	2.0578	2.0635	2.0630	2.0692	-0.15	-0.10	-0.05	0.277	0.021
1.7875	1.8000	1.7989	1.8125	2.0578	2.0635	2.0630	2.0692	-0.05	0.00	0.05	0.381	0.027
1.7875	1.8000	1.7989	1.8125	2.0578	2.0635	2.0630	2.0692	0.05	0.10	0.15	0.549	0.029
1.7875	1.8000	1.7989	1.8125	2.0578	2.0635	2.0630	2.0692	0.15	0.20	0.25	0.679	0.035
1.7875	1.8000	1.7989	1.8125	2.0578	2.0635	2.0630	2.0692	0.25	0.30	0.35	0.824	0.038
1.7875	1.8000	1.7989	1.8125	2.0578	2.0635	2.0630	2.0692	0.35	0.40	0.45	0.996	0.046
1.7875	1.8000	1.7989	1.8125	2.0578	2.0635	2.0630	2.0692	0.45	0.50	0.55	1.185	0.048
1.7875	1.8000	1.7989	1.8125	2.0578	2.0635	2.0630	2.0692	0.55	0.60	0.65	1.424	0.059
1.7875	1.8000	1.7989	1.8125	2.0578	2.0635	2.0630	2.0692	0.65	0.70	0.75	1.599	0.069
1.7875	1.8000	1.7989	1.8125	2.0578	2.0635	2.0630	2.0692	0.75	0.80	0.85	1.664	0.074
1.7875	1.8000	1.7989	1.8125	2.0578	2.0635	2.0630	2.0692	0.85	0.90	0.95	1.919	0.115
1.8125	1.8250	1.8241	1.8375	2.0692	2.0749	2.0745	2.0805	-0.85	-0.80	-0.75	0.416	0.048
1.8125	1.8250	1.8241	1.8375	2.0692	2.0749	2.0745	2.0805	-0.75	-0.70	-0.65	0.343	0.032
1.8125	1.8250	1.8241	1.8375	2.0692	2.0749	2.0745	2.0805	-0.65	-0.60	-0.55	0.223	0.026
1.8125	1.8250	1.8241	1.8375	2.0692	2.0749	2.0745	2.0805	-0.55	-0.50	-0.45	0.175	0.019
1.8125	1.8250	1.8241	1.8375	2.0692	2.0749	2.0745	2.0805	-0.45	-0.40	-0.35	0.134	0.017
1.8125	1.8250	1.8241	1.8375	2.0692	2.0749	2.0745	2.0805	-0.35	-0.30	-0.25	0.131	0.015
1.8125	1.8250	1.8241	1.8375	2.0692	2.0749	2.0745	2.0805	-0.25	-0.20	-0.15	0.169	0.017
1.8125	1.8250	1.8241	1.8375	2.0692	2.0749	2.0745	2.0805	-0.15	-0.10	-0.05	0.268	0.021
1.8125	1.8250	1.8241	1.8375	2.0692	2.0749	2.0745	2.0805	-0.05	0.00	0.05	0.363	0.026
1.8125	1.8250	1.8241	1.8375	2.0692	2.0749	2.0745	2.0805	0.05	0.10	0.15	0.507	0.028
1.8125	1.8250	1.8241	1.8375	2.0692	2.0749	2.0745	2.0805	0.15	0.20	0.25	0.643	0.033
1.8125	1.8250	1.8241	1.8375	2.0692	2.0749	2.0745	2.0805	0.25	0.30	0.35	0.905	0.040
1.8125	1.8250	1.8241	1.8375	2.0692	2.0749	2.0745	2.0805	0.35	0.40	0.45	1.005	0.042
1.8125	1.8250	1.8241	1.8375	2.0692	2.0749	2.0745	2.0805	0.45	0.50	0.55	1.205	0.047
1.8125	1.8250	1.8241	1.8375	2.0692	2.0749	2.0745	2.0805	0.55	0.60	0.65	1.422	0.059
1.8125	1.8250	1.8241	1.8375	2.0692	2.0749	2.0745	2.0805	0.65	0.70	0.75	1.643	0.064
1.8125	1.8250	1.8241	1.8375	2.0692	2.0749	2.0745	2.0805	0.75	0.80	0.85	1.640	0.069
1.8125	1.8250	1.8241	1.8375	2.0692	2.0749	2.0745	2.0805	0.85	0.90	0.95	1.868	0.109
1.8375	1.8500	1.8494	1.8625	2.0805	2.0861	2.0859	2.0917	-0.85	-0.80	-0.75	0.388	0.046

1.8375	1.8500	1.8494	1.8625	2.0805	2.0861	2.0859	2.0917	-0.75	-0.70	-0.65	0.284	0.029
1.8375	1.8500	1.8494	1.8625	2.0805	2.0861	2.0859	2.0917	-0.65	-0.60	-0.55	0.254	0.024
1.8375	1.8500	1.8494	1.8625	2.0805	2.0861	2.0859	2.0917	-0.55	-0.50	-0.45	0.167	0.018
1.8375	1.8500	1.8494	1.8625	2.0805	2.0861	2.0859	2.0917	-0.45	-0.40	-0.35	0.146	0.016
1.8375	1.8500	1.8494	1.8625	2.0805	2.0861	2.0859	2.0917	-0.35	-0.30	-0.25	0.168	0.015
1.8375	1.8500	1.8494	1.8625	2.0805	2.0861	2.0859	2.0917	-0.25	-0.20	-0.15	0.182	0.017
1.8375	1.8500	1.8494	1.8625	2.0805	2.0861	2.0859	2.0917	-0.15	-0.10	-0.05	0.246	0.019
1.8375	1.8500	1.8494	1.8625	2.0805	2.0861	2.0859	2.0917	-0.05	0.00	0.05	0.326	0.023
1.8375	1.8500	1.8494	1.8625	2.0805	2.0861	2.0859	2.0917	0.05	0.10	0.15	0.491	0.026
1.8375	1.8500	1.8494	1.8625	2.0805	2.0861	2.0859	2.0917	0.15	0.20	0.25	0.602	0.031
1.8375	1.8500	1.8494	1.8625	2.0805	2.0861	2.0859	2.0917	0.25	0.30	0.35	0.732	0.034
1.8375	1.8500	1.8494	1.8625	2.0805	2.0861	2.0859	2.0917	0.35	0.40	0.45	0.930	0.042
1.8375	1.8500	1.8494	1.8625	2.0805	2.0861	2.0859	2.0917	0.45	0.50	0.55	1.220	0.045
1.8375	1.8500	1.8494	1.8625	2.0805	2.0861	2.0859	2.0917	0.55	0.60	0.65	1.391	0.058
1.8375	1.8500	1.8494	1.8625	2.0805	2.0861	2.0859	2.0917	0.65	0.70	0.75	1.690	0.070
1.8375	1.8500	1.8494	1.8625	2.0805	2.0861	2.0859	2.0917	0.75	0.80	0.85	1.670	0.066
1.8375	1.8500	1.8494	1.8625	2.0805	2.0861	2.0859	2.0917	0.85	0.90	0.95	1.925	0.119
1.8625	1.8750	1.8746	1.8875	2.0917	2.0973	2.0972	2.1029	-0.85	-0.80	-0.75	0.353	0.052
1.8625	1.8750	1.8746	1.8875	2.0917	2.0973	2.0972	2.1029	-0.75	-0.70	-0.65	0.302	0.059
1.8625	1.8750	1.8746	1.8875	2.0917	2.0973	2.0972	2.1029	-0.65	-0.60	-0.55	0.238	0.029
1.8625	1.8750	1.8746	1.8875	2.0917	2.0973	2.0972	2.1029	-0.55	-0.50	-0.45	0.146	0.021
1.8625	1.8750	1.8746	1.8875	2.0917	2.0973	2.0972	2.1029	-0.45	-0.40	-0.35	0.183	0.023
1.8625	1.8750	1.8746	1.8875	2.0917	2.0973	2.0972	2.1029	-0.35	-0.30	-0.25	0.130	0.018
1.8625	1.8750	1.8746	1.8875	2.0917	2.0973	2.0972	2.1029	-0.25	-0.20	-0.15	0.138	0.018
1.8625	1.8750	1.8746	1.8875	2.0917	2.0973	2.0972	2.1029	-0.15	-0.10	-0.05	0.224	0.025
1.8625	1.8750	1.8746	1.8875	2.0917	2.0973	2.0972	2.1029	-0.05	0.00	0.05	0.341	0.032
1.8625	1.8750	1.8746	1.8875	2.0917	2.0973	2.0972	2.1029	0.05	0.10	0.15	0.436	0.031
1.8625	1.8750	1.8746	1.8875	2.0917	2.0973	2.0972	2.1029	0.15	0.20	0.25	0.531	0.035
1.8625	1.8750	1.8746	1.8875	2.0917	2.0973	2.0972	2.1029	0.25	0.30	0.35	0.725	0.044
1.8625	1.8750	1.8746	1.8875	2.0917	2.0973	2.0972	2.1029	0.35	0.40	0.45	0.958	0.056
1.8625	1.8750	1.8746	1.8875	2.0917	2.0973	2.0972	2.1029	0.45	0.50	0.55	1.151	0.059
1.8625	1.8750	1.8746	1.8875	2.0917	2.0973	2.0972	2.1029	0.55	0.60	0.65	1.456	0.078
1.8625	1.8750	1.8746	1.8875	2.0917	2.0973	2.0972	2.1029	0.65	0.70	0.75	1.675	0.090
1.8625	1.8750	1.8746	1.8875	2.0917	2.0973	2.0972	2.1029	0.75	0.80	0.85	1.770	0.095
1.8625	1.8750	1.8746	1.8875	2.0917	2.0973	2.0972	2.1029	0.85	0.90	0.95	1.766	0.131
1.8875	1.9000	1.8998	1.9125	2.1029	2.1085	2.1084	2.1141	-0.85	-0.80	-0.75	0.364	0.045
1.8875	1.9000	1.8998	1.9125	2.1029	2.1085	2.1084	2.1141	-0.75	-0.70	-0.65	0.287	0.027
1.8875	1.9000	1.8998	1.9125	2.1029	2.1085	2.1084	2.1141	-0.65	-0.60	-0.55	0.190	0.024
1.8875	1.9000	1.8998	1.9125	2.1029	2.1085	2.1084	2.1141	-0.55	-0.50	-0.45	0.167	0.020
1.8875	1.9000	1.8998	1.9125	2.1029	2.1085	2.1084	2.1141	-0.45	-0.40	-0.35	0.169	0.019
1.8875	1.9000	1.8998	1.9125	2.1029	2.1085	2.1084	2.1141	-0.35	-0.30	-0.25	0.148	0.015
1.8875	1.9000	1.8998	1.9125	2.1029	2.1085	2.1084	2.1141	-0.25	-0.20	-0.15	0.170	0.016
1.8875	1.9000	1.8998	1.9125	2.1029	2.1085	2.1084	2.1141	-0.15	-0.10	-0.05	0.226	0.019
1.8875	1.9000	1.8998	1.9125	2.1029	2.1085	2.1084	2.1141	-0.05	0.00	0.05	0.260	0.022
1.8875	1.9000	1.8998	1.9125	2.1029	2.1085	2.1084	2.1141	0.05	0.10	0.15	0.450	0.026
1.8875	1.9000	1.8998	1.9125	2.1029	2.1085	2.1084	2.1141	0.15	0.20	0.25	0.565	0.031
1.8875	1.9000	1.8998	1.9125	2.1029	2.1085	2.1084	2.1141	0.25	0.30	0.35	0.718	0.035
1.8875	1.9000	1.8998	1.9125	2.1029	2.1085	2.1084	2.1141	0.35	0.40	0.45	0.866	0.041
1.8875	1.9000	1.8998	1.9125	2.1029	2.1085	2.1084	2.1141	0.45	0.50	0.55	1.095	0.047
1.8875	1.9000	1.8998	1.9125	2.1029	2.1085	2.1084	2.1141	0.55	0.60	0.65	1.325	0.059
1.8875	1.9000	1.8998	1.9125	2.1029	2.1085	2.1084	2.1141	0.65	0.70	0.75	1.590	0.070
1.8875	1.9000	1.8998	1.9125	2.1029	2.1085	2.1084	2.1141	0.75	0.80	0.85	1.739	0.074
1.8875	1.9000	1.8998	1.9125	2.1029	2.1085	2.1084	2.1141	0.85	0.90	0.95	1.777	0.108
1.9125	1.9250	1.9251	1.9375	2.1141	2.1196	2.1196	2.1251	-0.85	-0.80	-0.75	0.351	0.042
1.9125	1.9250	1.9251	1.9375	2.1141	2.1196	2.1196	2.1251	-0.75	-0.70	-0.65	0.297	0.030
1.9125	1.9250	1.9251	1.9375	2.1141	2.1196	2.1196	2.1251	-0.65	-0.60	-0.55	0.252	0.023
1.9125	1.9250	1.9251	1.9375	2.1141	2.1196	2.1196	2.1251	-0.55	-0.50	-0.45	0.157	0.019
1.9125	1.9250	1.9251	1.9375	2.1141	2.1196	2.1196	2.1251	-0.45	-0.40	-0.35	0.138	0.017
1.9125	1.9250	1.9251	1.9375	2.1141	2.1196	2.1196	2.1251	-0.35	-0.30	-0.25	0.147	0.015
1.9125	1.9250	1.9251	1.9375	2.1141	2.1196	2.1196	2.1251	-0.25	-0.20	-0.15	0.168	0.016
1.9125	1.9250	1.9251	1.9375	2.1141	2.1196	2.1196	2.1251	-0.15	-0.10	-0.05	0.228	0.019
1.9125	1.9250	1.9251	1.9375	2.1141	2.1196	2.1196	2.1251	-0.05	0.00	0.05	0.266	0.023
1.9125	1.9250	1.9251	1.9375	2.1141	2.1196	2.1196	2.1251	0.05	0.10	0.15	0.415	0.024
1.9125	1.9250	1.9251	1.9375	2.1141	2.1196	2.1196	2.1251	0.15	0.20	0.25	0.570	0.031

1.9125	1.9250	1.9251	1.9375	2.1141	2.1196	2.1196	2.1251	0.25	0.30	0.35	0.736	0.036
1.9125	1.9250	1.9251	1.9375	2.1141	2.1196	2.1196	2.1251	0.35	0.40	0.45	0.895	0.041
1.9125	1.9250	1.9251	1.9375	2.1141	2.1196	2.1196	2.1251	0.45	0.50	0.55	1.075	0.044
1.9125	1.9250	1.9251	1.9375	2.1141	2.1196	2.1196	2.1251	0.55	0.60	0.65	1.238	0.058
1.9125	1.9250	1.9251	1.9375	2.1141	2.1196	2.1196	2.1251	0.65	0.70	0.75	1.615	0.069
1.9125	1.9250	1.9251	1.9375	2.1141	2.1196	2.1196	2.1251	0.75	0.80	0.85	1.747	0.070
1.9125	1.9250	1.9251	1.9375	2.1141	2.1196	2.1196	2.1251	0.85	0.90	0.95	1.628	0.098
1.9375	1.9500	1.9502	1.9625	2.1251	2.1306	2.1307	2.1361	-0.85	-0.80	-0.75	0.357	0.040
1.9375	1.9500	1.9502	1.9625	2.1251	2.1306	2.1307	2.1361	-0.75	-0.70	-0.65	0.296	0.034
1.9375	1.9500	1.9502	1.9625	2.1251	2.1306	2.1307	2.1361	-0.65	-0.60	-0.55	0.303	0.025
1.9375	1.9500	1.9502	1.9625	2.1251	2.1306	2.1307	2.1361	-0.55	-0.50	-0.45	0.166	0.017
1.9375	1.9500	1.9502	1.9625	2.1251	2.1306	2.1307	2.1361	-0.45	-0.40	-0.35	0.151	0.018
1.9375	1.9500	1.9502	1.9625	2.1251	2.1306	2.1307	2.1361	-0.35	-0.30	-0.25	0.146	0.015
1.9375	1.9500	1.9502	1.9625	2.1251	2.1306	2.1307	2.1361	-0.25	-0.20	-0.15	0.168	0.017
1.9375	1.9500	1.9502	1.9625	2.1251	2.1306	2.1307	2.1361	-0.15	-0.10	-0.05	0.223	0.020
1.9375	1.9500	1.9502	1.9625	2.1251	2.1306	2.1307	2.1361	-0.05	0.00	0.05	0.302	0.023
1.9375	1.9500	1.9502	1.9625	2.1251	2.1306	2.1307	2.1361	0.05	0.10	0.15	0.394	0.023
1.9375	1.9500	1.9502	1.9625	2.1251	2.1306	2.1307	2.1361	0.15	0.20	0.25	0.511	0.027
1.9375	1.9500	1.9502	1.9625	2.1251	2.1306	2.1307	2.1361	0.25	0.30	0.35	0.627	0.031
1.9375	1.9500	1.9502	1.9625	2.1251	2.1306	2.1307	2.1361	0.35	0.40	0.45	0.781	0.037
1.9375	1.9500	1.9502	1.9625	2.1251	2.1306	2.1307	2.1361	0.45	0.50	0.55	1.105	0.044
1.9375	1.9500	1.9502	1.9625	2.1251	2.1306	2.1307	2.1361	0.55	0.60	0.65	1.302	0.055
1.9375	1.9500	1.9502	1.9625	2.1251	2.1306	2.1307	2.1361	0.65	0.70	0.75	1.510	0.066
1.9375	1.9500	1.9502	1.9625	2.1251	2.1306	2.1307	2.1361	0.75	0.80	0.85	1.674	0.069
1.9375	1.9500	1.9502	1.9625	2.1251	2.1306	2.1307	2.1361	0.85	0.90	0.95	1.633	0.098
1.9625	1.9750	1.9754	1.9875	2.1361	2.1416	2.1418	2.1471	-0.85	-0.80	-0.75	0.348	0.040
1.9625	1.9750	1.9754	1.9875	2.1361	2.1416	2.1418	2.1471	-0.75	-0.70	-0.65	0.290	0.027
1.9625	1.9750	1.9754	1.9875	2.1361	2.1416	2.1418	2.1471	-0.65	-0.60	-0.55	0.252	0.023
1.9625	1.9750	1.9754	1.9875	2.1361	2.1416	2.1418	2.1471	-0.55	-0.50	-0.45	0.166	0.019
1.9625	1.9750	1.9754	1.9875	2.1361	2.1416	2.1418	2.1471	-0.45	-0.40	-0.35	0.169	0.018
1.9625	1.9750	1.9754	1.9875	2.1361	2.1416	2.1418	2.1471	-0.35	-0.30	-0.25	0.179	0.015
1.9625	1.9750	1.9754	1.9875	2.1361	2.1416	2.1418	2.1471	-0.25	-0.20	-0.15	0.171	0.017
1.9625	1.9750	1.9754	1.9875	2.1361	2.1416	2.1418	2.1471	-0.15	-0.10	-0.05	0.185	0.017
1.9625	1.9750	1.9754	1.9875	2.1361	2.1416	2.1418	2.1471	-0.05	0.00	0.05	0.225	0.020
1.9625	1.9750	1.9754	1.9875	2.1361	2.1416	2.1418	2.1471	0.05	0.10	0.15	0.297	0.020
1.9625	1.9750	1.9754	1.9875	2.1361	2.1416	2.1418	2.1471	0.15	0.20	0.25	0.472	0.026
1.9625	1.9750	1.9754	1.9875	2.1361	2.1416	2.1418	2.1471	0.25	0.30	0.35	0.650	0.032
1.9625	1.9750	1.9754	1.9875	2.1361	2.1416	2.1418	2.1471	0.35	0.40	0.45	0.793	0.036
1.9625	1.9750	1.9754	1.9875	2.1361	2.1416	2.1418	2.1471	0.45	0.50	0.55	1.014	0.043
1.9625	1.9750	1.9754	1.9875	2.1361	2.1416	2.1418	2.1471	0.55	0.60	0.65	1.163	0.055
1.9625	1.9750	1.9754	1.9875	2.1361	2.1416	2.1418	2.1471	0.65	0.70	0.75	1.528	0.066
1.9625	1.9750	1.9754	1.9875	2.1361	2.1416	2.1418	2.1471	0.75	0.80	0.85	1.568	0.067
1.9625	1.9750	1.9754	1.9875	2.1361	2.1416	2.1418	2.1471	0.85	0.90	0.95	1.805	0.101
1.9875	2.0000	2.0006	2.0125	2.1471	2.1525	2.1528	2.1580	-0.85	-0.80	-0.75	0.323	0.044
1.9875	2.0000	2.0006	2.0125	2.1471	2.1525	2.1528	2.1580	-0.75	-0.70	-0.65	0.325	0.033
1.9875	2.0000	2.0006	2.0125	2.1471	2.1525	2.1528	2.1580	-0.65	-0.60	-0.55	0.237	0.023
1.9875	2.0000	2.0006	2.0125	2.1471	2.1525	2.1528	2.1580	-0.55	-0.50	-0.45	0.142	0.017
1.9875	2.0000	2.0006	2.0125	2.1471	2.1525	2.1528	2.1580	-0.45	-0.40	-0.35	0.155	0.017
1.9875	2.0000	2.0006	2.0125	2.1471	2.1525	2.1528	2.1580	-0.35	-0.30	-0.25	0.139	0.014
1.9875	2.0000	2.0006	2.0125	2.1471	2.1525	2.1528	2.1580	-0.25	-0.20	-0.15	0.153	0.015
1.9875	2.0000	2.0006	2.0125	2.1471	2.1525	2.1528	2.1580	-0.15	-0.10	-0.05	0.194	0.018
1.9875	2.0000	2.0006	2.0125	2.1471	2.1525	2.1528	2.1580	-0.05	0.00	0.05	0.242	0.020
1.9875	2.0000	2.0006	2.0125	2.1471	2.1525	2.1528	2.1580	0.05	0.10	0.15	0.322	0.021
1.9875	2.0000	2.0006	2.0125	2.1471	2.1525	2.1528	2.1580	0.15	0.20	0.25	0.433	0.025
1.9875	2.0000	2.0006	2.0125	2.1471	2.1525	2.1528	2.1580	0.25	0.30	0.35	0.542	0.028
1.9875	2.0000	2.0006	2.0125	2.1471	2.1525	2.1528	2.1580	0.35	0.40	0.45	0.745	0.035
1.9875	2.0000	2.0006	2.0125	2.1471	2.1525	2.1528	2.1580	0.45	0.50	0.55	1.021	0.045
1.9875	2.0000	2.0006	2.0125	2.1471	2.1525	2.1528	2.1580	0.55	0.60	0.65	1.207	0.054
1.9875	2.0000	2.0006	2.0125	2.1471	2.1525	2.1528	2.1580	0.65	0.70	0.75	1.462	0.066
1.9875	2.0000	2.0006	2.0125	2.1471	2.1525	2.1528	2.1580	0.75	0.80	0.85	1.570	0.070
1.9875	2.0000	2.0006	2.0125	2.1471	2.1525	2.1528	2.1580	0.85	0.90	0.95	1.789	0.102
2.0125	2.0250	2.0257	2.0375	2.1580	2.1634	2.1637	2.1688	-0.85	-0.80	-0.75	0.287	0.036
2.0125	2.0250	2.0257	2.0375	2.1580	2.1634	2.1637	2.1688	-0.75	-0.70	-0.65	0.276	0.028
2.0125	2.0250	2.0257	2.0375	2.1580	2.1634	2.1637	2.1688	-0.65	-0.60	-0.55	0.287	0.024

2.0125	2.0250	2.0257	2.0375	2.1580	2.1634	2.1637	2.1688	-0.55	-0.50	-0.45	0.140	0.018
2.0125	2.0250	2.0257	2.0375	2.1580	2.1634	2.1637	2.1688	-0.45	-0.40	-0.35	0.165	0.018
2.0125	2.0250	2.0257	2.0375	2.1580	2.1634	2.1637	2.1688	-0.35	-0.30	-0.25	0.112	0.015
2.0125	2.0250	2.0257	2.0375	2.1580	2.1634	2.1637	2.1688	-0.25	-0.20	-0.15	0.162	0.016
2.0125	2.0250	2.0257	2.0375	2.1580	2.1634	2.1637	2.1688	-0.15	-0.10	-0.05	0.185	0.017
2.0125	2.0250	2.0257	2.0375	2.1580	2.1634	2.1637	2.1688	-0.05	0.00	0.05	0.190	0.018
2.0125	2.0250	2.0257	2.0375	2.1580	2.1634	2.1637	2.1688	0.05	0.10	0.15	0.264	0.020
2.0125	2.0250	2.0257	2.0375	2.1580	2.1634	2.1637	2.1688	0.15	0.20	0.25	0.436	0.025
2.0125	2.0250	2.0257	2.0375	2.1580	2.1634	2.1637	2.1688	0.25	0.30	0.35	0.571	0.029
2.0125	2.0250	2.0257	2.0375	2.1580	2.1634	2.1637	2.1688	0.35	0.40	0.45	0.755	0.035
2.0125	2.0250	2.0257	2.0375	2.1580	2.1634	2.1637	2.1688	0.45	0.50	0.55	0.881	0.041
2.0125	2.0250	2.0257	2.0375	2.1580	2.1634	2.1637	2.1688	0.55	0.60	0.65	1.249	0.054
2.0125	2.0250	2.0257	2.0375	2.1580	2.1634	2.1637	2.1688	0.65	0.70	0.75	1.592	0.071
2.0125	2.0250	2.0257	2.0375	2.1580	2.1634	2.1637	2.1688	0.75	0.80	0.85	1.654	0.073
2.0125	2.0250	2.0257	2.0375	2.1580	2.1634	2.1637	2.1688	0.85	0.90	0.95	1.761	0.105
2.0375	2.0500	2.0508	2.0625	2.1688	2.1742	2.1746	2.1796	-0.85	-0.80	-0.75	0.239	0.029
2.0375	2.0500	2.0508	2.0625	2.1688	2.1742	2.1746	2.1796	-0.75	-0.70	-0.65	0.249	0.028
2.0375	2.0500	2.0508	2.0625	2.1688	2.1742	2.1746	2.1796	-0.65	-0.60	-0.55	0.222	0.024
2.0375	2.0500	2.0508	2.0625	2.1688	2.1742	2.1746	2.1796	-0.55	-0.50	-0.45	0.174	0.022
2.0375	2.0500	2.0508	2.0625	2.1688	2.1742	2.1746	2.1796	-0.45	-0.40	-0.35	0.139	0.016
2.0375	2.0500	2.0508	2.0625	2.1688	2.1742	2.1746	2.1796	-0.35	-0.30	-0.25	0.116	0.014
2.0375	2.0500	2.0508	2.0625	2.1688	2.1742	2.1746	2.1796	-0.25	-0.20	-0.15	0.136	0.016
2.0375	2.0500	2.0508	2.0625	2.1688	2.1742	2.1746	2.1796	-0.15	-0.10	-0.05	0.141	0.016
2.0375	2.0500	2.0508	2.0625	2.1688	2.1742	2.1746	2.1796	-0.05	0.00	0.05	0.189	0.019
2.0375	2.0500	2.0508	2.0625	2.1688	2.1742	2.1746	2.1796	0.05	0.10	0.15	0.321	0.023
2.0375	2.0500	2.0508	2.0625	2.1688	2.1742	2.1746	2.1796	0.15	0.20	0.25	0.358	0.023
2.0375	2.0500	2.0508	2.0625	2.1688	2.1742	2.1746	2.1796	0.25	0.30	0.35	0.473	0.028
2.0375	2.0500	2.0508	2.0625	2.1688	2.1742	2.1746	2.1796	0.35	0.40	0.45	0.687	0.034
2.0375	2.0500	2.0508	2.0625	2.1688	2.1742	2.1746	2.1796	0.45	0.50	0.55	0.893	0.040
2.0375	2.0500	2.0508	2.0625	2.1688	2.1742	2.1746	2.1796	0.55	0.60	0.65	1.138	0.052
2.0375	2.0500	2.0508	2.0625	2.1688	2.1742	2.1746	2.1796	0.65	0.70	0.75	1.459	0.068
2.0375	2.0500	2.0508	2.0625	2.1688	2.1742	2.1746	2.1796	0.75	0.80	0.85	1.600	0.073
2.0375	2.0500	2.0508	2.0625	2.1688	2.1742	2.1746	2.1796	0.85	0.90	0.95	1.665	0.109
2.0625	2.0750	2.0759	2.0875	2.1796	2.1850	2.1854	2.1903	-0.85	-0.80	-0.75	0.174	0.031
2.0625	2.0750	2.0759	2.0875	2.1796	2.1850	2.1854	2.1903	-0.75	-0.70	-0.65	0.218	0.025
2.0625	2.0750	2.0759	2.0875	2.1796	2.1850	2.1854	2.1903	-0.65	-0.60	-0.55	0.248	0.025
2.0625	2.0750	2.0759	2.0875	2.1796	2.1850	2.1854	2.1903	-0.55	-0.50	-0.45	0.128	0.018
2.0625	2.0750	2.0759	2.0875	2.1796	2.1850	2.1854	2.1903	-0.45	-0.40	-0.35	0.117	0.017
2.0625	2.0750	2.0759	2.0875	2.1796	2.1850	2.1854	2.1903	-0.35	-0.30	-0.25	0.117	0.015
2.0625	2.0750	2.0759	2.0875	2.1796	2.1850	2.1854	2.1903	-0.25	-0.20	-0.15	0.116	0.014
2.0625	2.0750	2.0759	2.0875	2.1796	2.1850	2.1854	2.1903	-0.15	-0.10	-0.05	0.130	0.016
2.0625	2.0750	2.0759	2.0875	2.1796	2.1850	2.1854	2.1903	-0.05	0.00	0.05	0.174	0.018
2.0625	2.0750	2.0759	2.0875	2.1796	2.1850	2.1854	2.1903	0.05	0.10	0.15	0.274	0.021
2.0625	2.0750	2.0759	2.0875	2.1796	2.1850	2.1854	2.1903	0.15	0.20	0.25	0.368	0.025
2.0625	2.0750	2.0759	2.0875	2.1796	2.1850	2.1854	2.1903	0.25	0.30	0.35	0.499	0.030
2.0625	2.0750	2.0759	2.0875	2.1796	2.1850	2.1854	2.1903	0.35	0.40	0.45	0.678	0.036
2.0625	2.0750	2.0759	2.0875	2.1796	2.1850	2.1854	2.1903	0.45	0.50	0.55	0.834	0.035
2.0625	2.0750	2.0759	2.0875	2.1796	2.1850	2.1854	2.1903	0.55	0.60	0.65	1.022	0.049
2.0625	2.0750	2.0759	2.0875	2.1796	2.1850	2.1854	2.1903	0.65	0.70	0.75	1.354	0.067
2.0625	2.0750	2.0759	2.0875	2.1796	2.1850	2.1854	2.1903	0.75	0.80	0.85	1.636	0.070
2.0625	2.0750	2.0759	2.0875	2.1796	2.1850	2.1854	2.1903	0.85	0.90	0.95	1.859	0.113
2.0875	2.1000	2.1013	2.1125	2.1903	2.1957	2.1962	2.2010	-0.85	-0.80	-0.75	0.322	0.042
2.0875	2.1000	2.1013	2.1125	2.1903	2.1957	2.1962	2.2010	-0.75	-0.70	-0.65	0.214	0.026
2.0875	2.1000	2.1013	2.1125	2.1903	2.1957	2.1962	2.2010	-0.65	-0.60	-0.55	0.168	0.022
2.0875	2.1000	2.1013	2.1125	2.1903	2.1957	2.1962	2.2010	-0.55	-0.50	-0.45	0.163	0.020
2.0875	2.1000	2.1013	2.1125	2.1903	2.1957	2.1962	2.2010	-0.45	-0.40	-0.35	0.160	0.017
2.0875	2.1000	2.1013	2.1125	2.1903	2.1957	2.1962	2.2010	-0.35	-0.30	-0.25	0.102	0.013
2.0875	2.1000	2.1013	2.1125	2.1903	2.1957	2.1962	2.2010	-0.25	-0.20	-0.15	0.134	0.014
2.0875	2.1000	2.1013	2.1125	2.1903	2.1957	2.1962	2.2010	-0.15	-0.10	-0.05	0.118	0.015
2.0875	2.1000	2.1013	2.1125	2.1903	2.1957	2.1962	2.2010	-0.05	0.00	0.05	0.178	0.017
2.0875	2.1000	2.1013	2.1125	2.1903	2.1957	2.1962	2.2010	0.05	0.10	0.15	0.239	0.020
2.0875	2.1000	2.1013	2.1125	2.1903	2.1957	2.1962	2.2010	0.15	0.20	0.25	0.322	0.022
2.0875	2.1000	2.1013	2.1125	2.1903	2.1957	2.1962	2.2010	0.25	0.30	0.35	0.463	0.027
2.0875	2.1000	2.1013	2.1125	2.1903	2.1957	2.1962	2.2010	0.35	0.40	0.45	0.585	0.032

2.0875	2.1000	2.1013	2.1125	2.1903	2.1957	2.1962	2.2010	0.45	0.50	0.55	0.823	0.037
2.0875	2.1000	2.1013	2.1125	2.1903	2.1957	2.1962	2.2010	0.55	0.60	0.65	1.039	0.049
2.0875	2.1000	2.1013	2.1125	2.1903	2.1957	2.1962	2.2010	0.65	0.70	0.75	1.362	0.065
2.0875	2.1000	2.1013	2.1125	2.1903	2.1957	2.1962	2.2010	0.75	0.80	0.85	1.581	0.069
2.0875	2.1000	2.1013	2.1125	2.1903	2.1957	2.1962	2.2010	0.85	0.90	0.95	1.693	0.101
2.1125	2.1250	2.1259	2.1375	2.2010	2.2064	2.2067	2.2117	-0.85	-0.80	-0.75	0.191	0.030
2.1125	2.1250	2.1259	2.1375	2.2010	2.2064	2.2067	2.2117	-0.75	-0.70	-0.65	0.204	0.023
2.1125	2.1250	2.1259	2.1375	2.2010	2.2064	2.2067	2.2117	-0.65	-0.60	-0.55	0.171	0.019
2.1125	2.1250	2.1259	2.1375	2.2010	2.2064	2.2067	2.2117	-0.55	-0.50	-0.45	0.154	0.022
2.1125	2.1250	2.1259	2.1375	2.2010	2.2064	2.2067	2.2117	-0.45	-0.40	-0.35	0.097	0.015
2.1125	2.1250	2.1259	2.1375	2.2010	2.2064	2.2067	2.2117	-0.35	-0.30	-0.25	0.132	0.015
2.1125	2.1250	2.1259	2.1375	2.2010	2.2064	2.2067	2.2117	-0.25	-0.20	-0.15	0.116	0.014
2.1125	2.1250	2.1259	2.1375	2.2010	2.2064	2.2067	2.2117	-0.15	-0.10	-0.05	0.115	0.017
2.1125	2.1250	2.1259	2.1375	2.2010	2.2064	2.2067	2.2117	-0.05	0.00	0.05	0.180	0.018
2.1125	2.1250	2.1259	2.1375	2.2010	2.2064	2.2067	2.2117	0.05	0.10	0.15	0.225	0.020
2.1125	2.1250	2.1259	2.1375	2.2010	2.2064	2.2067	2.2117	0.15	0.20	0.25	0.364	0.025
2.1125	2.1250	2.1259	2.1375	2.2010	2.2064	2.2067	2.2117	0.25	0.30	0.35	0.369	0.025
2.1125	2.1250	2.1259	2.1375	2.2010	2.2064	2.2067	2.2117	0.35	0.40	0.45	0.611	0.032
2.1125	2.1250	2.1259	2.1375	2.2010	2.2064	2.2067	2.2117	0.45	0.50	0.55	0.839	0.040
2.1125	2.1250	2.1259	2.1375	2.2010	2.2064	2.2067	2.2117	0.55	0.60	0.65	1.053	0.051
2.1125	2.1250	2.1259	2.1375	2.2010	2.2064	2.2067	2.2117	0.65	0.70	0.75	1.250	0.063
2.1125	2.1250	2.1259	2.1375	2.2010	2.2064	2.2067	2.2117	0.75	0.80	0.85	1.710	0.076
2.1125	2.1250	2.1259	2.1375	2.2010	2.2064	2.2067	2.2117	0.85	0.90	0.95	1.754	0.112
2.1375	2.1500	2.1513	2.1625	2.2117	2.2170	2.2175	2.2222	-0.85	-0.80	-0.75	0.230	0.029
2.1375	2.1500	2.1513	2.1625	2.2117	2.2170	2.2175	2.2222	-0.75	-0.70	-0.65	0.225	0.023
2.1375	2.1500	2.1513	2.1625	2.2117	2.2170	2.2175	2.2222	-0.65	-0.60	-0.55	0.129	0.016
2.1375	2.1500	2.1513	2.1625	2.2117	2.2170	2.2175	2.2222	-0.55	-0.50	-0.45	0.120	0.014
2.1375	2.1500	2.1513	2.1625	2.2117	2.2170	2.2175	2.2222	-0.45	-0.40	-0.35	0.121	0.015
2.1375	2.1500	2.1513	2.1625	2.2117	2.2170	2.2175	2.2222	-0.35	-0.30	-0.25	0.117	0.013
2.1375	2.1500	2.1513	2.1625	2.2117	2.2170	2.2175	2.2222	-0.25	-0.20	-0.15	0.114	0.014
2.1375	2.1500	2.1513	2.1625	2.2117	2.2170	2.2175	2.2222	-0.15	-0.10	-0.05	0.112	0.015
2.1375	2.1500	2.1513	2.1625	2.2117	2.2170	2.2175	2.2222	-0.05	0.00	0.05	0.138	0.016
2.1375	2.1500	2.1513	2.1625	2.2117	2.2170	2.2175	2.2222	0.05	0.10	0.15	0.166	0.017
2.1375	2.1500	2.1513	2.1625	2.2117	2.2170	2.2175	2.2222	0.15	0.20	0.25	0.306	0.022
2.1375	2.1500	2.1513	2.1625	2.2117	2.2170	2.2175	2.2222	0.25	0.30	0.35	0.384	0.024
2.1375	2.1500	2.1513	2.1625	2.2117	2.2170	2.2175	2.2222	0.35	0.40	0.45	0.533	0.029
2.1375	2.1500	2.1513	2.1625	2.2117	2.2170	2.2175	2.2222	0.45	0.50	0.55	0.778	0.036
2.1375	2.1500	2.1513	2.1625	2.2117	2.2170	2.2175	2.2222	0.55	0.60	0.65	0.958	0.047
2.1375	2.1500	2.1513	2.1625	2.2117	2.2170	2.2175	2.2222	0.65	0.70	0.75	1.421	0.065
2.1375	2.1500	2.1513	2.1625	2.2117	2.2170	2.2175	2.2222	0.75	0.80	0.85	1.589	0.071
2.1375	2.1500	2.1513	2.1625	2.2117	2.2170	2.2175	2.2222	0.85	0.90	0.95	1.664	0.104
2.1625	2.1750	2.1767	2.1875	2.2222	2.2275	2.2282	2.2328	-0.85	-0.80	-0.75	0.273	0.035
2.1625	2.1750	2.1767	2.1875	2.2222	2.2275	2.2282	2.2328	-0.75	-0.70	-0.65	0.221	0.029
2.1625	2.1750	2.1767	2.1875	2.2222	2.2275	2.2282	2.2328	-0.65	-0.60	-0.55	0.183	0.024
2.1625	2.1750	2.1767	2.1875	2.2222	2.2275	2.2282	2.2328	-0.55	-0.50	-0.45	0.132	0.024
2.1625	2.1750	2.1767	2.1875	2.2222	2.2275	2.2282	2.2328	-0.45	-0.40	-0.35	0.114	0.018
2.1625	2.1750	2.1767	2.1875	2.2222	2.2275	2.2282	2.2328	-0.35	-0.30	-0.25	0.118	0.016
2.1625	2.1750	2.1767	2.1875	2.2222	2.2275	2.2282	2.2328	-0.25	-0.20	-0.15	0.118	0.015
2.1625	2.1750	2.1767	2.1875	2.2222	2.2275	2.2282	2.2328	-0.15	-0.10	-0.05	0.143	0.019
2.1625	2.1750	2.1767	2.1875	2.2222	2.2275	2.2282	2.2328	-0.05	0.00	0.05	0.180	0.020
2.1625	2.1750	2.1767	2.1875	2.2222	2.2275	2.2282	2.2328	0.05	0.10	0.15	0.172	0.021
2.1625	2.1750	2.1767	2.1875	2.2222	2.2275	2.2282	2.2328	0.15	0.20	0.25	0.295	0.025
2.1625	2.1750	2.1767	2.1875	2.2222	2.2275	2.2282	2.2328	0.25	0.30	0.35	0.380	0.029
2.1625	2.1750	2.1767	2.1875	2.2222	2.2275	2.2282	2.2328	0.35	0.40	0.45	0.494	0.033
2.1625	2.1750	2.1767	2.1875	2.2222	2.2275	2.2282	2.2328	0.45	0.50	0.55	0.741	0.042
2.1625	2.1750	2.1767	2.1875	2.2222	2.2275	2.2282	2.2328	0.55	0.60	0.65	1.003	0.056
2.1625	2.1750	2.1767	2.1875	2.2222	2.2275	2.2282	2.2328	0.65	0.70	0.75	1.298	0.071
2.1625	2.1750	2.1767	2.1875	2.2222	2.2275	2.2282	2.2328	0.75	0.80	0.85	1.491	0.078
2.1625	2.1750	2.1767	2.1875	2.2222	2.2275	2.2282	2.2328	0.85	0.90	0.95	1.767	0.128
2.1875	2.2000	2.2020	2.2125	2.2328	2.2380	2.2389	2.2433	-0.85	-0.80	-0.75	0.246	0.034
2.1875	2.2000	2.2020	2.2125	2.2328	2.2380	2.2389	2.2433	-0.75	-0.70	-0.65	0.145	0.026
2.1875	2.2000	2.2020	2.2125	2.2328	2.2380	2.2389	2.2433	-0.65	-0.60	-0.55	0.129	0.019
2.1875	2.2000	2.2020	2.2125	2.2328	2.2380	2.2389	2.2433	-0.55	-0.50	-0.45	0.142	0.026
2.1875	2.2000	2.2020	2.2125	2.2328	2.2380	2.2389	2.2433	-0.45	-0.40	-0.35	0.101	0.016

2.1875	2.2000	2.2020	2.2125	2.2328	2.2380	2.2389	2.2433	-0.35	-0.30	-0.25	0.093	0.014
2.1875	2.2000	2.2020	2.2125	2.2328	2.2380	2.2389	2.2433	-0.25	-0.20	-0.15	0.105	0.016
2.1875	2.2000	2.2020	2.2125	2.2328	2.2380	2.2389	2.2433	-0.15	-0.10	-0.05	0.133	0.016
2.1875	2.2000	2.2020	2.2125	2.2328	2.2380	2.2389	2.2433	-0.05	0.00	0.05	0.161	0.017
2.1875	2.2000	2.2020	2.2125	2.2328	2.2380	2.2389	2.2433	0.05	0.10	0.15	0.152	0.019
2.1875	2.2000	2.2020	2.2125	2.2328	2.2380	2.2389	2.2433	0.15	0.20	0.25	0.273	0.024
2.1875	2.2000	2.2020	2.2125	2.2328	2.2380	2.2389	2.2433	0.25	0.30	0.35	0.385	0.029
2.1875	2.2000	2.2020	2.2125	2.2328	2.2380	2.2389	2.2433	0.35	0.40	0.45	0.486	0.029
2.1875	2.2000	2.2020	2.2125	2.2328	2.2380	2.2389	2.2433	0.45	0.50	0.55	0.659	0.040
2.1875	2.2000	2.2020	2.2125	2.2328	2.2380	2.2389	2.2433	0.55	0.60	0.65	0.968	0.051
2.1875	2.2000	2.2020	2.2125	2.2328	2.2380	2.2389	2.2433	0.65	0.70	0.75	1.279	0.067
2.1875	2.2000	2.2020	2.2125	2.2328	2.2380	2.2389	2.2433	0.75	0.80	0.85	1.680	0.083
2.1875	2.2000	2.2020	2.2125	2.2328	2.2380	2.2389	2.2433	0.85	0.90	0.95	1.617	0.110
2.2125	2.2250	2.2273	2.2375	2.2433	2.2485	2.2494	2.2537	-0.85	-0.80	-0.75	0.180	0.033
2.2125	2.2250	2.2273	2.2375	2.2433	2.2485	2.2494	2.2537	-0.75	-0.70	-0.65	0.185	0.014
2.2125	2.2250	2.2273	2.2375	2.2433	2.2485	2.2494	2.2537	-0.65	-0.60	-0.55	0.185	0.026
2.2125	2.2250	2.2273	2.2375	2.2433	2.2485	2.2494	2.2537	-0.55	-0.50	-0.45	0.152	0.021
2.2125	2.2250	2.2273	2.2375	2.2433	2.2485	2.2494	2.2537	-0.45	-0.40	-0.35	0.102	0.014
2.2125	2.2250	2.2273	2.2375	2.2433	2.2485	2.2494	2.2537	-0.35	-0.30	-0.25	0.111	0.014
2.2125	2.2250	2.2273	2.2375	2.2433	2.2485	2.2494	2.2537	-0.25	-0.20	-0.15	0.076	0.013
2.2125	2.2250	2.2273	2.2375	2.2433	2.2485	2.2494	2.2537	-0.15	-0.10	-0.05	0.106	0.014
2.2125	2.2250	2.2273	2.2375	2.2433	2.2485	2.2494	2.2537	-0.05	0.00	0.05	0.149	0.016
2.2125	2.2250	2.2273	2.2375	2.2433	2.2485	2.2494	2.2537	0.05	0.10	0.15	0.165	0.018
2.2125	2.2250	2.2273	2.2375	2.2433	2.2485	2.2494	2.2537	0.15	0.20	0.25	0.196	0.020
2.2125	2.2250	2.2273	2.2375	2.2433	2.2485	2.2494	2.2537	0.25	0.30	0.35	0.369	0.026
2.2125	2.2250	2.2273	2.2375	2.2433	2.2485	2.2494	2.2537	0.35	0.40	0.45	0.464	0.028
2.2125	2.2250	2.2273	2.2375	2.2433	2.2485	2.2494	2.2537	0.45	0.50	0.55	0.683	0.036
2.2125	2.2250	2.2273	2.2375	2.2433	2.2485	2.2494	2.2537	0.55	0.60	0.65	0.830	0.046
2.2125	2.2250	2.2273	2.2375	2.2433	2.2485	2.2494	2.2537	0.65	0.70	0.75	1.347	0.067
2.2125	2.2250	2.2273	2.2375	2.2433	2.2485	2.2494	2.2537	0.75	0.80	0.85	1.508	0.072
2.2125	2.2250	2.2273	2.2375	2.2433	2.2485	2.2494	2.2537	0.85	0.90	0.95	1.645	0.107
2.2375	2.2500	2.2525	2.2625	2.2537	2.2589	2.2599	2.2641	-0.85	-0.80	-0.75	0.131	0.026
2.2375	2.2500	2.2525	2.2625	2.2537	2.2589	2.2599	2.2641	-0.75	-0.70	-0.65	0.170	0.024
2.2375	2.2500	2.2525	2.2625	2.2537	2.2589	2.2599	2.2641	-0.65	-0.60	-0.55	0.183	0.023
2.2375	2.2500	2.2525	2.2625	2.2537	2.2589	2.2599	2.2641	-0.55	-0.50	-0.45	0.091	0.017
2.2375	2.2500	2.2525	2.2625	2.2537	2.2589	2.2599	2.2641	-0.45	-0.40	-0.35	0.094	0.013
2.2375	2.2500	2.2525	2.2625	2.2537	2.2589	2.2599	2.2641	-0.35	-0.30	-0.25	0.100	0.013
2.2375	2.2500	2.2525	2.2625	2.2537	2.2589	2.2599	2.2641	-0.25	-0.20	-0.15	0.091	0.013
2.2375	2.2500	2.2525	2.2625	2.2537	2.2589	2.2599	2.2641	-0.15	-0.10	-0.05	0.113	0.016
2.2375	2.2500	2.2525	2.2625	2.2537	2.2589	2.2599	2.2641	-0.05	0.00	0.05	0.131	0.015
2.2375	2.2500	2.2525	2.2625	2.2537	2.2589	2.2599	2.2641	0.05	0.10	0.15	0.175	0.019
2.2375	2.2500	2.2525	2.2625	2.2537	2.2589	2.2599	2.2641	0.15	0.20	0.25	0.207	0.020
2.2375	2.2500	2.2525	2.2625	2.2537	2.2589	2.2599	2.2641	0.25	0.30	0.35	0.320	0.025
2.2375	2.2500	2.2525	2.2625	2.2537	2.2589	2.2599	2.2641	0.35	0.40	0.45	0.398	0.027
2.2375	2.2500	2.2525	2.2625	2.2537	2.2589	2.2599	2.2641	0.45	0.50	0.55	0.559	0.033
2.2375	2.2500	2.2525	2.2625	2.2537	2.2589	2.2599	2.2641	0.55	0.60	0.65	0.858	0.051
2.2375	2.2500	2.2525	2.2625	2.2537	2.2589	2.2599	2.2641	0.65	0.70	0.75	1.272	0.060
2.2375	2.2500	2.2525	2.2625	2.2537	2.2589	2.2599	2.2641	0.75	0.80	0.85	1.633	0.075
2.2375	2.2500	2.2525	2.2625	2.2537	2.2589	2.2599	2.2641	0.85	0.90	0.95	1.620	0.115
2.2625	2.2750	2.2778	2.2875	2.2641	2.2692	2.2704	2.2744	-0.85	-0.80	-0.75	0.233	0.033
2.2625	2.2750	2.2778	2.2875	2.2641	2.2692	2.2704	2.2744	-0.75	-0.70	-0.65	0.160	0.024
2.2625	2.2750	2.2778	2.2875	2.2641	2.2692	2.2704	2.2744	-0.65	-0.60	-0.55	0.134	0.020
2.2625	2.2750	2.2778	2.2875	2.2641	2.2692	2.2704	2.2744	-0.55	-0.50	-0.45	0.136	0.018
2.2625	2.2750	2.2778	2.2875	2.2641	2.2692	2.2704	2.2744	-0.45	-0.40	-0.35	0.100	0.015
2.2625	2.2750	2.2778	2.2875	2.2641	2.2692	2.2704	2.2744	-0.35	-0.30	-0.25	0.111	0.014
2.2625	2.2750	2.2778	2.2875	2.2641	2.2692	2.2704	2.2744	-0.25	-0.20	-0.15	0.076	0.012
2.2625	2.2750	2.2778	2.2875	2.2641	2.2692	2.2704	2.2744	-0.15	-0.10	-0.05	0.070	0.012
2.2625	2.2750	2.2778	2.2875	2.2641	2.2692	2.2704	2.2744	-0.05	0.00	0.05	0.144	0.016
2.2625	2.2750	2.2778	2.2875	2.2641	2.2692	2.2704	2.2744	0.05	0.10	0.15	0.134	0.015
2.2625	2.2750	2.2778	2.2875	2.2641	2.2692	2.2704	2.2744	0.15	0.20	0.25	0.211	0.021
2.2625	2.2750	2.2778	2.2875	2.2641	2.2692	2.2704	2.2744	0.25	0.30	0.35	0.321	0.027
2.2625	2.2750	2.2778	2.2875	2.2641	2.2692	2.2704	2.2744	0.35	0.40	0.45	0.404	0.027
2.2625	2.2750	2.2778	2.2875	2.2641	2.2692	2.2704	2.2744	0.45	0.50	0.55	0.635	0.036
2.2625	2.2750	2.2778	2.2875	2.2641	2.2692	2.2704	2.2744	0.55	0.60	0.65	0.860	0.047

2.2625	2.2750	2.2778	2.2875	2.2641	2.2692	2.2704	2.2744	0.65	0.70	0.75	1.181	0.057
2.2625	2.2750	2.2778	2.2875	2.2641	2.2692	2.2704	2.2744	0.75	0.80	0.85	1.438	0.071
2.2625	2.2750	2.2778	2.2875	2.2641	2.2692	2.2704	2.2744	0.85	0.90	0.95	1.734	0.114
2.2875	2.3000	2.3030	2.3125	2.2744	2.2796	2.2808	2.2847	-0.85	-0.80	-0.75	0.237	0.033
2.2875	2.3000	2.3030	2.3125	2.2744	2.2796	2.2808	2.2847	-0.75	-0.70	-0.65	0.145	0.021
2.2875	2.3000	2.3030	2.3125	2.2744	2.2796	2.2808	2.2847	-0.65	-0.60	-0.55	0.123	0.019
2.2875	2.3000	2.3030	2.3125	2.2744	2.2796	2.2808	2.2847	-0.55	-0.50	-0.45	0.108	0.020
2.2875	2.3000	2.3030	2.3125	2.2744	2.2796	2.2808	2.2847	-0.45	-0.40	-0.35	0.131	0.019
2.2875	2.3000	2.3030	2.3125	2.2744	2.2796	2.2808	2.2847	-0.35	-0.30	-0.25	0.061	0.011
2.2875	2.3000	2.3030	2.3125	2.2744	2.2796	2.2808	2.2847	-0.25	-0.20	-0.15	0.114	0.014
2.2875	2.3000	2.3030	2.3125	2.2744	2.2796	2.2808	2.2847	-0.15	-0.10	-0.05	0.076	0.015
2.2875	2.3000	2.3030	2.3125	2.2744	2.2796	2.2808	2.2847	-0.05	0.00	0.05	0.088	0.014
2.2875	2.3000	2.3030	2.3125	2.2744	2.2796	2.2808	2.2847	0.05	0.10	0.15	0.131	0.017
2.2875	2.3000	2.3030	2.3125	2.2744	2.2796	2.2808	2.2847	0.15	0.20	0.25	0.158	0.021
2.2875	2.3000	2.3030	2.3125	2.2744	2.2796	2.2808	2.2847	0.25	0.30	0.35	0.263	0.024
2.2875	2.3000	2.3030	2.3125	2.2744	2.2796	2.2808	2.2847	0.35	0.40	0.45	0.409	0.028
2.2875	2.3000	2.3030	2.3125	2.2744	2.2796	2.2808	2.2847	0.45	0.50	0.55	0.534	0.035
2.2875	2.3000	2.3030	2.3125	2.2744	2.2796	2.2808	2.2847	0.55	0.60	0.65	0.753	0.049
2.2875	2.3000	2.3030	2.3125	2.2744	2.2796	2.2808	2.2847	0.65	0.70	0.75	1.185	0.061
2.2875	2.3000	2.3030	2.3125	2.2744	2.2796	2.2808	2.2847	0.75	0.80	0.85	1.610	0.086
2.2875	2.3000	2.3030	2.3125	2.2744	2.2796	2.2808	2.2847	0.85	0.90	0.95	1.788	0.121
2.3125	2.3250	2.3282	2.3375	2.2847	2.2898	2.2911	2.2949	-0.85	-0.80	-0.75	0.165	0.030
2.3125	2.3250	2.3282	2.3375	2.2847	2.2898	2.2911	2.2949	-0.75	-0.70	-0.65	0.144	0.026
2.3125	2.3250	2.3282	2.3375	2.2847	2.2898	2.2911	2.2949	-0.65	-0.60	-0.55	0.148	0.027
2.3125	2.3250	2.3282	2.3375	2.2847	2.2898	2.2911	2.2949	-0.55	-0.50	-0.45	0.106	0.021
2.3125	2.3250	2.3282	2.3375	2.2847	2.2898	2.2911	2.2949	-0.45	-0.40	-0.35	0.131	0.019
2.3125	2.3250	2.3282	2.3375	2.2847	2.2898	2.2911	2.2949	-0.35	-0.30	-0.25	0.107	0.015
2.3125	2.3250	2.3282	2.3375	2.2847	2.2898	2.2911	2.2949	-0.25	-0.20	-0.15	0.044	0.011
2.3125	2.3250	2.3282	2.3375	2.2847	2.2898	2.2911	2.2949	-0.15	-0.10	-0.05	0.073	0.015
2.3125	2.3250	2.3282	2.3375	2.2847	2.2898	2.2911	2.2949	-0.05	0.00	0.05	0.103	0.016
2.3125	2.3250	2.3282	2.3375	2.2847	2.2898	2.2911	2.2949	0.05	0.10	0.15	0.124	0.017
2.3125	2.3250	2.3282	2.3375	2.2847	2.2898	2.2911	2.2949	0.15	0.20	0.25	0.149	0.020
2.3125	2.3250	2.3282	2.3375	2.2847	2.2898	2.2911	2.2949	0.25	0.30	0.35	0.255	0.025
2.3125	2.3250	2.3282	2.3375	2.2847	2.2898	2.2911	2.2949	0.35	0.40	0.45	0.403	0.030
2.3125	2.3250	2.3282	2.3375	2.2847	2.2898	2.2911	2.2949	0.45	0.50	0.55	0.569	0.040
2.3125	2.3250	2.3282	2.3375	2.2847	2.2898	2.2911	2.2949	0.55	0.60	0.65	0.892	0.056
2.3125	2.3250	2.3282	2.3375	2.2847	2.2898	2.2911	2.2949	0.65	0.70	0.75	1.243	0.070
2.3125	2.3250	2.3282	2.3375	2.2847	2.2898	2.2911	2.2949	0.75	0.80	0.85	1.316	0.076
2.3125	2.3250	2.3282	2.3375	2.2847	2.2898	2.2911	2.2949	0.85	0.90	0.95	1.600	0.124
2.3375	2.3500	2.3534	2.3625	2.2949	2.3000	2.3014	2.3051	-0.85	-0.80	-0.75	0.146	0.027
2.3375	2.3500	2.3534	2.3625	2.2949	2.3000	2.3014	2.3051	-0.75	-0.70	-0.65	0.101	0.019
2.3375	2.3500	2.3534	2.3625	2.2949	2.3000	2.3014	2.3051	-0.65	-0.60	-0.55	0.109	0.022
2.3375	2.3500	2.3534	2.3625	2.2949	2.3000	2.3014	2.3051	-0.55	-0.50	-0.45	0.114	0.015
2.3375	2.3500	2.3534	2.3625	2.2949	2.3000	2.3014	2.3051	-0.45	-0.40	-0.35	0.102	0.019
2.3375	2.3500	2.3534	2.3625	2.2949	2.3000	2.3014	2.3051	-0.35	-0.30	-0.25	0.099	0.013
2.3375	2.3500	2.3534	2.3625	2.2949	2.3000	2.3014	2.3051	-0.25	-0.20	-0.15	0.092	0.012
2.3375	2.3500	2.3534	2.3625	2.2949	2.3000	2.3014	2.3051	-0.15	-0.10	-0.05	0.110	0.015
2.3375	2.3500	2.3534	2.3625	2.2949	2.3000	2.3014	2.3051	-0.05	0.00	0.05	0.088	0.014
2.3375	2.3500	2.3534	2.3625	2.2949	2.3000	2.3014	2.3051	0.05	0.10	0.15	0.149	0.020
2.3375	2.3500	2.3534	2.3625	2.2949	2.3000	2.3014	2.3051	0.15	0.20	0.25	0.178	0.020
2.3375	2.3500	2.3534	2.3625	2.2949	2.3000	2.3014	2.3051	0.25	0.30	0.35	0.259	0.027
2.3375	2.3500	2.3534	2.3625	2.2949	2.3000	2.3014	2.3051	0.35	0.40	0.45	0.382	0.029
2.3375	2.3500	2.3534	2.3625	2.2949	2.3000	2.3014	2.3051	0.45	0.50	0.55	0.580	0.042
2.3375	2.3500	2.3534	2.3625	2.2949	2.3000	2.3014	2.3051	0.55	0.60	0.65	0.725	0.050
2.3375	2.3500	2.3534	2.3625	2.2949	2.3000	2.3014	2.3051	0.65	0.70	0.75	1.087	0.066
2.3375	2.3500	2.3534	2.3625	2.2949	2.3000	2.3014	2.3051	0.75	0.80	0.85	1.672	0.087
2.3375	2.3500	2.3534	2.3625	2.2949	2.3000	2.3014	2.3051	0.85	0.90	0.95	1.665	0.141
2.3625	2.3750	2.3785	2.3875	2.3051	2.3102	2.3117	2.3153	-0.85	-0.80	-0.75	0.000	0.000
2.3625	2.3750	2.3785	2.3875	2.3051	2.3102	2.3117	2.3153	-0.75	-0.70	-0.65	0.000	0.000
2.3625	2.3750	2.3785	2.3875	2.3051	2.3102	2.3117	2.3153	-0.65	-0.60	-0.55	0.000	0.000
2.3625	2.3750	2.3785	2.3875	2.3051	2.3102	2.3117	2.3153	-0.55	-0.50	-0.45	0.000	0.000
2.3625	2.3750	2.3785	2.3875	2.3051	2.3102	2.3117	2.3153	-0.45	-0.40	-0.35	0.000	0.000
2.3625	2.3750	2.3785	2.3875	2.3051	2.3102	2.3117	2.3153	-0.35	-0.30	-0.25	0.000	0.000
2.3625	2.3750	2.3785	2.3875	2.3051	2.3102	2.3117	2.3153	-0.25	-0.20	-0.15	0.000	0.000

2.3626	2.3750	2.3785	2.3875	2.3051	2.3102	2.3117	2.3153	-0.15	-0.10	-0.05	0.000	0.000
2.3625	2.3750	2.3785	2.3875	2.3051	2.3102	2.3117	2.3153	-0.05	0.00	0.05	0.000	0.000
2.3625	2.3750	2.3785	2.3875	2.3051	2.3102	2.3117	2.3153	0.05	0.10	0.15	0.000	0.000
2.3625	2.3750	2.3785	2.3875	2.3051	2.3102	2.3117	2.3153	0.15	0.20	0.25	0.000	0.000
2.3625	2.3750	2.3785	2.3875	2.3051	2.3102	2.3117	2.3153	0.25	0.30	0.35	0.000	0.000
2.3625	2.3750	2.3785	2.3875	2.3051	2.3102	2.3117	2.3153	0.35	0.40	0.45	0.000	0.000
2.3625	2.3750	2.3785	2.3875	2.3051	2.3102	2.3117	2.3153	0.45	0.50	0.55	0.000	0.000
2.3625	2.3750	2.3785	2.3875	2.3051	2.3102	2.3117	2.3153	0.55	0.60	0.65	0.000	0.000
2.3625	2.3750	2.3785	2.3875	2.3051	2.3102	2.3117	2.3153	0.65	0.70	0.75	0.000	0.000
2.3625	2.3750	2.3785	2.3875	2.3051	2.3102	2.3117	2.3153	0.75	0.80	0.85	0.000	0.000
2.3625	2.3750	2.3785	2.3875	2.3051	2.3102	2.3117	2.3153	0.85	0.90	0.95	0.000	0.000
2.3875	2.4000	2.4050	2.4125	2.3153	2.3204	2.3224	2.3254	-0.85	-0.80	-0.75	0.000	0.000
2.3875	2.4000	2.4050	2.4125	2.3153	2.3204	2.3224	2.3254	-0.75	-0.70	-0.65	0.000	0.000
2.3875	2.4000	2.4050	2.4125	2.3153	2.3204	2.3224	2.3254	-0.65	-0.60	-0.55	0.000	0.000
2.3875	2.4000	2.4050	2.4125	2.3153	2.3204	2.3224	2.3254	-0.55	-0.50	-0.45	0.000	0.000
2.3875	2.4000	2.4050	2.4125	2.3153	2.3204	2.3224	2.3254	-0.45	-0.40	-0.35	0.000	0.000
2.3875	2.4000	2.4050	2.4125	2.3153	2.3204	2.3224	2.3254	-0.35	-0.30	-0.25	0.000	0.000
2.3875	2.4000	2.4050	2.4125	2.3153	2.3204	2.3224	2.3254	-0.25	-0.20	-0.15	0.000	0.000
2.3875	2.4000	2.4050	2.4125	2.3153	2.3204	2.3224	2.3254	-0.15	-0.10	-0.05	0.000	0.000
2.3875	2.4000	2.4050	2.4125	2.3153	2.3204	2.3224	2.3254	-0.05	0.00	0.05	0.000	0.000
2.3875	2.4000	2.4050	2.4125	2.3153	2.3204	2.3224	2.3254	0.05	0.10	0.15	0.000	0.000
2.3875	2.4000	2.4050	2.4125	2.3153	2.3204	2.3224	2.3254	0.15	0.20	0.25	0.000	0.000
2.3875	2.4000	2.4050	2.4125	2.3153	2.3204	2.3224	2.3254	0.25	0.30	0.35	0.000	0.000
2.3875	2.4000	2.4050	2.4125	2.3153	2.3204	2.3224	2.3254	0.35	0.40	0.45	0.000	0.000
2.3875	2.4000	2.4050	2.4125	2.3153	2.3204	2.3224	2.3254	0.45	0.50	0.55	0.000	0.000
2.3875	2.4000	2.4050	2.4125	2.3153	2.3204	2.3224	2.3254	0.55	0.60	0.65	0.000	0.000
2.3875	2.4000	2.4050	2.4125	2.3153	2.3204	2.3224	2.3254	0.65	0.70	0.75	0.000	0.000
2.3875	2.4000	2.4050	2.4125	2.3153	2.3204	2.3224	2.3254	0.75	0.80	0.85	0.000	0.000
2.3875	2.4000	2.4050	2.4125	2.3153	2.3204	2.3224	2.3254	0.85	0.90	0.95	0.000	0.000
2.4125	2.4250	2.4301	2.4375	2.3254	2.3304	2.3325	2.3355	-0.85	-0.80	-0.75	0.232	0.097
2.4125	2.4250	2.4301	2.4375	2.3254	2.3304	2.3325	2.3355	-0.75	-0.70	-0.65	0.107	0.031
2.4125	2.4250	2.4301	2.4375	2.3254	2.3304	2.3325	2.3355	-0.65	-0.60	-0.55	0.077	0.025
2.4125	2.4250	2.4301	2.4375	2.3254	2.3304	2.3325	2.3355	-0.55	-0.50	-0.45	0.103	0.020
2.4125	2.4250	2.4301	2.4375	2.3254	2.3304	2.3325	2.3355	-0.45	-0.40	-0.35	0.053	0.014
2.4125	2.4250	2.4301	2.4375	2.3254	2.3304	2.3325	2.3355	-0.35	-0.30	-0.25	0.078	0.019
2.4125	2.4250	2.4301	2.4375	2.3254	2.3304	2.3325	2.3355	-0.25	-0.20	-0.15	0.072	0.016
2.4125	2.4250	2.4301	2.4375	2.3254	2.3304	2.3325	2.3355	-0.15	-0.10	-0.05	0.060	0.023
2.4125	2.4250	2.4301	2.4375	2.3254	2.3304	2.3325	2.3355	-0.05	0.00	0.05	0.139	0.023
2.4125	2.4250	2.4301	2.4375	2.3254	2.3304	2.3325	2.3355	0.05	0.10	0.15	0.104	0.027
2.4125	2.4250	2.4301	2.4375	2.3254	2.3304	2.3325	2.3355	0.15	0.20	0.25	0.170	0.023
2.4125	2.4250	2.4301	2.4375	2.3254	2.3304	2.3325	2.3355	0.25	0.30	0.35	0.226	0.034
2.4125	2.4250	2.4301	2.4375	2.3254	2.3304	2.3325	2.3355	0.35	0.40	0.45	0.325	0.032
2.4125	2.4250	2.4301	2.4375	2.3254	2.3304	2.3325	2.3355	0.45	0.50	0.55	0.511	0.052
2.4125	2.4250	2.4301	2.4375	2.3254	2.3304	2.3325	2.3355	0.55	0.60	0.65	0.965	0.070
2.4125	2.4250	2.4301	2.4375	2.3254	2.3304	2.3325	2.3355	0.65	0.70	0.75	1.315	0.085
2.4125	2.4250	2.4301	2.4375	2.3254	2.3304	2.3325	2.3355	0.75	0.80	0.85	1.794	0.107
2.4125	2.4250	2.4301	2.4375	2.3254	2.3304	2.3325	2.3355	0.85	0.90	0.95	1.919	0.162
2.4375	2.4500	2.4552	2.4625	2.3355	2.3405	2.3426	2.3455	-0.85	-0.80	-0.75	0.171	0.015
2.4375	2.4500	2.4552	2.4625	2.3355	2.3405	2.3426	2.3455	-0.75	-0.70	-0.65	0.147	0.051
2.4375	2.4500	2.4552	2.4625	2.3355	2.3405	2.3426	2.3455	-0.65	-0.60	-0.55	0.102	0.019
2.4375	2.4500	2.4552	2.4625	2.3355	2.3405	2.3426	2.3455	-0.55	-0.50	-0.45	0.176	0.026
2.4375	2.4500	2.4552	2.4625	2.3355	2.3405	2.3426	2.3455	-0.45	-0.40	-0.35	0.091	0.017
2.4375	2.4500	2.4552	2.4625	2.3355	2.3405	2.3426	2.3455	-0.35	-0.30	-0.25	0.109	0.019
2.4375	2.4500	2.4552	2.4625	2.3355	2.3405	2.3426	2.3455	-0.25	-0.20	-0.15	0.061	0.013
2.4375	2.4500	2.4552	2.4625	2.3355	2.3405	2.3426	2.3455	-0.15	-0.10	-0.05	0.086	0.014
2.4375	2.4500	2.4552	2.4625	2.3355	2.3405	2.3426	2.3455	-0.05	0.00	0.05	0.084	0.018
2.4375	2.4500	2.4552	2.4625	2.3355	2.3405	2.3426	2.3455	0.05	0.10	0.15	0.097	0.021
2.4375	2.4500	2.4552	2.4625	2.3355	2.3405	2.3426	2.3455	0.15	0.20	0.25	0.092	0.017
2.4375	2.4500	2.4552	2.4625	2.3355	2.3405	2.3426	2.3455	0.25	0.30	0.35	0.221	0.028
2.4375	2.4500	2.4552	2.4625	2.3355	2.3405	2.3426	2.3455	0.35	0.40	0.45	0.315	0.027
2.4375	2.4500	2.4552	2.4625	2.3355	2.3405	2.3426	2.3455	0.45	0.50	0.55	0.455	0.038
2.4375	2.4500	2.4552	2.4625	2.3355	2.3405	2.3426	2.3455	0.55	0.60	0.65	0.908	0.066
2.4375	2.4500	2.4552	2.4625	2.3355	2.3405	2.3426	2.3455	0.65	0.70	0.75	1.125	0.072
2.4375	2.4500	2.4552	2.4625	2.3355	2.3405	2.3426	2.3455	0.75	0.80	0.85	1.502	0.084

2.4375	2.4500	2.4552	2.4625	2.3355	2.3405	2.3426	2.3455	0.85	0.90	0.95	1.410	0.129
2.4625	2.4750	2.4803	2.4875	2.3455	2.3505	2.3526	2.3555	-0.85	-0.80	-0.75	0.064	0.027
2.4625	2.4750	2.4803	2.4875	2.3455	2.3505	2.3526	2.3555	-0.75	-0.70	-0.65	0.057	0.020
2.4625	2.4750	2.4803	2.4875	2.3455	2.3505	2.3526	2.3555	-0.65	-0.60	-0.55	0.096	0.024
2.4625	2.4750	2.4803	2.4875	2.3455	2.3505	2.3526	2.3555	-0.55	-0.50	-0.45	0.046	0.014
2.4625	2.4750	2.4803	2.4875	2.3455	2.3505	2.3526	2.3555	-0.45	-0.40	-0.35	0.019	0.009
2.4625	2.4750	2.4803	2.4875	2.3455	2.3505	2.3526	2.3555	-0.35	-0.30	-0.25	0.099	0.016
2.4625	2.4750	2.4803	2.4875	2.3455	2.3505	2.3526	2.3555	-0.25	-0.20	-0.15	0.093	0.014
2.4625	2.4750	2.4803	2.4875	2.3455	2.3505	2.3526	2.3555	-0.15	-0.10	-0.05	0.076	0.017
2.4625	2.4750	2.4803	2.4875	2.3455	2.3505	2.3526	2.3555	-0.05	0.00	0.05	0.057	0.014
2.4625	2.4750	2.4803	2.4875	2.3455	2.3505	2.3526	2.3555	0.05	0.10	0.15	0.071	0.015
2.4625	2.4750	2.4803	2.4875	2.3455	2.3505	2.3526	2.3555	0.15	0.20	0.25	0.118	0.022
2.4625	2.4750	2.4803	2.4875	2.3455	2.3505	2.3526	2.3555	0.25	0.30	0.35	0.170	0.025
2.4625	2.4750	2.4803	2.4875	2.3455	2.3505	2.3526	2.3555	0.35	0.40	0.45	0.263	0.030
2.4625	2.4750	2.4803	2.4875	2.3455	2.3505	2.3526	2.3555	0.45	0.50	0.55	0.365	0.037
2.4625	2.4750	2.4803	2.4875	2.3455	2.3505	2.3526	2.3555	0.55	0.60	0.65	0.740	0.056
2.4625	2.4750	2.4803	2.4875	2.3455	2.3505	2.3526	2.3555	0.65	0.70	0.75	1.088	0.070
2.4625	2.4750	2.4803	2.4875	2.3455	2.3505	2.3526	2.3555	0.75	0.80	0.85	1.279	0.081
2.4625	2.4750	2.4803	2.4875	2.3455	2.3505	2.3526	2.3555	0.85	0.90	0.95	1.707	0.154
2.4875	2.5000	2.5053	2.5125	2.3555	2.3604	2.3626	2.3654	-0.85	-0.80	-0.75	0.114	0.023
2.4875	2.5000	2.5053	2.5125	2.3555	2.3604	2.3626	2.3654	-0.75	-0.70	-0.65	0.092	0.019
2.4875	2.5000	2.5053	2.5125	2.3555	2.3604	2.3626	2.3654	-0.65	-0.60	-0.55	0.085	0.020
2.4875	2.5000	2.5053	2.5125	2.3555	2.3604	2.3626	2.3654	-0.55	-0.50	-0.45	0.056	0.013
2.4875	2.5000	2.5053	2.5125	2.3555	2.3604	2.3626	2.3654	-0.45	-0.40	-0.35	0.082	0.015
2.4875	2.5000	2.5053	2.5125	2.3555	2.3604	2.3626	2.3654	-0.35	-0.30	-0.25	0.030	0.012
2.4875	2.5000	2.5053	2.5125	2.3555	2.3604	2.3626	2.3654	-0.25	-0.20	-0.15	0.053	0.011
2.4875	2.5000	2.5053	2.5125	2.3555	2.3604	2.3626	2.3654	-0.15	-0.10	-0.05	0.067	0.016
2.4875	2.5000	2.5053	2.5125	2.3555	2.3604	2.3626	2.3654	-0.05	0.00	0.05	0.102	0.015
2.4875	2.5000	2.5053	2.5125	2.3555	2.3604	2.3626	2.3654	0.05	0.10	0.15	0.085	0.019
2.4875	2.5000	2.5053	2.5125	2.3555	2.3604	2.3626	2.3654	0.15	0.20	0.25	0.106	0.020
2.4875	2.5000	2.5053	2.5125	2.3555	2.3604	2.3626	2.3654	0.25	0.30	0.35	0.157	0.022
2.4875	2.5000	2.5053	2.5125	2.3555	2.3604	2.3626	2.3654	0.35	0.40	0.45	0.224	0.029
2.4875	2.5000	2.5053	2.5125	2.3555	2.3604	2.3626	2.3654	0.45	0.50	0.55	0.422	0.038
2.4875	2.5000	2.5053	2.5125	2.3555	2.3604	2.3626	2.3654	0.55	0.60	0.65	0.709	0.053
2.4875	2.5000	2.5053	2.5125	2.3555	2.3604	2.3626	2.3654	0.65	0.70	0.75	0.983	0.062
2.4875	2.5000	2.5053	2.5125	2.3555	2.3604	2.3626	2.3654	0.75	0.80	0.85	1.346	0.088
2.4875	2.5000	2.5053	2.5125	2.3555	2.3604	2.3626	2.3654	0.85	0.90	0.95	1.728	0.150
2.5125	2.5250	2.5303	2.5375	2.3654	2.3704	2.3725	2.3753	-0.85	-0.80	-0.75	0.144	0.017
2.5125	2.5250	2.5303	2.5375	2.3654	2.3704	2.3725	2.3753	-0.75	-0.70	-0.65	0.057	0.018
2.5125	2.5250	2.5303	2.5375	2.3654	2.3704	2.3725	2.3753	-0.65	-0.60	-0.55	0.117	0.026
2.5125	2.5250	2.5303	2.5375	2.3654	2.3704	2.3725	2.3753	-0.55	-0.50	-0.45	0.064	0.017
2.5125	2.5250	2.5303	2.5375	2.3654	2.3704	2.3725	2.3753	-0.45	-0.40	-0.35	0.065	0.015
2.5125	2.5250	2.5303	2.5375	2.3654	2.3704	2.3725	2.3753	-0.35	-0.30	-0.25	0.089	0.021
2.5125	2.5250	2.5303	2.5375	2.3654	2.3704	2.3725	2.3753	-0.25	-0.20	-0.15	0.053	0.016
2.5125	2.5250	2.5303	2.5375	2.3654	2.3704	2.3725	2.3753	-0.15	-0.10	-0.05	0.065	0.015
2.5125	2.5250	2.5303	2.5375	2.3654	2.3704	2.3725	2.3753	-0.05	0.00	0.05	0.079	0.015
2.5125	2.5250	2.5303	2.5375	2.3654	2.3704	2.3725	2.3753	0.05	0.10	0.15	0.058	0.014
2.5125	2.5250	2.5303	2.5375	2.3654	2.3704	2.3725	2.3753	0.15	0.20	0.25	0.107	0.020
2.5125	2.5250	2.5303	2.5375	2.3654	2.3704	2.3725	2.3753	0.25	0.30	0.35	0.205	0.025
2.5125	2.5250	2.5303	2.5375	2.3654	2.3704	2.3725	2.3753	0.35	0.40	0.45	0.240	0.027
2.5125	2.5250	2.5303	2.5375	2.3654	2.3704	2.3725	2.3753	0.45	0.50	0.55	0.332	0.033
2.5125	2.5250	2.5303	2.5375	2.3654	2.3704	2.3725	2.3753	0.55	0.60	0.65	0.596	0.054
2.5125	2.5250	2.5303	2.5375	2.3654	2.3704	2.3725	2.3753	0.65	0.70	0.75	1.061	0.078
2.5125	2.5250	2.5303	2.5375	2.3654	2.3704	2.3725	2.3753	0.75	0.80	0.85	1.438	0.089
2.5125	2.5250	2.5303	2.5375	2.3654	2.3704	2.3725	2.3753	0.85	0.90	0.95	1.646	0.190
2.5375	2.5500	2.5552	2.5625	2.3753	2.3802	2.3823	2.3852	-0.85	-0.80	-0.75	0.085	0.029
2.5375	2.5500	2.5552	2.5625	2.3753	2.3802	2.3823	2.3852	-0.75	-0.70	-0.65	0.126	0.026
2.5375	2.5500	2.5552	2.5625	2.3753	2.3802	2.3823	2.3852	-0.65	-0.60	-0.55	0.068	0.018
2.5375	2.5500	2.5552	2.5625	2.3753	2.3802	2.3823	2.3852	-0.55	-0.50	-0.45	0.096	0.027
2.5375	2.5500	2.5552	2.5625	2.3753	2.3802	2.3823	2.3852	-0.45	-0.40	-0.35	0.053	0.021
2.5375	2.5500	2.5552	2.5625	2.3753	2.3802	2.3823	2.3852	-0.35	-0.30	-0.25	0.029	0.010
2.5375	2.5500	2.5552	2.5625	2.3753	2.3802	2.3823	2.3852	-0.25	-0.20	-0.15	0.041	0.014
2.5375	2.5500	2.5552	2.5625	2.3753	2.3802	2.3823	2.3852	-0.15	-0.10	-0.05	0.051	0.016
2.5375	2.5500	2.5552	2.5625	2.3753	2.3802	2.3823	2.3852	-0.05	0.00	0.05	0.069	0.015

2.5375	2.5500	2.5552	2.5625	2.3753	2.3802	2.3823	2.3852	0.05	0.10	0.15	0.076	0.020
2.5375	2.5500	2.5552	2.5625	2.3753	2.3802	2.3823	2.3852	0.15	0.20	0.25	0.066	0.021
2.5375	2.5500	2.5552	2.5625	2.3753	2.3802	2.3823	2.3852	0.25	0.30	0.35	0.149	0.027
2.5375	2.5500	2.5552	2.5625	2.3753	2.3802	2.3823	2.3852	0.35	0.40	0.45	0.243	0.029
2.5375	2.5500	2.5552	2.5625	2.3753	2.3802	2.3823	2.3852	0.45	0.50	0.55	0.356	0.040
2.5375	2.5500	2.5552	2.5625	2.3753	2.3802	2.3823	2.3852	0.55	0.60	0.65	0.643	0.059
2.5375	2.5500	2.5552	2.5625	2.3753	2.3802	2.3823	2.3852	0.65	0.70	0.75	0.945	0.080
2.5375	2.5500	2.5552	2.5625	2.3753	2.3802	2.3823	2.3852	0.75	0.80	0.85	1.495	0.098
2.5375	2.5500	2.5552	2.5625	2.3753	2.3802	2.3823	2.3852	0.85	0.90	0.95	1.888	0.167
2.5625	2.5750	2.5801	2.5875	2.3852	2.3901	2.3921	2.3950	-0.85	-0.80	-0.75	0.079	0.012
2.5625	2.5750	2.5801	2.5875	2.3852	2.3901	2.3921	2.3950	-0.75	-0.70	-0.65	0.038	0.017
2.5625	2.5750	2.5801	2.5875	2.3852	2.3901	2.3921	2.3950	-0.65	-0.60	-0.55	0.098	0.026
2.5625	2.5750	2.5801	2.5875	2.3852	2.3901	2.3921	2.3950	-0.55	-0.50	-0.45	0.102	0.023
2.5625	2.5750	2.5801	2.5875	2.3852	2.3901	2.3921	2.3950	-0.45	-0.40	-0.35	0.074	0.020
2.5625	2.5750	2.5801	2.5875	2.3852	2.3901	2.3921	2.3950	-0.35	-0.30	-0.25	0.058	0.023
2.5625	2.5750	2.5801	2.5875	2.3852	2.3901	2.3921	2.3950	-0.25	-0.20	-0.15	0.057	0.013
2.5625	2.5750	2.5801	2.5875	2.3852	2.3901	2.3921	2.3950	-0.15	-0.10	-0.05	0.080	0.017
2.5625	2.5750	2.5801	2.5875	2.3852	2.3901	2.3921	2.3950	-0.05	0.00	0.05	0.076	0.016
2.5625	2.5750	2.5801	2.5875	2.3852	2.3901	2.3921	2.3950	0.05	0.10	0.15	0.071	0.025
2.5625	2.5750	2.5801	2.5875	2.3852	2.3901	2.3921	2.3950	0.15	0.20	0.25	0.124	0.022
2.5625	2.5750	2.5801	2.5875	2.3852	2.3901	2.3921	2.3950	0.25	0.30	0.35	0.148	0.026
2.5625	2.5750	2.5801	2.5875	2.3852	2.3901	2.3921	2.3950	0.35	0.40	0.45	0.157	0.029
2.5625	2.5750	2.5801	2.5875	2.3852	2.3901	2.3921	2.3950	0.45	0.50	0.55	0.420	0.045
2.5625	2.5750	2.5801	2.5875	2.3852	2.3901	2.3921	2.3950	0.55	0.60	0.65	0.718	0.064
2.5625	2.5750	2.5801	2.5875	2.3852	2.3901	2.3921	2.3950	0.65	0.70	0.75	1.114	0.083
2.5625	2.5750	2.5801	2.5875	2.3852	2.3901	2.3921	2.3950	0.75	0.80	0.85	1.269	0.095
2.5625	2.5750	2.5801	2.5875	2.3852	2.3901	2.3921	2.3950	0.85	0.90	0.95	1.473	0.201
2.5875	2.6000	2.6050	2.6125	2.3950	2.3999	2.4018	2.4047	-0.85	-0.80	-0.75	0.131	0.035
2.5875	2.6000	2.6050	2.6125	2.3950	2.3999	2.4018	2.4047	-0.75	-0.70	-0.65	0.060	0.018
2.5875	2.6000	2.6050	2.6125	2.3950	2.3999	2.4018	2.4047	-0.65	-0.60	-0.55	0.065	0.015
2.5875	2.6000	2.6050	2.6125	2.3950	2.3999	2.4018	2.4047	-0.55	-0.50	-0.45	0.073	0.017
2.5875	2.6000	2.6050	2.6125	2.3950	2.3999	2.4018	2.4047	-0.45	-0.40	-0.35	0.072	0.015
2.5875	2.6000	2.6050	2.6125	2.3950	2.3999	2.4018	2.4047	-0.35	-0.30	-0.25	0.069	0.018
2.5875	2.6000	2.6050	2.6125	2.3950	2.3999	2.4018	2.4047	-0.25	-0.20	-0.15	0.074	0.018
2.5875	2.6000	2.6050	2.6125	2.3950	2.3999	2.4018	2.4047	-0.15	-0.10	-0.05	0.044	0.015
2.5875	2.6000	2.6050	2.6125	2.3950	2.3999	2.4018	2.4047	-0.05	0.00	0.05	0.069	0.016
2.5875	2.6000	2.6050	2.6125	2.3950	2.3999	2.4018	2.4047	0.05	0.10	0.15	0.103	0.018
2.5875	2.6000	2.6050	2.6125	2.3950	2.3999	2.4018	2.4047	0.15	0.20	0.25	0.130	0.024
2.5875	2.6000	2.6050	2.6125	2.3950	2.3999	2.4018	2.4047	0.25	0.30	0.35	0.110	0.025
2.5875	2.6000	2.6050	2.6125	2.3950	2.3999	2.4018	2.4047	0.35	0.40	0.45	0.235	0.026
2.5875	2.6000	2.6050	2.6125	2.3950	2.3999	2.4018	2.4047	0.45	0.50	0.55	0.320	0.036
2.5875	2.6000	2.6050	2.6125	2.3950	2.3999	2.4018	2.4047	0.55	0.60	0.65	0.559	0.052
2.5875	2.6000	2.6050	2.6125	2.3950	2.3999	2.4018	2.4047	0.65	0.70	0.75	0.844	0.061
2.5875	2.6000	2.6050	2.6125	2.3950	2.3999	2.4018	2.4047	0.75	0.80	0.85	1.450	0.089
2.5875	2.6000	2.6050	2.6125	2.3950	2.3999	2.4018	2.4047	0.85	0.90	0.95	1.889	0.177
2.6125	2.6250	2.6299	2.6375	2.4047	2.4096	2.4115	2.4145	-0.85	-0.80	-0.75	0.132	0.028
2.6125	2.6250	2.6299	2.6375	2.4047	2.4096	2.4115	2.4145	-0.75	-0.70	-0.65	0.077	0.024
2.6125	2.6250	2.6299	2.6375	2.4047	2.4096	2.4115	2.4145	-0.65	-0.60	-0.55	0.079	0.016
2.6125	2.6250	2.6299	2.6375	2.4047	2.4096	2.4115	2.4145	-0.55	-0.50	-0.45	0.065	0.016
2.6125	2.6250	2.6299	2.6375	2.4047	2.4096	2.4115	2.4145	-0.45	-0.40	-0.35	0.104	0.022
2.6125	2.6250	2.6299	2.6375	2.4047	2.4096	2.4115	2.4145	-0.35	-0.30	-0.25	0.045	0.011
2.6125	2.6250	2.6299	2.6375	2.4047	2.4096	2.4115	2.4145	-0.25	-0.20	-0.15	0.063	0.013
2.6125	2.6250	2.6299	2.6375	2.4047	2.4096	2.4115	2.4145	-0.15	-0.10	-0.05	0.085	0.015
2.6125	2.6250	2.6299	2.6375	2.4047	2.4096	2.4115	2.4145	-0.05	0.00	0.05	0.100	0.016
2.6125	2.6250	2.6299	2.6375	2.4047	2.4096	2.4115	2.4145	0.05	0.10	0.15	0.107	0.022
2.6125	2.6250	2.6299	2.6375	2.4047	2.4096	2.4115	2.4145	0.15	0.20	0.25	0.117	0.018
2.6125	2.6250	2.6299	2.6375	2.4047	2.4096	2.4115	2.4145	0.25	0.30	0.35	0.154	0.025
2.6125	2.6250	2.6299	2.6375	2.4047	2.4096	2.4115	2.4145	0.35	0.40	0.45	0.237	0.027
2.6125	2.6250	2.6299	2.6375	2.4047	2.4096	2.4115	2.4145	0.45	0.50	0.55	0.323	0.036
2.6125	2.6250	2.6299	2.6375	2.4047	2.4096	2.4115	2.4145	0.55	0.60	0.65	0.556	0.049
2.6125	2.6250	2.6299	2.6375	2.4047	2.4096	2.4115	2.4145	0.65	0.70	0.75	0.860	0.059
2.6125	2.6250	2.6299	2.6375	2.4047	2.4096	2.4115	2.4145	0.75	0.80	0.85	1.385	0.083
2.6125	2.6250	2.6299	2.6375	2.4047	2.4096	2.4115	2.4145	0.85	0.90	0.95	1.662	0.162
2.6375	2.6500	2.6547	2.6625	2.4145	2.4193	2.4212	2.4242	-0.85	-0.80	-0.75	0.093	0.026

2.6375	2.6500	2.6547	2.6625	2.4145	2.4193	2.4212	2.4242	-0.75	-0.70	-0.65	0.069	0.017
2.6375	2.6500	2.6547	2.6625	2.4145	2.4193	2.4212	2.4242	-0.65	-0.60	-0.55	0.028	0.010
2.6375	2.6500	2.6547	2.6625	2.4145	2.4193	2.4212	2.4242	-0.55	-0.50	-0.45	0.071	0.022
2.6375	2.6500	2.6547	2.6625	2.4145	2.4193	2.4212	2.4242	-0.45	-0.40	-0.35	0.063	0.020
2.6375	2.6500	2.6547	2.6625	2.4145	2.4193	2.4212	2.4242	-0.35	-0.30	-0.25	0.061	0.012
2.6375	2.6500	2.6547	2.6625	2.4145	2.4193	2.4212	2.4242	-0.25	-0.20	-0.15	0.079	0.016
2.6375	2.6500	2.6547	2.6625	2.4145	2.4193	2.4212	2.4242	-0.15	-0.10	-0.05	0.063	0.017
2.6375	2.6500	2.6547	2.6625	2.4145	2.4193	2.4212	2.4242	-0.05	0.00	0.05	0.055	0.019
2.6375	2.6500	2.6547	2.6625	2.4145	2.4193	2.4212	2.4242	0.05	0.10	0.15	0.065	0.014
2.6375	2.6500	2.6547	2.6625	2.4145	2.4193	2.4212	2.4242	0.15	0.20	0.25	0.079	0.022
2.6375	2.6500	2.6547	2.6625	2.4145	2.4193	2.4212	2.4242	0.25	0.30	0.35	0.129	0.020
2.6375	2.6500	2.6547	2.6625	2.4145	2.4193	2.4212	2.4242	0.35	0.40	0.45	0.175	0.025
2.6375	2.6500	2.6547	2.6625	2.4145	2.4193	2.4212	2.4242	0.45	0.50	0.55	0.255	0.035
2.6375	2.6500	2.6547	2.6625	2.4145	2.4193	2.4212	2.4242	0.55	0.60	0.65	0.672	0.058
2.6375	2.6500	2.6547	2.6625	2.4145	2.4193	2.4212	2.4242	0.65	0.70	0.75	0.889	0.066
2.6375	2.6500	2.6547	2.6625	2.4145	2.4193	2.4212	2.4242	0.75	0.80	0.85	1.428	0.101
2.6375	2.6500	2.6547	2.6625	2.4145	2.4193	2.4212	2.4242	0.85	0.90	0.95	1.732	0.190
2.6625	2.6750	2.6795	2.6875	2.4242	2.4290	2.4307	2.4338	-0.85	-0.80	-0.75	0.189	0.050
2.6625	2.6750	2.6795	2.6875	2.4242	2.4290	2.4307	2.4338	-0.75	-0.70	-0.65	0.084	0.019
2.6625	2.6750	2.6795	2.6875	2.4242	2.4290	2.4307	2.4338	-0.65	-0.60	-0.55	0.091	0.031
2.6625	2.6750	2.6795	2.6875	2.4242	2.4290	2.4307	2.4338	-0.55	-0.50	-0.45	0.083	0.022
2.6625	2.6750	2.6795	2.6875	2.4242	2.4290	2.4307	2.4338	-0.45	-0.40	-0.35	0.104	0.023
2.6625	2.6750	2.6795	2.6875	2.4242	2.4290	2.4307	2.4338	-0.35	-0.30	-0.25	0.073	0.023
2.6625	2.6750	2.6795	2.6875	2.4242	2.4290	2.4307	2.4338	-0.25	-0.20	-0.15	0.053	0.012
2.6625	2.6750	2.6795	2.6875	2.4242	2.4290	2.4307	2.4338	-0.15	-0.10	-0.05	0.051	0.013
2.6625	2.6750	2.6795	2.6875	2.4242	2.4290	2.4307	2.4338	-0.05	0.00	0.05	0.047	0.015
2.6625	2.6750	2.6795	2.6875	2.4242	2.4290	2.4307	2.4338	0.05	0.10	0.15	0.037	0.011
2.6625	2.6750	2.6795	2.6875	2.4242	2.4290	2.4307	2.4338	0.15	0.20	0.25	0.110	0.022
2.6625	2.6750	2.6795	2.6875	2.4242	2.4290	2.4307	2.4338	0.25	0.30	0.35	0.129	0.021
2.6625	2.6750	2.6795	2.6875	2.4242	2.4290	2.4307	2.4338	0.35	0.40	0.45	0.177	0.024
2.6625	2.6750	2.6795	2.6875	2.4242	2.4290	2.4307	2.4338	0.45	0.50	0.55	0.314	0.040
2.6625	2.6750	2.6795	2.6875	2.4242	2.4290	2.4307	2.4338	0.55	0.60	0.65	0.581	0.057
2.6625	2.6750	2.6795	2.6875	2.4242	2.4290	2.4307	2.4338	0.65	0.70	0.75	0.943	0.070
2.6625	2.6750	2.6795	2.6875	2.4242	2.4290	2.4307	2.4338	0.75	0.80	0.85	1.198	0.088
2.6625	2.6750	2.6795	2.6875	2.4242	2.4290	2.4307	2.4338	0.85	0.90	0.95	1.784	0.176
2.6875	2.7000	2.7042	2.7125	2.4338	2.4386	2.4403	2.4435	-0.85	-0.80	-0.75	0.108	0.027
2.6875	2.7000	2.7042	2.7125	2.4338	2.4386	2.4403	2.4435	-0.75	-0.70	-0.65	0.092	0.023
2.6875	2.7000	2.7042	2.7125	2.4338	2.4386	2.4403	2.4435	-0.65	-0.60	-0.55	0.025	0.010
2.6875	2.7000	2.7042	2.7125	2.4338	2.4386	2.4403	2.4435	-0.55	-0.50	-0.45	0.050	0.016
2.6875	2.7000	2.7042	2.7125	2.4338	2.4386	2.4403	2.4435	-0.45	-0.40	-0.35	0.025	0.012
2.6875	2.7000	2.7042	2.7125	2.4338	2.4386	2.4403	2.4435	-0.35	-0.30	-0.25	0.025	0.013
2.6875	2.7000	2.7042	2.7125	2.4338	2.4386	2.4403	2.4435	-0.25	-0.20	-0.15	0.073	0.019
2.6875	2.7000	2.7042	2.7125	2.4338	2.4386	2.4403	2.4435	-0.15	-0.10	-0.05	0.062	0.015
2.6875	2.7000	2.7042	2.7125	2.4338	2.4386	2.4403	2.4435	-0.05	0.00	0.05	0.063	0.013
2.6875	2.7000	2.7042	2.7125	2.4338	2.4386	2.4403	2.4435	0.05	0.10	0.15	0.070	0.012
2.6875	2.7000	2.7042	2.7125	2.4338	2.4386	2.4403	2.4435	0.15	0.20	0.25	0.093	0.018
2.6875	2.7000	2.7042	2.7125	2.4338	2.4386	2.4403	2.4435	0.25	0.30	0.35	0.129	0.018
2.6875	2.7000	2.7042	2.7125	2.4338	2.4386	2.4403	2.4435	0.35	0.40	0.45	0.154	0.021
2.6875	2.7000	2.7042	2.7125	2.4338	2.4386	2.4403	2.4435	0.45	0.50	0.55	0.248	0.029
2.6875	2.7000	2.7042	2.7125	2.4338	2.4386	2.4403	2.4435	0.55	0.60	0.65	0.613	0.052
2.6875	2.7000	2.7042	2.7125	2.4338	2.4386	2.4403	2.4435	0.65	0.70	0.75	0.936	0.065
2.6875	2.7000	2.7042	2.7125	2.4338	2.4386	2.4403	2.4435	0.75	0.80	0.85	1.485	0.091
2.6875	2.7000	2.7042	2.7125	2.4338	2.4386	2.4403	2.4435	0.85	0.90	0.95	1.771	0.159
2.7125	2.7250	2.7289	2.7375	2.4435	2.4482	2.4497	2.4530	-0.85	-0.80	-0.75	0.079	0.025
2.7125	2.7250	2.7289	2.7375	2.4435	2.4482	2.4497	2.4530	-0.75	-0.70	-0.65	0.136	0.034
2.7125	2.7250	2.7289	2.7375	2.4435	2.4482	2.4497	2.4530	-0.65	-0.60	-0.55	0.050	0.016
2.7125	2.7250	2.7289	2.7375	2.4435	2.4482	2.4497	2.4530	-0.55	-0.50	-0.45	0.056	0.016
2.7125	2.7250	2.7289	2.7375	2.4435	2.4482	2.4497	2.4530	-0.45	-0.40	-0.35	0.047	0.012
2.7125	2.7250	2.7289	2.7375	2.4435	2.4482	2.4497	2.4530	-0.35	-0.30	-0.25	0.068	0.016
2.7125	2.7250	2.7289	2.7375	2.4435	2.4482	2.4497	2.4530	-0.25	-0.20	-0.15	0.038	0.010
2.7125	2.7250	2.7289	2.7375	2.4435	2.4482	2.4497	2.4530	-0.15	-0.10	-0.05	0.042	0.012
2.7125	2.7250	2.7289	2.7375	2.4435	2.4482	2.4497	2.4530	-0.05	0.00	0.05	0.082	0.022
2.7125	2.7250	2.7289	2.7375	2.4435	2.4482	2.4497	2.4530	0.05	0.10	0.15	0.091	0.017
2.7125	2.7250	2.7289	2.7375	2.4435	2.4482	2.4497	2.4530	0.15	0.20	0.25	0.105	0.019

2.7125	2.7250	2.7289	2.7375	2.4435	2.4482	2.4497	2.4530	0.25	0.30	0.35	0.119	0.020
2.7125	2.7250	2.7289	2.7375	2.4435	2.4482	2.4497	2.4530	0.35	0.40	0.45	0.166	0.027
2.7125	2.7250	2.7289	2.7375	2.4435	2.4482	2.4497	2.4530	0.45	0.50	0.55	0.318	0.040
2.7125	2.7250	2.7289	2.7375	2.4435	2.4482	2.4497	2.4530	0.55	0.60	0.65	0.530	0.054
2.7125	2.7250	2.7289	2.7375	2.4435	2.4482	2.4497	2.4530	0.65	0.70	0.75	0.860	0.064
2.7125	2.7250	2.7289	2.7375	2.4435	2.4482	2.4497	2.4530	0.75	0.80	0.85	1.392	0.092
2.7125	2.7250	2.7289	2.7375	2.4435	2.4482	2.4497	2.4530	0.85	0.90	0.95	1.437	0.166
2.7375	2.7500	2.7536	2.7625	2.4530	2.4578	2.4592	2.4626	-0.85	-0.80	-0.75	0.054	0.027
2.7375	2.7500	2.7536	2.7625	2.4530	2.4578	2.4592	2.4626	-0.75	-0.70	-0.65	0.098	0.030
2.7375	2.7500	2.7536	2.7625	2.4530	2.4578	2.4592	2.4626	-0.65	-0.60	-0.55	0.049	0.019
2.7375	2.7500	2.7536	2.7625	2.4530	2.4578	2.4592	2.4626	-0.55	-0.50	-0.45	0.020	0.017
2.7375	2.7500	2.7536	2.7625	2.4530	2.4578	2.4592	2.4626	-0.45	-0.40	-0.35	0.016	0.011
2.7375	2.7500	2.7536	2.7625	2.4530	2.4578	2.4592	2.4626	-0.35	-0.30	-0.25	0.053	0.015
2.7375	2.7500	2.7536	2.7625	2.4530	2.4578	2.4592	2.4626	-0.25	-0.20	-0.15	0.023	0.015
2.7375	2.7500	2.7536	2.7625	2.4530	2.4578	2.4592	2.4626	-0.15	-0.10	-0.05	0.075	0.020
2.7375	2.7500	2.7536	2.7625	2.4530	2.4578	2.4592	2.4626	-0.05	0.00	0.05	0.043	0.017
2.7375	2.7500	2.7536	2.7625	2.4530	2.4578	2.4592	2.4626	0.05	0.10	0.15	0.108	0.005
2.7375	2.7500	2.7536	2.7625	2.4530	2.4578	2.4592	2.4626	0.15	0.20	0.25	0.032	0.010
2.7375	2.7500	2.7536	2.7625	2.4530	2.4578	2.4592	2.4626	0.25	0.30	0.35	0.144	0.029
2.7375	2.7500	2.7536	2.7625	2.4530	2.4578	2.4592	2.4626	0.35	0.40	0.45	0.196	0.034
2.7375	2.7500	2.7536	2.7625	2.4530	2.4578	2.4592	2.4626	0.45	0.50	0.55	0.349	0.048
2.7375	2.7500	2.7536	2.7625	2.4530	2.4578	2.4592	2.4626	0.55	0.60	0.65	0.631	0.071
2.7375	2.7500	2.7536	2.7625	2.4530	2.4578	2.4592	2.4626	0.65	0.70	0.75	0.883	0.086
2.7375	2.7500	2.7536	2.7625	2.4530	2.4578	2.4592	2.4626	0.75	0.80	0.85	1.456	0.112
2.7375	2.7500	2.7536	2.7625	2.4530	2.4578	2.4592	2.4626	0.85	0.90	0.95	1.543	0.188
2.7625	2.7750	2.7782	2.7875	2.4626	2.4673	2.4686	2.4721	-0.85	-0.80	-0.75	0.063	0.028
2.7625	2.7750	2.7782	2.7875	2.4626	2.4673	2.4686	2.4721	-0.75	-0.70	-0.65	0.064	0.019
2.7625	2.7750	2.7782	2.7875	2.4626	2.4673	2.4686	2.4721	-0.65	-0.60	-0.55	0.063	0.019
2.7625	2.7750	2.7782	2.7875	2.4626	2.4673	2.4686	2.4721	-0.55	-0.50	-0.45	0.051	0.014
2.7625	2.7750	2.7782	2.7875	2.4626	2.4673	2.4686	2.4721	-0.45	-0.40	-0.35	0.030	0.015
2.7625	2.7750	2.7782	2.7875	2.4626	2.4673	2.4686	2.4721	-0.35	-0.30	-0.25	0.041	0.015
2.7625	2.7750	2.7782	2.7875	2.4626	2.4673	2.4686	2.4721	-0.25	-0.20	-0.15	0.040	0.012
2.7625	2.7750	2.7782	2.7875	2.4626	2.4673	2.4686	2.4721	-0.15	-0.10	-0.05	0.030	0.010
2.7625	2.7750	2.7782	2.7875	2.4626	2.4673	2.4686	2.4721	-0.05	0.00	0.05	0.077	0.016
2.7625	2.7750	2.7782	2.7875	2.4626	2.4673	2.4686	2.4721	0.05	0.10	0.15	0.046	0.011
2.7625	2.7750	2.7782	2.7875	2.4626	2.4673	2.4686	2.4721	0.15	0.20	0.25	0.051	0.016
2.7625	2.7750	2.7782	2.7875	2.4626	2.4673	2.4686	2.4721	0.25	0.30	0.35	0.142	0.023
2.7625	2.7750	2.7782	2.7875	2.4626	2.4673	2.4686	2.4721	0.35	0.40	0.45	0.147	0.025
2.7625	2.7750	2.7782	2.7875	2.4626	2.4673	2.4686	2.4721	0.45	0.50	0.55	0.268	0.045
2.7625	2.7750	2.7782	2.7875	2.4626	2.4673	2.4686	2.4721	0.55	0.60	0.65	0.386	0.051
2.7625	2.7750	2.7782	2.7875	2.4626	2.4673	2.4686	2.4721	0.65	0.70	0.75	0.925	0.071
2.7625	2.7750	2.7782	2.7875	2.4626	2.4673	2.4686	2.4721	0.75	0.80	0.85	1.354	0.101
2.7625	2.7750	2.7782	2.7875	2.4626	2.4673	2.4686	2.4721	0.85	0.90	0.95	1.718	0.196
2.7875	2.8000	2.8028	2.8125	2.4721	2.4768	2.4779	2.4816	-0.85	-0.80	-0.75	0.027	0.023
2.7875	2.8000	2.8028	2.8125	2.4721	2.4768	2.4779	2.4816	-0.75	-0.70	-0.65	0.028	0.013
2.7875	2.8000	2.8028	2.8125	2.4721	2.4768	2.4779	2.4816	-0.65	-0.60	-0.55	0.045	0.016
2.7875	2.8000	2.8028	2.8125	2.4721	2.4768	2.4779	2.4816	-0.55	-0.50	-0.45	0.000	0.000
2.7875	2.8000	2.8028	2.8125	2.4721	2.4768	2.4779	2.4816	-0.45	-0.40	-0.35	0.048	0.015
2.7875	2.8000	2.8028	2.8125	2.4721	2.4768	2.4779	2.4816	-0.35	-0.30	-0.25	0.063	0.019
2.7875	2.8000	2.8028	2.8125	2.4721	2.4768	2.4779	2.4816	-0.25	-0.20	-0.15	0.075	0.016
2.7875	2.8000	2.8028	2.8125	2.4721	2.4768	2.4779	2.4816	-0.15	-0.10	-0.05	0.078	0.015
2.7875	2.8000	2.8028	2.8125	2.4721	2.4768	2.4779	2.4816	-0.05	0.00	0.05	0.051	0.018
2.7875	2.8000	2.8028	2.8125	2.4721	2.4768	2.4779	2.4816	0.05	0.10	0.15	0.060	0.017
2.7875	2.8000	2.8028	2.8125	2.4721	2.4768	2.4779	2.4816	0.15	0.20	0.25	0.065	0.018
2.7875	2.8000	2.8028	2.8125	2.4721	2.4768	2.4779	2.4816	0.25	0.30	0.35	0.093	0.020
2.7875	2.8000	2.8028	2.8125	2.4721	2.4768	2.4779	2.4816	0.35	0.40	0.45	0.136	0.026
2.7875	2.8000	2.8028	2.8125	2.4721	2.4768	2.4779	2.4816	0.45	0.50	0.55	0.340	0.039
2.7875	2.8000	2.8028	2.8125	2.4721	2.4768	2.4779	2.4816	0.55	0.60	0.65	0.553	0.060
2.7875	2.8000	2.8028	2.8125	2.4721	2.4768	2.4779	2.4816	0.65	0.70	0.75	0.766	0.058
2.7875	2.8000	2.8028	2.8125	2.4721	2.4768	2.4779	2.4816	0.75	0.80	0.85	1.418	0.102
2.7875	2.8000	2.8028	2.8125	2.4721	2.4768	2.4779	2.4816	0.85	0.90	0.95	1.652	0.201
2.8125	2.8250	2.8274	2.8375	2.4816	2.4863	2.4872	2.4910	-0.85	-0.80	-0.75	0.080	0.027
2.8125	2.8250	2.8274	2.8375	2.4816	2.4863	2.4872	2.4910	-0.75	-0.70	-0.65	0.032	0.016
2.8125	2.8250	2.8274	2.8375	2.4816	2.4863	2.4872	2.4910	-0.65	-0.60	-0.55	0.050	0.017

2.8125	2.8250	2.8274	2.8375	2.4816	2.4863	2.4872	2.4910	-0.55	-0.50	-0.45	0.026	0.016
2.8125	2.8250	2.8274	2.8375	2.4816	2.4863	2.4872	2.4910	-0.45	-0.40	-0.35	0.072	0.026
2.8125	2.8250	2.8274	2.8375	2.4816	2.4863	2.4872	2.4910	-0.35	-0.30	-0.25	0.063	0.015
2.8125	2.8250	2.8274	2.8375	2.4816	2.4863	2.4872	2.4910	-0.25	-0.20	-0.15	0.054	0.013
2.8125	2.8250	2.8274	2.8375	2.4816	2.4863	2.4872	2.4910	-0.15	-0.10	-0.05	0.053	0.013
2.8125	2.8250	2.8274	2.8375	2.4816	2.4863	2.4872	2.4910	-0.05	0.00	0.05	0.032	0.013
2.8125	2.8250	2.8274	2.8375	2.4816	2.4863	2.4872	2.4910	0.05	0.10	0.15	0.039	0.012
2.8125	2.8250	2.8274	2.8375	2.4816	2.4863	2.4872	2.4910	0.15	0.20	0.25	0.067	0.019
2.8125	2.8250	2.8274	2.8375	2.4816	2.4863	2.4872	2.4910	0.25	0.30	0.35	0.145	0.028
2.8125	2.8250	2.8274	2.8375	2.4816	2.4863	2.4872	2.4910	0.35	0.40	0.45	0.136	0.025
2.8125	2.8250	2.8274	2.8375	2.4816	2.4863	2.4872	2.4910	0.45	0.50	0.55	0.345	0.042
2.8125	2.8250	2.8274	2.8375	2.4816	2.4863	2.4872	2.4910	0.55	0.60	0.65	0.515	0.057
2.8125	2.8250	2.8274	2.8375	2.4816	2.4863	2.4872	2.4910	0.65	0.70	0.75	0.836	0.074
2.8125	2.8250	2.8274	2.8375	2.4816	2.4863	2.4872	2.4910	0.75	0.80	0.85	1.377	0.103
2.8125	2.8250	2.8274	2.8375	2.4816	2.4863	2.4872	2.4910	0.85	0.90	0.95	1.495	0.177
2.8375	2.8500	2.8519	2.8625	2.4910	2.4957	2.4964	2.5004	-0.85	-0.80	-0.75	0.100	0.031
2.8375	2.8500	2.8519	2.8625	2.4910	2.4957	2.4964	2.5004	-0.75	-0.70	-0.65	0.045	0.019
2.8375	2.8500	2.8519	2.8625	2.4910	2.4957	2.4964	2.5004	-0.65	-0.60	-0.55	0.011	0.006
2.8375	2.8500	2.8519	2.8625	2.4910	2.4957	2.4964	2.5004	-0.55	-0.50	-0.45	0.017	0.008
2.8375	2.8500	2.8519	2.8625	2.4910	2.4957	2.4964	2.5004	-0.45	-0.40	-0.35	0.026	0.012
2.8375	2.8500	2.8519	2.8625	2.4910	2.4957	2.4964	2.5004	-0.35	-0.30	-0.25	0.053	0.013
2.8375	2.8500	2.8519	2.8625	2.4910	2.4957	2.4964	2.5004	-0.25	-0.20	-0.15	0.047	0.014
2.8375	2.8500	2.8519	2.8625	2.4910	2.4957	2.4964	2.5004	-0.15	-0.10	-0.05	0.071	0.010
2.8375	2.8500	2.8519	2.8625	2.4910	2.4957	2.4964	2.5004	-0.05	0.00	0.05	0.057	0.017
2.8375	2.8500	2.8519	2.8625	2.4910	2.4957	2.4964	2.5004	0.05	0.10	0.15	0.061	0.016
2.8375	2.8500	2.8519	2.8625	2.4910	2.4957	2.4964	2.5004	0.15	0.20	0.25	0.053	0.015
2.8375	2.8500	2.8519	2.8625	2.4910	2.4957	2.4964	2.5004	0.25	0.30	0.35	0.112	0.026
2.8375	2.8500	2.8519	2.8625	2.4910	2.4957	2.4964	2.5004	0.35	0.40	0.45	0.134	0.021
2.8375	2.8500	2.8519	2.8625	2.4910	2.4957	2.4964	2.5004	0.45	0.50	0.55	0.334	0.038
2.8375	2.8500	2.8519	2.8625	2.4910	2.4957	2.4964	2.5004	0.55	0.60	0.65	0.605	0.056
2.8375	2.8500	2.8519	2.8625	2.4910	2.4957	2.4964	2.5004	0.65	0.70	0.75	0.933	0.066
2.8375	2.8500	2.8519	2.8625	2.4910	2.4957	2.4964	2.5004	0.75	0.80	0.85	1.266	0.085
2.8375	2.8500	2.8519	2.8625	2.4910	2.4957	2.4964	2.5004	0.85	0.90	0.95	1.294	0.130
2.8625	2.8750	2.8764	2.8875	2.5004	2.5051	2.5056	2.5098	-0.85	-0.80	-0.75	0.000	0.000
2.8625	2.8750	2.8764	2.8875	2.5004	2.5051	2.5056	2.5098	-0.75	-0.70	-0.65	0.035	0.016
2.8625	2.8750	2.8764	2.8875	2.5004	2.5051	2.5056	2.5098	-0.65	-0.60	-0.55	0.028	0.013
2.8625	2.8750	2.8764	2.8875	2.5004	2.5051	2.5056	2.5098	-0.55	-0.50	-0.45	0.039	0.020
2.8625	2.8750	2.8764	2.8875	2.5004	2.5051	2.5056	2.5098	-0.45	-0.40	-0.35	0.051	0.023
2.8625	2.8750	2.8764	2.8875	2.5004	2.5051	2.5056	2.5098	-0.35	-0.30	-0.25	0.015	0.008
2.8625	2.8750	2.8764	2.8875	2.5004	2.5051	2.5056	2.5098	-0.25	-0.20	-0.15	0.052	0.017
2.8625	2.8750	2.8764	2.8875	2.5004	2.5051	2.5056	2.5098	-0.15	-0.10	-0.05	0.028	0.010
2.8625	2.8750	2.8764	2.8875	2.5004	2.5051	2.5056	2.5098	-0.05	0.00	0.05	0.035	0.015
2.8625	2.8750	2.8764	2.8875	2.5004	2.5051	2.5056	2.5098	0.05	0.10	0.15	0.046	0.014
2.8625	2.8750	2.8764	2.8875	2.5004	2.5051	2.5056	2.5098	0.15	0.20	0.25	0.077	0.020
2.8625	2.8750	2.8764	2.8875	2.5004	2.5051	2.5056	2.5098	0.25	0.30	0.35	0.085	0.020
2.8625	2.8750	2.8764	2.8875	2.5004	2.5051	2.5056	2.5098	0.35	0.40	0.45	0.154	0.025
2.8625	2.8750	2.8764	2.8875	2.5004	2.5051	2.5056	2.5098	0.45	0.50	0.55	0.305	0.042
2.8625	2.8750	2.8764	2.8875	2.5004	2.5051	2.5056	2.5098	0.55	0.60	0.65	0.443	0.062
2.8625	2.8750	2.8764	2.8875	2.5004	2.5051	2.5056	2.5098	0.65	0.70	0.75	0.834	0.070
2.8625	2.8750	2.8764	2.8875	2.5004	2.5051	2.5056	2.5098	0.75	0.80	0.85	1.147	0.096
2.8625	2.8750	2.8764	2.8875	2.5004	2.5051	2.5056	2.5098	0.85	0.90	0.95	1.531	0.198
2.8875	2.9000	2.9008	2.9125	2.5098	2.5144	2.5147	2.5191	-0.85	-0.80	-0.75	0.047	0.021
2.8875	2.9000	2.9008	2.9125	2.5098	2.5144	2.5147	2.5191	-0.75	-0.70	-0.65	0.016	0.013
2.8875	2.9000	2.9008	2.9125	2.5098	2.5144	2.5147	2.5191	-0.65	-0.60	-0.55	0.036	0.012
2.8875	2.9000	2.9008	2.9125	2.5098	2.5144	2.5147	2.5191	-0.55	-0.50	-0.45	0.025	0.012
2.8875	2.9000	2.9008	2.9125	2.5098	2.5144	2.5147	2.5191	-0.45	-0.40	-0.35	0.018	0.009
2.8875	2.9000	2.9008	2.9125	2.5098	2.5144	2.5147	2.5191	-0.35	-0.30	-0.25	0.020	0.012
2.8875	2.9000	2.9008	2.9125	2.5098	2.5144	2.5147	2.5191	-0.25	-0.20	-0.15	0.034	0.012
2.8875	2.9000	2.9008	2.9125	2.5098	2.5144	2.5147	2.5191	-0.15	-0.10	-0.05	0.071	0.014
2.8875	2.9000	2.9008	2.9125	2.5098	2.5144	2.5147	2.5191	-0.05	0.00	0.05	0.077	0.026
2.8875	2.9000	2.9008	2.9125	2.5098	2.5144	2.5147	2.5191	0.05	0.10	0.15	0.073	0.013
2.8875	2.9000	2.9008	2.9125	2.5098	2.5144	2.5147	2.5191	0.15	0.20	0.25	0.072	0.018
2.8875	2.9000	2.9008	2.9125	2.5098	2.5144	2.5147	2.5191	0.25	0.30	0.35	0.063	0.021
2.8875	2.9000	2.9008	2.9125	2.5098	2.5144	2.5147	2.5191	0.35	0.40	0.45	0.152	0.025

2.8875	2.9000	2.9008	2.9125	2.5098	2.5144	2.5147	2.5191	0.45	0.50	0.55	0.249	0.035
2.8875	2.9000	2.9008	2.9125	2.5098	2.5144	2.5147	2.5191	0.55	0.60	0.65	0.499	0.054
2.8875	2.9000	2.9008	2.9125	2.5098	2.5144	2.5147	2.5191	0.65	0.70	0.75	0.957	0.072
2.8875	2.9000	2.9008	2.9125	2.5098	2.5144	2.5147	2.5191	0.75	0.80	0.85	1.216	0.091
2.8875	2.9000	2.9008	2.9125	2.5098	2.5144	2.5147	2.5191	0.85	0.90	0.95	1.827	0.309
2.9125	2.9250	2.9253	2.9375	2.5191	2.5237	2.5238	2.5284	-0.85	-0.80	-0.75	0.114	0.045
2.9125	2.9250	2.9253	2.9375	2.5191	2.5237	2.5238	2.5284	-0.75	-0.70	-0.65	0.020	0.009
2.9125	2.9250	2.9253	2.9375	2.5191	2.5237	2.5238	2.5284	-0.65	-0.60	-0.55	0.047	0.014
2.9125	2.9250	2.9253	2.9375	2.5191	2.5237	2.5238	2.5284	-0.55	-0.50	-0.45	0.029	0.012
2.9125	2.9250	2.9253	2.9375	2.5191	2.5237	2.5238	2.5284	-0.45	-0.40	-0.35	0.040	0.013
2.9125	2.9250	2.9253	2.9375	2.5191	2.5237	2.5238	2.5284	-0.35	-0.30	-0.25	0.010	0.009
2.9125	2.9250	2.9253	2.9375	2.5191	2.5237	2.5238	2.5284	-0.25	-0.20	-0.15	0.046	0.017
2.9125	2.9250	2.9253	2.9375	2.5191	2.5237	2.5238	2.5284	-0.15	-0.10	-0.05	0.095	0.020
2.9125	2.9250	2.9253	2.9375	2.5191	2.5237	2.5238	2.5284	-0.05	0.00	0.05	0.028	0.011
2.9125	2.9250	2.9253	2.9375	2.5191	2.5237	2.5238	2.5284	0.05	0.10	0.15	0.053	0.016
2.9125	2.9250	2.9253	2.9375	2.5191	2.5237	2.5238	2.5284	0.15	0.20	0.25	0.046	0.013
2.9125	2.9250	2.9253	2.9375	2.5191	2.5237	2.5238	2.5284	0.25	0.30	0.35	0.051	0.015
2.9125	2.9250	2.9253	2.9375	2.5191	2.5237	2.5238	2.5284	0.35	0.40	0.45	0.169	0.022
2.9125	2.9250	2.9253	2.9375	2.5191	2.5237	2.5238	2.5284	0.45	0.50	0.55	0.226	0.035
2.9125	2.9250	2.9253	2.9375	2.5191	2.5237	2.5238	2.5284	0.55	0.60	0.65	0.457	0.050
2.9125	2.9250	2.9253	2.9375	2.5191	2.5237	2.5238	2.5284	0.65	0.70	0.75	0.755	0.063
2.9125	2.9250	2.9253	2.9375	2.5191	2.5237	2.5238	2.5284	0.75	0.80	0.85	1.321	0.101
2.9125	2.9250	2.9253	2.9375	2.5191	2.5237	2.5238	2.5284	0.85	0.90	0.95	1.538	0.167
2.9375	2.9500	2.9496	2.9625	2.5284	2.5330	2.5329	2.5376	-0.85	-0.80	-0.75	0.078	0.023
2.9375	2.9500	2.9496	2.9625	2.5284	2.5330	2.5329	2.5376	-0.75	-0.70	-0.65	0.040	0.021
2.9375	2.9500	2.9496	2.9625	2.5284	2.5330	2.5329	2.5376	-0.65	-0.60	-0.55	0.042	0.013
2.9375	2.9500	2.9496	2.9625	2.5284	2.5330	2.5329	2.5376	-0.55	-0.50	-0.45	0.055	0.026
2.9375	2.9500	2.9496	2.9625	2.5284	2.5330	2.5329	2.5376	-0.45	-0.40	-0.35	0.044	0.019
2.9375	2.9500	2.9496	2.9625	2.5284	2.5330	2.5329	2.5376	-0.35	-0.30	-0.25	0.039	0.009
2.9375	2.9500	2.9496	2.9625	2.5284	2.5330	2.5329	2.5376	-0.25	-0.20	-0.15	0.041	0.013
2.9375	2.9500	2.9496	2.9625	2.5284	2.5330	2.5329	2.5376	-0.15	-0.10	-0.05	0.027	0.011
2.9375	2.9500	2.9496	2.9625	2.5284	2.5330	2.5329	2.5376	-0.05	0.00	0.05	0.041	0.022
2.9375	2.9500	2.9496	2.9625	2.5284	2.5330	2.5329	2.5376	0.05	0.10	0.15	0.063	0.017
2.9375	2.9500	2.9496	2.9625	2.5284	2.5330	2.5329	2.5376	0.15	0.20	0.25	0.066	0.018
2.9375	2.9500	2.9496	2.9625	2.5284	2.5330	2.5329	2.5376	0.25	0.30	0.35	0.063	0.017
2.9375	2.9500	2.9496	2.9625	2.5284	2.5330	2.5329	2.5376	0.35	0.40	0.45	0.127	0.027
2.9375	2.9500	2.9496	2.9625	2.5284	2.5330	2.5329	2.5376	0.45	0.50	0.55	0.198	0.035
2.9375	2.9500	2.9496	2.9625	2.5284	2.5330	2.5329	2.5376	0.55	0.60	0.65	0.421	0.047
2.9375	2.9500	2.9496	2.9625	2.5284	2.5330	2.5329	2.5376	0.65	0.70	0.75	0.679	0.059
2.9375	2.9500	2.9496	2.9625	2.5284	2.5330	2.5329	2.5376	0.75	0.80	0.85	1.427	0.098
2.9375	2.9500	2.9496	2.9625	2.5284	2.5330	2.5329	2.5376	0.85	0.90	0.95	1.911	0.209
2.9625	2.9750	0.0000	2.9875	2.5376	2.5423	0.0000	2.5469	-0.85	-0.80	-0.75	0.000	0.000
2.9625	2.9750	0.0000	2.9875	2.5376	2.5423	0.0000	2.5469	-0.75	-0.70	-0.65	0.000	0.000
2.9625	2.9750	0.0000	2.9875	2.5376	2.5423	0.0000	2.5469	-0.65	-0.60	-0.55	0.000	0.000
2.9625	2.9750	0.0000	2.9875	2.5376	2.5423	0.0000	2.5469	-0.55	-0.50	-0.45	0.000	0.000
2.9625	2.9750	0.0000	2.9875	2.5376	2.5423	0.0000	2.5469	-0.45	-0.40	-0.35	0.000	0.000
2.9625	2.9750	0.0000	2.9875	2.5376	2.5423	0.0000	2.5469	-0.35	-0.30	-0.25	0.000	0.000
2.9625	2.9750	0.0000	2.9875	2.5376	2.5423	0.0000	2.5469	-0.25	-0.20	-0.15	0.000	0.000
2.9625	2.9750	0.0000	2.9875	2.5376	2.5423	0.0000	2.5469	-0.15	-0.10	-0.05	0.000	0.000
2.9625	2.9750	0.0000	2.9875	2.5376	2.5423	0.0000	2.5469	-0.05	0.00	0.05	0.000	0.000
2.9625	2.9750	0.0000	2.9875	2.5376	2.5423	0.0000	2.5469	0.05	0.10	0.15	0.000	0.000
2.9625	2.9750	0.0000	2.9875	2.5376	2.5423	0.0000	2.5469	0.15	0.20	0.25	0.000	0.000
2.9625	2.9750	0.0000	2.9875	2.5376	2.5423	0.0000	2.5469	0.25	0.30	0.35	0.000	0.000
2.9625	2.9750	0.0000	2.9875	2.5376	2.5423	0.0000	2.5469	0.35	0.40	0.45	0.000	0.000
2.9625	2.9750	0.0000	2.9875	2.5376	2.5423	0.0000	2.5469	0.45	0.50	0.55	0.000	0.000
2.9625	2.9750	0.0000	2.9875	2.5376	2.5423	0.0000	2.5469	0.55	0.60	0.65	0.000	0.000
2.9625	2.9750	0.0000	2.9875	2.5376	2.5423	0.0000	2.5469	0.65	0.70	0.75	0.000	0.000
2.9625	2.9750	0.0000	2.9875	2.5376	2.5423	0.0000	2.5469	0.75	0.80	0.85	0.000	0.000
2.9625	2.9750	0.0000	2.9875	2.5376	2.5423	0.0000	2.5469	0.85	0.90	0.95	0.000	0.000

Appendix C

Data Table: $K^+\Sigma^\circ$ Differential Cross Section

This appendix contains tables of numerical values for the $K^+\Sigma^\circ$ differential cross section. The table consist of thirteen columns, which are interpreted as follows:

1. Column 1: Lower limit of E_γ bin (GeV)
2. Column 2: Nominal midpoint of E_γ bin (GeV)
3. Column 3: Corrected midpoint of E_γ bin (GeV)
4. Column 4: Upper limit of E_γ bin (GeV)
5. Column 5: Lower limit of W bin (GeV)
6. Column 6: Nominal idpoint of W bin (GeV)
7. Column 7: Corrected midpoint of W bin (GeV)
8. Column 8: Upper limit of W bin (GeV)
9. Column 9: Lower limit of $\cos(\theta_{KCM})$ bin
10. Column 10: Midpoint of $\cos(\theta_{KCM})$ bin
11. Column 11: Lower limit of $\cos(\theta_{KCM})$ bin
12. Column 12: $\frac{d\sigma}{d(\cos\theta_{KCM})}$ in $\mu barns$.
13. Column 13: Error on datapoint. Expressed in $\mu barns$.

C.1 Data Table

1.0875	1.1000	1.0944	1.1125	1.7091	1.7160	1.7129	1.7228	-0.85	-0.80	-0.75	0.000	0.000
1.0875	1.1000	1.0944	1.1125	1.7091	1.7160	1.7129	1.7228	-0.75	-0.70	-0.65	0.000	0.000
1.0875	1.1000	1.0944	1.1125	1.7091	1.7160	1.7129	1.7228	-0.65	-0.60	-0.55	0.000	0.000
1.0875	1.1000	1.0944	1.1125	1.7091	1.7160	1.7129	1.7228	-0.55	-0.50	-0.45	0.000	0.000
1.0875	1.1000	1.0944	1.1125	1.7091	1.7160	1.7129	1.7228	-0.45	-0.40	-0.35	0.278	0.099
1.0875	1.1000	1.0944	1.1125	1.7091	1.7160	1.7129	1.7228	-0.35	-0.30	-0.25	0.318	0.097
1.0875	1.1000	1.0944	1.1125	1.7091	1.7160	1.7129	1.7228	-0.25	-0.20	-0.15	0.221	0.067
1.0875	1.1000	1.0944	1.1125	1.7091	1.7160	1.7129	1.7228	-0.15	-0.10	-0.05	0.353	0.098
1.0875	1.1000	1.0944	1.1125	1.7091	1.7160	1.7129	1.7228	-0.05	0.00	0.05	0.265	0.070

1.0875	1.1000	1.0944	1.1125	1.7091	1.7160	1.7129	1.7228	0.05	0.10	0.15	0.318	0.078
1.0875	1.1000	1.0944	1.1125	1.7091	1.7160	1.7129	1.7228	0.15	0.20	0.25	0.317	0.075
1.0875	1.1000	1.0944	1.1125	1.7091	1.7160	1.7129	1.7228	0.25	0.30	0.35	0.400	0.074
1.0875	1.1000	1.0944	1.1125	1.7091	1.7160	1.7129	1.7228	0.35	0.40	0.45	0.268	0.058
1.0875	1.1000	1.0944	1.1125	1.7091	1.7160	1.7129	1.7228	0.45	0.50	0.55	0.367	0.069
1.0875	1.1000	1.0944	1.1125	1.7091	1.7160	1.7129	1.7228	0.55	0.60	0.65	0.397	0.079
1.0875	1.1000	1.0944	1.1125	1.7091	1.7160	1.7129	1.7228	0.65	0.70	0.75	0.273	0.059
1.0875	1.1000	1.0944	1.1125	1.7091	1.7160	1.7129	1.7228	0.75	0.80	0.85	0.241	0.101
1.0875	1.1000	1.0944	1.1125	1.7091	1.7160	1.7129	1.7228	0.85	0.90	0.95	0.000	0.000
1.1125	1.1250	1.1194	1.1375	1.7228	1.7296	1.7265	1.7364	-0.85	-0.80	-0.75	0.000	0.000
1.1125	1.1250	1.1194	1.1375	1.7228	1.7296	1.7265	1.7364	-0.75	-0.70	-0.65	0.000	0.000
1.1125	1.1250	1.1194	1.1375	1.7228	1.7296	1.7265	1.7364	-0.65	-0.60	-0.55	0.000	0.000
1.1125	1.1250	1.1194	1.1375	1.7228	1.7296	1.7265	1.7364	-0.55	-0.50	-0.45	0.000	0.000
1.1125	1.1250	1.1194	1.1375	1.7228	1.7296	1.7265	1.7364	-0.45	-0.40	-0.35	0.161	0.077
1.1125	1.1250	1.1194	1.1375	1.7228	1.7296	1.7265	1.7364	-0.35	-0.30	-0.25	0.371	0.155
1.1125	1.1250	1.1194	1.1375	1.7228	1.7296	1.7265	1.7364	-0.25	-0.20	-0.15	0.324	0.085
1.1125	1.1250	1.1194	1.1375	1.7228	1.7296	1.7265	1.7364	-0.15	-0.10	-0.05	0.214	0.073
1.1125	1.1250	1.1194	1.1375	1.7228	1.7296	1.7265	1.7364	-0.05	0.00	0.05	0.502	0.107
1.1125	1.1250	1.1194	1.1375	1.7228	1.7296	1.7265	1.7364	0.05	0.10	0.15	0.329	0.088
1.1125	1.1250	1.1194	1.1375	1.7228	1.7296	1.7265	1.7364	0.15	0.20	0.25	0.407	0.087
1.1125	1.1250	1.1194	1.1375	1.7228	1.7296	1.7265	1.7364	0.25	0.30	0.35	0.480	0.089
1.1125	1.1250	1.1194	1.1375	1.7228	1.7296	1.7265	1.7364	0.35	0.40	0.45	0.407	0.078
1.1125	1.1250	1.1194	1.1375	1.7228	1.7296	1.7265	1.7364	0.45	0.50	0.55	0.517	0.089
1.1125	1.1250	1.1194	1.1375	1.7228	1.7296	1.7265	1.7364	0.55	0.60	0.65	0.445	0.078
1.1125	1.1250	1.1194	1.1375	1.7228	1.7296	1.7265	1.7364	0.65	0.70	0.75	0.415	0.076
1.1125	1.1250	1.1194	1.1375	1.7228	1.7296	1.7265	1.7364	0.75	0.80	0.85	0.416	0.091
1.1125	1.1250	1.1194	1.1375	1.7228	1.7296	1.7265	1.7364	0.85	0.90	0.95	0.000	0.000
1.1375	1.1500	1.1444	1.1625	1.7364	1.7431	1.7401	1.7498	-0.85	-0.80	-0.75	0.000	0.000
1.1375	1.1500	1.1444	1.1625	1.7364	1.7431	1.7401	1.7498	-0.75	-0.70	-0.65	0.000	0.000
1.1375	1.1500	1.1444	1.1625	1.7364	1.7431	1.7401	1.7498	-0.65	-0.60	-0.55	0.000	0.000
1.1375	1.1500	1.1444	1.1625	1.7364	1.7431	1.7401	1.7498	-0.55	-0.50	-0.45	0.404	0.107
1.1375	1.1500	1.1444	1.1625	1.7364	1.7431	1.7401	1.7498	-0.45	-0.40	-0.35	0.492	0.079
1.1375	1.1500	1.1444	1.1625	1.7364	1.7431	1.7401	1.7498	-0.35	-0.30	-0.25	0.453	0.074
1.1375	1.1500	1.1444	1.1625	1.7364	1.7431	1.7401	1.7498	-0.25	-0.20	-0.15	0.525	0.073
1.1375	1.1500	1.1444	1.1625	1.7364	1.7431	1.7401	1.7498	-0.15	-0.10	-0.05	0.406	0.056
1.1375	1.1500	1.1444	1.1625	1.7364	1.7431	1.7401	1.7498	-0.05	0.00	0.05	0.521	0.071
1.1375	1.1500	1.1444	1.1625	1.7364	1.7431	1.7401	1.7498	0.05	0.10	0.15	0.438	0.066
1.1375	1.1500	1.1444	1.1625	1.7364	1.7431	1.7401	1.7498	0.15	0.20	0.25	0.467	0.058
1.1375	1.1500	1.1444	1.1625	1.7364	1.7431	1.7401	1.7498	0.25	0.30	0.35	0.579	0.062
1.1375	1.1500	1.1444	1.1625	1.7364	1.7431	1.7401	1.7498	0.35	0.40	0.45	0.674	0.071
1.1375	1.1500	1.1444	1.1625	1.7364	1.7431	1.7401	1.7498	0.45	0.50	0.55	0.616	0.066
1.1375	1.1500	1.1444	1.1625	1.7364	1.7431	1.7401	1.7498	0.55	0.60	0.65	0.592	0.062
1.1375	1.1500	1.1444	1.1625	1.7364	1.7431	1.7401	1.7498	0.65	0.70	0.75	0.501	0.062
1.1375	1.1500	1.1444	1.1625	1.7364	1.7431	1.7401	1.7498	0.75	0.80	0.85	0.591	0.075
1.1375	1.1500	1.1444	1.1625	1.7364	1.7431	1.7401	1.7498	0.85	0.90	0.95	0.000	0.000
1.1625	1.1750	1.1694	1.1875	1.7498	1.7565	1.7535	1.7632	-0.85	-0.80	-0.75	0.000	0.000
1.1625	1.1750	1.1694	1.1875	1.7498	1.7565	1.7535	1.7632	-0.75	-0.70	-0.65	0.000	0.000
1.1625	1.1750	1.1694	1.1875	1.7498	1.7565	1.7535	1.7632	-0.65	-0.60	-0.55	0.000	0.000
1.1625	1.1750	1.1694	1.1875	1.7498	1.7565	1.7535	1.7632	-0.55	-0.50	-0.45	0.411	0.096
1.1625	1.1750	1.1694	1.1875	1.7498	1.7565	1.7535	1.7632	-0.45	-0.40	-0.35	0.542	0.091
1.1625	1.1750	1.1694	1.1875	1.7498	1.7565	1.7535	1.7632	-0.35	-0.30	-0.25	0.475	0.078
1.1625	1.1750	1.1694	1.1875	1.7498	1.7565	1.7535	1.7632	-0.25	-0.20	-0.15	0.454	0.069
1.1625	1.1750	1.1694	1.1875	1.7498	1.7565	1.7535	1.7632	-0.15	-0.10	-0.05	0.420	0.068
1.1625	1.1750	1.1694	1.1875	1.7498	1.7565	1.7535	1.7632	-0.05	0.00	0.05	0.591	0.077
1.1625	1.1750	1.1694	1.1875	1.7498	1.7565	1.7535	1.7632	0.05	0.10	0.15	0.527	0.075
1.1625	1.1750	1.1694	1.1875	1.7498	1.7565	1.7535	1.7632	0.15	0.20	0.25	0.622	0.072
1.1625	1.1750	1.1694	1.1875	1.7498	1.7565	1.7535	1.7632	0.25	0.30	0.35	0.528	0.062
1.1625	1.1750	1.1694	1.1875	1.7498	1.7565	1.7535	1.7632	0.35	0.40	0.45	0.765	0.081
1.1625	1.1750	1.1694	1.1875	1.7498	1.7565	1.7535	1.7632	0.45	0.50	0.55	0.776	0.075
1.1625	1.1750	1.1694	1.1875	1.7498	1.7565	1.7535	1.7632	0.55	0.60	0.65	0.552	0.057
1.1625	1.1750	1.1694	1.1875	1.7498	1.7565	1.7535	1.7632	0.65	0.70	0.75	0.582	0.072
1.1625	1.1750	1.1694	1.1875	1.7498	1.7565	1.7535	1.7632	0.75	0.80	0.85	0.849	0.093
1.1625	1.1750	1.1694	1.1875	1.7498	1.7565	1.7535	1.7632	0.85	0.90	0.95	0.564	0.137
1.1875	1.2000	1.1944	1.2125	1.7632	1.7698	1.7668	1.7764	-0.85	-0.80	-0.75	0.000	0.000

1.1875	1.2000	1.1944	1.2125	1.7632	1.7698	1.7668	1.7764	-0.75	-0.70	-0.65	0.000	0.000
1.1875	1.2000	1.1944	1.2125	1.7632	1.7698	1.7668	1.7764	-0.65	-0.60	-0.55	0.471	0.230
1.1875	1.2000	1.1944	1.2125	1.7632	1.7698	1.7668	1.7764	-0.55	-0.50	-0.45	0.508	0.100
1.1875	1.2000	1.1944	1.2125	1.7632	1.7698	1.7668	1.7764	-0.45	-0.40	-0.35	0.633	0.090
1.1875	1.2000	1.1944	1.2125	1.7632	1.7698	1.7668	1.7764	-0.35	-0.30	-0.25	0.477	0.071
1.1875	1.2000	1.1944	1.2125	1.7632	1.7698	1.7668	1.7764	-0.25	-0.20	-0.15	0.434	0.059
1.1875	1.2000	1.1944	1.2125	1.7632	1.7698	1.7668	1.7764	-0.15	-0.10	-0.05	0.514	0.065
1.1875	1.2000	1.1944	1.2125	1.7632	1.7698	1.7668	1.7764	-0.05	0.00	0.05	0.587	0.071
1.1875	1.2000	1.1944	1.2125	1.7632	1.7698	1.7668	1.7764	0.05	0.10	0.15	0.674	0.073
1.1875	1.2000	1.1944	1.2125	1.7632	1.7698	1.7668	1.7764	0.15	0.20	0.25	0.746	0.070
1.1875	1.2000	1.1944	1.2125	1.7632	1.7698	1.7668	1.7764	0.25	0.30	0.35	0.868	0.080
1.1875	1.2000	1.1944	1.2125	1.7632	1.7698	1.7668	1.7764	0.35	0.40	0.45	0.782	0.071
1.1875	1.2000	1.1944	1.2125	1.7632	1.7698	1.7668	1.7764	0.45	0.50	0.55	0.955	0.078
1.1875	1.2000	1.1944	1.2125	1.7632	1.7698	1.7668	1.7764	0.55	0.60	0.65	0.822	0.078
1.1875	1.2000	1.1944	1.2125	1.7632	1.7698	1.7668	1.7764	0.65	0.70	0.75	0.747	0.077
1.1875	1.2000	1.1944	1.2125	1.7632	1.7698	1.7668	1.7764	0.75	0.80	0.85	0.791	0.079
1.1875	1.2000	1.1944	1.2125	1.7632	1.7698	1.7668	1.7764	0.85	0.90	0.95	0.605	0.149
1.2125	1.2250	1.2193	1.2375	1.7764	1.7830	1.7800	1.7896	-0.85	-0.80	-0.75	0.000	0.000
1.2125	1.2250	1.2193	1.2375	1.7764	1.7830	1.7800	1.7896	-0.75	-0.70	-0.65	0.000	0.000
1.2125	1.2250	1.2193	1.2375	1.7764	1.7830	1.7800	1.7896	-0.65	-0.60	-0.55	0.563	0.139
1.2125	1.2250	1.2193	1.2375	1.7764	1.7830	1.7800	1.7896	-0.55	-0.50	-0.45	0.461	0.078
1.2125	1.2250	1.2193	1.2375	1.7764	1.7830	1.7800	1.7896	-0.45	-0.40	-0.35	0.505	0.072
1.2125	1.2250	1.2193	1.2375	1.7764	1.7830	1.7800	1.7896	-0.35	-0.30	-0.25	0.564	0.066
1.2125	1.2250	1.2193	1.2375	1.7764	1.7830	1.7800	1.7896	-0.25	-0.20	-0.15	0.617	0.062
1.2125	1.2250	1.2193	1.2375	1.7764	1.7830	1.7800	1.7896	-0.15	-0.10	-0.05	0.779	0.072
1.2125	1.2250	1.2193	1.2375	1.7764	1.7830	1.7800	1.7896	-0.05	0.00	0.05	0.692	0.068
1.2125	1.2250	1.2193	1.2375	1.7764	1.7830	1.7800	1.7896	0.05	0.10	0.15	0.761	0.067
1.2125	1.2250	1.2193	1.2375	1.7764	1.7830	1.7800	1.7896	0.15	0.20	0.25	0.869	0.068
1.2125	1.2250	1.2193	1.2375	1.7764	1.7830	1.7800	1.7896	0.25	0.30	0.35	1.005	0.076
1.2125	1.2250	1.2193	1.2375	1.7764	1.7830	1.7800	1.7896	0.35	0.40	0.45	0.942	0.069
1.2125	1.2250	1.2193	1.2375	1.7764	1.7830	1.7800	1.7896	0.45	0.50	0.55	0.923	0.069
1.2125	1.2250	1.2193	1.2375	1.7764	1.7830	1.7800	1.7896	0.55	0.60	0.65	0.889	0.061
1.2125	1.2250	1.2193	1.2375	1.7764	1.7830	1.7800	1.7896	0.65	0.70	0.75	1.009	0.087
1.2125	1.2250	1.2193	1.2375	1.7764	1.7830	1.7800	1.7896	0.75	0.80	0.85	0.809	0.072
1.2125	1.2250	1.2193	1.2375	1.7764	1.7830	1.7800	1.7896	0.85	0.90	0.95	0.609	0.116
1.2375	1.2500	1.2442	1.2625	1.7896	1.7961	1.7931	1.8026	-0.85	-0.80	-0.75	0.000	0.000
1.2375	1.2500	1.2442	1.2625	1.7896	1.7961	1.7931	1.8026	-0.75	-0.70	-0.65	0.000	0.000
1.2375	1.2500	1.2442	1.2625	1.7896	1.7961	1.7931	1.8026	-0.65	-0.60	-0.55	0.307	0.074
1.2375	1.2500	1.2442	1.2625	1.7896	1.7961	1.7931	1.8026	-0.55	-0.50	-0.45	0.549	0.075
1.2375	1.2500	1.2442	1.2625	1.7896	1.7961	1.7931	1.8026	-0.45	-0.40	-0.35	0.625	0.067
1.2375	1.2500	1.2442	1.2625	1.7896	1.7961	1.7931	1.8026	-0.35	-0.30	-0.25	0.758	0.067
1.2375	1.2500	1.2442	1.2625	1.7896	1.7961	1.7931	1.8026	-0.25	-0.20	-0.15	0.857	0.071
1.2375	1.2500	1.2442	1.2625	1.7896	1.7961	1.7931	1.8026	-0.15	-0.10	-0.05	0.871	0.066
1.2375	1.2500	1.2442	1.2625	1.7896	1.7961	1.7931	1.8026	-0.05	0.00	0.05	0.820	0.067
1.2375	1.2500	1.2442	1.2625	1.7896	1.7961	1.7931	1.8026	0.05	0.10	0.15	0.979	0.071
1.2375	1.2500	1.2442	1.2625	1.7896	1.7961	1.7931	1.8026	0.15	0.20	0.25	1.131	0.076
1.2375	1.2500	1.2442	1.2625	1.7896	1.7961	1.7931	1.8026	0.25	0.30	0.35	1.140	0.077
1.2375	1.2500	1.2442	1.2625	1.7896	1.7961	1.7931	1.8026	0.35	0.40	0.45	1.188	0.065
1.2375	1.2500	1.2442	1.2625	1.7896	1.7961	1.7931	1.8026	0.45	0.50	0.55	1.003	0.062
1.2375	1.2500	1.2442	1.2625	1.7896	1.7961	1.7931	1.8026	0.55	0.60	0.65	0.952	0.062
1.2375	1.2500	1.2442	1.2625	1.7896	1.7961	1.7931	1.8026	0.65	0.70	0.75	0.986	0.074
1.2375	1.2500	1.2442	1.2625	1.7896	1.7961	1.7931	1.8026	0.75	0.80	0.85	0.954	0.070
1.2375	1.2500	1.2442	1.2625	1.7896	1.7961	1.7931	1.8026	0.85	0.90	0.95	0.714	0.111
1.2625	1.2750	1.2692	1.2875	1.8026	1.8091	1.8061	1.8156	-0.85	-0.80	-0.75	0.000	0.000
1.2625	1.2750	1.2692	1.2875	1.8026	1.8091	1.8061	1.8156	-0.75	-0.70	-0.65	0.000	0.000
1.2625	1.2750	1.2692	1.2875	1.8026	1.8091	1.8061	1.8156	-0.65	-0.60	-0.55	0.417	0.072
1.2625	1.2750	1.2692	1.2875	1.8026	1.8091	1.8061	1.8156	-0.55	-0.50	-0.45	0.629	0.072
1.2625	1.2750	1.2692	1.2875	1.8026	1.8091	1.8061	1.8156	-0.45	-0.40	-0.35	0.813	0.071
1.2625	1.2750	1.2692	1.2875	1.8026	1.8091	1.8061	1.8156	-0.35	-0.30	-0.25	0.737	0.063
1.2625	1.2750	1.2692	1.2875	1.8026	1.8091	1.8061	1.8156	-0.25	-0.20	-0.15	0.939	0.069
1.2625	1.2750	1.2692	1.2875	1.8026	1.8091	1.8061	1.8156	-0.15	-0.10	-0.05	1.060	0.069
1.2625	1.2750	1.2692	1.2875	1.8026	1.8091	1.8061	1.8156	-0.05	0.00	0.05	1.058	0.072
1.2625	1.2750	1.2692	1.2875	1.8026	1.8091	1.8061	1.8156	0.05	0.10	0.15	1.194	0.073
1.2625	1.2750	1.2692	1.2875	1.8026	1.8091	1.8061	1.8156	0.15	0.20	0.25	1.226	0.072

1.2625	1.2750	1.2692	1.2875	1.8026	1.8091	1.8061	1.8156	0.25	0.30	0.35	1.156	0.067
1.2625	1.2750	1.2692	1.2875	1.8026	1.8091	1.8061	1.8156	0.35	0.40	0.45	1.137	0.064
1.2625	1.2750	1.2692	1.2875	1.8026	1.8091	1.8061	1.8156	0.45	0.50	0.55	1.103	0.066
1.2625	1.2750	1.2692	1.2875	1.8026	1.8091	1.8061	1.8156	0.55	0.60	0.65	1.133	0.077
1.2625	1.2750	1.2692	1.2875	1.8026	1.8091	1.8061	1.8156	0.65	0.70	0.75	1.057	0.061
1.2625	1.2750	1.2692	1.2875	1.8026	1.8091	1.8061	1.8156	0.75	0.80	0.85	0.906	0.067
1.2625	1.2750	1.2692	1.2875	1.8026	1.8091	1.8061	1.8156	0.85	0.90	0.95	0.843	0.108
1.2875	1.3000	1.2944	1.3125	1.8156	1.8220	1.8192	1.8285	-0.85	-0.80	-0.75	0.000	0.000
1.2875	1.3000	1.2944	1.3125	1.8156	1.8220	1.8192	1.8285	-0.75	-0.70	-0.65	0.000	0.000
1.2875	1.3000	1.2944	1.3125	1.8156	1.8220	1.8192	1.8285	-0.65	-0.60	-0.55	0.386	0.090
1.2875	1.3000	1.2944	1.3125	1.8156	1.8220	1.8192	1.8285	-0.55	-0.50	-0.45	0.621	0.089
1.2875	1.3000	1.2944	1.3125	1.8156	1.8220	1.8192	1.8285	-0.45	-0.40	-0.35	0.765	0.088
1.2875	1.3000	1.2944	1.3125	1.8156	1.8220	1.8192	1.8285	-0.35	-0.30	-0.25	0.901	0.086
1.2875	1.3000	1.2944	1.3125	1.8156	1.8220	1.8192	1.8285	-0.25	-0.20	-0.15	1.024	0.092
1.2875	1.3000	1.2944	1.3125	1.8156	1.8220	1.8192	1.8285	-0.15	-0.10	-0.05	1.203	0.095
1.2875	1.3000	1.2944	1.3125	1.8156	1.8220	1.8192	1.8285	-0.05	0.00	0.05	1.178	0.100
1.2875	1.3000	1.2944	1.3125	1.8156	1.8220	1.8192	1.8285	0.05	0.10	0.15	1.312	0.103
1.2875	1.3000	1.2944	1.3125	1.8156	1.8220	1.8192	1.8285	0.15	0.20	0.25	1.471	0.100
1.2875	1.3000	1.2944	1.3125	1.8156	1.8220	1.8192	1.8285	0.25	0.30	0.35	1.442	0.100
1.2875	1.3000	1.2944	1.3125	1.8156	1.8220	1.8192	1.8285	0.35	0.40	0.45	1.500	0.097
1.2875	1.3000	1.2944	1.3125	1.8156	1.8220	1.8192	1.8285	0.45	0.50	0.55	1.174	0.084
1.2875	1.3000	1.2944	1.3125	1.8156	1.8220	1.8192	1.8285	0.55	0.60	0.65	1.448	0.098
1.2875	1.3000	1.2944	1.3125	1.8156	1.8220	1.8192	1.8285	0.65	0.70	0.75	1.127	0.085
1.2875	1.3000	1.2944	1.3125	1.8156	1.8220	1.8192	1.8285	0.75	0.80	0.85	1.124	0.080
1.2875	1.3000	1.2944	1.3125	1.8156	1.8220	1.8192	1.8285	0.85	0.90	0.95	0.986	0.149
1.3125	1.3250	1.3197	1.3375	1.8285	1.8349	1.8322	1.8413	-0.85	-0.80	-0.75	0.000	0.000
1.3125	1.3250	1.3197	1.3375	1.8285	1.8349	1.8322	1.8413	-0.75	-0.70	-0.65	0.409	0.139
1.3125	1.3250	1.3197	1.3375	1.8285	1.8349	1.8322	1.8413	-0.65	-0.60	-0.55	0.462	0.083
1.3125	1.3250	1.3197	1.3375	1.8285	1.8349	1.8322	1.8413	-0.55	-0.50	-0.45	0.667	0.086
1.3125	1.3250	1.3197	1.3375	1.8285	1.8349	1.8322	1.8413	-0.45	-0.40	-0.35	1.000	0.096
1.3125	1.3250	1.3197	1.3375	1.8285	1.8349	1.8322	1.8413	-0.35	-0.30	-0.25	1.135	0.097
1.3125	1.3250	1.3197	1.3375	1.8285	1.8349	1.8322	1.8413	-0.25	-0.20	-0.15	1.203	0.087
1.3125	1.3250	1.3197	1.3375	1.8285	1.8349	1.8322	1.8413	-0.15	-0.10	-0.05	1.473	0.103
1.3125	1.3250	1.3197	1.3375	1.8285	1.8349	1.8322	1.8413	-0.05	0.00	0.05	1.544	0.110
1.3125	1.3250	1.3197	1.3375	1.8285	1.8349	1.8322	1.8413	0.05	0.10	0.15	1.406	0.099
1.3125	1.3250	1.3197	1.3375	1.8285	1.8349	1.8322	1.8413	0.15	0.20	0.25	1.474	0.093
1.3125	1.3250	1.3197	1.3375	1.8285	1.8349	1.8322	1.8413	0.25	0.30	0.35	1.746	0.112
1.3125	1.3250	1.3197	1.3375	1.8285	1.8349	1.8322	1.8413	0.35	0.40	0.45	1.482	0.089
1.3125	1.3250	1.3197	1.3375	1.8285	1.8349	1.8322	1.8413	0.45	0.50	0.55	1.569	0.099
1.3125	1.3250	1.3197	1.3375	1.8285	1.8349	1.8322	1.8413	0.55	0.60	0.65	1.321	0.087
1.3125	1.3250	1.3197	1.3375	1.8285	1.8349	1.8322	1.8413	0.65	0.70	0.75	1.353	0.086
1.3125	1.3250	1.3197	1.3375	1.8285	1.8349	1.8322	1.8413	0.75	0.80	0.85	1.142	0.096
1.3125	1.3250	1.3197	1.3375	1.8285	1.8349	1.8322	1.8413	0.85	0.90	0.95	1.185	0.158
1.3375	1.3500	1.3449	1.3625	1.8413	1.8476	1.8450	1.8540	-0.85	-0.80	-0.75	0.000	0.000
1.3375	1.3500	1.3449	1.3625	1.8413	1.8476	1.8450	1.8540	-0.75	-0.70	-0.65	0.551	0.138
1.3375	1.3500	1.3449	1.3625	1.8413	1.8476	1.8450	1.8540	-0.65	-0.60	-0.55	0.459	0.075
1.3375	1.3500	1.3449	1.3625	1.8413	1.8476	1.8450	1.8540	-0.55	-0.50	-0.45	0.682	0.078
1.3375	1.3500	1.3449	1.3625	1.8413	1.8476	1.8450	1.8540	-0.45	-0.40	-0.35	0.826	0.073
1.3375	1.3500	1.3449	1.3625	1.8413	1.8476	1.8450	1.8540	-0.35	-0.30	-0.25	0.995	0.075
1.3375	1.3500	1.3449	1.3625	1.8413	1.8476	1.8450	1.8540	-0.25	-0.20	-0.15	1.270	0.082
1.3375	1.3500	1.3449	1.3625	1.8413	1.8476	1.8450	1.8540	-0.15	-0.10	-0.05	1.485	0.090
1.3375	1.3500	1.3449	1.3625	1.8413	1.8476	1.8450	1.8540	-0.05	0.00	0.05	1.437	0.088
1.3375	1.3500	1.3449	1.3625	1.8413	1.8476	1.8450	1.8540	0.05	0.10	0.15	1.564	0.093
1.3375	1.3500	1.3449	1.3625	1.8413	1.8476	1.8450	1.8540	0.15	0.20	0.25	1.607	0.086
1.3375	1.3500	1.3449	1.3625	1.8413	1.8476	1.8450	1.8540	0.25	0.30	0.35	1.583	0.087
1.3375	1.3500	1.3449	1.3625	1.8413	1.8476	1.8450	1.8540	0.35	0.40	0.45	1.651	0.083
1.3375	1.3500	1.3449	1.3625	1.8413	1.8476	1.8450	1.8540	0.45	0.50	0.55	1.631	0.084
1.3375	1.3500	1.3449	1.3625	1.8413	1.8476	1.8450	1.8540	0.55	0.60	0.65	1.620	0.090
1.3375	1.3500	1.3449	1.3625	1.8413	1.8476	1.8450	1.8540	0.65	0.70	0.75	1.366	0.079
1.3375	1.3500	1.3449	1.3625	1.8413	1.8476	1.8450	1.8540	0.75	0.80	0.85	1.017	0.075
1.3375	1.3500	1.3449	1.3625	1.8413	1.8476	1.8450	1.8540	0.85	0.90	0.95	1.051	0.120
1.3625	1.3750	1.3702	1.3875	1.8540	1.8603	1.8578	1.8666	-0.85	-0.80	-0.75	0.000	0.000
1.3625	1.3750	1.3702	1.3875	1.8540	1.8603	1.8578	1.8666	-0.75	-0.70	-0.65	0.663	0.114
1.3625	1.3750	1.3702	1.3875	1.8540	1.8603	1.8578	1.8666	-0.65	-0.60	-0.55	0.566	0.078

1.3625	1.3750	1.3702	1.3875	1.8540	1.8603	1.8578	1.8666	-0.55	-0.50	-0.45	0.836	0.078
1.3625	1.3750	1.3702	1.3875	1.8540	1.8603	1.8578	1.8666	-0.45	-0.40	-0.35	0.917	0.069
1.3625	1.3750	1.3702	1.3875	1.8540	1.8603	1.8578	1.8666	-0.35	-0.30	-0.25	1.203	0.075
1.3625	1.3750	1.3702	1.3875	1.8540	1.8603	1.8578	1.8666	-0.25	-0.20	-0.15	1.361	0.075
1.3625	1.3750	1.3702	1.3875	1.8540	1.8603	1.8578	1.8666	-0.15	-0.10	-0.05	1.591	0.084
1.3625	1.3750	1.3702	1.3875	1.8540	1.8603	1.8578	1.8666	-0.05	0.00	0.05	1.711	0.090
1.3625	1.3750	1.3702	1.3875	1.8540	1.8603	1.8578	1.8666	0.05	0.10	0.15	1.733	0.091
1.3625	1.3750	1.3702	1.3875	1.8540	1.8603	1.8578	1.8666	0.15	0.20	0.25	1.947	0.090
1.3625	1.3750	1.3702	1.3875	1.8540	1.8603	1.8578	1.8666	0.25	0.30	0.35	1.858	0.089
1.3625	1.3750	1.3702	1.3875	1.8540	1.8603	1.8578	1.8666	0.35	0.40	0.45	1.736	0.074
1.3625	1.3750	1.3702	1.3875	1.8540	1.8603	1.8578	1.8666	0.45	0.50	0.55	1.847	0.083
1.3625	1.3750	1.3702	1.3875	1.8540	1.8603	1.8578	1.8666	0.55	0.60	0.65	1.741	0.086
1.3625	1.3750	1.3702	1.3875	1.8540	1.8603	1.8578	1.8666	0.65	0.70	0.75	1.491	0.076
1.3625	1.3750	1.3702	1.3875	1.8540	1.8603	1.8578	1.8666	0.75	0.80	0.85	1.282	0.076
1.3625	1.3750	1.3702	1.3875	1.8540	1.8603	1.8578	1.8666	0.85	0.90	0.95	1.007	0.104
1.3875	1.4000	1.3954	1.4125	1.8666	1.8728	1.8705	1.8791	-0.85	-0.80	-0.75	0.000	0.000
1.3875	1.4000	1.3954	1.4125	1.8666	1.8728	1.8705	1.8791	-0.75	-0.70	-0.65	0.387	0.067
1.3875	1.4000	1.3954	1.4125	1.8666	1.8728	1.8705	1.8791	-0.65	-0.60	-0.55	0.474	0.057
1.3875	1.4000	1.3954	1.4125	1.8666	1.8728	1.8705	1.8791	-0.55	-0.50	-0.45	0.665	0.060
1.3875	1.4000	1.3954	1.4125	1.8666	1.8728	1.8705	1.8791	-0.45	-0.40	-0.35	0.983	0.064
1.3875	1.4000	1.3954	1.4125	1.8666	1.8728	1.8705	1.8791	-0.35	-0.30	-0.25	1.097	0.061
1.3875	1.4000	1.3954	1.4125	1.8666	1.8728	1.8705	1.8791	-0.25	-0.20	-0.15	1.371	0.068
1.3875	1.4000	1.3954	1.4125	1.8666	1.8728	1.8705	1.8791	-0.15	-0.10	-0.05	1.647	0.075
1.3875	1.4000	1.3954	1.4125	1.8666	1.8728	1.8705	1.8791	-0.05	0.00	0.05	1.680	0.079
1.3875	1.4000	1.3954	1.4125	1.8666	1.8728	1.8705	1.8791	0.05	0.10	0.15	1.739	0.077
1.3875	1.4000	1.3954	1.4125	1.8666	1.8728	1.8705	1.8791	0.15	0.20	0.25	1.773	0.072
1.3875	1.4000	1.3954	1.4125	1.8666	1.8728	1.8705	1.8791	0.25	0.30	0.35	1.823	0.078
1.3875	1.4000	1.3954	1.4125	1.8666	1.8728	1.8705	1.8791	0.35	0.40	0.45	1.789	0.066
1.3875	1.4000	1.3954	1.4125	1.8666	1.8728	1.8705	1.8791	0.45	0.50	0.55	1.829	0.081
1.3875	1.4000	1.3954	1.4125	1.8666	1.8728	1.8705	1.8791	0.55	0.60	0.65	1.669	0.074
1.3875	1.4000	1.3954	1.4125	1.8666	1.8728	1.8705	1.8791	0.65	0.70	0.75	1.519	0.064
1.3875	1.4000	1.3954	1.4125	1.8666	1.8728	1.8705	1.8791	0.75	0.80	0.85	1.468	0.087
1.3875	1.4000	1.3954	1.4125	1.8666	1.8728	1.8705	1.8791	0.85	0.90	0.95	1.053	0.091
1.4125	1.4250	1.4206	1.4375	1.8791	1.8853	1.8831	1.8915	-0.85	-0.80	-0.75	0.000	0.000
1.4125	1.4250	1.4206	1.4375	1.8791	1.8853	1.8831	1.8915	-0.75	-0.70	-0.65	0.418	0.089
1.4125	1.4250	1.4206	1.4375	1.8791	1.8853	1.8831	1.8915	-0.65	-0.60	-0.55	0.466	0.064
1.4125	1.4250	1.4206	1.4375	1.8791	1.8853	1.8831	1.8915	-0.55	-0.50	-0.45	0.796	0.090
1.4125	1.4250	1.4206	1.4375	1.8791	1.8853	1.8831	1.8915	-0.45	-0.40	-0.35	0.888	0.077
1.4125	1.4250	1.4206	1.4375	1.8791	1.8853	1.8831	1.8915	-0.35	-0.30	-0.25	1.130	0.082
1.4125	1.4250	1.4206	1.4375	1.8791	1.8853	1.8831	1.8915	-0.25	-0.20	-0.15	1.546	0.099
1.4125	1.4250	1.4206	1.4375	1.8791	1.8853	1.8831	1.8915	-0.15	-0.10	-0.05	1.761	0.104
1.4125	1.4250	1.4206	1.4375	1.8791	1.8853	1.8831	1.8915	-0.05	0.00	0.05	1.938	0.115
1.4125	1.4250	1.4206	1.4375	1.8791	1.8853	1.8831	1.8915	0.05	0.10	0.15	1.651	0.089
1.4125	1.4250	1.4206	1.4375	1.8791	1.8853	1.8831	1.8915	0.15	0.20	0.25	2.096	0.108
1.4125	1.4250	1.4206	1.4375	1.8791	1.8853	1.8831	1.8915	0.25	0.30	0.35	1.961	0.105
1.4125	1.4250	1.4206	1.4375	1.8791	1.8853	1.8831	1.8915	0.35	0.40	0.45	1.729	0.091
1.4125	1.4250	1.4206	1.4375	1.8791	1.8853	1.8831	1.8915	0.45	0.50	0.55	1.996	0.101
1.4125	1.4250	1.4206	1.4375	1.8791	1.8853	1.8831	1.8915	0.55	0.60	0.65	1.626	0.091
1.4125	1.4250	1.4206	1.4375	1.8791	1.8853	1.8831	1.8915	0.65	0.70	0.75	1.498	0.090
1.4125	1.4250	1.4206	1.4375	1.8791	1.8853	1.8831	1.8915	0.75	0.80	0.85	1.435	0.110
1.4125	1.4250	1.4206	1.4375	1.8791	1.8853	1.8831	1.8915	0.85	0.90	0.95	1.437	0.148
1.4375	1.4500	1.4457	1.4625	1.8915	1.8977	1.8956	1.9039	-0.85	-0.80	-0.75	0.000	0.000
1.4375	1.4500	1.4457	1.4625	1.8915	1.8977	1.8956	1.9039	-0.75	-0.70	-0.65	0.523	0.074
1.4375	1.4500	1.4457	1.4625	1.8915	1.8977	1.8956	1.9039	-0.65	-0.60	-0.55	0.390	0.045
1.4375	1.4500	1.4457	1.4625	1.8915	1.8977	1.8956	1.9039	-0.55	-0.50	-0.45	0.645	0.054
1.4375	1.4500	1.4457	1.4625	1.8915	1.8977	1.8956	1.9039	-0.45	-0.40	-0.35	0.949	0.057
1.4375	1.4500	1.4457	1.4625	1.8915	1.8977	1.8956	1.9039	-0.35	-0.30	-0.25	1.204	0.064
1.4375	1.4500	1.4457	1.4625	1.8915	1.8977	1.8956	1.9039	-0.25	-0.20	-0.15	1.386	0.066
1.4375	1.4500	1.4457	1.4625	1.8915	1.8977	1.8956	1.9039	-0.15	-0.10	-0.05	1.502	0.068
1.4375	1.4500	1.4457	1.4625	1.8915	1.8977	1.8956	1.9039	-0.05	0.00	0.05	1.710	0.078
1.4375	1.4500	1.4457	1.4625	1.8915	1.8977	1.8956	1.9039	0.05	0.10	0.15	1.747	0.077
1.4375	1.4500	1.4457	1.4625	1.8915	1.8977	1.8956	1.9039	0.15	0.20	0.25	1.770	0.072
1.4375	1.4500	1.4457	1.4625	1.8915	1.8977	1.8956	1.9039	0.25	0.30	0.35	1.833	0.075
1.4375	1.4500	1.4457	1.4625	1.8915	1.8977	1.8956	1.9039	0.35	0.40	0.45	1.763	0.072

1.4375	1.4500	1.4457	1.4625	1.8915	1.8977	1.8956	1.9039	0.45	0.50	0.55	1.859	0.073
1.4375	1.4500	1.4457	1.4625	1.8915	1.8977	1.8956	1.9039	0.55	0.60	0.65	1.484	0.064
1.4375	1.4500	1.4457	1.4625	1.8915	1.8977	1.8956	1.9039	0.65	0.70	0.75	1.475	0.069
1.4375	1.4500	1.4457	1.4625	1.8915	1.8977	1.8956	1.9039	0.75	0.80	0.85	1.298	0.081
1.4375	1.4500	1.4457	1.4625	1.8915	1.8977	1.8956	1.9039	0.85	0.90	0.95	1.229	0.108
1.4625	1.4750	1.4709	1.4875	1.9039	1.9100	1.9080	1.9162	-0.85	-0.80	-0.75	0.000	0.000
1.4625	1.4750	1.4709	1.4875	1.9039	1.9100	1.9080	1.9162	-0.75	-0.70	-0.65	0.344	0.054
1.4625	1.4750	1.4709	1.4875	1.9039	1.9100	1.9080	1.9162	-0.65	-0.60	-0.55	0.506	0.052
1.4625	1.4750	1.4709	1.4875	1.9039	1.9100	1.9080	1.9162	-0.55	-0.50	-0.45	0.562	0.047
1.4625	1.4750	1.4709	1.4875	1.9039	1.9100	1.9080	1.9162	-0.45	-0.40	-0.35	0.802	0.049
1.4625	1.4750	1.4709	1.4875	1.9039	1.9100	1.9080	1.9162	-0.35	-0.30	-0.25	1.102	0.057
1.4625	1.4750	1.4709	1.4875	1.9039	1.9100	1.9080	1.9162	-0.25	-0.20	-0.15	1.459	0.069
1.4625	1.4750	1.4709	1.4875	1.9039	1.9100	1.9080	1.9162	-0.15	-0.10	-0.05	1.533	0.068
1.4625	1.4750	1.4709	1.4875	1.9039	1.9100	1.9080	1.9162	-0.05	0.00	0.05	1.493	0.068
1.4625	1.4750	1.4709	1.4875	1.9039	1.9100	1.9080	1.9162	0.05	0.10	0.15	1.638	0.066
1.4625	1.4750	1.4709	1.4875	1.9039	1.9100	1.9080	1.9162	0.15	0.20	0.25	1.736	0.070
1.4625	1.4750	1.4709	1.4875	1.9039	1.9100	1.9080	1.9162	0.25	0.30	0.35	1.785	0.070
1.4625	1.4750	1.4709	1.4875	1.9039	1.9100	1.9080	1.9162	0.35	0.40	0.45	1.574	0.062
1.4625	1.4750	1.4709	1.4875	1.9039	1.9100	1.9080	1.9162	0.45	0.50	0.55	1.584	0.064
1.4625	1.4750	1.4709	1.4875	1.9039	1.9100	1.9080	1.9162	0.55	0.60	0.65	1.452	0.062
1.4625	1.4750	1.4709	1.4875	1.9039	1.9100	1.9080	1.9162	0.65	0.70	0.75	1.382	0.063
1.4625	1.4750	1.4709	1.4875	1.9039	1.9100	1.9080	1.9162	0.75	0.80	0.85	1.265	0.068
1.4625	1.4750	1.4709	1.4875	1.9039	1.9100	1.9080	1.9162	0.85	0.90	0.95	0.964	0.086
1.4875	1.5000	1.4960	1.5125	1.9162	1.9223	1.9203	1.9284	-0.85	-0.80	-0.75	0.225	0.101
1.4875	1.5000	1.4960	1.5125	1.9162	1.9223	1.9203	1.9284	-0.75	-0.70	-0.65	0.371	0.051
1.4875	1.5000	1.4960	1.5125	1.9162	1.9223	1.9203	1.9284	-0.65	-0.60	-0.55	0.442	0.049
1.4875	1.5000	1.4960	1.5125	1.9162	1.9223	1.9203	1.9284	-0.55	-0.50	-0.45	0.568	0.054
1.4875	1.5000	1.4960	1.5125	1.9162	1.9223	1.9203	1.9284	-0.45	-0.40	-0.35	0.811	0.053
1.4875	1.5000	1.4960	1.5125	1.9162	1.9223	1.9203	1.9284	-0.35	-0.30	-0.25	1.058	0.060
1.4875	1.5000	1.4960	1.5125	1.9162	1.9223	1.9203	1.9284	-0.25	-0.20	-0.15	1.196	0.060
1.4875	1.5000	1.4960	1.5125	1.9162	1.9223	1.9203	1.9284	-0.15	-0.10	-0.05	1.401	0.067
1.4875	1.5000	1.4960	1.5125	1.9162	1.9223	1.9203	1.9284	-0.05	0.00	0.05	1.377	0.068
1.4875	1.5000	1.4960	1.5125	1.9162	1.9223	1.9203	1.9284	0.05	0.10	0.15	1.582	0.069
1.4875	1.5000	1.4960	1.5125	1.9162	1.9223	1.9203	1.9284	0.15	0.20	0.25	1.705	0.071
1.4875	1.5000	1.4960	1.5125	1.9162	1.9223	1.9203	1.9284	0.25	0.30	0.35	1.698	0.071
1.4875	1.5000	1.4960	1.5125	1.9162	1.9223	1.9203	1.9284	0.35	0.40	0.45	1.582	0.066
1.4875	1.5000	1.4960	1.5125	1.9162	1.9223	1.9203	1.9284	0.45	0.50	0.55	1.557	0.060
1.4875	1.5000	1.4960	1.5125	1.9162	1.9223	1.9203	1.9284	0.55	0.60	0.65	1.470	0.063
1.4875	1.5000	1.4960	1.5125	1.9162	1.9223	1.9203	1.9284	0.65	0.70	0.75	1.138	0.058
1.4875	1.5000	1.4960	1.5125	1.9162	1.9223	1.9203	1.9284	0.75	0.80	0.85	1.265	0.073
1.4875	1.5000	1.4960	1.5125	1.9162	1.9223	1.9203	1.9284	0.85	0.90	0.95	0.997	0.094
1.5125	1.5250	1.5211	1.5375	1.9284	1.9344	1.9326	1.9405	-0.85	-0.80	-0.75	0.263	0.094
1.5125	1.5250	1.5211	1.5375	1.9284	1.9344	1.9326	1.9405	-0.75	-0.70	-0.65	0.223	0.045
1.5125	1.5250	1.5211	1.5375	1.9284	1.9344	1.9326	1.9405	-0.65	-0.60	-0.55	0.365	0.040
1.5125	1.5250	1.5211	1.5375	1.9284	1.9344	1.9326	1.9405	-0.55	-0.50	-0.45	0.507	0.048
1.5125	1.5250	1.5211	1.5375	1.9284	1.9344	1.9326	1.9405	-0.45	-0.40	-0.35	0.751	0.049
1.5125	1.5250	1.5211	1.5375	1.9284	1.9344	1.9326	1.9405	-0.35	-0.30	-0.25	0.953	0.053
1.5125	1.5250	1.5211	1.5375	1.9284	1.9344	1.9326	1.9405	-0.25	-0.20	-0.15	1.158	0.058
1.5125	1.5250	1.5211	1.5375	1.9284	1.9344	1.9326	1.9405	-0.15	-0.10	-0.05	1.340	0.060
1.5125	1.5250	1.5211	1.5375	1.9284	1.9344	1.9326	1.9405	-0.05	0.00	0.05	1.514	0.070
1.5125	1.5250	1.5211	1.5375	1.9284	1.9344	1.9326	1.9405	0.05	0.10	0.15	1.521	0.063
1.5125	1.5250	1.5211	1.5375	1.9284	1.9344	1.9326	1.9405	0.15	0.20	0.25	1.649	0.067
1.5125	1.5250	1.5211	1.5375	1.9284	1.9344	1.9326	1.9405	0.25	0.30	0.35	1.543	0.064
1.5125	1.5250	1.5211	1.5375	1.9284	1.9344	1.9326	1.9405	0.35	0.40	0.45	1.525	0.063
1.5125	1.5250	1.5211	1.5375	1.9284	1.9344	1.9326	1.9405	0.45	0.50	0.55	1.437	0.059
1.5125	1.5250	1.5211	1.5375	1.9284	1.9344	1.9326	1.9405	0.55	0.60	0.65	1.381	0.057
1.5125	1.5250	1.5211	1.5375	1.9284	1.9344	1.9326	1.9405	0.65	0.70	0.75	1.211	0.059
1.5125	1.5250	1.5211	1.5375	1.9284	1.9344	1.9326	1.9405	0.75	0.80	0.85	1.361	0.070
1.5125	1.5250	1.5211	1.5375	1.9284	1.9344	1.9326	1.9405	0.85	0.90	0.95	1.199	0.096
1.5375	1.5500	1.5462	1.5625	1.9405	1.9465	1.9447	1.9525	-0.85	-0.80	-0.75	0.332	0.102
1.5375	1.5500	1.5462	1.5625	1.9405	1.9465	1.9447	1.9525	-0.75	-0.70	-0.65	0.192	0.039
1.5375	1.5500	1.5462	1.5625	1.9405	1.9465	1.9447	1.9525	-0.65	-0.60	-0.55	0.274	0.034
1.5375	1.5500	1.5462	1.5625	1.9405	1.9465	1.9447	1.9525	-0.55	-0.50	-0.45	0.379	0.038
1.5375	1.5500	1.5462	1.5625	1.9405	1.9465	1.9447	1.9525	-0.45	-0.40	-0.35	0.593	0.042

1.5375	1.5500	1.5462	1.5625	1.9405	1.9465	1.9447	1.9525	-0.35	-0.30	-0.25	0.877	0.051
1.5375	1.5500	1.5462	1.5625	1.9405	1.9465	1.9447	1.9525	-0.25	-0.20	-0.15	1.125	0.057
1.5375	1.5500	1.5462	1.5625	1.9405	1.9465	1.9447	1.9525	-0.15	-0.10	-0.05	1.093	0.050
1.5375	1.5500	1.5462	1.5625	1.9405	1.9465	1.9447	1.9525	-0.05	0.00	0.05	1.367	0.064
1.5375	1.5500	1.5462	1.5625	1.9405	1.9465	1.9447	1.9525	0.05	0.10	0.15	1.383	0.059
1.5375	1.5500	1.5462	1.5625	1.9405	1.9465	1.9447	1.9525	0.15	0.20	0.25	1.624	0.067
1.5375	1.5500	1.5462	1.5625	1.9405	1.9465	1.9447	1.9525	0.25	0.30	0.35	1.480	0.060
1.5375	1.5500	1.5462	1.5625	1.9405	1.9465	1.9447	1.9525	0.35	0.40	0.45	1.405	0.055
1.5375	1.5500	1.5462	1.5625	1.9405	1.9465	1.9447	1.9525	0.45	0.50	0.55	1.319	0.057
1.5375	1.5500	1.5462	1.5625	1.9405	1.9465	1.9447	1.9525	0.55	0.60	0.65	1.408	0.060
1.5375	1.5500	1.5462	1.5625	1.9405	1.9465	1.9447	1.9525	0.65	0.70	0.75	1.288	0.062
1.5375	1.5500	1.5462	1.5625	1.9405	1.9465	1.9447	1.9525	0.75	0.80	0.85	1.271	0.070
1.5375	1.5500	1.5462	1.5625	1.9405	1.9465	1.9447	1.9525	0.85	0.90	0.95	1.055	0.087
1.5625	1.5750	1.5713	1.5875	1.9525	1.9585	1.9568	1.9645	-0.85	-0.80	-0.75	0.207	0.061
1.5625	1.5750	1.5713	1.5875	1.9525	1.9585	1.9568	1.9645	-0.75	-0.70	-0.65	0.202	0.032
1.5625	1.5750	1.5713	1.5875	1.9525	1.9585	1.9568	1.9645	-0.65	-0.60	-0.55	0.272	0.031
1.5625	1.5750	1.5713	1.5875	1.9525	1.9585	1.9568	1.9645	-0.55	-0.50	-0.45	0.324	0.032
1.5625	1.5750	1.5713	1.5875	1.9525	1.9585	1.9568	1.9645	-0.45	-0.40	-0.35	0.569	0.038
1.5625	1.5750	1.5713	1.5875	1.9525	1.9585	1.9568	1.9645	-0.35	-0.30	-0.25	0.720	0.041
1.5625	1.5750	1.5713	1.5875	1.9525	1.9585	1.9568	1.9645	-0.25	-0.20	-0.15	0.982	0.047
1.5625	1.5750	1.5713	1.5875	1.9525	1.9585	1.9568	1.9645	-0.15	-0.10	-0.05	1.111	0.050
1.5625	1.5750	1.5713	1.5875	1.9525	1.9585	1.9568	1.9645	-0.05	0.00	0.05	1.232	0.055
1.5625	1.5750	1.5713	1.5875	1.9525	1.9585	1.9568	1.9645	0.05	0.10	0.15	1.364	0.056
1.5625	1.5750	1.5713	1.5875	1.9525	1.9585	1.9568	1.9645	0.15	0.20	0.25	1.366	0.055
1.5625	1.5750	1.5713	1.5875	1.9525	1.9585	1.9568	1.9645	0.25	0.30	0.35	1.553	0.061
1.5625	1.5750	1.5713	1.5875	1.9525	1.9585	1.9568	1.9645	0.35	0.40	0.45	1.400	0.057
1.5625	1.5750	1.5713	1.5875	1.9525	1.9585	1.9568	1.9645	0.45	0.50	0.55	1.372	0.053
1.5625	1.5750	1.5713	1.5875	1.9525	1.9585	1.9568	1.9645	0.55	0.60	0.65	1.289	0.052
1.5625	1.5750	1.5713	1.5875	1.9525	1.9585	1.9568	1.9645	0.65	0.70	0.75	1.303	0.059
1.5625	1.5750	1.5713	1.5875	1.9525	1.9585	1.9568	1.9645	0.75	0.80	0.85	1.339	0.068
1.5625	1.5750	1.5713	1.5875	1.9525	1.9585	1.9568	1.9645	0.85	0.90	0.95	0.995	0.083
1.5875	1.6000	1.5960	1.6125	1.9645	1.9705	1.9686	1.9764	-0.85	-0.80	-0.75	0.155	0.050
1.5875	1.6000	1.5960	1.6125	1.9645	1.9705	1.9686	1.9764	-0.75	-0.70	-0.65	0.139	0.027
1.5875	1.6000	1.5960	1.6125	1.9645	1.9705	1.9686	1.9764	-0.65	-0.60	-0.55	0.178	0.023
1.5875	1.6000	1.5960	1.6125	1.9645	1.9705	1.9686	1.9764	-0.55	-0.50	-0.45	0.256	0.027
1.5875	1.6000	1.5960	1.6125	1.9645	1.9705	1.9686	1.9764	-0.45	-0.40	-0.35	0.473	0.034
1.5875	1.6000	1.5960	1.6125	1.9645	1.9705	1.9686	1.9764	-0.35	-0.30	-0.25	0.713	0.040
1.5875	1.6000	1.5960	1.6125	1.9645	1.9705	1.9686	1.9764	-0.25	-0.20	-0.15	0.846	0.042
1.5875	1.6000	1.5960	1.6125	1.9645	1.9705	1.9686	1.9764	-0.15	-0.10	-0.05	1.044	0.047
1.5875	1.6000	1.5960	1.6125	1.9645	1.9705	1.9686	1.9764	-0.05	0.00	0.05	1.035	0.049
1.5875	1.6000	1.5960	1.6125	1.9645	1.9705	1.9686	1.9764	0.05	0.10	0.15	1.212	0.051
1.5875	1.6000	1.5960	1.6125	1.9645	1.9705	1.9686	1.9764	0.15	0.20	0.25	1.260	0.051
1.5875	1.6000	1.5960	1.6125	1.9645	1.9705	1.9686	1.9764	0.25	0.30	0.35	1.310	0.053
1.5875	1.6000	1.5960	1.6125	1.9645	1.9705	1.9686	1.9764	0.35	0.40	0.45	1.212	0.045
1.5875	1.6000	1.5960	1.6125	1.9645	1.9705	1.9686	1.9764	0.45	0.50	0.55	1.220	0.050
1.5875	1.6000	1.5960	1.6125	1.9645	1.9705	1.9686	1.9764	0.55	0.60	0.65	1.302	0.049
1.5875	1.6000	1.5960	1.6125	1.9645	1.9705	1.9686	1.9764	0.65	0.70	0.75	1.309	0.060
1.5875	1.6000	1.5960	1.6125	1.9645	1.9705	1.9686	1.9764	0.75	0.80	0.85	1.260	0.067
1.5875	1.6000	1.5960	1.6125	1.9645	1.9705	1.9686	1.9764	0.85	0.90	0.95	1.076	0.083
1.6125	1.6250	1.6214	1.6375	1.9764	1.9824	1.9806	1.9883	-0.85	-0.80	-0.75	0.230	0.054
1.6125	1.6250	1.6214	1.6375	1.9764	1.9824	1.9806	1.9883	-0.75	-0.70	-0.65	0.219	0.031
1.6125	1.6250	1.6214	1.6375	1.9764	1.9824	1.9806	1.9883	-0.65	-0.60	-0.55	0.188	0.025
1.6125	1.6250	1.6214	1.6375	1.9764	1.9824	1.9806	1.9883	-0.55	-0.50	-0.45	0.291	0.027
1.6125	1.6250	1.6214	1.6375	1.9764	1.9824	1.9806	1.9883	-0.45	-0.40	-0.35	0.433	0.030
1.6125	1.6250	1.6214	1.6375	1.9764	1.9824	1.9806	1.9883	-0.35	-0.30	-0.25	0.601	0.036
1.6125	1.6250	1.6214	1.6375	1.9764	1.9824	1.9806	1.9883	-0.25	-0.20	-0.15	0.789	0.039
1.6125	1.6250	1.6214	1.6375	1.9764	1.9824	1.9806	1.9883	-0.15	-0.10	-0.05	0.924	0.045
1.6125	1.6250	1.6214	1.6375	1.9764	1.9824	1.9806	1.9883	-0.05	0.00	0.05	0.971	0.048
1.6125	1.6250	1.6214	1.6375	1.9764	1.9824	1.9806	1.9883	0.05	0.10	0.15	1.130	0.047
1.6125	1.6250	1.6214	1.6375	1.9764	1.9824	1.9806	1.9883	0.15	0.20	0.25	1.263	0.051
1.6125	1.6250	1.6214	1.6375	1.9764	1.9824	1.9806	1.9883	0.25	0.30	0.35	1.368	0.053
1.6125	1.6250	1.6214	1.6375	1.9764	1.9824	1.9806	1.9883	0.35	0.40	0.45	1.324	0.049
1.6125	1.6250	1.6214	1.6375	1.9764	1.9824	1.9806	1.9883	0.45	0.50	0.55	1.237	0.053
1.6125	1.6250	1.6214	1.6375	1.9764	1.9824	1.9806	1.9883	0.55	0.60	0.65	1.169	0.047

1.6125	1.6250	1.6214	1.6375	1.9764	1.9824	1.9806	1.9883	0.65	0.70	0.75	1.224	0.058
1.6125	1.6250	1.6214	1.6375	1.9764	1.9824	1.9806	1.9883	0.75	0.80	0.85	1.085	0.057
1.6125	1.6250	1.6214	1.6375	1.9764	1.9824	1.9806	1.9883	0.85	0.90	0.95	1.090	0.086
1.6375	1.6500	1.6468	1.6625	1.9883	1.9942	1.9926	2.0000	-0.85	-0.80	-0.75	0.133	0.046
1.6375	1.6500	1.6468	1.6625	1.9883	1.9942	1.9926	2.0000	-0.75	-0.70	-0.65	0.189	0.036
1.6375	1.6500	1.6468	1.6625	1.9883	1.9942	1.9926	2.0000	-0.65	-0.60	-0.55	0.193	0.031
1.6375	1.6500	1.6468	1.6625	1.9883	1.9942	1.9926	2.0000	-0.55	-0.50	-0.45	0.204	0.028
1.6375	1.6500	1.6468	1.6625	1.9883	1.9942	1.9926	2.0000	-0.45	-0.40	-0.35	0.401	0.035
1.6375	1.6500	1.6468	1.6625	1.9883	1.9942	1.9926	2.0000	-0.35	-0.30	-0.25	0.510	0.036
1.6375	1.6500	1.6468	1.6625	1.9883	1.9942	1.9926	2.0000	-0.25	-0.20	-0.15	0.756	0.044
1.6375	1.6500	1.6468	1.6625	1.9883	1.9942	1.9926	2.0000	-0.15	-0.10	-0.05	1.011	0.050
1.6375	1.6500	1.6468	1.6625	1.9883	1.9942	1.9926	2.0000	-0.05	0.00	0.05	1.013	0.057
1.6375	1.6500	1.6468	1.6625	1.9883	1.9942	1.9926	2.0000	0.05	0.10	0.15	0.995	0.048
1.6375	1.6500	1.6468	1.6625	1.9883	1.9942	1.9926	2.0000	0.15	0.20	0.25	1.038	0.050
1.6375	1.6500	1.6468	1.6625	1.9883	1.9942	1.9926	2.0000	0.25	0.30	0.35	1.233	0.055
1.6375	1.6500	1.6468	1.6625	1.9883	1.9942	1.9926	2.0000	0.35	0.40	0.45	1.188	0.056
1.6375	1.6500	1.6468	1.6625	1.9883	1.9942	1.9926	2.0000	0.45	0.50	0.55	1.148	0.054
1.6375	1.6500	1.6468	1.6625	1.9883	1.9942	1.9926	2.0000	0.55	0.60	0.65	1.274	0.058
1.6375	1.6500	1.6468	1.6625	1.9883	1.9942	1.9926	2.0000	0.65	0.70	0.75	1.218	0.065
1.6375	1.6500	1.6468	1.6625	1.9883	1.9942	1.9926	2.0000	0.75	0.80	0.85	1.309	0.073
1.6375	1.6500	1.6468	1.6625	1.9883	1.9942	1.9926	2.0000	0.85	0.90	0.95	1.211	0.105
1.6625	1.6750	1.6722	1.6875	2.0000	2.0059	2.0046	2.0117	-0.85	-0.80	-0.75	0.241	0.048
1.6625	1.6750	1.6722	1.6875	2.0000	2.0059	2.0046	2.0117	-0.75	-0.70	-0.65	0.157	0.024
1.6625	1.6750	1.6722	1.6875	2.0000	2.0059	2.0046	2.0117	-0.65	-0.60	-0.55	0.178	0.021
1.6625	1.6750	1.6722	1.6875	2.0000	2.0059	2.0046	2.0117	-0.55	-0.50	-0.45	0.202	0.021
1.6625	1.6750	1.6722	1.6875	2.0000	2.0059	2.0046	2.0117	-0.45	-0.40	-0.35	0.397	0.030
1.6625	1.6750	1.6722	1.6875	2.0000	2.0059	2.0046	2.0117	-0.35	-0.30	-0.25	0.504	0.031
1.6625	1.6750	1.6722	1.6875	2.0000	2.0059	2.0046	2.0117	-0.25	-0.20	-0.15	0.655	0.034
1.6625	1.6750	1.6722	1.6875	2.0000	2.0059	2.0046	2.0117	-0.15	-0.10	-0.05	0.806	0.039
1.6625	1.6750	1.6722	1.6875	2.0000	2.0059	2.0046	2.0117	-0.05	0.00	0.05	0.941	0.046
1.6625	1.6750	1.6722	1.6875	2.0000	2.0059	2.0046	2.0117	0.05	0.10	0.15	0.987	0.043
1.6625	1.6750	1.6722	1.6875	2.0000	2.0059	2.0046	2.0117	0.15	0.20	0.25	1.146	0.046
1.6625	1.6750	1.6722	1.6875	2.0000	2.0059	2.0046	2.0117	0.25	0.30	0.35	1.056	0.044
1.6625	1.6750	1.6722	1.6875	2.0000	2.0059	2.0046	2.0117	0.35	0.40	0.45	1.182	0.046
1.6625	1.6750	1.6722	1.6875	2.0000	2.0059	2.0046	2.0117	0.45	0.50	0.55	1.252	0.050
1.6625	1.6750	1.6722	1.6875	2.0000	2.0059	2.0046	2.0117	0.55	0.60	0.65	1.169	0.048
1.6625	1.6750	1.6722	1.6875	2.0000	2.0059	2.0046	2.0117	0.65	0.70	0.75	1.304	0.061
1.6625	1.6750	1.6722	1.6875	2.0000	2.0059	2.0046	2.0117	0.75	0.80	0.85	1.302	0.067
1.6625	1.6750	1.6722	1.6875	2.0000	2.0059	2.0046	2.0117	0.85	0.90	0.95	1.162	0.083
1.6875	1.7000	1.6976	1.7125	2.0117	2.0175	2.0164	2.0233	-0.85	-0.80	-0.75	0.148	0.020
1.6875	1.7000	1.6976	1.7125	2.0117	2.0175	2.0164	2.0233	-0.75	-0.70	-0.65	0.130	0.024
1.6875	1.7000	1.6976	1.7125	2.0117	2.0175	2.0164	2.0233	-0.65	-0.60	-0.55	0.193	0.029
1.6875	1.7000	1.6976	1.7125	2.0117	2.0175	2.0164	2.0233	-0.55	-0.50	-0.45	0.189	0.022
1.6875	1.7000	1.6976	1.7125	2.0117	2.0175	2.0164	2.0233	-0.45	-0.40	-0.35	0.330	0.027
1.6875	1.7000	1.6976	1.7125	2.0117	2.0175	2.0164	2.0233	-0.35	-0.30	-0.25	0.439	0.030
1.6875	1.7000	1.6976	1.7125	2.0117	2.0175	2.0164	2.0233	-0.25	-0.20	-0.15	0.628	0.036
1.6875	1.7000	1.6976	1.7125	2.0117	2.0175	2.0164	2.0233	-0.15	-0.10	-0.05	0.790	0.040
1.6875	1.7000	1.6976	1.7125	2.0117	2.0175	2.0164	2.0233	-0.05	0.00	0.05	0.872	0.043
1.6875	1.7000	1.6976	1.7125	2.0117	2.0175	2.0164	2.0233	0.05	0.10	0.15	0.981	0.042
1.6875	1.7000	1.6976	1.7125	2.0117	2.0175	2.0164	2.0233	0.15	0.20	0.25	1.063	0.046
1.6875	1.7000	1.6976	1.7125	2.0117	2.0175	2.0164	2.0233	0.25	0.30	0.35	1.075	0.044
1.6875	1.7000	1.6976	1.7125	2.0117	2.0175	2.0164	2.0233	0.35	0.40	0.45	1.120	0.050
1.6875	1.7000	1.6976	1.7125	2.0117	2.0175	2.0164	2.0233	0.45	0.50	0.55	1.214	0.050
1.6875	1.7000	1.6976	1.7125	2.0117	2.0175	2.0164	2.0233	0.55	0.60	0.65	1.187	0.050
1.6875	1.7000	1.6976	1.7125	2.0117	2.0175	2.0164	2.0233	0.65	0.70	0.75	1.364	0.062
1.6875	1.7000	1.6976	1.7125	2.0117	2.0175	2.0164	2.0233	0.75	0.80	0.85	1.229	0.063
1.6875	1.7000	1.6976	1.7125	2.0117	2.0175	2.0164	2.0233	0.85	0.90	0.95	1.135	0.083
1.7125	1.7250	1.7229	1.7375	2.0233	2.0291	2.0282	2.0349	-0.85	-0.80	-0.75	0.196	0.037
1.7125	1.7250	1.7229	1.7375	2.0233	2.0291	2.0282	2.0349	-0.75	-0.70	-0.65	0.201	0.024
1.7125	1.7250	1.7229	1.7375	2.0233	2.0291	2.0282	2.0349	-0.65	-0.60	-0.55	0.150	0.020
1.7125	1.7250	1.7229	1.7375	2.0233	2.0291	2.0282	2.0349	-0.55	-0.50	-0.45	0.210	0.023
1.7125	1.7250	1.7229	1.7375	2.0233	2.0291	2.0282	2.0349	-0.45	-0.40	-0.35	0.345	0.026
1.7125	1.7250	1.7229	1.7375	2.0233	2.0291	2.0282	2.0349	-0.35	-0.30	-0.25	0.317	0.024
1.7125	1.7250	1.7229	1.7375	2.0233	2.0291	2.0282	2.0349	-0.25	-0.20	-0.15	0.571	0.032

1.7125	1.7250	1.7229	1.7375	2.0233	2.0291	2.0282	2.0349	-0.15	-0.10	-0.05	0.642	0.035
1.7125	1.7250	1.7229	1.7375	2.0233	2.0291	2.0282	2.0349	-0.05	0.00	0.05	0.801	0.040
1.7125	1.7250	1.7229	1.7375	2.0233	2.0291	2.0282	2.0349	0.05	0.10	0.15	0.824	0.036
1.7125	1.7250	1.7229	1.7375	2.0233	2.0291	2.0282	2.0349	0.15	0.20	0.25	0.996	0.044
1.7125	1.7250	1.7229	1.7375	2.0233	2.0291	2.0282	2.0349	0.25	0.30	0.35	1.155	0.047
1.7125	1.7250	1.7229	1.7375	2.0233	2.0291	2.0282	2.0349	0.35	0.40	0.45	1.108	0.044
1.7125	1.7250	1.7229	1.7375	2.0233	2.0291	2.0282	2.0349	0.45	0.50	0.55	1.180	0.048
1.7125	1.7250	1.7229	1.7375	2.0233	2.0291	2.0282	2.0349	0.55	0.60	0.65	1.233	0.052
1.7125	1.7250	1.7229	1.7375	2.0233	2.0291	2.0282	2.0349	0.65	0.70	0.75	1.421	0.065
1.7125	1.7250	1.7229	1.7375	2.0233	2.0291	2.0282	2.0349	0.75	0.80	0.85	1.384	0.069
1.7125	1.7250	1.7229	1.7375	2.0233	2.0291	2.0282	2.0349	0.85	0.90	0.95	1.115	0.085
1.7375	1.7500	1.7482	1.7625	2.0349	2.0407	2.0398	2.0464	-0.85	-0.80	-0.75	0.300	0.052
1.7375	1.7500	1.7482	1.7625	2.0349	2.0407	2.0398	2.0464	-0.75	-0.70	-0.65	0.208	0.029
1.7375	1.7500	1.7482	1.7625	2.0349	2.0407	2.0398	2.0464	-0.65	-0.60	-0.55	0.130	0.020
1.7375	1.7500	1.7482	1.7625	2.0349	2.0407	2.0398	2.0464	-0.55	-0.50	-0.45	0.193	0.024
1.7375	1.7500	1.7482	1.7625	2.0349	2.0407	2.0398	2.0464	-0.45	-0.40	-0.35	0.251	0.023
1.7375	1.7500	1.7482	1.7625	2.0349	2.0407	2.0398	2.0464	-0.35	-0.30	-0.25	0.383	0.027
1.7375	1.7500	1.7482	1.7625	2.0349	2.0407	2.0398	2.0464	-0.25	-0.20	-0.15	0.549	0.031
1.7375	1.7500	1.7482	1.7625	2.0349	2.0407	2.0398	2.0464	-0.15	-0.10	-0.05	0.738	0.039
1.7375	1.7500	1.7482	1.7625	2.0349	2.0407	2.0398	2.0464	-0.05	0.00	0.05	0.776	0.041
1.7375	1.7500	1.7482	1.7625	2.0349	2.0407	2.0398	2.0464	0.05	0.10	0.15	0.834	0.037
1.7375	1.7500	1.7482	1.7625	2.0349	2.0407	2.0398	2.0464	0.15	0.20	0.25	0.923	0.041
1.7375	1.7500	1.7482	1.7625	2.0349	2.0407	2.0398	2.0464	0.25	0.30	0.35	1.061	0.045
1.7375	1.7500	1.7482	1.7625	2.0349	2.0407	2.0398	2.0464	0.35	0.40	0.45	1.181	0.051
1.7375	1.7500	1.7482	1.7625	2.0349	2.0407	2.0398	2.0464	0.45	0.50	0.55	1.192	0.048
1.7375	1.7500	1.7482	1.7625	2.0349	2.0407	2.0398	2.0464	0.55	0.60	0.65	1.223	0.050
1.7375	1.7500	1.7482	1.7625	2.0349	2.0407	2.0398	2.0464	0.65	0.70	0.75	1.424	0.066
1.7375	1.7500	1.7482	1.7625	2.0349	2.0407	2.0398	2.0464	0.75	0.80	0.85	1.394	0.069
1.7375	1.7500	1.7482	1.7625	2.0349	2.0407	2.0398	2.0464	0.85	0.90	0.95	1.289	0.098
1.7625	1.7750	1.7736	1.7875	2.0464	2.0521	2.0515	2.0578	-0.85	-0.80	-0.75	0.236	0.044
1.7625	1.7750	1.7736	1.7875	2.0464	2.0521	2.0515	2.0578	-0.75	-0.70	-0.65	0.224	0.028
1.7625	1.7750	1.7736	1.7875	2.0464	2.0521	2.0515	2.0578	-0.65	-0.60	-0.55	0.133	0.019
1.7625	1.7750	1.7736	1.7875	2.0464	2.0521	2.0515	2.0578	-0.55	-0.50	-0.45	0.166	0.019
1.7625	1.7750	1.7736	1.7875	2.0464	2.0521	2.0515	2.0578	-0.45	-0.40	-0.35	0.253	0.022
1.7625	1.7750	1.7736	1.7875	2.0464	2.0521	2.0515	2.0578	-0.35	-0.30	-0.25	0.346	0.025
1.7625	1.7750	1.7736	1.7875	2.0464	2.0521	2.0515	2.0578	-0.25	-0.20	-0.15	0.494	0.030
1.7625	1.7750	1.7736	1.7875	2.0464	2.0521	2.0515	2.0578	-0.15	-0.10	-0.05	0.657	0.036
1.7625	1.7750	1.7736	1.7875	2.0464	2.0521	2.0515	2.0578	-0.05	0.00	0.05	0.671	0.037
1.7625	1.7750	1.7736	1.7875	2.0464	2.0521	2.0515	2.0578	0.05	0.10	0.15	0.830	0.040
1.7625	1.7750	1.7736	1.7875	2.0464	2.0521	2.0515	2.0578	0.15	0.20	0.25	0.905	0.041
1.7625	1.7750	1.7736	1.7875	2.0464	2.0521	2.0515	2.0578	0.25	0.30	0.35	1.020	0.044
1.7625	1.7750	1.7736	1.7875	2.0464	2.0521	2.0515	2.0578	0.35	0.40	0.45	1.026	0.046
1.7625	1.7750	1.7736	1.7875	2.0464	2.0521	2.0515	2.0578	0.45	0.50	0.55	1.193	0.050
1.7625	1.7750	1.7736	1.7875	2.0464	2.0521	2.0515	2.0578	0.55	0.60	0.65	1.281	0.052
1.7625	1.7750	1.7736	1.7875	2.0464	2.0521	2.0515	2.0578	0.65	0.70	0.75	1.329	0.062
1.7625	1.7750	1.7736	1.7875	2.0464	2.0521	2.0515	2.0578	0.75	0.80	0.85	1.370	0.069
1.7625	1.7750	1.7736	1.7875	2.0464	2.0521	2.0515	2.0578	0.85	0.90	0.95	1.257	0.092
1.7875	1.8000	1.7989	1.8125	2.0578	2.0635	2.0630	2.0692	-0.85	-0.80	-0.75	0.208	0.043
1.7875	1.8000	1.7989	1.8125	2.0578	2.0635	2.0630	2.0692	-0.75	-0.70	-0.65	0.222	0.030
1.7875	1.8000	1.7989	1.8125	2.0578	2.0635	2.0630	2.0692	-0.65	-0.60	-0.55	0.139	0.026
1.7875	1.8000	1.7989	1.8125	2.0578	2.0635	2.0630	2.0692	-0.55	-0.50	-0.45	0.158	0.023
1.7875	1.8000	1.7989	1.8125	2.0578	2.0635	2.0630	2.0692	-0.45	-0.40	-0.35	0.243	0.026
1.7875	1.8000	1.7989	1.8125	2.0578	2.0635	2.0630	2.0692	-0.35	-0.30	-0.25	0.299	0.025
1.7875	1.8000	1.7989	1.8125	2.0578	2.0635	2.0630	2.0692	-0.25	-0.20	-0.15	0.527	0.032
1.7875	1.8000	1.7989	1.8125	2.0578	2.0635	2.0630	2.0692	-0.15	-0.10	-0.05	0.574	0.034
1.7875	1.8000	1.7989	1.8125	2.0578	2.0635	2.0630	2.0692	-0.05	0.00	0.05	0.708	0.039
1.7875	1.8000	1.7989	1.8125	2.0578	2.0635	2.0630	2.0692	0.05	0.10	0.15	0.782	0.039
1.7875	1.8000	1.7989	1.8125	2.0578	2.0635	2.0630	2.0692	0.15	0.20	0.25	0.909	0.043
1.7875	1.8000	1.7989	1.8125	2.0578	2.0635	2.0630	2.0692	0.25	0.30	0.35	0.916	0.043
1.7875	1.8000	1.7989	1.8125	2.0578	2.0635	2.0630	2.0692	0.35	0.40	0.45	1.031	0.049
1.7875	1.8000	1.7989	1.8125	2.0578	2.0635	2.0630	2.0692	0.45	0.50	0.55	1.094	0.049
1.7875	1.8000	1.7989	1.8125	2.0578	2.0635	2.0630	2.0692	0.55	0.60	0.65	1.139	0.055
1.7875	1.8000	1.7989	1.8125	2.0578	2.0635	2.0630	2.0692	0.65	0.70	0.75	1.360	0.069
1.7875	1.8000	1.7989	1.8125	2.0578	2.0635	2.0630	2.0692	0.75	0.80	0.85	1.411	0.075

1.7875	1.8000	1.7989	1.8125	2.0578	2.0635	2.0630	2.0692	0.85	0.90	0.95	1.231	0.098
1.8125	1.8250	1.8241	1.8375	2.0692	2.0749	2.0745	2.0805	-0.85	-0.80	-0.75	0.290	0.047
1.8125	1.8250	1.8241	1.8375	2.0692	2.0749	2.0745	2.0805	-0.75	-0.70	-0.65	0.258	0.032
1.8125	1.8250	1.8241	1.8375	2.0692	2.0749	2.0745	2.0805	-0.65	-0.60	-0.55	0.164	0.023
1.8125	1.8250	1.8241	1.8375	2.0692	2.0749	2.0745	2.0805	-0.55	-0.50	-0.45	0.172	0.021
1.8125	1.8250	1.8241	1.8375	2.0692	2.0749	2.0745	2.0805	-0.45	-0.40	-0.35	0.238	0.022
1.8125	1.8250	1.8241	1.8375	2.0692	2.0749	2.0745	2.0805	-0.35	-0.30	-0.25	0.289	0.024
1.8125	1.8250	1.8241	1.8375	2.0692	2.0749	2.0745	2.0805	-0.25	-0.20	-0.15	0.475	0.030
1.8125	1.8250	1.8241	1.8375	2.0692	2.0749	2.0745	2.0805	-0.15	-0.10	-0.05	0.512	0.031
1.8125	1.8250	1.8241	1.8375	2.0692	2.0749	2.0745	2.0805	-0.05	0.00	0.05	0.575	0.033
1.8125	1.8250	1.8241	1.8375	2.0692	2.0749	2.0745	2.0805	0.05	0.10	0.15	0.765	0.036
1.8125	1.8250	1.8241	1.8375	2.0692	2.0749	2.0745	2.0805	0.15	0.20	0.25	0.818	0.040
1.8125	1.8250	1.8241	1.8375	2.0692	2.0749	2.0745	2.0805	0.25	0.30	0.35	0.946	0.043
1.8125	1.8250	1.8241	1.8375	2.0692	2.0749	2.0745	2.0805	0.35	0.40	0.45	1.022	0.046
1.8125	1.8250	1.8241	1.8375	2.0692	2.0749	2.0745	2.0805	0.45	0.50	0.55	1.168	0.050
1.8125	1.8250	1.8241	1.8375	2.0692	2.0749	2.0745	2.0805	0.55	0.60	0.65	1.126	0.052
1.8125	1.8250	1.8241	1.8375	2.0692	2.0749	2.0745	2.0805	0.65	0.70	0.75	1.216	0.055
1.8125	1.8250	1.8241	1.8375	2.0692	2.0749	2.0745	2.0805	0.75	0.80	0.85	1.441	0.070
1.8125	1.8250	1.8241	1.8375	2.0692	2.0749	2.0745	2.0805	0.85	0.90	0.95	1.326	0.099
1.8375	1.8500	1.8494	1.8625	2.0805	2.0861	2.0859	2.0917	-0.85	-0.80	-0.75	0.214	0.042
1.8375	1.8500	1.8494	1.8625	2.0805	2.0861	2.0859	2.0917	-0.75	-0.70	-0.65	0.284	0.032
1.8375	1.8500	1.8494	1.8625	2.0805	2.0861	2.0859	2.0917	-0.65	-0.60	-0.55	0.216	0.023
1.8375	1.8500	1.8494	1.8625	2.0805	2.0861	2.0859	2.0917	-0.55	-0.50	-0.45	0.167	0.021
1.8375	1.8500	1.8494	1.8625	2.0805	2.0861	2.0859	2.0917	-0.45	-0.40	-0.35	0.219	0.020
1.8375	1.8500	1.8494	1.8625	2.0805	2.0861	2.0859	2.0917	-0.35	-0.30	-0.25	0.301	0.023
1.8375	1.8500	1.8494	1.8625	2.0805	2.0861	2.0859	2.0917	-0.25	-0.20	-0.15	0.404	0.030
1.8375	1.8500	1.8494	1.8625	2.0805	2.0861	2.0859	2.0917	-0.15	-0.10	-0.05	0.435	0.029
1.8375	1.8500	1.8494	1.8625	2.0805	2.0861	2.0859	2.0917	-0.05	0.00	0.05	0.578	0.032
1.8375	1.8500	1.8494	1.8625	2.0805	2.0861	2.0859	2.0917	0.05	0.10	0.15	0.683	0.034
1.8375	1.8500	1.8494	1.8625	2.0805	2.0861	2.0859	2.0917	0.15	0.20	0.25	0.779	0.038
1.8375	1.8500	1.8494	1.8625	2.0805	2.0861	2.0859	2.0917	0.25	0.30	0.35	0.871	0.040
1.8375	1.8500	1.8494	1.8625	2.0805	2.0861	2.0859	2.0917	0.35	0.40	0.45	1.033	0.047
1.8375	1.8500	1.8494	1.8625	2.0805	2.0861	2.0859	2.0917	0.45	0.50	0.55	1.050	0.044
1.8375	1.8500	1.8494	1.8625	2.0805	2.0861	2.0859	2.0917	0.55	0.60	0.65	1.200	0.055
1.8375	1.8500	1.8494	1.8625	2.0805	2.0861	2.0859	2.0917	0.65	0.70	0.75	1.215	0.061
1.8375	1.8500	1.8494	1.8625	2.0805	2.0861	2.0859	2.0917	0.75	0.80	0.85	1.320	0.062
1.8375	1.8500	1.8494	1.8625	2.0805	2.0861	2.0859	2.0917	0.85	0.90	0.95	1.077	0.088
1.8625	1.8750	1.8746	1.8875	2.0917	2.0973	2.0972	2.1029	-0.85	-0.80	-0.75	0.365	0.066
1.8625	1.8750	1.8746	1.8875	2.0917	2.0973	2.0972	2.1029	-0.75	-0.70	-0.65	0.261	0.040
1.8625	1.8750	1.8746	1.8875	2.0917	2.0973	2.0972	2.1029	-0.65	-0.60	-0.55	0.169	0.025
1.8625	1.8750	1.8746	1.8875	2.0917	2.0973	2.0972	2.1029	-0.55	-0.50	-0.45	0.189	0.026
1.8625	1.8750	1.8746	1.8875	2.0917	2.0973	2.0972	2.1029	-0.45	-0.40	-0.35	0.213	0.026
1.8625	1.8750	1.8746	1.8875	2.0917	2.0973	2.0972	2.1029	-0.35	-0.30	-0.25	0.276	0.028
1.8625	1.8750	1.8746	1.8875	2.0917	2.0973	2.0972	2.1029	-0.25	-0.20	-0.15	0.323	0.030
1.8625	1.8750	1.8746	1.8875	2.0917	2.0973	2.0972	2.1029	-0.15	-0.10	-0.05	0.431	0.041
1.8625	1.8750	1.8746	1.8875	2.0917	2.0973	2.0972	2.1029	-0.05	0.00	0.05	0.593	0.044
1.8625	1.8750	1.8746	1.8875	2.0917	2.0973	2.0972	2.1029	0.05	0.10	0.15	0.651	0.041
1.8625	1.8750	1.8746	1.8875	2.0917	2.0973	2.0972	2.1029	0.15	0.20	0.25	0.762	0.048
1.8625	1.8750	1.8746	1.8875	2.0917	2.0973	2.0972	2.1029	0.25	0.30	0.35	0.856	0.053
1.8625	1.8750	1.8746	1.8875	2.0917	2.0973	2.0972	2.1029	0.35	0.40	0.45	1.038	0.063
1.8625	1.8750	1.8746	1.8875	2.0917	2.0973	2.0972	2.1029	0.45	0.50	0.55	1.163	0.064
1.8625	1.8750	1.8746	1.8875	2.0917	2.0973	2.0972	2.1029	0.55	0.60	0.65	1.250	0.076
1.8625	1.8750	1.8746	1.8875	2.0917	2.0973	2.0972	2.1029	0.65	0.70	0.75	1.480	0.090
1.8625	1.8750	1.8746	1.8875	2.0917	2.0973	2.0972	2.1029	0.75	0.80	0.85	1.319	0.087
1.8625	1.8750	1.8746	1.8875	2.0917	2.0973	2.0972	2.1029	0.85	0.90	0.95	1.171	0.127
1.8875	1.9000	1.8998	1.9125	2.1029	2.1085	2.1084	2.1141	-0.85	-0.80	-0.75	0.310	0.046
1.8875	1.9000	1.8998	1.9125	2.1029	2.1085	2.1084	2.1141	-0.75	-0.70	-0.65	0.254	0.029
1.8875	1.9000	1.8998	1.9125	2.1029	2.1085	2.1084	2.1141	-0.65	-0.60	-0.55	0.129	0.020
1.8875	1.9000	1.8998	1.9125	2.1029	2.1085	2.1084	2.1141	-0.55	-0.50	-0.45	0.121	0.018
1.8875	1.9000	1.8998	1.9125	2.1029	2.1085	2.1084	2.1141	-0.45	-0.40	-0.35	0.170	0.020
1.8875	1.9000	1.8998	1.9125	2.1029	2.1085	2.1084	2.1141	-0.35	-0.30	-0.25	0.248	0.021
1.8875	1.9000	1.8998	1.9125	2.1029	2.1085	2.1084	2.1141	-0.25	-0.20	-0.15	0.347	0.024
1.8875	1.9000	1.8998	1.9125	2.1029	2.1085	2.1084	2.1141	-0.15	-0.10	-0.05	0.417	0.029
1.8875	1.9000	1.8998	1.9125	2.1029	2.1085	2.1084	2.1141	-0.05	0.00	0.05	0.519	0.032

1.8875	1.9000	1.8998	1.9125	2.1029	2.1085	2.1084	2.1141	0.05	0.10	0.15	0.601	0.032
1.8875	1.9000	1.8998	1.9125	2.1029	2.1085	2.1084	2.1141	0.15	0.20	0.25	0.808	0.041
1.8875	1.9000	1.8998	1.9125	2.1029	2.1085	2.1084	2.1141	0.25	0.30	0.35	0.812	0.040
1.8875	1.9000	1.8998	1.9125	2.1029	2.1085	2.1084	2.1141	0.35	0.40	0.45	0.992	0.048
1.8875	1.9000	1.8998	1.9125	2.1029	2.1085	2.1084	2.1141	0.45	0.50	0.55	1.035	0.046
1.8875	1.9000	1.8998	1.9125	2.1029	2.1085	2.1084	2.1141	0.55	0.60	0.65	1.264	0.061
1.8875	1.9000	1.8998	1.9125	2.1029	2.1085	2.1084	2.1141	0.65	0.70	0.75	1.220	0.064
1.8875	1.9000	1.8998	1.9125	2.1029	2.1085	2.1084	2.1141	0.75	0.80	0.85	1.209	0.061
1.8875	1.9000	1.8998	1.9125	2.1029	2.1085	2.1084	2.1141	0.85	0.90	0.95	0.988	0.089
1.9125	1.9250	1.9251	1.9375	2.1141	2.1196	2.1196	2.1251	-0.85	-0.80	-0.75	0.368	0.054
1.9125	1.9250	1.9251	1.9375	2.1141	2.1196	2.1196	2.1251	-0.75	-0.70	-0.65	0.277	0.032
1.9125	1.9250	1.9251	1.9375	2.1141	2.1196	2.1196	2.1251	-0.65	-0.60	-0.55	0.167	0.020
1.9125	1.9250	1.9251	1.9375	2.1141	2.1196	2.1196	2.1251	-0.55	-0.50	-0.45	0.114	0.019
1.9125	1.9250	1.9251	1.9375	2.1141	2.1196	2.1196	2.1251	-0.45	-0.40	-0.35	0.179	0.019
1.9125	1.9250	1.9251	1.9375	2.1141	2.1196	2.1196	2.1251	-0.35	-0.30	-0.25	0.252	0.023
1.9125	1.9250	1.9251	1.9375	2.1141	2.1196	2.1196	2.1251	-0.25	-0.20	-0.15	0.312	0.023
1.9125	1.9250	1.9251	1.9375	2.1141	2.1196	2.1196	2.1251	-0.15	-0.10	-0.05	0.464	0.030
1.9125	1.9250	1.9251	1.9375	2.1141	2.1196	2.1196	2.1251	-0.05	0.00	0.05	0.500	0.031
1.9125	1.9250	1.9251	1.9375	2.1141	2.1196	2.1196	2.1251	0.05	0.10	0.15	0.623	0.032
1.9125	1.9250	1.9251	1.9375	2.1141	2.1196	2.1196	2.1251	0.15	0.20	0.25	0.708	0.036
1.9125	1.9250	1.9251	1.9375	2.1141	2.1196	2.1196	2.1251	0.25	0.30	0.35	0.807	0.040
1.9125	1.9250	1.9251	1.9375	2.1141	2.1196	2.1196	2.1251	0.35	0.40	0.45	0.884	0.042
1.9125	1.9250	1.9251	1.9375	2.1141	2.1196	2.1196	2.1251	0.45	0.50	0.55	1.002	0.045
1.9125	1.9250	1.9251	1.9375	2.1141	2.1196	2.1196	2.1251	0.55	0.60	0.65	1.200	0.061
1.9125	1.9250	1.9251	1.9375	2.1141	2.1196	2.1196	2.1251	0.65	0.70	0.75	1.171	0.060
1.9125	1.9250	1.9251	1.9375	2.1141	2.1196	2.1196	2.1251	0.75	0.80	0.85	1.272	0.062
1.9125	1.9250	1.9251	1.9375	2.1141	2.1196	2.1196	2.1251	0.85	0.90	0.95	1.093	0.086
1.9375	1.9500	1.9502	1.9625	2.1251	2.1306	2.1307	2.1361	-0.85	-0.80	-0.75	0.318	0.044
1.9375	1.9500	1.9502	1.9625	2.1251	2.1306	2.1307	2.1361	-0.75	-0.70	-0.65	0.200	0.027
1.9375	1.9500	1.9502	1.9625	2.1251	2.1306	2.1307	2.1361	-0.65	-0.60	-0.55	0.187	0.022
1.9375	1.9500	1.9502	1.9625	2.1251	2.1306	2.1307	2.1361	-0.55	-0.50	-0.45	0.138	0.017
1.9375	1.9500	1.9502	1.9625	2.1251	2.1306	2.1307	2.1361	-0.45	-0.40	-0.35	0.158	0.018
1.9375	1.9500	1.9502	1.9625	2.1251	2.1306	2.1307	2.1361	-0.35	-0.30	-0.25	0.241	0.020
1.9375	1.9500	1.9502	1.9625	2.1251	2.1306	2.1307	2.1361	-0.25	-0.20	-0.15	0.258	0.022
1.9375	1.9500	1.9502	1.9625	2.1251	2.1306	2.1307	2.1361	-0.15	-0.10	-0.05	0.418	0.030
1.9375	1.9500	1.9502	1.9625	2.1251	2.1306	2.1307	2.1361	-0.05	0.00	0.05	0.520	0.030
1.9375	1.9500	1.9502	1.9625	2.1251	2.1306	2.1307	2.1361	0.05	0.10	0.15	0.589	0.030
1.9375	1.9500	1.9502	1.9625	2.1251	2.1306	2.1307	2.1361	0.15	0.20	0.25	0.645	0.032
1.9375	1.9500	1.9502	1.9625	2.1251	2.1306	2.1307	2.1361	0.25	0.30	0.35	0.759	0.037
1.9375	1.9500	1.9502	1.9625	2.1251	2.1306	2.1307	2.1361	0.35	0.40	0.45	0.857	0.040
1.9375	1.9500	1.9502	1.9625	2.1251	2.1306	2.1307	2.1361	0.45	0.50	0.55	1.015	0.043
1.9375	1.9500	1.9502	1.9625	2.1251	2.1306	2.1307	2.1361	0.55	0.60	0.65	1.149	0.054
1.9375	1.9500	1.9502	1.9625	2.1251	2.1306	2.1307	2.1361	0.65	0.70	0.75	1.286	0.062
1.9375	1.9500	1.9502	1.9625	2.1251	2.1306	2.1307	2.1361	0.75	0.80	0.85	1.329	0.069
1.9375	1.9500	1.9502	1.9625	2.1251	2.1306	2.1307	2.1361	0.85	0.90	0.95	0.931	0.085
1.9625	1.9750	1.9754	1.9875	2.1361	2.1416	2.1418	2.1471	-0.85	-0.80	-0.75	0.372	0.049
1.9625	1.9750	1.9754	1.9875	2.1361	2.1416	2.1418	2.1471	-0.75	-0.70	-0.65	0.233	0.026
1.9625	1.9750	1.9754	1.9875	2.1361	2.1416	2.1418	2.1471	-0.65	-0.60	-0.55	0.206	0.021
1.9625	1.9750	1.9754	1.9875	2.1361	2.1416	2.1418	2.1471	-0.55	-0.50	-0.45	0.178	0.021
1.9625	1.9750	1.9754	1.9875	2.1361	2.1416	2.1418	2.1471	-0.45	-0.40	-0.35	0.168	0.019
1.9625	1.9750	1.9754	1.9875	2.1361	2.1416	2.1418	2.1471	-0.35	-0.30	-0.25	0.201	0.015
1.9625	1.9750	1.9754	1.9875	2.1361	2.1416	2.1418	2.1471	-0.25	-0.20	-0.15	0.300	0.023
1.9625	1.9750	1.9754	1.9875	2.1361	2.1416	2.1418	2.1471	-0.15	-0.10	-0.05	0.319	0.025
1.9625	1.9750	1.9754	1.9875	2.1361	2.1416	2.1418	2.1471	-0.05	0.00	0.05	0.431	0.028
1.9625	1.9750	1.9754	1.9875	2.1361	2.1416	2.1418	2.1471	0.05	0.10	0.15	0.525	0.028
1.9625	1.9750	1.9754	1.9875	2.1361	2.1416	2.1418	2.1471	0.15	0.20	0.25	0.645	0.033
1.9625	1.9750	1.9754	1.9875	2.1361	2.1416	2.1418	2.1471	0.25	0.30	0.35	0.764	0.037
1.9625	1.9750	1.9754	1.9875	2.1361	2.1416	2.1418	2.1471	0.35	0.40	0.45	0.764	0.037
1.9625	1.9750	1.9754	1.9875	2.1361	2.1416	2.1418	2.1471	0.45	0.50	0.55	0.977	0.043
1.9625	1.9750	1.9754	1.9875	2.1361	2.1416	2.1418	2.1471	0.55	0.60	0.65	1.075	0.057
1.9625	1.9750	1.9754	1.9875	2.1361	2.1416	2.1418	2.1471	0.65	0.70	0.75	1.287	0.064
1.9625	1.9750	1.9754	1.9875	2.1361	2.1416	2.1418	2.1471	0.75	0.80	0.85	1.092	0.062
1.9625	1.9750	1.9754	1.9875	2.1361	2.1416	2.1418	2.1471	0.85	0.90	0.95	0.839	0.072
1.9875	2.0000	2.0006	2.0125	2.1471	2.1525	2.1528	2.1580	-0.85	-0.80	-0.75	0.292	0.045

1.9875	2.0000	2.0006	2.0125	2.1471	2.1525	2.1528	2.1580	-0.75	-0.70	-0.65	0.274	0.031
1.9875	2.0000	2.0006	2.0125	2.1471	2.1525	2.1528	2.1580	-0.65	-0.60	-0.55	0.241	0.024
1.9875	2.0000	2.0006	2.0125	2.1471	2.1525	2.1528	2.1580	-0.55	-0.50	-0.45	0.112	0.016
1.9875	2.0000	2.0006	2.0125	2.1471	2.1525	2.1528	2.1580	-0.45	-0.40	-0.35	0.142	0.017
1.9875	2.0000	2.0006	2.0125	2.1471	2.1525	2.1528	2.1580	-0.35	-0.30	-0.25	0.196	0.017
1.9875	2.0000	2.0006	2.0125	2.1471	2.1525	2.1528	2.1580	-0.25	-0.20	-0.15	0.283	0.021
1.9875	2.0000	2.0006	2.0125	2.1471	2.1525	2.1528	2.1580	-0.15	-0.10	-0.05	0.341	0.025
1.9875	2.0000	2.0006	2.0125	2.1471	2.1525	2.1528	2.1580	-0.05	0.00	0.05	0.389	0.025
1.9875	2.0000	2.0006	2.0125	2.1471	2.1525	2.1528	2.1580	0.05	0.10	0.15	0.556	0.030
1.9875	2.0000	2.0006	2.0125	2.1471	2.1525	2.1528	2.1580	0.15	0.20	0.25	0.601	0.031
1.9875	2.0000	2.0006	2.0125	2.1471	2.1525	2.1528	2.1580	0.25	0.30	0.35	0.719	0.035
1.9875	2.0000	2.0006	2.0125	2.1471	2.1525	2.1528	2.1580	0.35	0.40	0.45	0.766	0.038
1.9875	2.0000	2.0006	2.0125	2.1471	2.1525	2.1528	2.1580	0.45	0.50	0.55	0.845	0.041
1.9875	2.0000	2.0006	2.0125	2.1471	2.1525	2.1528	2.1580	0.55	0.60	0.65	1.104	0.054
1.9875	2.0000	2.0006	2.0125	2.1471	2.1525	2.1528	2.1580	0.65	0.70	0.75	1.211	0.063
1.9875	2.0000	2.0006	2.0125	2.1471	2.1525	2.1528	2.1580	0.75	0.80	0.85	1.059	0.061
1.9875	2.0000	2.0006	2.0125	2.1471	2.1525	2.1528	2.1580	0.85	0.90	0.95	0.932	0.078
2.0125	2.0250	2.0257	2.0375	2.1580	2.1634	2.1637	2.1688	-0.85	-0.80	-0.75	0.428	0.053
2.0125	2.0250	2.0257	2.0375	2.1580	2.1634	2.1637	2.1688	-0.75	-0.70	-0.65	0.367	0.036
2.0125	2.0250	2.0257	2.0375	2.1580	2.1634	2.1637	2.1688	-0.65	-0.60	-0.55	0.198	0.023
2.0125	2.0250	2.0257	2.0375	2.1580	2.1634	2.1637	2.1688	-0.55	-0.50	-0.45	0.133	0.018
2.0125	2.0250	2.0257	2.0375	2.1580	2.1634	2.1637	2.1688	-0.45	-0.40	-0.35	0.164	0.018
2.0125	2.0250	2.0257	2.0375	2.1580	2.1634	2.1637	2.1688	-0.35	-0.30	-0.25	0.176	0.018
2.0125	2.0250	2.0257	2.0375	2.1580	2.1634	2.1637	2.1688	-0.25	-0.20	-0.15	0.260	0.022
2.0125	2.0250	2.0257	2.0375	2.1580	2.1634	2.1637	2.1688	-0.15	-0.10	-0.05	0.340	0.027
2.0125	2.0250	2.0257	2.0375	2.1580	2.1634	2.1637	2.1688	-0.05	0.00	0.05	0.417	0.026
2.0125	2.0250	2.0257	2.0375	2.1580	2.1634	2.1637	2.1688	0.05	0.10	0.15	0.425	0.025
2.0125	2.0250	2.0257	2.0375	2.1580	2.1634	2.1637	2.1688	0.15	0.20	0.25	0.574	0.030
2.0125	2.0250	2.0257	2.0375	2.1580	2.1634	2.1637	2.1688	0.25	0.30	0.35	0.629	0.032
2.0125	2.0250	2.0257	2.0375	2.1580	2.1634	2.1637	2.1688	0.35	0.40	0.45	0.771	0.038
2.0125	2.0250	2.0257	2.0375	2.1580	2.1634	2.1637	2.1688	0.45	0.50	0.55	0.843	0.041
2.0125	2.0250	2.0257	2.0375	2.1580	2.1634	2.1637	2.1688	0.55	0.60	0.65	1.159	0.055
2.0125	2.0250	2.0257	2.0375	2.1580	2.1634	2.1637	2.1688	0.65	0.70	0.75	1.224	0.062
2.0125	2.0250	2.0257	2.0375	2.1580	2.1634	2.1637	2.1688	0.75	0.80	0.85	1.065	0.064
2.0125	2.0250	2.0257	2.0375	2.1580	2.1634	2.1637	2.1688	0.85	0.90	0.95	1.025	0.096
2.0375	2.0500	2.0508	2.0625	2.1688	2.1742	2.1746	2.1796	-0.85	-0.80	-0.75	0.400	0.057
2.0375	2.0500	2.0508	2.0625	2.1688	2.1742	2.1746	2.1796	-0.75	-0.70	-0.65	0.307	0.036
2.0375	2.0500	2.0508	2.0625	2.1688	2.1742	2.1746	2.1796	-0.65	-0.60	-0.55	0.225	0.025
2.0375	2.0500	2.0508	2.0625	2.1688	2.1742	2.1746	2.1796	-0.55	-0.50	-0.45	0.136	0.019
2.0375	2.0500	2.0508	2.0625	2.1688	2.1742	2.1746	2.1796	-0.45	-0.40	-0.35	0.140	0.017
2.0375	2.0500	2.0508	2.0625	2.1688	2.1742	2.1746	2.1796	-0.35	-0.30	-0.25	0.141	0.017
2.0375	2.0500	2.0508	2.0625	2.1688	2.1742	2.1746	2.1796	-0.25	-0.20	-0.15	0.232	0.021
2.0375	2.0500	2.0508	2.0625	2.1688	2.1742	2.1746	2.1796	-0.15	-0.10	-0.05	0.283	0.023
2.0375	2.0500	2.0508	2.0625	2.1688	2.1742	2.1746	2.1796	-0.05	0.00	0.05	0.338	0.025
2.0375	2.0500	2.0508	2.0625	2.1688	2.1742	2.1746	2.1796	0.05	0.10	0.15	0.461	0.028
2.0375	2.0500	2.0508	2.0625	2.1688	2.1742	2.1746	2.1796	0.15	0.20	0.25	0.536	0.029
2.0375	2.0500	2.0508	2.0625	2.1688	2.1742	2.1746	2.1796	0.25	0.30	0.35	0.593	0.033
2.0375	2.0500	2.0508	2.0625	2.1688	2.1742	2.1746	2.1796	0.35	0.40	0.45	0.864	0.041
2.0375	2.0500	2.0508	2.0625	2.1688	2.1742	2.1746	2.1796	0.45	0.50	0.55	0.848	0.042
2.0375	2.0500	2.0508	2.0625	2.1688	2.1742	2.1746	2.1796	0.55	0.60	0.65	1.062	0.054
2.0375	2.0500	2.0508	2.0625	2.1688	2.1742	2.1746	2.1796	0.65	0.70	0.75	1.228	0.067
2.0375	2.0500	2.0508	2.0625	2.1688	2.1742	2.1746	2.1796	0.75	0.80	0.85	1.077	0.062
2.0375	2.0500	2.0508	2.0625	2.1688	2.1742	2.1746	2.1796	0.85	0.90	0.95	0.937	0.089
2.0625	2.0750	2.0759	2.0875	2.1796	2.1850	2.1854	2.1903	-0.85	-0.80	-0.75	0.345	0.051
2.0625	2.0750	2.0759	2.0875	2.1796	2.1850	2.1854	2.1903	-0.75	-0.70	-0.65	0.304	0.033
2.0625	2.0750	2.0759	2.0875	2.1796	2.1850	2.1854	2.1903	-0.65	-0.60	-0.55	0.186	0.021
2.0625	2.0750	2.0759	2.0875	2.1796	2.1850	2.1854	2.1903	-0.55	-0.50	-0.45	0.118	0.019
2.0625	2.0750	2.0759	2.0875	2.1796	2.1850	2.1854	2.1903	-0.45	-0.40	-0.35	0.100	0.016
2.0625	2.0750	2.0759	2.0875	2.1796	2.1850	2.1854	2.1903	-0.35	-0.30	-0.25	0.145	0.017
2.0625	2.0750	2.0759	2.0875	2.1796	2.1850	2.1854	2.1903	-0.25	-0.20	-0.15	0.209	0.022
2.0625	2.0750	2.0759	2.0875	2.1796	2.1850	2.1854	2.1903	-0.15	-0.10	-0.05	0.229	0.024
2.0625	2.0750	2.0759	2.0875	2.1796	2.1850	2.1854	2.1903	-0.05	0.00	0.05	0.304	0.023
2.0625	2.0750	2.0759	2.0875	2.1796	2.1850	2.1854	2.1903	0.05	0.10	0.15	0.440	0.028
2.0625	2.0750	2.0759	2.0875	2.1796	2.1850	2.1854	2.1903	0.15	0.20	0.25	0.517	0.031

2.0625	2.0750	2.0759	2.0875	2.1796	2.1850	2.1854	2.1903	0.25	0.30	0.35	0.610	0.035
2.0625	2.0750	2.0759	2.0875	2.1796	2.1850	2.1854	2.1903	0.35	0.40	0.45	0.672	0.036
2.0625	2.0750	2.0759	2.0875	2.1796	2.1850	2.1854	2.1903	0.45	0.50	0.55	0.875	0.040
2.0625	2.0750	2.0759	2.0875	2.1796	2.1850	2.1854	2.1903	0.55	0.60	0.65	1.032	0.055
2.0625	2.0750	2.0759	2.0875	2.1796	2.1850	2.1854	2.1903	0.65	0.70	0.75	1.235	0.068
2.0625	2.0750	2.0759	2.0875	2.1796	2.1850	2.1854	2.1903	0.75	0.80	0.85	1.066	0.060
2.0625	2.0750	2.0759	2.0875	2.1796	2.1850	2.1854	2.1903	0.85	0.90	0.95	0.938	0.091
2.0875	2.1000	2.1013	2.1125	2.1903	2.1957	2.1962	2.2010	-0.85	-0.80	-0.75	0.364	0.052
2.0875	2.1000	2.1013	2.1125	2.1903	2.1957	2.1962	2.2010	-0.75	-0.70	-0.65	0.333	0.033
2.0875	2.1000	2.1013	2.1125	2.1903	2.1957	2.1962	2.2010	-0.65	-0.60	-0.55	0.205	0.025
2.0875	2.1000	2.1013	2.1125	2.1903	2.1957	2.1962	2.2010	-0.55	-0.50	-0.45	0.152	0.020
2.0875	2.1000	2.1013	2.1125	2.1903	2.1957	2.1962	2.2010	-0.45	-0.40	-0.35	0.137	0.016
2.0875	2.1000	2.1013	2.1125	2.1903	2.1957	2.1962	2.2010	-0.35	-0.30	-0.25	0.174	0.017
2.0875	2.1000	2.1013	2.1125	2.1903	2.1957	2.1962	2.2010	-0.25	-0.20	-0.15	0.167	0.019
2.0875	2.1000	2.1013	2.1125	2.1903	2.1957	2.1962	2.2010	-0.15	-0.10	-0.05	0.230	0.020
2.0875	2.1000	2.1013	2.1125	2.1903	2.1957	2.1962	2.2010	-0.05	0.00	0.05	0.292	0.023
2.0875	2.1000	2.1013	2.1125	2.1903	2.1957	2.1962	2.2010	0.05	0.10	0.15	0.454	0.028
2.0875	2.1000	2.1013	2.1125	2.1903	2.1957	2.1962	2.2010	0.15	0.20	0.25	0.496	0.029
2.0875	2.1000	2.1013	2.1125	2.1903	2.1957	2.1962	2.2010	0.25	0.30	0.35	0.591	0.033
2.0875	2.1000	2.1013	2.1125	2.1903	2.1957	2.1962	2.2010	0.35	0.40	0.45	0.653	0.035
2.0875	2.1000	2.1013	2.1125	2.1903	2.1957	2.1962	2.2010	0.45	0.50	0.55	0.897	0.042
2.0875	2.1000	2.1013	2.1125	2.1903	2.1957	2.1962	2.2010	0.55	0.60	0.65	1.022	0.054
2.0875	2.1000	2.1013	2.1125	2.1903	2.1957	2.1962	2.2010	0.65	0.70	0.75	1.152	0.063
2.0875	2.1000	2.1013	2.1125	2.1903	2.1957	2.1962	2.2010	0.75	0.80	0.85	1.068	0.059
2.0875	2.1000	2.1013	2.1125	2.1903	2.1957	2.1962	2.2010	0.85	0.90	0.95	0.841	0.080
2.1125	2.1250	2.1259	2.1375	2.2010	2.2064	2.2067	2.2117	-0.85	-0.80	-0.75	0.272	0.046
2.1125	2.1250	2.1259	2.1375	2.2010	2.2064	2.2067	2.2117	-0.75	-0.70	-0.65	0.323	0.033
2.1125	2.1250	2.1259	2.1375	2.2010	2.2064	2.2067	2.2117	-0.65	-0.60	-0.55	0.227	0.023
2.1125	2.1250	2.1259	2.1375	2.2010	2.2064	2.2067	2.2117	-0.55	-0.50	-0.45	0.199	0.024
2.1125	2.1250	2.1259	2.1375	2.2010	2.2064	2.2067	2.2117	-0.45	-0.40	-0.35	0.136	0.018
2.1125	2.1250	2.1259	2.1375	2.2010	2.2064	2.2067	2.2117	-0.35	-0.30	-0.25	0.136	0.016
2.1125	2.1250	2.1259	2.1375	2.2010	2.2064	2.2067	2.2117	-0.25	-0.20	-0.15	0.213	0.020
2.1125	2.1250	2.1259	2.1375	2.2010	2.2064	2.2067	2.2117	-0.15	-0.10	-0.05	0.227	0.023
2.1125	2.1250	2.1259	2.1375	2.2010	2.2064	2.2067	2.2117	-0.05	0.00	0.05	0.255	0.022
2.1125	2.1250	2.1259	2.1375	2.2010	2.2064	2.2067	2.2117	0.05	0.10	0.15	0.376	0.026
2.1125	2.1250	2.1259	2.1375	2.2010	2.2064	2.2067	2.2117	0.15	0.20	0.25	0.483	0.029
2.1125	2.1250	2.1259	2.1375	2.2010	2.2064	2.2067	2.2117	0.25	0.30	0.35	0.548	0.034
2.1125	2.1250	2.1259	2.1375	2.2010	2.2064	2.2067	2.2117	0.35	0.40	0.45	0.690	0.037
2.1125	2.1250	2.1259	2.1375	2.2010	2.2064	2.2067	2.2117	0.45	0.50	0.55	0.823	0.041
2.1125	2.1250	2.1259	2.1375	2.2010	2.2064	2.2067	2.2117	0.55	0.60	0.65	1.012	0.053
2.1125	2.1250	2.1259	2.1375	2.2010	2.2064	2.2067	2.2117	0.65	0.70	0.75	1.090	0.064
2.1125	2.1250	2.1259	2.1375	2.2010	2.2064	2.2067	2.2117	0.75	0.80	0.85	1.115	0.065
2.1125	2.1250	2.1259	2.1375	2.2010	2.2064	2.2067	2.2117	0.85	0.90	0.95	1.272	0.111
2.1375	2.1500	2.1513	2.1625	2.2117	2.2170	2.2175	2.2222	-0.85	-0.80	-0.75	0.380	0.045
2.1375	2.1500	2.1513	2.1625	2.2117	2.2170	2.2175	2.2222	-0.75	-0.70	-0.65	0.302	0.031
2.1375	2.1500	2.1513	2.1625	2.2117	2.2170	2.2175	2.2222	-0.65	-0.60	-0.55	0.214	0.022
2.1375	2.1500	2.1513	2.1625	2.2117	2.2170	2.2175	2.2222	-0.55	-0.50	-0.45	0.149	0.019
2.1375	2.1500	2.1513	2.1625	2.2117	2.2170	2.2175	2.2222	-0.45	-0.40	-0.35	0.123	0.016
2.1375	2.1500	2.1513	2.1625	2.2117	2.2170	2.2175	2.2222	-0.35	-0.30	-0.25	0.119	0.014
2.1375	2.1500	2.1513	2.1625	2.2117	2.2170	2.2175	2.2222	-0.25	-0.20	-0.15	0.169	0.018
2.1375	2.1500	2.1513	2.1625	2.2117	2.2170	2.2175	2.2222	-0.15	-0.10	-0.05	0.226	0.021
2.1375	2.1500	2.1513	2.1625	2.2117	2.2170	2.2175	2.2222	-0.05	0.00	0.05	0.259	0.020
2.1375	2.1500	2.1513	2.1625	2.2117	2.2170	2.2175	2.2222	0.05	0.10	0.15	0.292	0.022
2.1375	2.1500	2.1513	2.1625	2.2117	2.2170	2.2175	2.2222	0.15	0.20	0.25	0.401	0.026
2.1375	2.1500	2.1513	2.1625	2.2117	2.2170	2.2175	2.2222	0.25	0.30	0.35	0.501	0.029
2.1375	2.1500	2.1513	2.1625	2.2117	2.2170	2.2175	2.2222	0.35	0.40	0.45	0.563	0.030
2.1375	2.1500	2.1513	2.1625	2.2117	2.2170	2.2175	2.2222	0.45	0.50	0.55	0.770	0.038
2.1375	2.1500	2.1513	2.1625	2.2117	2.2170	2.2175	2.2222	0.55	0.60	0.65	0.965	0.049
2.1375	2.1500	2.1513	2.1625	2.2117	2.2170	2.2175	2.2222	0.65	0.70	0.75	1.167	0.063
2.1375	2.1500	2.1513	2.1625	2.2117	2.2170	2.2175	2.2222	0.75	0.80	0.85	1.000	0.060
2.1375	2.1500	2.1513	2.1625	2.2117	2.2170	2.2175	2.2222	0.85	0.90	0.95	0.969	0.098
2.1625	2.1750	2.1767	2.1875	2.2222	2.2275	2.2282	2.2328	-0.85	-0.80	-0.75	0.419	0.051
2.1625	2.1750	2.1767	2.1875	2.2222	2.2275	2.2282	2.2328	-0.75	-0.70	-0.65	0.337	0.041
2.1625	2.1750	2.1767	2.1875	2.2222	2.2275	2.2282	2.2328	-0.65	-0.60	-0.55	0.240	0.029

2.1625	2.1750	2.1767	2.1875	2.2222	2.2275	2.2282	2.2328	-0.55	-0.50	-0.45	0.232	0.030
2.1625	2.1750	2.1767	2.1875	2.2222	2.2275	2.2282	2.2328	-0.45	-0.40	-0.35	0.168	0.020
2.1625	2.1750	2.1767	2.1875	2.2222	2.2275	2.2282	2.2328	-0.35	-0.30	-0.25	0.162	0.020
2.1625	2.1750	2.1767	2.1875	2.2222	2.2275	2.2282	2.2328	-0.25	-0.20	-0.15	0.231	0.024
2.1625	2.1750	2.1767	2.1875	2.2222	2.2275	2.2282	2.2328	-0.15	-0.10	-0.05	0.214	0.026
2.1625	2.1750	2.1767	2.1875	2.2222	2.2275	2.2282	2.2328	-0.05	0.00	0.05	0.305	0.026
2.1625	2.1750	2.1767	2.1875	2.2222	2.2275	2.2282	2.2328	0.05	0.10	0.15	0.318	0.028
2.1625	2.1750	2.1767	2.1875	2.2222	2.2275	2.2282	2.2328	0.15	0.20	0.25	0.412	0.031
2.1625	2.1750	2.1767	2.1875	2.2222	2.2275	2.2282	2.2328	0.25	0.30	0.35	0.515	0.037
2.1625	2.1750	2.1767	2.1875	2.2222	2.2275	2.2282	2.2328	0.35	0.40	0.45	0.610	0.037
2.1625	2.1750	2.1767	2.1875	2.2222	2.2275	2.2282	2.2328	0.45	0.50	0.55	0.789	0.044
2.1625	2.1750	2.1767	2.1875	2.2222	2.2275	2.2282	2.2328	0.55	0.60	0.65	1.069	0.063
2.1625	2.1750	2.1767	2.1875	2.2222	2.2275	2.2282	2.2328	0.65	0.70	0.75	1.066	0.070
2.1625	2.1750	2.1767	2.1875	2.2222	2.2275	2.2282	2.2328	0.75	0.80	0.85	1.085	0.070
2.1625	2.1750	2.1767	2.1875	2.2222	2.2275	2.2282	2.2328	0.85	0.90	0.95	1.259	0.130
2.1875	2.2000	2.2020	2.2125	2.2328	2.2380	2.2389	2.2433	-0.85	-0.80	-0.75	0.388	0.052
2.1875	2.2000	2.2020	2.2125	2.2328	2.2380	2.2389	2.2433	-0.75	-0.70	-0.65	0.317	0.038
2.1875	2.2000	2.2020	2.2125	2.2328	2.2380	2.2389	2.2433	-0.65	-0.60	-0.55	0.246	0.028
2.1875	2.2000	2.2020	2.2125	2.2328	2.2380	2.2389	2.2433	-0.55	-0.50	-0.45	0.163	0.025
2.1875	2.2000	2.2020	2.2125	2.2328	2.2380	2.2389	2.2433	-0.45	-0.40	-0.35	0.129	0.020
2.1875	2.2000	2.2020	2.2125	2.2328	2.2380	2.2389	2.2433	-0.35	-0.30	-0.25	0.148	0.018
2.1875	2.2000	2.2020	2.2125	2.2328	2.2380	2.2389	2.2433	-0.25	-0.20	-0.15	0.171	0.020
2.1875	2.2000	2.2020	2.2125	2.2328	2.2380	2.2389	2.2433	-0.15	-0.10	-0.05	0.203	0.017
2.1875	2.2000	2.2020	2.2125	2.2328	2.2380	2.2389	2.2433	-0.05	0.00	0.05	0.261	0.022
2.1875	2.2000	2.2020	2.2125	2.2328	2.2380	2.2389	2.2433	0.05	0.10	0.15	0.316	0.026
2.1875	2.2000	2.2020	2.2125	2.2328	2.2380	2.2389	2.2433	0.15	0.20	0.25	0.400	0.029
2.1875	2.2000	2.2020	2.2125	2.2328	2.2380	2.2389	2.2433	0.25	0.30	0.35	0.461	0.031
2.1875	2.2000	2.2020	2.2125	2.2328	2.2380	2.2389	2.2433	0.35	0.40	0.45	0.617	0.036
2.1875	2.2000	2.2020	2.2125	2.2328	2.2380	2.2389	2.2433	0.45	0.50	0.55	0.735	0.044
2.1875	2.2000	2.2020	2.2125	2.2328	2.2380	2.2389	2.2433	0.55	0.60	0.65	1.059	0.062
2.1875	2.2000	2.2020	2.2125	2.2328	2.2380	2.2389	2.2433	0.65	0.70	0.75	0.982	0.061
2.1875	2.2000	2.2020	2.2125	2.2328	2.2380	2.2389	2.2433	0.75	0.80	0.85	1.021	0.067
2.1875	2.2000	2.2020	2.2125	2.2328	2.2380	2.2389	2.2433	0.85	0.90	0.95	0.880	0.098
2.2125	2.2250	2.2273	2.2375	2.2433	2.2485	2.2494	2.2537	-0.85	-0.80	-0.75	0.321	0.049
2.2125	2.2250	2.2273	2.2375	2.2433	2.2485	2.2494	2.2537	-0.75	-0.70	-0.65	0.317	0.034
2.2125	2.2250	2.2273	2.2375	2.2433	2.2485	2.2494	2.2537	-0.65	-0.60	-0.55	0.198	0.025
2.2125	2.2250	2.2273	2.2375	2.2433	2.2485	2.2494	2.2537	-0.55	-0.50	-0.45	0.159	0.021
2.2125	2.2250	2.2273	2.2375	2.2433	2.2485	2.2494	2.2537	-0.45	-0.40	-0.35	0.121	0.016
2.2125	2.2250	2.2273	2.2375	2.2433	2.2485	2.2494	2.2537	-0.35	-0.30	-0.25	0.121	0.015
2.2125	2.2250	2.2273	2.2375	2.2433	2.2485	2.2494	2.2537	-0.25	-0.20	-0.15	0.111	0.014
2.2125	2.2250	2.2273	2.2375	2.2433	2.2485	2.2494	2.2537	-0.15	-0.10	-0.05	0.177	0.020
2.2125	2.2250	2.2273	2.2375	2.2433	2.2485	2.2494	2.2537	-0.05	0.00	0.05	0.250	0.021
2.2125	2.2250	2.2273	2.2375	2.2433	2.2485	2.2494	2.2537	0.05	0.10	0.15	0.260	0.022
2.2125	2.2250	2.2273	2.2375	2.2433	2.2485	2.2494	2.2537	0.15	0.20	0.25	0.350	0.025
2.2125	2.2250	2.2273	2.2375	2.2433	2.2485	2.2494	2.2537	0.25	0.30	0.35	0.441	0.029
2.2125	2.2250	2.2273	2.2375	2.2433	2.2485	2.2494	2.2537	0.35	0.40	0.45	0.580	0.033
2.2125	2.2250	2.2273	2.2375	2.2433	2.2485	2.2494	2.2537	0.45	0.50	0.55	0.761	0.039
2.2125	2.2250	2.2273	2.2375	2.2433	2.2485	2.2494	2.2537	0.55	0.60	0.65	0.878	0.050
2.2125	2.2250	2.2273	2.2375	2.2433	2.2485	2.2494	2.2537	0.65	0.70	0.75	1.079	0.066
2.2125	2.2250	2.2273	2.2375	2.2433	2.2485	2.2494	2.2537	0.75	0.80	0.85	0.943	0.061
2.2125	2.2250	2.2273	2.2375	2.2433	2.2485	2.2494	2.2537	0.85	0.90	0.95	1.178	0.109
2.2375	2.2500	2.2525	2.2625	2.2537	2.2589	2.2599	2.2641	-0.85	-0.80	-0.75	0.307	0.051
2.2375	2.2500	2.2525	2.2625	2.2537	2.2589	2.2599	2.2641	-0.75	-0.70	-0.65	0.346	0.036
2.2375	2.2500	2.2525	2.2625	2.2537	2.2589	2.2599	2.2641	-0.65	-0.60	-0.55	0.223	0.025
2.2375	2.2500	2.2525	2.2625	2.2537	2.2589	2.2599	2.2641	-0.55	-0.50	-0.45	0.165	0.023
2.2375	2.2500	2.2525	2.2625	2.2537	2.2589	2.2599	2.2641	-0.45	-0.40	-0.35	0.133	0.016
2.2375	2.2500	2.2525	2.2625	2.2537	2.2589	2.2599	2.2641	-0.35	-0.30	-0.25	0.131	0.016
2.2375	2.2500	2.2525	2.2625	2.2537	2.2589	2.2599	2.2641	-0.25	-0.20	-0.15	0.134	0.016
2.2375	2.2500	2.2525	2.2625	2.2537	2.2589	2.2599	2.2641	-0.15	-0.10	-0.05	0.208	0.024
2.2375	2.2500	2.2525	2.2625	2.2537	2.2589	2.2599	2.2641	-0.05	0.00	0.05	0.252	0.021
2.2375	2.2500	2.2525	2.2625	2.2537	2.2589	2.2599	2.2641	0.05	0.10	0.15	0.222	0.021
2.2375	2.2500	2.2525	2.2625	2.2537	2.2589	2.2599	2.2641	0.15	0.20	0.25	0.345	0.027
2.2375	2.2500	2.2525	2.2625	2.2537	2.2589	2.2599	2.2641	0.25	0.30	0.35	0.413	0.030
2.2375	2.2500	2.2525	2.2625	2.2537	2.2589	2.2599	2.2641	0.35	0.40	0.45	0.597	0.033

2.2375	2.2500	2.2525	2.2625	2.2537	2.2589	2.2599	2.2641	0.45	0.50	0.55	0.671	0.039
2.2375	2.2500	2.2525	2.2625	2.2537	2.2589	2.2599	2.2641	0.55	0.60	0.65	0.888	0.054
2.2375	2.2500	2.2525	2.2625	2.2537	2.2589	2.2599	2.2641	0.65	0.70	0.75	0.967	0.057
2.2375	2.2500	2.2525	2.2625	2.2537	2.2589	2.2599	2.2641	0.75	0.80	0.85	1.131	0.068
2.2375	2.2500	2.2525	2.2625	2.2537	2.2589	2.2599	2.2641	0.85	0.90	0.95	0.844	0.094
2.2625	2.2750	2.2778	2.2875	2.2641	2.2692	2.2704	2.2744	-0.85	-0.80	-0.75	0.360	0.048
2.2625	2.2750	2.2778	2.2875	2.2641	2.2692	2.2704	2.2744	-0.75	-0.70	-0.65	0.278	0.031
2.2625	2.2750	2.2778	2.2875	2.2641	2.2692	2.2704	2.2744	-0.65	-0.60	-0.55	0.245	0.027
2.2625	2.2750	2.2778	2.2875	2.2641	2.2692	2.2704	2.2744	-0.55	-0.50	-0.45	0.234	0.025
2.2625	2.2750	2.2778	2.2875	2.2641	2.2692	2.2704	2.2744	-0.45	-0.40	-0.35	0.093	0.014
2.2625	2.2750	2.2778	2.2875	2.2641	2.2692	2.2704	2.2744	-0.35	-0.30	-0.25	0.117	0.014
2.2625	2.2750	2.2778	2.2875	2.2641	2.2692	2.2704	2.2744	-0.25	-0.20	-0.15	0.104	0.017
2.2625	2.2750	2.2778	2.2875	2.2641	2.2692	2.2704	2.2744	-0.15	-0.10	-0.05	0.140	0.019
2.2625	2.2750	2.2778	2.2875	2.2641	2.2692	2.2704	2.2744	-0.05	0.00	0.05	0.212	0.019
2.2625	2.2750	2.2778	2.2875	2.2641	2.2692	2.2704	2.2744	0.05	0.10	0.15	0.230	0.020
2.2625	2.2750	2.2778	2.2875	2.2641	2.2692	2.2704	2.2744	0.15	0.20	0.25	0.280	0.023
2.2625	2.2750	2.2778	2.2875	2.2641	2.2692	2.2704	2.2744	0.25	0.30	0.35	0.386	0.032
2.2625	2.2750	2.2778	2.2875	2.2641	2.2692	2.2704	2.2744	0.35	0.40	0.45	0.524	0.030
2.2625	2.2750	2.2778	2.2875	2.2641	2.2692	2.2704	2.2744	0.45	0.50	0.55	0.660	0.039
2.2625	2.2750	2.2778	2.2875	2.2641	2.2692	2.2704	2.2744	0.55	0.60	0.65	0.836	0.049
2.2625	2.2750	2.2778	2.2875	2.2641	2.2692	2.2704	2.2744	0.65	0.70	0.75	0.988	0.056
2.2625	2.2750	2.2778	2.2875	2.2641	2.2692	2.2704	2.2744	0.75	0.80	0.85	0.970	0.063
2.2625	2.2750	2.2778	2.2875	2.2641	2.2692	2.2704	2.2744	0.85	0.90	0.95	0.876	0.087
2.2875	2.3000	2.3030	2.3125	2.2744	2.2796	2.2808	2.2847	-0.85	-0.80	-0.75	0.326	0.050
2.2875	2.3000	2.3030	2.3125	2.2744	2.2796	2.2808	2.2847	-0.75	-0.70	-0.65	0.313	0.033
2.2875	2.3000	2.3030	2.3125	2.2744	2.2796	2.2808	2.2847	-0.65	-0.60	-0.55	0.262	0.028
2.2875	2.3000	2.3030	2.3125	2.2744	2.2796	2.2808	2.2847	-0.55	-0.50	-0.45	0.164	0.024
2.2875	2.3000	2.3030	2.3125	2.2744	2.2796	2.2808	2.2847	-0.45	-0.40	-0.35	0.093	0.017
2.2875	2.3000	2.3030	2.3125	2.2744	2.2796	2.2808	2.2847	-0.35	-0.30	-0.25	0.107	0.016
2.2875	2.3000	2.3030	2.3125	2.2744	2.2796	2.2808	2.2847	-0.25	-0.20	-0.15	0.146	0.017
2.2875	2.3000	2.3030	2.3125	2.2744	2.2796	2.2808	2.2847	-0.15	-0.10	-0.05	0.126	0.019
2.2875	2.3000	2.3030	2.3125	2.2744	2.2796	2.2808	2.2847	-0.05	0.00	0.05	0.140	0.017
2.2875	2.3000	2.3030	2.3125	2.2744	2.2796	2.2808	2.2847	0.05	0.10	0.15	0.210	0.020
2.2875	2.3000	2.3030	2.3125	2.2744	2.2796	2.2808	2.2847	0.15	0.20	0.25	0.256	0.026
2.2875	2.3000	2.3030	2.3125	2.2744	2.2796	2.2808	2.2847	0.25	0.30	0.35	0.366	0.030
2.2875	2.3000	2.3030	2.3125	2.2744	2.2796	2.2808	2.2847	0.35	0.40	0.45	0.489	0.031
2.2875	2.3000	2.3030	2.3125	2.2744	2.2796	2.2808	2.2847	0.45	0.50	0.55	0.669	0.041
2.2875	2.3000	2.3030	2.3125	2.2744	2.2796	2.2808	2.2847	0.55	0.60	0.65	0.848	0.055
2.2875	2.3000	2.3030	2.3125	2.2744	2.2796	2.2808	2.2847	0.65	0.70	0.75	1.126	0.064
2.2875	2.3000	2.3030	2.3125	2.2744	2.2796	2.2808	2.2847	0.75	0.80	0.85	1.040	0.072
2.2875	2.3000	2.3030	2.3125	2.2744	2.2796	2.2808	2.2847	0.85	0.90	0.95	1.196	0.115
2.3125	2.3250	2.3282	2.3375	2.2847	2.2898	2.2911	2.2949	-0.85	-0.80	-0.75	0.393	0.055
2.3125	2.3250	2.3282	2.3375	2.2847	2.2898	2.2911	2.2949	-0.75	-0.70	-0.65	0.240	0.037
2.3125	2.3250	2.3282	2.3375	2.2847	2.2898	2.2911	2.2949	-0.65	-0.60	-0.55	0.266	0.033
2.3125	2.3250	2.3282	2.3375	2.2847	2.2898	2.2911	2.2949	-0.55	-0.50	-0.45	0.137	0.023
2.3125	2.3250	2.3282	2.3375	2.2847	2.2898	2.2911	2.2949	-0.45	-0.40	-0.35	0.122	0.019
2.3125	2.3250	2.3282	2.3375	2.2847	2.2898	2.2911	2.2949	-0.35	-0.30	-0.25	0.099	0.016
2.3125	2.3250	2.3282	2.3375	2.2847	2.2898	2.2911	2.2949	-0.25	-0.20	-0.15	0.094	0.015
2.3125	2.3250	2.3282	2.3375	2.2847	2.2898	2.2911	2.2949	-0.15	-0.10	-0.05	0.135	0.020
2.3125	2.3250	2.3282	2.3375	2.2847	2.2898	2.2911	2.2949	-0.05	0.00	0.05	0.183	0.020
2.3125	2.3250	2.3282	2.3375	2.2847	2.2898	2.2911	2.2949	0.05	0.10	0.15	0.158	0.020
2.3125	2.3250	2.3282	2.3375	2.2847	2.2898	2.2911	2.2949	0.15	0.20	0.25	0.254	0.026
2.3125	2.3250	2.3282	2.3375	2.2847	2.2898	2.2911	2.2949	0.25	0.30	0.35	0.331	0.028
2.3125	2.3250	2.3282	2.3375	2.2847	2.2898	2.2911	2.2949	0.35	0.40	0.45	0.490	0.035
2.3125	2.3250	2.3282	2.3375	2.2847	2.2898	2.2911	2.2949	0.45	0.50	0.55	0.682	0.044
2.3125	2.3250	2.3282	2.3375	2.2847	2.2898	2.2911	2.2949	0.55	0.60	0.65	0.736	0.054
2.3125	2.3250	2.3282	2.3375	2.2847	2.2898	2.2911	2.2949	0.65	0.70	0.75	1.053	0.068
2.3125	2.3250	2.3282	2.3375	2.2847	2.2898	2.2911	2.2949	0.75	0.80	0.85	1.016	0.073
2.3125	2.3250	2.3282	2.3375	2.2847	2.2898	2.2911	2.2949	0.85	0.90	0.95	0.733	0.091
2.3375	2.3500	2.3534	2.3625	2.2949	2.3000	2.3014	2.3051	-0.85	-0.80	-0.75	0.362	0.053
2.3375	2.3500	2.3534	2.3625	2.2949	2.3000	2.3014	2.3051	-0.75	-0.70	-0.65	0.238	0.034
2.3375	2.3500	2.3534	2.3625	2.2949	2.3000	2.3014	2.3051	-0.65	-0.60	-0.55	0.213	0.028
2.3375	2.3500	2.3534	2.3625	2.2949	2.3000	2.3014	2.3051	-0.55	-0.50	-0.45	0.189	0.022
2.3375	2.3500	2.3534	2.3625	2.2949	2.3000	2.3014	2.3051	-0.45	-0.40	-0.35	0.102	0.021

2.3375	2.3500	2.3534	2.3625	2.2949	2.3000	2.3014	2.3061	-0.35	-0.30	-0.25	0.104	0.015
2.3375	2.3500	2.3534	2.3625	2.2949	2.3000	2.3014	2.3061	-0.25	-0.20	-0.15	0.108	0.017
2.3375	2.3500	2.3534	2.3625	2.2949	2.3000	2.3014	2.3061	-0.15	-0.10	-0.05	0.182	0.020
2.3375	2.3500	2.3534	2.3625	2.2949	2.3000	2.3014	2.3061	-0.05	0.00	0.05	0.134	0.019
2.3375	2.3500	2.3534	2.3625	2.2949	2.3000	2.3014	2.3061	0.05	0.10	0.15	0.181	0.021
2.3375	2.3500	2.3534	2.3625	2.2949	2.3000	2.3014	2.3061	0.15	0.20	0.25	0.239	0.024
2.3375	2.3500	2.3534	2.3625	2.2949	2.3000	2.3014	2.3061	0.25	0.30	0.35	0.343	0.029
2.3375	2.3500	2.3534	2.3625	2.2949	2.3000	2.3014	2.3061	0.35	0.40	0.45	0.459	0.033
2.3375	2.3500	2.3534	2.3625	2.2949	2.3000	2.3014	2.3061	0.45	0.50	0.55	0.564	0.042
2.3375	2.3500	2.3534	2.3625	2.2949	2.3000	2.3014	2.3061	0.55	0.60	0.65	0.812	0.058
2.3375	2.3500	2.3534	2.3625	2.2949	2.3000	2.3014	2.3061	0.65	0.70	0.75	0.987	0.067
2.3375	2.3500	2.3534	2.3625	2.2949	2.3000	2.3014	2.3061	0.75	0.80	0.85	1.242	0.079
2.3375	2.3500	2.3534	2.3625	2.2949	2.3000	2.3014	2.3061	0.85	0.90	0.95	0.947	0.121
2.3625	2.3750	2.3785	2.3875	2.3051	2.3102	2.3117	2.3153	-0.85	-0.80	-0.75	0.000	0.000
2.3625	2.3750	2.3785	2.3875	2.3051	2.3102	2.3117	2.3153	-0.75	-0.70	-0.65	0.000	0.000
2.3625	2.3750	2.3785	2.3875	2.3051	2.3102	2.3117	2.3153	-0.65	-0.60	-0.55	0.000	0.000
2.3625	2.3750	2.3785	2.3875	2.3051	2.3102	2.3117	2.3153	-0.55	-0.50	-0.45	0.000	0.000
2.3625	2.3750	2.3785	2.3875	2.3051	2.3102	2.3117	2.3153	-0.45	-0.40	-0.35	0.000	0.000
2.3625	2.3750	2.3785	2.3875	2.3051	2.3102	2.3117	2.3153	-0.35	-0.30	-0.25	0.000	0.000
2.3625	2.3750	2.3785	2.3875	2.3051	2.3102	2.3117	2.3153	-0.25	-0.20	-0.15	0.000	0.000
2.3625	2.3750	2.3785	2.3875	2.3051	2.3102	2.3117	2.3153	-0.15	-0.10	-0.05	0.000	0.000
2.3625	2.3750	2.3785	2.3875	2.3051	2.3102	2.3117	2.3153	-0.05	0.00	0.05	0.000	0.000
2.3625	2.3750	2.3785	2.3875	2.3051	2.3102	2.3117	2.3153	0.05	0.10	0.15	0.000	0.000
2.3625	2.3750	2.3785	2.3875	2.3051	2.3102	2.3117	2.3153	0.15	0.20	0.25	0.000	0.000
2.3625	2.3750	2.3785	2.3875	2.3051	2.3102	2.3117	2.3153	0.25	0.30	0.35	0.000	0.000
2.3625	2.3750	2.3785	2.3875	2.3051	2.3102	2.3117	2.3153	0.35	0.40	0.45	0.000	0.000
2.3625	2.3750	2.3785	2.3875	2.3051	2.3102	2.3117	2.3153	0.45	0.50	0.55	0.000	0.000
2.3625	2.3750	2.3785	2.3875	2.3051	2.3102	2.3117	2.3153	0.55	0.60	0.65	0.000	0.000
2.3625	2.3750	2.3785	2.3875	2.3051	2.3102	2.3117	2.3153	0.65	0.70	0.75	0.000	0.000
2.3625	2.3750	2.3785	2.3875	2.3051	2.3102	2.3117	2.3153	0.75	0.80	0.85	0.000	0.000
2.3625	2.3750	2.3785	2.3875	2.3051	2.3102	2.3117	2.3153	0.85	0.90	0.95	0.000	0.000
2.3875	2.4000	2.4050	2.4125	2.3153	2.3204	2.3224	2.3264	-0.85	-0.80	-0.75	0.000	0.000
2.3875	2.4000	2.4050	2.4125	2.3153	2.3204	2.3224	2.3264	-0.75	-0.70	-0.65	0.000	0.000
2.3875	2.4000	2.4050	2.4125	2.3153	2.3204	2.3224	2.3264	-0.65	-0.60	-0.55	0.000	0.000
2.3875	2.4000	2.4050	2.4125	2.3153	2.3204	2.3224	2.3264	-0.55	-0.50	-0.45	0.000	0.000
2.3875	2.4000	2.4050	2.4125	2.3153	2.3204	2.3224	2.3264	-0.45	-0.40	-0.35	0.000	0.000
2.3875	2.4000	2.4050	2.4125	2.3153	2.3204	2.3224	2.3264	-0.35	-0.30	-0.25	0.000	0.000
2.3875	2.4000	2.4050	2.4125	2.3153	2.3204	2.3224	2.3264	-0.25	-0.20	-0.15	0.000	0.000
2.3875	2.4000	2.4050	2.4125	2.3153	2.3204	2.3224	2.3264	-0.15	-0.10	-0.05	0.000	0.000
2.3875	2.4000	2.4050	2.4125	2.3153	2.3204	2.3224	2.3264	-0.05	0.00	0.05	0.000	0.000
2.3875	2.4000	2.4050	2.4125	2.3153	2.3204	2.3224	2.3264	0.05	0.10	0.15	0.000	0.000
2.3875	2.4000	2.4050	2.4125	2.3153	2.3204	2.3224	2.3264	0.15	0.20	0.25	0.000	0.000
2.3875	2.4000	2.4050	2.4125	2.3153	2.3204	2.3224	2.3264	0.25	0.30	0.35	0.000	0.000
2.3875	2.4000	2.4050	2.4125	2.3153	2.3204	2.3224	2.3264	0.35	0.40	0.45	0.000	0.000
2.3875	2.4000	2.4050	2.4125	2.3153	2.3204	2.3224	2.3264	0.45	0.50	0.55	0.000	0.000
2.3875	2.4000	2.4050	2.4125	2.3153	2.3204	2.3224	2.3264	0.55	0.60	0.65	0.000	0.000
2.3875	2.4000	2.4050	2.4125	2.3153	2.3204	2.3224	2.3264	0.65	0.70	0.75	0.000	0.000
2.3875	2.4000	2.4050	2.4125	2.3153	2.3204	2.3224	2.3264	0.75	0.80	0.85	0.000	0.000
2.3875	2.4000	2.4050	2.4125	2.3153	2.3204	2.3224	2.3264	0.85	0.90	0.95	0.000	0.000
2.4125	2.4250	2.4301	2.4375	2.3264	2.3304	2.3325	2.3355	-0.85	-0.80	-0.75	0.417	0.075
2.4125	2.4250	2.4301	2.4375	2.3264	2.3304	2.3325	2.3355	-0.75	-0.70	-0.65	0.272	0.044
2.4125	2.4250	2.4301	2.4375	2.3264	2.3304	2.3325	2.3355	-0.65	-0.60	-0.55	0.257	0.043
2.4125	2.4250	2.4301	2.4375	2.3264	2.3304	2.3325	2.3355	-0.55	-0.50	-0.45	0.126	0.022
2.4125	2.4250	2.4301	2.4375	2.3264	2.3304	2.3325	2.3355	-0.45	-0.40	-0.35	0.171	0.026
2.4125	2.4250	2.4301	2.4375	2.3264	2.3304	2.3325	2.3355	-0.35	-0.30	-0.25	0.097	0.021
2.4125	2.4250	2.4301	2.4375	2.3264	2.3304	2.3325	2.3355	-0.25	-0.20	-0.15	0.060	0.017
2.4125	2.4250	2.4301	2.4375	2.3264	2.3304	2.3325	2.3355	-0.15	-0.10	-0.05	0.081	0.052
2.4125	2.4250	2.4301	2.4375	2.3264	2.3304	2.3325	2.3355	-0.05	0.00	0.05	0.139	0.024
2.4125	2.4250	2.4301	2.4375	2.3264	2.3304	2.3325	2.3355	0.05	0.10	0.15	0.196	0.028
2.4125	2.4250	2.4301	2.4375	2.3264	2.3304	2.3325	2.3355	0.15	0.20	0.25	0.190	0.025
2.4125	2.4250	2.4301	2.4375	2.3264	2.3304	2.3325	2.3355	0.25	0.30	0.35	0.372	0.039
2.4125	2.4250	2.4301	2.4375	2.3264	2.3304	2.3325	2.3355	0.35	0.40	0.45	0.385	0.036
2.4125	2.4250	2.4301	2.4375	2.3264	2.3304	2.3325	2.3355	0.45	0.50	0.55	0.639	0.056
2.4125	2.4250	2.4301	2.4375	2.3264	2.3304	2.3325	2.3355	0.55	0.60	0.65	0.852	0.068

2.4125	2.4250	2.4301	2.4375	2.3254	2.3304	2.3325	2.3355	0.65	0.70	0.75	1.129	0.088
2.4125	2.4250	2.4301	2.4375	2.3254	2.3304	2.3325	2.3355	0.75	0.80	0.85	1.337	0.098
2.4125	2.4250	2.4301	2.4375	2.3254	2.3304	2.3325	2.3355	0.85	0.90	0.95	1.804	0.175
2.4375	2.4500	2.4552	2.4625	2.3355	2.3405	2.3426	2.3455	-0.85	-0.80	-0.75	0.278	0.050
2.4375	2.4500	2.4552	2.4625	2.3355	2.3405	2.3426	2.3455	-0.75	-0.70	-0.65	0.292	0.081
2.4375	2.4500	2.4552	2.4625	2.3355	2.3405	2.3426	2.3455	-0.65	-0.60	-0.55	0.222	0.030
2.4375	2.4500	2.4552	2.4625	2.3355	2.3405	2.3426	2.3455	-0.55	-0.50	-0.45	0.166	0.026
2.4375	2.4500	2.4552	2.4625	2.3355	2.3405	2.3426	2.3455	-0.45	-0.40	-0.35	0.093	0.017
2.4375	2.4500	2.4552	2.4625	2.3355	2.3405	2.3426	2.3455	-0.35	-0.30	-0.25	0.063	0.013
2.4375	2.4500	2.4552	2.4625	2.3355	2.3405	2.3426	2.3455	-0.25	-0.20	-0.15	0.092	0.017
2.4375	2.4500	2.4552	2.4625	2.3355	2.3405	2.3426	2.3455	-0.15	-0.10	-0.05	0.051	0.012
2.4375	2.4500	2.4552	2.4625	2.3355	2.3405	2.3426	2.3455	-0.05	0.00	0.05	0.110	0.019
2.4375	2.4500	2.4552	2.4625	2.3355	2.3405	2.3426	2.3455	0.05	0.10	0.15	0.155	0.021
2.4375	2.4500	2.4552	2.4625	2.3355	2.3405	2.3426	2.3455	0.15	0.20	0.25	0.138	0.020
2.4375	2.4500	2.4552	2.4625	2.3355	2.3405	2.3426	2.3455	0.25	0.30	0.35	0.266	0.030
2.4375	2.4500	2.4552	2.4625	2.3355	2.3405	2.3426	2.3455	0.35	0.40	0.45	0.393	0.032
2.4375	2.4500	2.4552	2.4625	2.3355	2.3405	2.3426	2.3455	0.45	0.50	0.55	0.546	0.043
2.4375	2.4500	2.4552	2.4625	2.3355	2.3405	2.3426	2.3455	0.55	0.60	0.65	0.803	0.060
2.4375	2.4500	2.4552	2.4625	2.3355	2.3405	2.3426	2.3455	0.65	0.70	0.75	0.842	0.063
2.4375	2.4500	2.4552	2.4625	2.3355	2.3405	2.3426	2.3455	0.75	0.80	0.85	1.140	0.079
2.4375	2.4500	2.4552	2.4625	2.3355	2.3405	2.3426	2.3455	0.85	0.90	0.95	1.294	0.156
2.4625	2.4750	2.4803	2.4875	2.3455	2.3505	2.3526	2.3555	-0.85	-0.80	-0.75	0.154	0.044
2.4625	2.4750	2.4803	2.4875	2.3455	2.3505	2.3526	2.3555	-0.75	-0.70	-0.65	0.286	0.048
2.4625	2.4750	2.4803	2.4875	2.3455	2.3505	2.3526	2.3555	-0.65	-0.60	-0.55	0.141	0.029
2.4625	2.4750	2.4803	2.4875	2.3455	2.3505	2.3526	2.3555	-0.55	-0.50	-0.45	0.132	0.023
2.4625	2.4750	2.4803	2.4875	2.3455	2.3505	2.3526	2.3555	-0.45	-0.40	-0.35	0.100	0.017
2.4625	2.4750	2.4803	2.4875	2.3455	2.3505	2.3526	2.3555	-0.35	-0.30	-0.25	0.088	0.016
2.4625	2.4750	2.4803	2.4875	2.3455	2.3505	2.3526	2.3555	-0.25	-0.20	-0.15	0.078	0.013
2.4625	2.4750	2.4803	2.4875	2.3455	2.3505	2.3526	2.3555	-0.15	-0.10	-0.05	0.076	0.021
2.4625	2.4750	2.4803	2.4875	2.3455	2.3505	2.3526	2.3555	-0.05	0.00	0.05	0.062	0.015
2.4625	2.4750	2.4803	2.4875	2.3455	2.3505	2.3526	2.3555	0.05	0.10	0.15	0.117	0.020
2.4625	2.4750	2.4803	2.4875	2.3455	2.3505	2.3526	2.3555	0.15	0.20	0.25	0.176	0.024
2.4625	2.4750	2.4803	2.4875	2.3455	2.3505	2.3526	2.3555	0.25	0.30	0.35	0.161	0.028
2.4625	2.4750	2.4803	2.4875	2.3455	2.3505	2.3526	2.3555	0.35	0.40	0.45	0.410	0.033
2.4625	2.4750	2.4803	2.4875	2.3455	2.3505	2.3526	2.3555	0.45	0.50	0.55	0.612	0.048
2.4625	2.4750	2.4803	2.4875	2.3455	2.3505	2.3526	2.3555	0.55	0.60	0.65	0.783	0.064
2.4625	2.4750	2.4803	2.4875	2.3455	2.3505	2.3526	2.3555	0.65	0.70	0.75	0.819	0.070
2.4625	2.4750	2.4803	2.4875	2.3455	2.3505	2.3526	2.3555	0.75	0.80	0.85	0.971	0.076
2.4625	2.4750	2.4803	2.4875	2.3455	2.3505	2.3526	2.3555	0.85	0.90	0.95	1.044	0.131
2.4875	2.5000	2.5053	2.5125	2.3555	2.3604	2.3626	2.3654	-0.85	-0.80	-0.75	0.229	0.038
2.4875	2.5000	2.5053	2.5125	2.3555	2.3604	2.3626	2.3654	-0.75	-0.70	-0.65	0.257	0.035
2.4875	2.5000	2.5053	2.5125	2.3555	2.3604	2.3626	2.3654	-0.65	-0.60	-0.55	0.205	0.028
2.4875	2.5000	2.5053	2.5125	2.3555	2.3604	2.3626	2.3654	-0.55	-0.50	-0.45	0.154	0.023
2.4875	2.5000	2.5053	2.5125	2.3555	2.3604	2.3626	2.3654	-0.45	-0.40	-0.35	0.116	0.016
2.4875	2.5000	2.5053	2.5125	2.3555	2.3604	2.3626	2.3654	-0.35	-0.30	-0.25	0.116	0.028
2.4875	2.5000	2.5053	2.5125	2.3555	2.3604	2.3626	2.3654	-0.25	-0.20	-0.15	0.066	0.015
2.4875	2.5000	2.5053	2.5125	2.3555	2.3604	2.3626	2.3654	-0.15	-0.10	-0.05	0.077	0.019
2.4875	2.5000	2.5053	2.5125	2.3555	2.3604	2.3626	2.3654	-0.05	0.00	0.05	0.086	0.018
2.4875	2.5000	2.5053	2.5125	2.3555	2.3604	2.3626	2.3654	0.05	0.10	0.15	0.135	0.022
2.4875	2.5000	2.5053	2.5125	2.3555	2.3604	2.3626	2.3654	0.15	0.20	0.25	0.180	0.027
2.4875	2.5000	2.5053	2.5125	2.3555	2.3604	2.3626	2.3654	0.25	0.30	0.35	0.189	0.024
2.4875	2.5000	2.5053	2.5125	2.3555	2.3604	2.3626	2.3654	0.35	0.40	0.45	0.315	0.030
2.4875	2.5000	2.5053	2.5125	2.3555	2.3604	2.3626	2.3654	0.45	0.50	0.55	0.496	0.045
2.4875	2.5000	2.5053	2.5125	2.3555	2.3604	2.3626	2.3654	0.55	0.60	0.65	0.653	0.052
2.4875	2.5000	2.5053	2.5125	2.3555	2.3604	2.3626	2.3654	0.65	0.70	0.75	0.916	0.065
2.4875	2.5000	2.5053	2.5125	2.3555	2.3604	2.3626	2.3654	0.75	0.80	0.85	1.074	0.077
2.4875	2.5000	2.5053	2.5125	2.3555	2.3604	2.3626	2.3654	0.85	0.90	0.95	1.068	0.140
2.5125	2.5250	2.5303	2.5375	2.3654	2.3704	2.3725	2.3753	-0.85	-0.80	-0.75	0.235	0.045
2.5125	2.5250	2.5303	2.5375	2.3654	2.3704	2.3725	2.3753	-0.75	-0.70	-0.65	0.221	0.035
2.5125	2.5250	2.5303	2.5375	2.3654	2.3704	2.3725	2.3753	-0.65	-0.60	-0.55	0.197	0.032
2.5125	2.5250	2.5303	2.5375	2.3654	2.3704	2.3725	2.3753	-0.55	-0.50	-0.45	0.138	0.023
2.5125	2.5250	2.5303	2.5375	2.3654	2.3704	2.3725	2.3753	-0.45	-0.40	-0.35	0.086	0.016
2.5125	2.5250	2.5303	2.5375	2.3654	2.3704	2.3725	2.3753	-0.35	-0.30	-0.25	0.086	0.019
2.5125	2.5250	2.5303	2.5375	2.3654	2.3704	2.3725	2.3753	-0.25	-0.20	-0.15	0.077	0.019

2.5125	2.5250	2.5303	2.5375	2.3654	2.3704	2.3725	2.3753	-0.15	-0.10	-0.05	0.049	0.013
2.5125	2.5250	2.5303	2.5375	2.3654	2.3704	2.3725	2.3753	-0.05	0.00	0.05	0.075	0.020
2.5125	2.5250	2.5303	2.5375	2.3654	2.3704	2.3725	2.3753	0.05	0.10	0.15	0.106	0.018
2.5125	2.5250	2.5303	2.5375	2.3654	2.3704	2.3725	2.3753	0.15	0.20	0.25	0.153	0.025
2.5125	2.5250	2.5303	2.5375	2.3654	2.3704	2.3725	2.3753	0.25	0.30	0.35	0.250	0.028
2.5125	2.5250	2.5303	2.5375	2.3654	2.3704	2.3725	2.3753	0.35	0.40	0.45	0.326	0.030
2.5125	2.5250	2.5303	2.5375	2.3654	2.3704	2.3725	2.3753	0.45	0.50	0.55	0.500	0.042
2.5125	2.5250	2.5303	2.5375	2.3654	2.3704	2.3725	2.3753	0.55	0.60	0.65	0.682	0.058
2.5125	2.5250	2.5303	2.5375	2.3654	2.3704	2.3725	2.3753	0.65	0.70	0.75	0.888	0.076
2.5125	2.5250	2.5303	2.5375	2.3654	2.3704	2.3725	2.3753	0.75	0.80	0.85	1.120	0.087
2.5125	2.5250	2.5303	2.5375	2.3654	2.3704	2.3725	2.3753	0.85	0.90	0.95	1.100	0.161
2.5375	2.5500	2.5552	2.5625	2.3753	2.3802	2.3823	2.3852	-0.85	-0.80	-0.75	0.263	0.061
2.5375	2.5500	2.5552	2.5625	2.3753	2.3802	2.3823	2.3852	-0.75	-0.70	-0.65	0.261	0.038
2.5375	2.5500	2.5552	2.5625	2.3753	2.3802	2.3823	2.3852	-0.65	-0.60	-0.55	0.190	0.029
2.5375	2.5500	2.5552	2.5625	2.3753	2.3802	2.3823	2.3852	-0.55	-0.50	-0.45	0.134	0.030
2.5375	2.5500	2.5552	2.5625	2.3753	2.3802	2.3823	2.3852	-0.45	-0.40	-0.35	0.064	0.018
2.5375	2.5500	2.5552	2.5625	2.3753	2.3802	2.3823	2.3852	-0.35	-0.30	-0.25	0.030	0.010
2.5375	2.5500	2.5552	2.5625	2.3753	2.3802	2.3823	2.3852	-0.25	-0.20	-0.15	0.035	0.013
2.5375	2.5500	2.5552	2.5625	2.3753	2.3802	2.3823	2.3852	-0.15	-0.10	-0.05	0.043	0.014
2.5375	2.5500	2.5552	2.5625	2.3753	2.3802	2.3823	2.3852	-0.05	0.00	0.05	0.046	0.014
2.5375	2.5500	2.5552	2.5625	2.3753	2.3802	2.3823	2.3852	0.05	0.10	0.15	0.090	0.020
2.5375	2.5500	2.5552	2.5625	2.3753	2.3802	2.3823	2.3852	0.15	0.20	0.25	0.113	0.030
2.5375	2.5500	2.5552	2.5625	2.3753	2.3802	2.3823	2.3852	0.25	0.30	0.35	0.188	0.027
2.5375	2.5500	2.5552	2.5625	2.3753	2.3802	2.3823	2.3852	0.35	0.40	0.45	0.299	0.032
2.5375	2.5500	2.5552	2.5625	2.3753	2.3802	2.3823	2.3852	0.45	0.50	0.55	0.405	0.044
2.5375	2.5500	2.5552	2.5625	2.3753	2.3802	2.3823	2.3852	0.55	0.60	0.65	0.638	0.058
2.5375	2.5500	2.5552	2.5625	2.3753	2.3802	2.3823	2.3852	0.65	0.70	0.75	0.857	0.088
2.5375	2.5500	2.5552	2.5625	2.3753	2.3802	2.3823	2.3852	0.75	0.80	0.85	1.087	0.091
2.5375	2.5500	2.5552	2.5625	2.3753	2.3802	2.3823	2.3852	0.85	0.90	0.95	0.955	0.144
2.5625	2.5750	2.5801	2.5875	2.3852	2.3901	2.3921	2.3950	-0.85	-0.80	-0.75	0.159	0.085
2.5625	2.5750	2.5801	2.5875	2.3852	2.3901	2.3921	2.3950	-0.75	-0.70	-0.65	0.200	0.042
2.5625	2.5750	2.5801	2.5875	2.3852	2.3901	2.3921	2.3950	-0.65	-0.60	-0.55	0.252	0.043
2.5625	2.5750	2.5801	2.5875	2.3852	2.3901	2.3921	2.3950	-0.55	-0.50	-0.45	0.123	0.024
2.5625	2.5750	2.5801	2.5875	2.3852	2.3901	2.3921	2.3950	-0.45	-0.40	-0.35	0.102	0.023
2.5625	2.5750	2.5801	2.5875	2.3852	2.3901	2.3921	2.3950	-0.35	-0.30	-0.25	0.036	0.015
2.5625	2.5750	2.5801	2.5875	2.3852	2.3901	2.3921	2.3950	-0.25	-0.20	-0.15	0.046	0.011
2.5625	2.5750	2.5801	2.5875	2.3852	2.3901	2.3921	2.3950	-0.15	-0.10	-0.05	0.096	0.020
2.5625	2.5750	2.5801	2.5875	2.3852	2.3901	2.3921	2.3950	-0.05	0.00	0.05	0.051	0.014
2.5625	2.5750	2.5801	2.5875	2.3852	2.3901	2.3921	2.3950	0.05	0.10	0.15	0.056	0.018
2.5625	2.5750	2.5801	2.5875	2.3852	2.3901	2.3921	2.3950	0.15	0.20	0.25	0.141	0.030
2.5625	2.5750	2.5801	2.5875	2.3852	2.3901	2.3921	2.3950	0.25	0.30	0.35	0.184	0.029
2.5625	2.5750	2.5801	2.5875	2.3852	2.3901	2.3921	2.3950	0.35	0.40	0.45	0.260	0.033
2.5625	2.5750	2.5801	2.5875	2.3852	2.3901	2.3921	2.3950	0.45	0.50	0.55	0.491	0.057
2.5625	2.5750	2.5801	2.5875	2.3852	2.3901	2.3921	2.3950	0.55	0.60	0.65	0.668	0.069
2.5625	2.5750	2.5801	2.5875	2.3852	2.3901	2.3921	2.3950	0.65	0.70	0.75	0.773	0.084
2.5625	2.5750	2.5801	2.5875	2.3852	2.3901	2.3921	2.3950	0.75	0.80	0.85	1.117	0.092
2.5625	2.5750	2.5801	2.5875	2.3852	2.3901	2.3921	2.3950	0.85	0.90	0.95	0.925	0.162
2.5875	2.6000	2.6050	2.6125	2.3950	2.3999	2.4018	2.4047	-0.85	-0.80	-0.75	0.189	0.043
2.5875	2.6000	2.6050	2.6125	2.3950	2.3999	2.4018	2.4047	-0.75	-0.70	-0.65	0.184	0.029
2.5875	2.6000	2.6050	2.6125	2.3950	2.3999	2.4018	2.4047	-0.65	-0.60	-0.55	0.160	0.022
2.5875	2.6000	2.6050	2.6125	2.3950	2.3999	2.4018	2.4047	-0.55	-0.50	-0.45	0.146	0.025
2.5875	2.6000	2.6050	2.6125	2.3950	2.3999	2.4018	2.4047	-0.45	-0.40	-0.35	0.072	0.015
2.5875	2.6000	2.6050	2.6125	2.3950	2.3999	2.4018	2.4047	-0.35	-0.30	-0.25	0.076	0.017
2.5875	2.6000	2.6050	2.6125	2.3950	2.3999	2.4018	2.4047	-0.25	-0.20	-0.15	0.063	0.016
2.5875	2.6000	2.6050	2.6125	2.3950	2.3999	2.4018	2.4047	-0.15	-0.10	-0.05	0.071	0.025
2.5875	2.6000	2.6050	2.6125	2.3950	2.3999	2.4018	2.4047	-0.05	0.00	0.05	0.040	0.013
2.5875	2.6000	2.6050	2.6125	2.3950	2.3999	2.4018	2.4047	0.05	0.10	0.15	0.108	0.017
2.5875	2.6000	2.6050	2.6125	2.3950	2.3999	2.4018	2.4047	0.15	0.20	0.25	0.124	0.023
2.5875	2.6000	2.6050	2.6125	2.3950	2.3999	2.4018	2.4047	0.25	0.30	0.35	0.141	0.026
2.5875	2.6000	2.6050	2.6125	2.3950	2.3999	2.4018	2.4047	0.35	0.40	0.45	0.314	0.038
2.5875	2.6000	2.6050	2.6125	2.3950	2.3999	2.4018	2.4047	0.45	0.50	0.55	0.464	0.047
2.5875	2.6000	2.6050	2.6125	2.3950	2.3999	2.4018	2.4047	0.55	0.60	0.65	0.684	0.061
2.5875	2.6000	2.6050	2.6125	2.3950	2.3999	2.4018	2.4047	0.65	0.70	0.75	0.760	0.063
2.5875	2.6000	2.6050	2.6125	2.3950	2.3999	2.4018	2.4047	0.75	0.80	0.85	1.036	0.081

2.5875	2.6000	2.6050	2.6125	2.3950	2.3999	2.4018	2.4047	0.85	0.90	0.95	1.368	0.162
2.6125	2.6250	2.6299	2.6375	2.4047	2.4096	2.4115	2.4145	-0.85	-0.80	-0.75	0.212	0.041
2.6125	2.6250	2.6299	2.6375	2.4047	2.4096	2.4115	2.4145	-0.75	-0.70	-0.65	0.191	0.036
2.6125	2.6250	2.6299	2.6375	2.4047	2.4096	2.4115	2.4145	-0.65	-0.60	-0.55	0.200	0.030
2.6125	2.6250	2.6299	2.6375	2.4047	2.4096	2.4115	2.4145	-0.55	-0.50	-0.45	0.098	0.018
2.6125	2.6250	2.6299	2.6375	2.4047	2.4096	2.4115	2.4145	-0.45	-0.40	-0.35	0.062	0.013
2.6125	2.6250	2.6299	2.6375	2.4047	2.4096	2.4115	2.4145	-0.35	-0.30	-0.25	0.056	0.011
2.6125	2.6250	2.6299	2.6375	2.4047	2.4096	2.4115	2.4145	-0.25	-0.20	-0.15	0.091	0.017
2.6125	2.6250	2.6299	2.6375	2.4047	2.4096	2.4115	2.4145	-0.15	-0.10	-0.05	0.074	0.017
2.6125	2.6250	2.6299	2.6375	2.4047	2.4096	2.4115	2.4145	-0.05	0.00	0.05	0.074	0.016
2.6125	2.6250	2.6299	2.6375	2.4047	2.4096	2.4115	2.4145	0.05	0.10	0.15	0.078	0.017
2.6125	2.6250	2.6299	2.6375	2.4047	2.4096	2.4115	2.4145	0.15	0.20	0.25	0.103	0.018
2.6125	2.6250	2.6299	2.6375	2.4047	2.4096	2.4115	2.4145	0.25	0.30	0.35	0.220	0.027
2.6125	2.6250	2.6299	2.6375	2.4047	2.4096	2.4115	2.4145	0.35	0.40	0.45	0.256	0.024
2.6125	2.6250	2.6299	2.6375	2.4047	2.4096	2.4115	2.4145	0.45	0.50	0.55	0.385	0.038
2.6125	2.6250	2.6299	2.6375	2.4047	2.4096	2.4115	2.4145	0.55	0.60	0.65	0.586	0.049
2.6125	2.6250	2.6299	2.6375	2.4047	2.4096	2.4115	2.4145	0.65	0.70	0.75	0.853	0.064
2.6125	2.6250	2.6299	2.6375	2.4047	2.4096	2.4115	2.4145	0.75	0.80	0.85	0.877	0.067
2.6125	2.6250	2.6299	2.6375	2.4047	2.4096	2.4115	2.4145	0.85	0.90	0.95	1.225	0.160
2.6375	2.6500	2.6547	2.6625	2.4145	2.4193	2.4212	2.4242	-0.85	-0.80	-0.75	0.238	0.048
2.6375	2.6500	2.6547	2.6625	2.4145	2.4193	2.4212	2.4242	-0.75	-0.70	-0.65	0.166	0.028
2.6375	2.6500	2.6547	2.6625	2.4145	2.4193	2.4212	2.4242	-0.65	-0.60	-0.55	0.131	0.031
2.6375	2.6500	2.6547	2.6625	2.4145	2.4193	2.4212	2.4242	-0.55	-0.50	-0.45	0.088	0.022
2.6375	2.6500	2.6547	2.6625	2.4145	2.4193	2.4212	2.4242	-0.45	-0.40	-0.35	0.074	0.019
2.6375	2.6500	2.6547	2.6625	2.4145	2.4193	2.4212	2.4242	-0.35	-0.30	-0.25	0.097	0.015
2.6375	2.6500	2.6547	2.6625	2.4145	2.4193	2.4212	2.4242	-0.25	-0.20	-0.15	0.036	0.011
2.6375	2.6500	2.6547	2.6625	2.4145	2.4193	2.4212	2.4242	-0.15	-0.10	-0.05	0.112	0.027
2.6375	2.6500	2.6547	2.6625	2.4145	2.4193	2.4212	2.4242	-0.05	0.00	0.05	0.039	0.012
2.6375	2.6500	2.6547	2.6625	2.4145	2.4193	2.4212	2.4242	0.05	0.10	0.15	0.063	0.015
2.6375	2.6500	2.6547	2.6625	2.4145	2.4193	2.4212	2.4242	0.15	0.20	0.25	0.092	0.031
2.6375	2.6500	2.6547	2.6625	2.4145	2.4193	2.4212	2.4242	0.25	0.30	0.35	0.141	0.021
2.6375	2.6500	2.6547	2.6625	2.4145	2.4193	2.4212	2.4242	0.35	0.40	0.45	0.210	0.028
2.6375	2.6500	2.6547	2.6625	2.4145	2.4193	2.4212	2.4242	0.45	0.50	0.55	0.388	0.044
2.6375	2.6500	2.6547	2.6625	2.4145	2.4193	2.4212	2.4242	0.55	0.60	0.65	0.661	0.073
2.6375	2.6500	2.6547	2.6625	2.4145	2.4193	2.4212	2.4242	0.65	0.70	0.75	0.636	0.060
2.6375	2.6500	2.6547	2.6625	2.4145	2.4193	2.4212	2.4242	0.75	0.80	0.85	1.139	0.116
2.6375	2.6500	2.6547	2.6625	2.4145	2.4193	2.4212	2.4242	0.85	0.90	0.95	1.287	0.196
2.6625	2.6750	2.6795	2.6875	2.4242	2.4290	2.4307	2.4338	-0.85	-0.80	-0.75	0.167	0.058
2.6625	2.6750	2.6795	2.6875	2.4242	2.4290	2.4307	2.4338	-0.75	-0.70	-0.65	0.190	0.029
2.6625	2.6750	2.6795	2.6875	2.4242	2.4290	2.4307	2.4338	-0.65	-0.60	-0.55	0.193	0.039
2.6625	2.6750	2.6795	2.6875	2.4242	2.4290	2.4307	2.4338	-0.55	-0.50	-0.45	0.115	0.023
2.6625	2.6750	2.6795	2.6875	2.4242	2.4290	2.4307	2.4338	-0.45	-0.40	-0.35	0.064	0.014
2.6625	2.6750	2.6795	2.6875	2.4242	2.4290	2.4307	2.4338	-0.35	-0.30	-0.25	0.068	0.027
2.6625	2.6750	2.6795	2.6875	2.4242	2.4290	2.4307	2.4338	-0.25	-0.20	-0.15	0.018	0.008
2.6625	2.6750	2.6795	2.6875	2.4242	2.4290	2.4307	2.4338	-0.15	-0.10	-0.05	0.018	0.011
2.6625	2.6750	2.6795	2.6875	2.4242	2.4290	2.4307	2.4338	-0.05	0.00	0.05	0.049	0.016
2.6625	2.6750	2.6795	2.6875	2.4242	2.4290	2.4307	2.4338	0.05	0.10	0.15	0.066	0.016
2.6625	2.6750	2.6795	2.6875	2.4242	2.4290	2.4307	2.4338	0.15	0.20	0.25	0.154	0.028
2.6625	2.6750	2.6795	2.6875	2.4242	2.4290	2.4307	2.4338	0.25	0.30	0.35	0.177	0.027
2.6625	2.6750	2.6795	2.6875	2.4242	2.4290	2.4307	2.4338	0.35	0.40	0.45	0.222	0.026
2.6625	2.6750	2.6795	2.6875	2.4242	2.4290	2.4307	2.4338	0.45	0.50	0.55	0.441	0.047
2.6625	2.6750	2.6795	2.6875	2.4242	2.4290	2.4307	2.4338	0.55	0.60	0.65	0.541	0.052
2.6625	2.6750	2.6795	2.6875	2.4242	2.4290	2.4307	2.4338	0.65	0.70	0.75	0.811	0.072
2.6625	2.6750	2.6795	2.6875	2.4242	2.4290	2.4307	2.4338	0.75	0.80	0.85	0.838	0.074
2.6625	2.6750	2.6795	2.6875	2.4242	2.4290	2.4307	2.4338	0.85	0.90	0.95	1.308	0.179
2.6875	2.7000	2.7042	2.7125	2.4338	2.4386	2.4403	2.4435	-0.85	-0.80	-0.75	0.220	0.053
2.6875	2.7000	2.7042	2.7125	2.4338	2.4386	2.4403	2.4435	-0.75	-0.70	-0.65	0.216	0.034
2.6875	2.7000	2.7042	2.7125	2.4338	2.4386	2.4403	2.4435	-0.65	-0.60	-0.55	0.125	0.026
2.6875	2.7000	2.7042	2.7125	2.4338	2.4386	2.4403	2.4435	-0.55	-0.50	-0.45	0.155	0.025
2.6875	2.7000	2.7042	2.7125	2.4338	2.4386	2.4403	2.4435	-0.45	-0.40	-0.35	0.090	0.022
2.6875	2.7000	2.7042	2.7125	2.4338	2.4386	2.4403	2.4435	-0.35	-0.30	-0.25	0.045	0.016
2.6875	2.7000	2.7042	2.7125	2.4338	2.4386	2.4403	2.4435	-0.25	-0.20	-0.15	0.061	0.021
2.6875	2.7000	2.7042	2.7125	2.4338	2.4386	2.4403	2.4435	-0.15	-0.10	-0.05	0.031	0.008
2.6875	2.7000	2.7042	2.7125	2.4338	2.4386	2.4403	2.4435	-0.05	0.00	0.05	0.048	0.012

2.6875	2.7000	2.7042	2.7125	2.4338	2.4386	2.4403	2.4435	0.05	0.10	0.15	0.088	0.015
2.6875	2.7000	2.7042	2.7125	2.4338	2.4386	2.4403	2.4435	0.15	0.20	0.25	0.106	0.031
2.6875	2.7000	2.7042	2.7125	2.4338	2.4386	2.4403	2.4435	0.25	0.30	0.35	0.161	0.020
2.6875	2.7000	2.7042	2.7125	2.4338	2.4386	2.4403	2.4435	0.35	0.40	0.45	0.220	0.025
2.6875	2.7000	2.7042	2.7125	2.4338	2.4386	2.4403	2.4435	0.45	0.50	0.55	0.320	0.034
2.6875	2.7000	2.7042	2.7125	2.4338	2.4386	2.4403	2.4435	0.55	0.60	0.65	0.556	0.051
2.6875	2.7000	2.7042	2.7125	2.4338	2.4386	2.4403	2.4435	0.65	0.70	0.75	0.751	0.057
2.6875	2.7000	2.7042	2.7125	2.4338	2.4386	2.4403	2.4435	0.75	0.80	0.85	0.957	0.076
2.6875	2.7000	2.7042	2.7125	2.4338	2.4386	2.4403	2.4435	0.85	0.90	0.95	1.651	0.174
2.7125	2.7250	2.7289	2.7375	2.4435	2.4482	2.4497	2.4530	-0.85	-0.80	-0.75	0.296	0.054
2.7125	2.7250	2.7289	2.7375	2.4435	2.4482	2.4497	2.4530	-0.75	-0.70	-0.65	0.216	0.044
2.7125	2.7250	2.7289	2.7375	2.4435	2.4482	2.4497	2.4530	-0.65	-0.60	-0.55	0.167	0.029
2.7125	2.7250	2.7289	2.7375	2.4435	2.4482	2.4497	2.4530	-0.55	-0.50	-0.45	0.127	0.025
2.7125	2.7250	2.7289	2.7375	2.4435	2.4482	2.4497	2.4530	-0.45	-0.40	-0.35	0.081	0.016
2.7125	2.7250	2.7289	2.7375	2.4435	2.4482	2.4497	2.4530	-0.35	-0.30	-0.25	0.079	0.018
2.7125	2.7250	2.7289	2.7375	2.4435	2.4482	2.4497	2.4530	-0.25	-0.20	-0.15	0.080	0.016
2.7125	2.7250	2.7289	2.7375	2.4435	2.4482	2.4497	2.4530	-0.15	-0.10	-0.05	0.036	0.012
2.7125	2.7250	2.7289	2.7375	2.4435	2.4482	2.4497	2.4530	-0.05	0.00	0.05	0.042	0.013
2.7125	2.7250	2.7289	2.7375	2.4435	2.4482	2.4497	2.4530	0.05	0.10	0.15	0.070	0.014
2.7125	2.7250	2.7289	2.7375	2.4435	2.4482	2.4497	2.4530	0.15	0.20	0.25	0.093	0.019
2.7125	2.7250	2.7289	2.7375	2.4435	2.4482	2.4497	2.4530	0.25	0.30	0.35	0.135	0.021
2.7125	2.7250	2.7289	2.7375	2.4435	2.4482	2.4497	2.4530	0.35	0.40	0.45	0.221	0.028
2.7125	2.7250	2.7289	2.7375	2.4435	2.4482	2.4497	2.4530	0.45	0.50	0.55	0.337	0.039
2.7125	2.7250	2.7289	2.7375	2.4435	2.4482	2.4497	2.4530	0.55	0.60	0.65	0.543	0.057
2.7125	2.7250	2.7289	2.7375	2.4435	2.4482	2.4497	2.4530	0.65	0.70	0.75	0.677	0.063
2.7125	2.7250	2.7289	2.7375	2.4435	2.4482	2.4497	2.4530	0.75	0.80	0.85	0.931	0.078
2.7125	2.7250	2.7289	2.7375	2.4435	2.4482	2.4497	2.4530	0.85	0.90	0.95	1.419	0.191
2.7375	2.7500	2.7536	2.7625	2.4530	2.4578	2.4592	2.4626	-0.85	-0.80	-0.75	0.173	0.044
2.7375	2.7500	2.7536	2.7625	2.4530	2.4578	2.4592	2.4626	-0.75	-0.70	-0.65	0.227	0.046
2.7375	2.7500	2.7536	2.7625	2.4530	2.4578	2.4592	2.4626	-0.65	-0.60	-0.55	0.104	0.025
2.7375	2.7500	2.7536	2.7625	2.4530	2.4578	2.4592	2.4626	-0.55	-0.50	-0.45	0.081	0.024
2.7375	2.7500	2.7536	2.7625	2.4530	2.4578	2.4592	2.4626	-0.45	-0.40	-0.35	0.023	0.012
2.7375	2.7500	2.7536	2.7625	2.4530	2.4578	2.4592	2.4626	-0.35	-0.30	-0.25	0.074	0.019
2.7375	2.7500	2.7536	2.7625	2.4530	2.4578	2.4592	2.4626	-0.25	-0.20	-0.15	0.040	0.019
2.7375	2.7500	2.7536	2.7625	2.4530	2.4578	2.4592	2.4626	-0.15	-0.10	-0.05	0.082	0.024
2.7375	2.7500	2.7536	2.7625	2.4530	2.4578	2.4592	2.4626	-0.05	0.00	0.05	0.032	0.014
2.7375	2.7500	2.7536	2.7625	2.4530	2.4578	2.4592	2.4626	0.05	0.10	0.15	0.122	0.005
2.7375	2.7500	2.7536	2.7625	2.4530	2.4578	2.4592	2.4626	0.15	0.20	0.25	0.069	0.025
2.7375	2.7500	2.7536	2.7625	2.4530	2.4578	2.4592	2.4626	0.25	0.30	0.35	0.224	0.044
2.7375	2.7500	2.7536	2.7625	2.4530	2.4578	2.4592	2.4626	0.35	0.40	0.45	0.263	0.038
2.7375	2.7500	2.7536	2.7625	2.4530	2.4578	2.4592	2.4626	0.45	0.50	0.55	0.314	0.054
2.7375	2.7500	2.7536	2.7625	2.4530	2.4578	2.4592	2.4626	0.55	0.60	0.65	0.514	0.064
2.7375	2.7500	2.7536	2.7625	2.4530	2.4578	2.4592	2.4626	0.65	0.70	0.75	0.776	0.082
2.7375	2.7500	2.7536	2.7625	2.4530	2.4578	2.4592	2.4626	0.75	0.80	0.85	1.131	0.107
2.7375	2.7500	2.7536	2.7625	2.4530	2.4578	2.4592	2.4626	0.85	0.90	0.95	1.526	0.219
2.7625	2.7750	2.7782	2.7875	2.4626	2.4673	2.4686	2.4721	-0.85	-0.80	-0.75	0.186	0.046
2.7625	2.7750	2.7782	2.7875	2.4626	2.4673	2.4686	2.4721	-0.75	-0.70	-0.65	0.229	0.041
2.7625	2.7750	2.7782	2.7875	2.4626	2.4673	2.4686	2.4721	-0.65	-0.60	-0.55	0.165	0.029
2.7625	2.7750	2.7782	2.7875	2.4626	2.4673	2.4686	2.4721	-0.55	-0.50	-0.45	0.123	0.023
2.7625	2.7750	2.7782	2.7875	2.4626	2.4673	2.4686	2.4721	-0.45	-0.40	-0.35	0.090	0.022
2.7625	2.7750	2.7782	2.7875	2.4626	2.4673	2.4686	2.4721	-0.35	-0.30	-0.25	0.076	0.026
2.7625	2.7750	2.7782	2.7875	2.4626	2.4673	2.4686	2.4721	-0.25	-0.20	-0.15	0.044	0.014
2.7625	2.7750	2.7782	2.7875	2.4626	2.4673	2.4686	2.4721	-0.15	-0.10	-0.05	0.087	0.025
2.7625	2.7750	2.7782	2.7875	2.4626	2.4673	2.4686	2.4721	-0.05	0.00	0.05	0.074	0.017
2.7625	2.7750	2.7782	2.7875	2.4626	2.4673	2.4686	2.4721	0.05	0.10	0.15	0.052	0.016
2.7625	2.7750	2.7782	2.7875	2.4626	2.4673	2.4686	2.4721	0.15	0.20	0.25	0.073	0.017
2.7625	2.7750	2.7782	2.7875	2.4626	2.4673	2.4686	2.4721	0.25	0.30	0.35	0.088	0.019
2.7625	2.7750	2.7782	2.7875	2.4626	2.4673	2.4686	2.4721	0.35	0.40	0.45	0.228	0.031
2.7625	2.7750	2.7782	2.7875	2.4626	2.4673	2.4686	2.4721	0.45	0.50	0.55	0.320	0.049
2.7625	2.7750	2.7782	2.7875	2.4626	2.4673	2.4686	2.4721	0.55	0.60	0.65	0.511	0.055
2.7625	2.7750	2.7782	2.7875	2.4626	2.4673	2.4686	2.4721	0.65	0.70	0.75	0.826	0.069
2.7625	2.7750	2.7782	2.7875	2.4626	2.4673	2.4686	2.4721	0.75	0.80	0.85	0.909	0.091
2.7625	2.7750	2.7782	2.7875	2.4626	2.4673	2.4686	2.4721	0.85	0.90	0.95	1.112	0.176
2.7875	2.8000	2.8028	2.8125	2.4721	2.4768	2.4779	2.4816	-0.85	-0.80	-0.75	0.158	0.057

2.7875	2.8000	2.8028	2.8125	2.4721	2.4768	2.4779	2.4816	-0.75	-0.70	-0.65	0.142	0.027
2.7875	2.8000	2.8028	2.8125	2.4721	2.4768	2.4779	2.4816	-0.65	-0.60	-0.55	0.122	0.023
2.7875	2.8000	2.8028	2.8125	2.4721	2.4768	2.4779	2.4816	-0.55	-0.50	-0.45	0.091	0.020
2.7875	2.8000	2.8028	2.8125	2.4721	2.4768	2.4779	2.4816	-0.45	-0.40	-0.35	0.068	0.017
2.7875	2.8000	2.8028	2.8125	2.4721	2.4768	2.4779	2.4816	-0.35	-0.30	-0.25	0.054	0.017
2.7875	2.8000	2.8028	2.8125	2.4721	2.4768	2.4779	2.4816	-0.25	-0.20	-0.15	0.047	0.005
2.7875	2.8000	2.8028	2.8125	2.4721	2.4768	2.4779	2.4816	-0.15	-0.10	-0.05	0.094	0.016
2.7875	2.8000	2.8028	2.8125	2.4721	2.4768	2.4779	2.4816	-0.05	0.00	0.05	0.035	0.016
2.7875	2.8000	2.8028	2.8125	2.4721	2.4768	2.4779	2.4816	0.05	0.10	0.15	0.026	0.011
2.7875	2.8000	2.8028	2.8125	2.4721	2.4768	2.4779	2.4816	0.15	0.20	0.25	0.025	0.010
2.7875	2.8000	2.8028	2.8125	2.4721	2.4768	2.4779	2.4816	0.25	0.30	0.35	0.123	0.022
2.7875	2.8000	2.8028	2.8125	2.4721	2.4768	2.4779	2.4816	0.35	0.40	0.45	0.145	0.027
2.7875	2.8000	2.8028	2.8125	2.4721	2.4768	2.4779	2.4816	0.45	0.50	0.55	0.334	0.043
2.7875	2.8000	2.8028	2.8125	2.4721	2.4768	2.4779	2.4816	0.55	0.60	0.65	0.469	0.060
2.7875	2.8000	2.8028	2.8125	2.4721	2.4768	2.4779	2.4816	0.65	0.70	0.75	0.795	0.055
2.7875	2.8000	2.8028	2.8125	2.4721	2.4768	2.4779	2.4816	0.75	0.80	0.85	0.968	0.095
2.7875	2.8000	2.8028	2.8125	2.4721	2.4768	2.4779	2.4816	0.85	0.90	0.95	1.426	0.225
2.8125	2.8250	2.8274	2.8375	2.4816	2.4863	2.4872	2.4910	-0.85	-0.80	-0.75	0.148	0.039
2.8125	2.8250	2.8274	2.8375	2.4816	2.4863	2.4872	2.4910	-0.75	-0.70	-0.65	0.131	0.030
2.8125	2.8250	2.8274	2.8375	2.4816	2.4863	2.4872	2.4910	-0.65	-0.60	-0.55	0.139	0.028
2.8125	2.8250	2.8274	2.8375	2.4816	2.4863	2.4872	2.4910	-0.55	-0.50	-0.45	0.054	0.018
2.8125	2.8250	2.8274	2.8375	2.4816	2.4863	2.4872	2.4910	-0.45	-0.40	-0.35	0.039	0.016
2.8125	2.8250	2.8274	2.8375	2.4816	2.4863	2.4872	2.4910	-0.35	-0.30	-0.25	0.071	0.014
2.8125	2.8250	2.8274	2.8375	2.4816	2.4863	2.4872	2.4910	-0.25	-0.20	-0.15	0.048	0.014
2.8125	2.8250	2.8274	2.8375	2.4816	2.4863	2.4872	2.4910	-0.15	-0.10	-0.05	0.075	0.017
2.8125	2.8250	2.8274	2.8375	2.4816	2.4863	2.4872	2.4910	-0.05	0.00	0.05	0.017	0.010
2.8125	2.8250	2.8274	2.8375	2.4816	2.4863	2.4872	2.4910	0.05	0.10	0.15	0.072	0.017
2.8125	2.8250	2.8274	2.8375	2.4816	2.4863	2.4872	2.4910	0.15	0.20	0.25	0.063	0.022
2.8125	2.8250	2.8274	2.8375	2.4816	2.4863	2.4872	2.4910	0.25	0.30	0.35	0.166	0.040
2.8125	2.8250	2.8274	2.8375	2.4816	2.4863	2.4872	2.4910	0.35	0.40	0.45	0.126	0.031
2.8125	2.8250	2.8274	2.8375	2.4816	2.4863	2.4872	2.4910	0.45	0.50	0.55	0.331	0.043
2.8125	2.8250	2.8274	2.8375	2.4816	2.4863	2.4872	2.4910	0.55	0.60	0.65	0.452	0.056
2.8125	2.8250	2.8274	2.8375	2.4816	2.4863	2.4872	2.4910	0.65	0.70	0.75	0.769	0.081
2.8125	2.8250	2.8274	2.8375	2.4816	2.4863	2.4872	2.4910	0.75	0.80	0.85	1.186	0.122
2.8125	2.8250	2.8274	2.8375	2.4816	2.4863	2.4872	2.4910	0.85	0.90	0.95	1.306	0.194
2.8375	2.8500	2.8519	2.8625	2.4910	2.4957	2.4964	2.5004	-0.85	-0.80	-0.75	0.139	0.039
2.8375	2.8500	2.8519	2.8625	2.4910	2.4957	2.4964	2.5004	-0.75	-0.70	-0.65	0.167	0.054
2.8375	2.8500	2.8519	2.8625	2.4910	2.4957	2.4964	2.5004	-0.65	-0.60	-0.55	0.108	0.023
2.8375	2.8500	2.8519	2.8625	2.4910	2.4957	2.4964	2.5004	-0.55	-0.50	-0.45	0.071	0.014
2.8375	2.8500	2.8519	2.8625	2.4910	2.4957	2.4964	2.5004	-0.45	-0.40	-0.35	0.104	0.021
2.8375	2.8500	2.8519	2.8625	2.4910	2.4957	2.4964	2.5004	-0.35	-0.30	-0.25	0.085	0.019
2.8375	2.8500	2.8519	2.8625	2.4910	2.4957	2.4964	2.5004	-0.25	-0.20	-0.15	0.073	0.017
2.8375	2.8500	2.8519	2.8625	2.4910	2.4957	2.4964	2.5004	-0.15	-0.10	-0.05	0.059	0.010
2.8375	2.8500	2.8519	2.8625	2.4910	2.4957	2.4964	2.5004	-0.05	0.00	0.05	0.026	0.008
2.8375	2.8500	2.8519	2.8625	2.4910	2.4957	2.4964	2.5004	0.05	0.10	0.15	0.050	0.016
2.8375	2.8500	2.8519	2.8625	2.4910	2.4957	2.4964	2.5004	0.15	0.20	0.25	0.046	0.010
2.8375	2.8500	2.8519	2.8625	2.4910	2.4957	2.4964	2.5004	0.25	0.30	0.35	0.094	0.023
2.8375	2.8500	2.8519	2.8625	2.4910	2.4957	2.4964	2.5004	0.35	0.40	0.45	0.136	0.021
2.8375	2.8500	2.8519	2.8625	2.4910	2.4957	2.4964	2.5004	0.45	0.50	0.55	0.282	0.036
2.8375	2.8500	2.8519	2.8625	2.4910	2.4957	2.4964	2.5004	0.55	0.60	0.65	0.487	0.052
2.8375	2.8500	2.8519	2.8625	2.4910	2.4957	2.4964	2.5004	0.65	0.70	0.75	0.686	0.064
2.8375	2.8500	2.8519	2.8625	2.4910	2.4957	2.4964	2.5004	0.75	0.80	0.85	0.906	0.092
2.8375	2.8500	2.8519	2.8625	2.4910	2.4957	2.4964	2.5004	0.85	0.90	0.95	1.254	0.153
2.8625	2.8750	2.8764	2.8875	2.5004	2.5051	2.5056	2.5098	-0.85	-0.80	-0.75	0.154	0.049
2.8625	2.8750	2.8764	2.8875	2.5004	2.5051	2.5056	2.5098	-0.75	-0.70	-0.65	0.163	0.034
2.8625	2.8750	2.8764	2.8875	2.5004	2.5051	2.5056	2.5098	-0.65	-0.60	-0.55	0.087	0.024
2.8625	2.8750	2.8764	2.8875	2.5004	2.5051	2.5056	2.5098	-0.55	-0.50	-0.45	0.107	0.029
2.8625	2.8750	2.8764	2.8875	2.5004	2.5051	2.5056	2.5098	-0.45	-0.40	-0.35	0.025	0.018
2.8625	2.8750	2.8764	2.8875	2.5004	2.5051	2.5056	2.5098	-0.35	-0.30	-0.25	0.028	0.018
2.8625	2.8750	2.8764	2.8875	2.5004	2.5051	2.5056	2.5098	-0.25	-0.20	-0.15	0.038	0.015
2.8625	2.8750	2.8764	2.8875	2.5004	2.5051	2.5056	2.5098	-0.15	-0.10	-0.05	0.045	0.018
2.8625	2.8750	2.8764	2.8875	2.5004	2.5051	2.5056	2.5098	-0.05	0.00	0.05	0.026	0.015
2.8625	2.8750	2.8764	2.8875	2.5004	2.5051	2.5056	2.5098	0.05	0.10	0.15	0.029	0.011
2.8625	2.8750	2.8764	2.8875	2.5004	2.5051	2.5056	2.5098	0.15	0.20	0.25	0.081	0.021

2.8625	2.8750	2.8764	2.8875	2.5004	2.5051	2.5056	2.5098	0.25	0.30	0.35	0.060	0.017
2.8625	2.8750	2.8764	2.8875	2.5004	2.5051	2.5056	2.5098	0.35	0.40	0.45	0.109	0.026
2.8625	2.8750	2.8764	2.8875	2.5004	2.5051	2.5056	2.5098	0.45	0.50	0.55	0.283	0.044
2.8625	2.8750	2.8764	2.8875	2.5004	2.5051	2.5056	2.5098	0.55	0.60	0.65	0.493	0.065
2.8625	2.8750	2.8764	2.8875	2.5004	2.5051	2.5056	2.5098	0.65	0.70	0.75	0.663	0.069
2.8625	2.8750	2.8764	2.8875	2.5004	2.5051	2.5056	2.5098	0.75	0.80	0.85	1.108	0.114
2.8625	2.8750	2.8764	2.8875	2.5004	2.5051	2.5056	2.5098	0.85	0.90	0.95	1.094	0.219
2.8875	2.9000	2.9008	2.9125	2.5098	2.5144	2.5147	2.5191	-0.85	-0.80	-0.75	0.159	0.049
2.8875	2.9000	2.9008	2.9125	2.5098	2.5144	2.5147	2.5191	-0.75	-0.70	-0.65	0.117	0.025
2.8875	2.9000	2.9008	2.9125	2.5098	2.5144	2.5147	2.5191	-0.65	-0.60	-0.55	0.122	0.020
2.8875	2.9000	2.9008	2.9125	2.5098	2.5144	2.5147	2.5191	-0.55	-0.50	-0.45	0.092	0.021
2.8875	2.9000	2.9008	2.9125	2.5098	2.5144	2.5147	2.5191	-0.45	-0.40	-0.35	0.058	0.014
2.8875	2.9000	2.9008	2.9125	2.5098	2.5144	2.5147	2.5191	-0.35	-0.30	-0.25	0.024	0.008
2.8875	2.9000	2.9008	2.9125	2.5098	2.5144	2.5147	2.5191	-0.25	-0.20	-0.15	0.022	0.008
2.8875	2.9000	2.9008	2.9125	2.5098	2.5144	2.5147	2.5191	-0.15	-0.10	-0.05	0.038	0.012
2.8875	2.9000	2.9008	2.9125	2.5098	2.5144	2.5147	2.5191	-0.05	0.00	0.05	0.061	0.025
2.8875	2.9000	2.9008	2.9125	2.5098	2.5144	2.5147	2.5191	0.05	0.10	0.15	0.067	0.016
2.8875	2.9000	2.9008	2.9125	2.5098	2.5144	2.5147	2.5191	0.15	0.20	0.25	0.094	0.019
2.8875	2.9000	2.9008	2.9125	2.5098	2.5144	2.5147	2.5191	0.25	0.30	0.35	0.105	0.038
2.8875	2.9000	2.9008	2.9125	2.5098	2.5144	2.5147	2.5191	0.35	0.40	0.45	0.182	0.025
2.8875	2.9000	2.9008	2.9125	2.5098	2.5144	2.5147	2.5191	0.45	0.50	0.55	0.306	0.043
2.8875	2.9000	2.9008	2.9125	2.5098	2.5144	2.5147	2.5191	0.55	0.60	0.65	0.528	0.056
2.8875	2.9000	2.9008	2.9125	2.5098	2.5144	2.5147	2.5191	0.65	0.70	0.75	0.712	0.066
2.8875	2.9000	2.9008	2.9125	2.5098	2.5144	2.5147	2.5191	0.75	0.80	0.85	0.976	0.093
2.8875	2.9000	2.9008	2.9125	2.5098	2.5144	2.5147	2.5191	0.85	0.90	0.95	1.132	0.225
2.9125	2.9250	2.9253	2.9375	2.5191	2.5237	2.5238	2.5284	-0.85	-0.80	-0.75	0.046	0.021
2.9125	2.9250	2.9253	2.9375	2.5191	2.5237	2.5238	2.5284	-0.75	-0.70	-0.65	0.175	0.033
2.9125	2.9250	2.9253	2.9375	2.5191	2.5237	2.5238	2.5284	-0.65	-0.60	-0.55	0.125	0.021
2.9125	2.9250	2.9253	2.9375	2.5191	2.5237	2.5238	2.5284	-0.55	-0.50	-0.45	0.111	0.022
2.9125	2.9250	2.9253	2.9375	2.5191	2.5237	2.5238	2.5284	-0.45	-0.40	-0.35	0.084	0.018
2.9125	2.9250	2.9253	2.9375	2.5191	2.5237	2.5238	2.5284	-0.35	-0.30	-0.25	0.085	0.013
2.9125	2.9250	2.9253	2.9375	2.5191	2.5237	2.5238	2.5284	-0.25	-0.20	-0.15	0.093	0.021
2.9125	2.9250	2.9253	2.9375	2.5191	2.5237	2.5238	2.5284	-0.15	-0.10	-0.05	0.047	0.012
2.9125	2.9250	2.9253	2.9375	2.5191	2.5237	2.5238	2.5284	-0.05	0.00	0.05	0.139	0.030
2.9125	2.9250	2.9253	2.9375	2.5191	2.5237	2.5238	2.5284	0.05	0.10	0.15	0.047	0.024
2.9125	2.9250	2.9253	2.9375	2.5191	2.5237	2.5238	2.5284	0.15	0.20	0.25	0.028	0.011
2.9125	2.9250	2.9253	2.9375	2.5191	2.5237	2.5238	2.5284	0.25	0.30	0.35	0.117	0.025
2.9125	2.9250	2.9253	2.9375	2.5191	2.5237	2.5238	2.5284	0.35	0.40	0.45	0.205	0.022
2.9125	2.9250	2.9253	2.9375	2.5191	2.5237	2.5238	2.5284	0.45	0.50	0.55	0.244	0.037
2.9125	2.9250	2.9253	2.9375	2.5191	2.5237	2.5238	2.5284	0.55	0.60	0.65	0.527	0.055
2.9125	2.9250	2.9253	2.9375	2.5191	2.5237	2.5238	2.5284	0.65	0.70	0.75	0.767	0.080
2.9125	2.9250	2.9253	2.9375	2.5191	2.5237	2.5238	2.5284	0.75	0.80	0.85	1.103	0.127
2.9125	2.9250	2.9253	2.9375	2.5191	2.5237	2.5238	2.5284	0.85	0.90	0.95	1.624	0.186
2.9375	2.9500	2.9496	2.9625	2.5284	2.5330	2.5329	2.5376	-0.85	-0.80	-0.75	0.165	0.044
2.9375	2.9500	2.9496	2.9625	2.5284	2.5330	2.5329	2.5376	-0.75	-0.70	-0.65	0.150	0.059
2.9375	2.9500	2.9496	2.9625	2.5284	2.5330	2.5329	2.5376	-0.65	-0.60	-0.55	0.095	0.020
2.9375	2.9500	2.9496	2.9625	2.5284	2.5330	2.5329	2.5376	-0.55	-0.50	-0.45	0.052	0.021
2.9375	2.9500	2.9496	2.9625	2.5284	2.5330	2.5329	2.5376	-0.45	-0.40	-0.35	0.059	0.022
2.9375	2.9500	2.9496	2.9625	2.5284	2.5330	2.5329	2.5376	-0.35	-0.30	-0.25	0.061	0.016
2.9375	2.9500	2.9496	2.9625	2.5284	2.5330	2.5329	2.5376	-0.25	-0.20	-0.15	0.059	0.016
2.9375	2.9500	2.9496	2.9625	2.5284	2.5330	2.5329	2.5376	-0.15	-0.10	-0.05	0.047	0.016
2.9375	2.9500	2.9496	2.9625	2.5284	2.5330	2.5329	2.5376	-0.05	0.00	0.05	0.043	0.015
2.9375	2.9500	2.9496	2.9625	2.5284	2.5330	2.5329	2.5376	0.05	0.10	0.15	0.095	0.027
2.9375	2.9500	2.9496	2.9625	2.5284	2.5330	2.5329	2.5376	0.15	0.20	0.25	0.048	0.019
2.9375	2.9500	2.9496	2.9625	2.5284	2.5330	2.5329	2.5376	0.25	0.30	0.35	0.061	0.016
2.9375	2.9500	2.9496	2.9625	2.5284	2.5330	2.5329	2.5376	0.35	0.40	0.45	0.095	0.024
2.9375	2.9500	2.9496	2.9625	2.5284	2.5330	2.5329	2.5376	0.45	0.50	0.55	0.290	0.041
2.9375	2.9500	2.9496	2.9625	2.5284	2.5330	2.5329	2.5376	0.55	0.60	0.65	0.407	0.051
2.9375	2.9500	2.9496	2.9625	2.5284	2.5330	2.5329	2.5376	0.65	0.70	0.75	0.575	0.060
2.9375	2.9500	2.9496	2.9625	2.5284	2.5330	2.5329	2.5376	0.75	0.80	0.85	1.064	0.094
2.9375	2.9500	2.9496	2.9625	2.5284	2.5330	2.5329	2.5376	0.85	0.90	0.95	1.190	0.184
2.9625	2.9750	0.0000	2.9875	2.5376	2.5423	0.0000	2.5469	-0.85	-0.80	-0.75	0.000	0.000
2.9625	2.9750	0.0000	2.9875	2.5376	2.5423	0.0000	2.5469	-0.75	-0.70	-0.65	0.000	0.000
2.9625	2.9750	0.0000	2.9875	2.5376	2.5423	0.0000	2.5469	-0.65	-0.60	-0.55	0.000	0.000

2.9625	2.9750	0.0000	2.9875	2.5376	2.5423	0.0000	2.5469	-0.55	-0.50	-0.45	0.000	0.000
2.9625	2.9750	0.0000	2.9875	2.5376	2.5423	0.0000	2.5469	-0.45	-0.40	-0.35	0.000	0.000
2.9625	2.9750	0.0000	2.9875	2.5376	2.5423	0.0000	2.5469	-0.35	-0.30	-0.25	0.000	0.000
2.9625	2.9750	0.0000	2.9875	2.5376	2.5423	0.0000	2.5469	-0.25	-0.20	-0.15	0.000	0.000
2.9625	2.9750	0.0000	2.9875	2.5376	2.5423	0.0000	2.5469	-0.15	-0.10	-0.05	0.000	0.000
2.9625	2.9750	0.0000	2.9875	2.5376	2.5423	0.0000	2.5469	-0.05	0.00	0.05	0.000	0.000
2.9625	2.9750	0.0000	2.9875	2.5376	2.5423	0.0000	2.5469	0.05	0.10	0.15	0.000	0.000
2.9625	2.9750	0.0000	2.9875	2.5376	2.5423	0.0000	2.5469	0.15	0.20	0.25	0.000	0.000
2.9625	2.9750	0.0000	2.9875	2.5376	2.5423	0.0000	2.5469	0.25	0.30	0.35	0.000	0.000
2.9625	2.9750	0.0000	2.9875	2.5376	2.5423	0.0000	2.5469	0.35	0.40	0.45	0.000	0.000
2.9625	2.9750	0.0000	2.9875	2.5376	2.5423	0.0000	2.5469	0.45	0.50	0.55	0.000	0.000
2.9625	2.9750	0.0000	2.9875	2.5376	2.5423	0.0000	2.5469	0.55	0.60	0.65	0.000	0.000
2.9625	2.9750	0.0000	2.9875	2.5376	2.5423	0.0000	2.5469	0.65	0.70	0.75	0.000	0.000
2.9625	2.9750	0.0000	2.9875	2.5376	2.5423	0.0000	2.5469	0.75	0.80	0.85	0.000	0.000
2.9625	2.9750	0.0000	2.9875	2.5376	2.5423	0.0000	2.5469	0.85	0.90	0.95	0.000	0.000

Appendix D

Data Table: C_x for $K^+\Lambda$

This appendix contains tables of numerical values for C_x for the $K^+\Lambda$ analysis. The table consist of thirteen columns, which are interpreted as follows:

1. Column 1: Lower limit of E_γ bin (GeV)
2. Column 2: Nominal midpoint of E_γ bin (GeV)
3. Column 3: Corrected midpoint of E_γ bin (GeV)
4. Column 4: Upper limit of E_γ bin (GeV)
5. Column 5: Lower limit of W bin (GeV)
6. Column 6: Nominal midpoint of W bin (GeV)
7. Column 7: Corrected midpoint of W bin (GeV)
8. Column 8: Upper limit of W bin (GeV)
9. Column 9: Lower limit of $\cos(\theta_{KCM})$ bin
10. Column 10: Midpoint of $\cos(\theta_{KCM})$ bin
11. Column 11: Upper limit of $\cos(\theta_{KCM})$ bin
12. Column 12: C_x . Double polarization observables are unitless.
13. Column 13: Error on datapoint.

D.1 Data Table

0.8875	0.9375	0.9318	0.9875	1.5955	1.6247	1.6214	1.6533	-0.85	-0.75	-0.65	0.000	0.000
0.8875	0.9375	0.9318	0.9875	1.5955	1.6247	1.6214	1.6533	-0.65	-0.55	-0.45	0.000	0.000
0.8875	0.9375	0.9318	0.9875	1.5955	1.6247	1.6214	1.6533	-0.45	-0.35	-0.25	0.000	0.000
0.8875	0.9375	0.9318	0.9875	1.5955	1.6247	1.6214	1.6533	-0.25	-0.15	-0.05	0.000	0.000
0.8875	0.9375	0.9318	0.9875	1.5955	1.6247	1.6214	1.6533	-0.05	0.05	0.15	0.000	0.000
0.8875	0.9375	0.9318	0.9875	1.5955	1.6247	1.6214	1.6533	0.15	0.25	0.35	0.000	0.000
0.8875	0.9375	0.9318	0.9875	1.5955	1.6247	1.6214	1.6533	0.35	0.45	0.55	0.000	0.000
0.8875	0.9375	0.9318	0.9875	1.5955	1.6247	1.6214	1.6533	0.55	0.65	0.75	0.000	0.000
0.8875	0.9375	0.9318	0.9875	1.5955	1.6247	1.6214	1.6533	0.75	0.85	0.95	0.000	0.000
0.9875	1.0375	1.0322	1.0875	1.6533	1.6814	1.6785	1.7091	-0.85	-0.75	-0.65	0.000	0.000
0.9875	1.0375	1.0322	1.0875	1.6533	1.6814	1.6785	1.7091	-0.65	-0.55	-0.45	0.114	0.724
0.9875	1.0375	1.0322	1.0875	1.6533	1.6814	1.6785	1.7091	-0.45	-0.35	-0.25	-0.960	0.269

0.9875	1.0375	1.0322	1.0875	1.6533	1.6814	1.6785	1.7091	-0.25	-0.15	-0.05	-0.304	0.186
0.9875	1.0375	1.0322	1.0875	1.6533	1.6814	1.6785	1.7091	-0.05	0.05	0.15	-0.470	0.169
0.9875	1.0375	1.0322	1.0875	1.6533	1.6814	1.6785	1.7091	0.15	0.25	0.35	-0.700	0.175
0.9875	1.0375	1.0322	1.0875	1.6533	1.6814	1.6785	1.7091	0.35	0.45	0.55	-0.444	0.139
0.9875	1.0375	1.0322	1.0875	1.6533	1.6814	1.6785	1.7091	0.55	0.65	0.75	-0.216	0.154
0.9875	1.0375	1.0322	1.0875	1.6533	1.6814	1.6785	1.7091	0.75	0.85	0.95	-0.126	0.190
1.0875	1.1375	1.1323	1.1875	1.7091	1.7364	1.7335	1.7632	-0.85	-0.75	-0.65	0.000	0.000
1.0875	1.1375	1.1323	1.1875	1.7091	1.7364	1.7335	1.7632	-0.65	-0.55	-0.45	-0.463	0.310
1.0875	1.1375	1.1323	1.1875	1.7091	1.7364	1.7335	1.7632	-0.45	-0.35	-0.25	-0.543	0.186
1.0875	1.1375	1.1323	1.1875	1.7091	1.7364	1.7335	1.7632	-0.25	-0.15	-0.05	-0.260	0.136
1.0875	1.1375	1.1323	1.1875	1.7091	1.7364	1.7335	1.7632	-0.05	0.05	0.15	-0.301	0.123
1.0875	1.1375	1.1323	1.1875	1.7091	1.7364	1.7335	1.7632	0.15	0.25	0.35	-0.426	0.108
1.0875	1.1375	1.1323	1.1875	1.7091	1.7364	1.7335	1.7632	0.35	0.45	0.55	-0.235	0.089
1.0875	1.1375	1.1323	1.1875	1.7091	1.7364	1.7335	1.7632	0.55	0.65	0.75	-0.189	0.103
1.0875	1.1375	1.1323	1.1875	1.7091	1.7364	1.7335	1.7632	0.75	0.85	0.95	-0.262	0.160
1.1875	1.2375	1.2320	1.2875	1.7632	1.7896	1.7867	1.8156	-0.85	-0.75	-0.65	0.140	1.021
1.1875	1.2375	1.2320	1.2875	1.7632	1.7896	1.7867	1.8156	-0.65	-0.55	-0.45	-0.224	0.228
1.1875	1.2375	1.2320	1.2875	1.7632	1.7896	1.7867	1.8156	-0.45	-0.35	-0.25	-0.065	0.138
1.1875	1.2375	1.2320	1.2875	1.7632	1.7896	1.7867	1.8156	-0.25	-0.15	-0.05	-0.375	0.112
1.1875	1.2375	1.2320	1.2875	1.7632	1.7896	1.7867	1.8156	-0.05	0.05	0.15	0.041	0.097
1.1875	1.2375	1.2320	1.2875	1.7632	1.7896	1.7867	1.8156	0.15	0.25	0.35	-0.185	0.081
1.1875	1.2375	1.2320	1.2875	1.7632	1.7896	1.7867	1.8156	0.35	0.45	0.55	-0.072	0.069
1.1875	1.2375	1.2320	1.2875	1.7632	1.7896	1.7867	1.8156	0.55	0.65	0.75	-0.061	0.069
1.1875	1.2375	1.2320	1.2875	1.7632	1.7896	1.7867	1.8156	0.75	0.85	0.95	-0.086	0.094
1.2875	1.3375	1.3324	1.3875	1.8156	1.8413	1.8387	1.8666	-0.85	-0.75	-0.65	0.024	0.303
1.2875	1.3375	1.3324	1.3875	1.8156	1.8413	1.8387	1.8666	-0.65	-0.55	-0.45	-0.094	0.148
1.2875	1.3375	1.3324	1.3875	1.8156	1.8413	1.8387	1.8666	-0.45	-0.35	-0.25	-0.237	0.109
1.2875	1.3375	1.3324	1.3875	1.8156	1.8413	1.8387	1.8666	-0.25	-0.15	-0.05	-0.160	0.089
1.2875	1.3375	1.3324	1.3875	1.8156	1.8413	1.8387	1.8666	-0.05	0.05	0.15	-0.056	0.081
1.2875	1.3375	1.3324	1.3875	1.8156	1.8413	1.8387	1.8666	0.15	0.25	0.35	-0.086	0.067
1.2875	1.3375	1.3324	1.3875	1.8156	1.8413	1.8387	1.8666	0.35	0.45	0.55	-0.139	0.063
1.2875	1.3375	1.3324	1.3875	1.8156	1.8413	1.8387	1.8666	0.55	0.65	0.75	-0.044	0.062
1.2875	1.3375	1.3324	1.3875	1.8156	1.8413	1.8387	1.8666	0.75	0.85	0.95	0.015	0.081
1.3875	1.4375	1.4331	1.4875	1.8666	1.8915	1.8894	1.9162	-0.85	-0.75	-0.65	-0.099	0.155
1.3875	1.4375	1.4331	1.4875	1.8666	1.8915	1.8894	1.9162	-0.65	-0.55	-0.45	-0.266	0.106
1.3875	1.4375	1.4331	1.4875	1.8666	1.8915	1.8894	1.9162	-0.45	-0.35	-0.25	-0.145	0.097
1.3875	1.4375	1.4331	1.4875	1.8666	1.8915	1.8894	1.9162	-0.25	-0.15	-0.05	0.050	0.078
1.3875	1.4375	1.4331	1.4875	1.8666	1.8915	1.8894	1.9162	-0.05	0.05	0.15	-0.074	0.070
1.3875	1.4375	1.4331	1.4875	1.8666	1.8915	1.8894	1.9162	0.15	0.25	0.35	-0.047	0.058
1.3875	1.4375	1.4331	1.4875	1.8666	1.8915	1.8894	1.9162	0.35	0.45	0.55	-0.149	0.053
1.3875	1.4375	1.4331	1.4875	1.8666	1.8915	1.8894	1.9162	0.55	0.65	0.75	-0.218	0.050
1.3875	1.4375	1.4331	1.4875	1.8666	1.8915	1.8894	1.9162	0.75	0.85	0.95	-0.038	0.067
1.4875	1.5375	1.5339	1.5875	1.9162	1.9405	1.9388	1.9645	-0.85	-0.75	-0.65	-0.086	0.129
1.4875	1.5375	1.5339	1.5875	1.9162	1.9405	1.9388	1.9645	-0.65	-0.55	-0.45	-0.104	0.115
1.4875	1.5375	1.5339	1.5875	1.9162	1.9405	1.9388	1.9645	-0.45	-0.35	-0.25	-0.047	0.093
1.4875	1.5375	1.5339	1.5875	1.9162	1.9405	1.9388	1.9645	-0.25	-0.15	-0.05	-0.027	0.080
1.4875	1.5375	1.5339	1.5875	1.9162	1.9405	1.9388	1.9645	-0.05	0.05	0.15	0.003	0.070
1.4875	1.5375	1.5339	1.5875	1.9162	1.9405	1.9388	1.9645	0.15	0.25	0.35	0.002	0.054
1.4875	1.5375	1.5339	1.5875	1.9162	1.9405	1.9388	1.9645	0.35	0.45	0.55	-0.076	0.047
1.4875	1.5375	1.5339	1.5875	1.9162	1.9405	1.9388	1.9645	0.55	0.65	0.75	-0.191	0.046
1.4875	1.5375	1.5339	1.5875	1.9162	1.9405	1.9388	1.9645	0.75	0.85	0.95	-0.084	0.060
1.5875	1.6375	1.6355	1.6875	1.9645	1.9883	1.9873	2.0117	-0.85	-0.75	-0.65	-0.216	0.155
1.5875	1.6375	1.6355	1.6875	1.9645	1.9883	1.9873	2.0117	-0.65	-0.55	-0.45	-0.058	0.135
1.5875	1.6375	1.6355	1.6875	1.9645	1.9883	1.9873	2.0117	-0.45	-0.35	-0.25	-0.140	0.116
1.5875	1.6375	1.6355	1.6875	1.9645	1.9883	1.9873	2.0117	-0.25	-0.15	-0.05	-0.014	0.112
1.5875	1.6375	1.6355	1.6875	1.9645	1.9883	1.9873	2.0117	-0.05	0.05	0.15	0.226	0.080
1.5875	1.6375	1.6355	1.6875	1.9645	1.9883	1.9873	2.0117	0.15	0.25	0.35	-0.105	0.059
1.5875	1.6375	1.6355	1.6875	1.9645	1.9883	1.9873	2.0117	0.35	0.45	0.55	-0.128	0.054
1.5875	1.6375	1.6355	1.6875	1.9645	1.9883	1.9873	2.0117	0.55	0.65	0.75	-0.319	0.049
1.5875	1.6375	1.6355	1.6875	1.9645	1.9883	1.9873	2.0117	0.75	0.85	0.95	-0.195	0.073
1.6875	1.7375	1.7368	1.7875	2.0117	2.0349	2.0346	2.0578	-0.85	-0.75	-0.65	-0.121	0.145
1.6875	1.7375	1.7368	1.7875	2.0117	2.0349	2.0346	2.0578	-0.65	-0.55	-0.45	-0.497	0.149
1.6875	1.7375	1.7368	1.7875	2.0117	2.0349	2.0346	2.0578	-0.45	-0.35	-0.25	-0.305	0.141
1.6875	1.7375	1.7368	1.7875	2.0117	2.0349	2.0346	2.0578	-0.25	-0.15	-0.05	-0.168	0.110

1.6875	1.7375	1.7368	1.7875	2.0117	2.0349	2.0346	2.0578	-0.05	0.05	0.15	-0.010	0.081
1.6875	1.7375	1.7368	1.7875	2.0117	2.0349	2.0346	2.0578	0.15	0.25	0.35	0.120	0.063
1.6875	1.7375	1.7368	1.7875	2.0117	2.0349	2.0346	2.0578	0.35	0.45	0.55	-0.112	0.050
1.6875	1.7375	1.7368	1.7875	2.0117	2.0349	2.0346	2.0578	0.55	0.65	0.75	-0.241	0.055
1.6875	1.7375	1.7368	1.7875	2.0117	2.0349	2.0346	2.0578	0.75	0.85	0.95	-0.331	0.071
1.7875	1.8375	1.8378	1.8875	2.0578	2.0805	2.0807	2.1029	-0.85	-0.75	-0.65	-0.384	0.180
1.7875	1.8375	1.8378	1.8875	2.0578	2.0805	2.0807	2.1029	-0.65	-0.55	-0.45	-0.618	0.189
1.7875	1.8375	1.8378	1.8875	2.0578	2.0805	2.0807	2.1029	-0.45	-0.35	-0.25	-0.960	0.190
1.7875	1.8375	1.8378	1.8875	2.0578	2.0805	2.0807	2.1029	-0.25	-0.15	-0.05	-0.056	0.139
1.7875	1.8375	1.8378	1.8875	2.0578	2.0805	2.0807	2.1029	-0.05	0.05	0.15	0.229	0.107
1.7875	1.8375	1.8378	1.8875	2.0578	2.0805	2.0807	2.1029	0.15	0.25	0.35	0.087	0.071
1.7875	1.8375	1.8378	1.8875	2.0578	2.0805	2.0807	2.1029	0.35	0.45	0.55	-0.109	0.056
1.7875	1.8375	1.8378	1.8875	2.0578	2.0805	2.0807	2.1029	0.55	0.65	0.75	-0.335	0.065
1.7875	1.8375	1.8378	1.8875	2.0578	2.0805	2.0807	2.1029	0.75	0.85	0.95	-0.448	0.074
1.8875	1.9375	1.9385	1.9875	2.1029	2.1251	2.1256	2.1471	-0.85	-0.75	-0.65	-0.522	0.182
1.8875	1.9375	1.9385	1.9875	2.1029	2.1251	2.1256	2.1471	-0.65	-0.55	-0.45	-1.082	0.181
1.8875	1.9375	1.9385	1.9875	2.1029	2.1251	2.1256	2.1471	-0.45	-0.35	-0.25	-0.957	0.174
1.8875	1.9375	1.9385	1.9875	2.1029	2.1251	2.1256	2.1471	-0.25	-0.15	-0.05	-0.558	0.150
1.8875	1.9375	1.9385	1.9875	2.1029	2.1251	2.1256	2.1471	-0.05	0.05	0.15	-0.034	0.111
1.8875	1.9375	1.9385	1.9875	2.1029	2.1251	2.1256	2.1471	0.15	0.25	0.35	0.290	0.077
1.8875	1.9375	1.9385	1.9875	2.1029	2.1251	2.1256	2.1471	0.35	0.45	0.55	-0.154	0.110
1.8875	1.9375	1.9385	1.9875	2.1029	2.1251	2.1256	2.1471	0.55	0.65	0.75	-0.328	0.166
1.8875	1.9375	1.9385	1.9875	2.1029	2.1251	2.1256	2.1471	0.75	0.85	0.95	-0.475	0.063
1.9875	2.0375	2.0389	2.0875	2.1471	2.1688	2.1695	2.1903	-0.85	-0.75	-0.65	-0.501	0.186
1.9875	2.0375	2.0389	2.0875	2.1471	2.1688	2.1695	2.1903	-0.65	-0.55	-0.45	-0.962	0.161
1.9875	2.0375	2.0389	2.0875	2.1471	2.1688	2.1695	2.1903	-0.45	-0.35	-0.25	-0.896	0.168
1.9875	2.0375	2.0389	2.0875	2.1471	2.1688	2.1695	2.1903	-0.25	-0.15	-0.05	-0.121	0.161
1.9875	2.0375	2.0389	2.0875	2.1471	2.1688	2.1695	2.1903	-0.05	0.05	0.15	0.053	0.121
1.9875	2.0375	2.0389	2.0875	2.1471	2.1688	2.1695	2.1903	0.15	0.25	0.35	0.078	0.088
1.9875	2.0375	2.0389	2.0875	2.1471	2.1688	2.1695	2.1903	0.35	0.45	0.55	-0.047	0.068
1.9875	2.0375	2.0389	2.0875	2.1471	2.1688	2.1695	2.1903	0.55	0.65	0.75	-0.431	0.062
1.9875	2.0375	2.0389	2.0875	2.1471	2.1688	2.1695	2.1903	0.75	0.85	0.95	-0.552	0.061
2.0875	2.1375	2.1391	2.1875	2.1903	2.2117	2.2123	2.2328	-0.85	-0.75	-0.65	-0.983	0.252
2.0875	2.1375	2.1391	2.1875	2.1903	2.2117	2.2123	2.2328	-0.65	-0.55	-0.45	-0.800	0.187
2.0875	2.1375	2.1391	2.1875	2.1903	2.2117	2.2123	2.2328	-0.45	-0.35	-0.25	-0.711	0.273
2.0875	2.1375	2.1391	2.1875	2.1903	2.2117	2.2123	2.2328	-0.25	-0.15	-0.05	-0.170	0.180
2.0875	2.1375	2.1391	2.1875	2.1903	2.2117	2.2123	2.2328	-0.05	0.05	0.15	-0.145	0.131
2.0875	2.1375	2.1391	2.1875	2.1903	2.2117	2.2123	2.2328	0.15	0.25	0.35	0.034	0.106
2.0875	2.1375	2.1391	2.1875	2.1903	2.2117	2.2123	2.2328	0.35	0.45	0.55	0.020	0.084
2.0875	2.1375	2.1391	2.1875	2.1903	2.2117	2.2123	2.2328	0.55	0.65	0.75	-0.299	0.056
2.0875	2.1375	2.1391	2.1875	2.1903	2.2117	2.2123	2.2328	0.75	0.85	0.95	-0.455	0.062
2.1875	2.2375	2.2402	2.2875	2.2328	2.2537	2.2548	2.2744	-0.85	-0.75	-0.65	-0.690	0.226
2.1875	2.2375	2.2402	2.2875	2.2328	2.2537	2.2548	2.2744	-0.65	-0.55	-0.45	-0.466	0.268
2.1875	2.2375	2.2402	2.2875	2.2328	2.2537	2.2548	2.2744	-0.45	-0.35	-0.25	-0.931	0.252
2.1875	2.2375	2.2402	2.2875	2.2328	2.2537	2.2548	2.2744	-0.25	-0.15	-0.05	-0.504	0.229
2.1875	2.2375	2.2402	2.2875	2.2328	2.2537	2.2548	2.2744	-0.05	0.05	0.15	0.206	0.194
2.1875	2.2375	2.2402	2.2875	2.2328	2.2537	2.2548	2.2744	0.15	0.25	0.35	0.245	0.136
2.1875	2.2375	2.2402	2.2875	2.2328	2.2537	2.2548	2.2744	0.35	0.45	0.55	-0.183	0.098
2.1875	2.2375	2.2402	2.2875	2.2328	2.2537	2.2548	2.2744	0.55	0.65	0.75	-0.466	0.077
2.1875	2.2375	2.2402	2.2875	2.2328	2.2537	2.2548	2.2744	0.75	0.85	0.95	-0.421	0.075
2.2875	2.3375	2.3408	2.3875	2.2744	2.2949	2.2963	2.3153	-0.85	-0.75	-0.65	-0.357	0.384
2.2875	2.3375	2.3408	2.3875	2.2744	2.2949	2.2963	2.3153	-0.65	-0.55	-0.45	-0.232	0.290
2.2875	2.3375	2.3408	2.3875	2.2744	2.2949	2.2963	2.3153	-0.45	-0.35	-0.25	-0.354	0.261
2.2875	2.3375	2.3408	2.3875	2.2744	2.2949	2.2963	2.3153	-0.25	-0.15	-0.05	-0.241	0.320
2.2875	2.3375	2.3408	2.3875	2.2744	2.2949	2.2963	2.3153	-0.05	0.05	0.15	0.280	0.299
2.2875	2.3375	2.3408	2.3875	2.2744	2.2949	2.2963	2.3153	0.15	0.25	0.35	0.636	0.194
2.2875	2.3375	2.3408	2.3875	2.2744	2.2949	2.2963	2.3153	0.35	0.45	0.55	0.032	0.130
2.2875	2.3375	2.3408	2.3875	2.2744	2.2949	2.2963	2.3153	0.55	0.65	0.75	-0.492	0.083
2.2875	2.3375	2.3408	2.3875	2.2744	2.2949	2.2963	2.3153	0.75	0.85	0.95	-0.450	0.087
2.3875	2.4375	2.4427	2.4875	2.3153	2.3355	2.3375	2.3555	-0.85	-0.75	-0.65	-0.790	0.385
2.3875	2.4375	2.4427	2.4875	2.3153	2.3355	2.3375	2.3555	-0.65	-0.55	-0.45	-0.697	0.422
2.3875	2.4375	2.4427	2.4875	2.3153	2.3355	2.3375	2.3555	-0.45	-0.35	-0.25	-0.253	0.402
2.3875	2.4375	2.4427	2.4875	2.3153	2.3355	2.3375	2.3555	-0.25	-0.15	-0.05	-0.521	0.366
2.3875	2.4375	2.4427	2.4875	2.3153	2.3355	2.3375	2.3555	-0.05	0.05	0.15	-0.097	0.278

2.3875	2.4375	2.4427	2.4875	2.3153	2.3355	2.3375	2.3555	0.15	0.25	0.35	0.107	0.231
2.3875	2.4375	2.4427	2.4875	2.3153	2.3355	2.3375	2.3555	0.35	0.45	0.55	0.191	0.156
2.3875	2.4375	2.4427	2.4875	2.3153	2.3355	2.3375	2.3555	0.55	0.65	0.75	-0.393	0.334
2.3875	2.4375	2.4427	2.4875	2.3153	2.3355	2.3375	2.3555	0.75	0.85	0.95	-0.416	0.157
2.4875	2.5375	2.5428	2.5875	2.3555	2.3753	2.3774	2.3950	-0.85	-0.75	-0.65	-0.393	0.432
2.4875	2.5375	2.5428	2.5875	2.3555	2.3753	2.3774	2.3950	-0.65	-0.55	-0.45	-0.007	0.420
2.4875	2.5375	2.5428	2.5875	2.3555	2.3753	2.3774	2.3950	-0.45	-0.35	-0.25	-0.938	0.466
2.4875	2.5375	2.5428	2.5875	2.3555	2.3753	2.3774	2.3950	-0.25	-0.15	-0.05	-0.188	0.406
2.4875	2.5375	2.5428	2.5875	2.3555	2.3753	2.3774	2.3950	-0.05	0.05	0.15	-0.521	0.403
2.4875	2.5375	2.5428	2.5875	2.3555	2.3753	2.3774	2.3950	0.15	0.25	0.35	-0.289	0.401
2.4875	2.5375	2.5428	2.5875	2.3555	2.3753	2.3774	2.3950	0.35	0.45	0.55	-0.426	0.189
2.4875	2.5375	2.5428	2.5875	2.3555	2.3753	2.3774	2.3950	0.55	0.65	0.75	-0.258	0.126
2.4875	2.5375	2.5428	2.5875	2.3555	2.3753	2.3774	2.3950	0.75	0.85	0.95	-0.450	0.114
2.5875	2.6375	2.6423	2.6875	2.3950	2.4145	2.4163	2.4338	-0.85	-0.75	-0.65	-0.135	0.569
2.5875	2.6375	2.6423	2.6875	2.3950	2.4145	2.4163	2.4338	-0.65	-0.55	-0.45	-0.102	0.554
2.5875	2.6375	2.6423	2.6875	2.3950	2.4145	2.4163	2.4338	-0.45	-0.35	-0.25	-0.903	0.472
2.5875	2.6375	2.6423	2.6875	2.3950	2.4145	2.4163	2.4338	-0.25	-0.15	-0.05	-0.866	0.533
2.5875	2.6375	2.6423	2.6875	2.3950	2.4145	2.4163	2.4338	-0.05	0.05	0.15	-0.052	0.534
2.5875	2.6375	2.6423	2.6875	2.3950	2.4145	2.4163	2.4338	0.15	0.25	0.35	0.122	0.405
2.5875	2.6375	2.6423	2.6875	2.3950	2.4145	2.4163	2.4338	0.35	0.45	0.55	-0.126	0.238
2.5875	2.6375	2.6423	2.6875	2.3950	2.4145	2.4163	2.4338	0.55	0.65	0.75	-0.385	0.140
2.5875	2.6375	2.6423	2.6875	2.3950	2.4145	2.4163	2.4338	0.75	0.85	0.95	-0.155	0.205
2.6875	2.7375	2.7413	2.7875	2.4338	2.4530	2.4545	2.4721	-0.85	-0.75	-0.65	0.534	0.796
2.6875	2.7375	2.7413	2.7875	2.4338	2.4530	2.4545	2.4721	-0.65	-0.55	-0.45	0.064	1.182
2.6875	2.7375	2.7413	2.7875	2.4338	2.4530	2.4545	2.4721	-0.45	-0.35	-0.25	0.105	0.713
2.6875	2.7375	2.7413	2.7875	2.4338	2.4530	2.4545	2.4721	-0.25	-0.15	-0.05	-0.289	0.442
2.6875	2.7375	2.7413	2.7875	2.4338	2.4530	2.4545	2.4721	-0.05	0.05	0.15	-0.549	0.717
2.6875	2.7375	2.7413	2.7875	2.4338	2.4530	2.4545	2.4721	0.15	0.25	0.35	0.071	0.402
2.6875	2.7375	2.7413	2.7875	2.4338	2.4530	2.4545	2.4721	0.35	0.45	0.55	-0.083	0.233
2.6875	2.7375	2.7413	2.7875	2.4338	2.4530	2.4545	2.4721	0.55	0.65	0.75	-0.474	0.213
2.6875	2.7375	2.7413	2.7875	2.4338	2.4530	2.4545	2.4721	0.75	0.85	0.95	-0.449	0.212

Appendix E

Data Table: C_z for $K^+\Lambda$

This appendix contains tables of numerical values for C_z for the $K^+\Lambda$ analysis. The table consist of thirteen columns, which are interpreted as follows:

1. Column 1: Lower limit of E_γ bin (GeV)
2. Column 2: Nominal midpoint of E_γ bin (GeV)
3. Column 3: Corrected midpoint of E_γ bin (GeV)
4. Column 4: Upper limit of E_γ bin (GeV)
5. Column 5: Lower limit of W bin (GeV)
6. Column 6: Nominal idpoint of W bin (GeV)
7. Column 7: Corrected midpoint of W bin (GeV)
8. Column 8: Upper limit of W bin (GeV)
9. Column 9: Lower limit of $\cos(\theta_{KCM})$ bin
10. Column 10: Midpoint of $\cos(\theta_{KCM})$ bin
11. Column 11: Lower limit of $\cos(\theta_{KCM})$ bin
12. Column 12: C_z . Double polarization observables are unitless.
13. Column 13: Error on datapoint.

E.1 Data Table

0.8875	0.9375	0.9318	0.9875	1.5955	1.6247	1.6214	1.6533	-0.85	-0.75	-0.65	0.000	0.000
0.8875	0.9375	0.9318	0.9875	1.5955	1.6247	1.6214	1.6533	-0.65	-0.55	-0.45	0.000	0.000
0.8875	0.9375	0.9318	0.9875	1.5955	1.6247	1.6214	1.6533	-0.45	-0.35	-0.25	0.000	0.000
0.8875	0.9375	0.9318	0.9875	1.5955	1.6247	1.6214	1.6533	-0.25	-0.15	-0.05	0.000	0.000
0.8875	0.9375	0.9318	0.9875	1.5955	1.6247	1.6214	1.6533	-0.05	0.05	0.15	0.000	0.000
0.8875	0.9375	0.9318	0.9875	1.5955	1.6247	1.6214	1.6533	0.15	0.25	0.35	0.000	0.000
0.8875	0.9375	0.9318	0.9875	1.5955	1.6247	1.6214	1.6533	0.35	0.45	0.55	0.000	0.000
0.8875	0.9375	0.9318	0.9875	1.5955	1.6247	1.6214	1.6533	0.55	0.65	0.75	0.000	0.000
0.8875	0.9375	0.9318	0.9875	1.5955	1.6247	1.6214	1.6533	0.75	0.85	0.95	0.000	0.000
0.9875	1.0375	1.0322	1.0875	1.6533	1.6814	1.6785	1.7091	-0.85	-0.75	-0.65	0.000	0.000
0.9875	1.0375	1.0322	1.0875	1.6533	1.6814	1.6785	1.7091	-0.65	-0.55	-0.45	0.698	0.542
0.9875	1.0375	1.0322	1.0875	1.6533	1.6814	1.6785	1.7091	-0.45	-0.35	-0.25	0.686	0.230

0.9875	1.0375	1.0322	1.0875	1.6533	1.6814	1.6785	1.7091	-0.25	-0.15	-0.05	0.812	0.172
0.9875	1.0375	1.0322	1.0875	1.6533	1.6814	1.6785	1.7091	-0.05	0.05	0.15	0.917	0.160
0.9875	1.0375	1.0322	1.0875	1.6533	1.6814	1.6785	1.7091	0.15	0.25	0.35	0.838	0.154
0.9875	1.0375	1.0322	1.0875	1.6533	1.6814	1.6785	1.7091	0.35	0.45	0.55	0.555	0.131
0.9875	1.0375	1.0322	1.0875	1.6533	1.6814	1.6785	1.7091	0.55	0.65	0.75	0.821	0.135
0.9875	1.0375	1.0322	1.0875	1.6533	1.6814	1.6785	1.7091	0.75	0.85	0.95	0.901	0.189
1.0875	1.1375	1.1323	1.1875	1.7091	1.7364	1.7335	1.7632	-0.85	-0.75	-0.65	0.000	0.000
1.0875	1.1375	1.1323	1.1875	1.7091	1.7364	1.7335	1.7632	-0.65	-0.55	-0.45	0.451	0.280
1.0875	1.1375	1.1323	1.1875	1.7091	1.7364	1.7335	1.7632	-0.45	-0.35	-0.25	0.742	0.179
1.0875	1.1375	1.1323	1.1875	1.7091	1.7364	1.7335	1.7632	-0.25	-0.15	-0.05	0.940	0.135
1.0875	1.1375	1.1323	1.1875	1.7091	1.7364	1.7335	1.7632	-0.05	0.05	0.15	1.004	0.117
1.0875	1.1375	1.1323	1.1875	1.7091	1.7364	1.7335	1.7632	0.15	0.25	0.35	0.983	0.110
1.0875	1.1375	1.1323	1.1875	1.7091	1.7364	1.7335	1.7632	0.35	0.45	0.55	0.752	0.085
1.0875	1.1375	1.1323	1.1875	1.7091	1.7364	1.7335	1.7632	0.55	0.65	0.75	0.893	0.084
1.0875	1.1375	1.1323	1.1875	1.7091	1.7364	1.7335	1.7632	0.75	0.85	0.95	1.017	0.111
1.1875	1.2375	1.2320	1.2875	1.7632	1.7896	1.7867	1.8156	-0.85	-0.75	-0.65	0.974	0.426
1.1875	1.2375	1.2320	1.2875	1.7632	1.7896	1.7867	1.8156	-0.65	-0.55	-0.45	1.002	0.205
1.1875	1.2375	1.2320	1.2875	1.7632	1.7896	1.7867	1.8156	-0.45	-0.35	-0.25	0.762	0.140
1.1875	1.2375	1.2320	1.2875	1.7632	1.7896	1.7867	1.8156	-0.25	-0.15	-0.05	0.848	0.113
1.1875	1.2375	1.2320	1.2875	1.7632	1.7896	1.7867	1.8156	-0.05	0.05	0.15	0.779	0.102
1.1875	1.2375	1.2320	1.2875	1.7632	1.7896	1.7867	1.8156	0.15	0.25	0.35	0.983	0.088
1.1875	1.2375	1.2320	1.2875	1.7632	1.7896	1.7867	1.8156	0.35	0.45	0.55	0.905	0.087
1.1875	1.2375	1.2320	1.2875	1.7632	1.7896	1.7867	1.8156	0.55	0.65	0.75	1.021	0.077
1.1875	1.2375	1.2320	1.2875	1.7632	1.7896	1.7867	1.8156	0.75	0.85	0.95	1.001	0.100
1.2875	1.3375	1.3324	1.3875	1.8156	1.8413	1.8387	1.8666	-0.85	-0.75	-0.65	0.982	0.238
1.2875	1.3375	1.3324	1.3875	1.8156	1.8413	1.8387	1.8666	-0.65	-0.55	-0.45	0.869	0.146
1.2875	1.3375	1.3324	1.3875	1.8156	1.8413	1.8387	1.8666	-0.45	-0.35	-0.25	1.067	0.112
1.2875	1.3375	1.3324	1.3875	1.8156	1.8413	1.8387	1.8666	-0.25	-0.15	-0.05	1.067	0.094
1.2875	1.3375	1.3324	1.3875	1.8156	1.8413	1.8387	1.8666	-0.05	0.05	0.15	0.891	0.098
1.2875	1.3375	1.3324	1.3875	1.8156	1.8413	1.8387	1.8666	0.15	0.25	0.35	0.943	0.074
1.2875	1.3375	1.3324	1.3875	1.8156	1.8413	1.8387	1.8666	0.35	0.45	0.55	1.016	0.066
1.2875	1.3375	1.3324	1.3875	1.8156	1.8413	1.8387	1.8666	0.55	0.65	0.75	0.998	0.064
1.2875	1.3375	1.3324	1.3875	1.8156	1.8413	1.8387	1.8666	0.75	0.85	0.95	0.998	0.080
1.3875	1.4375	1.4331	1.4875	1.8666	1.8915	1.8894	1.9162	-0.85	-0.75	-0.65	1.125	0.149
1.3875	1.4375	1.4331	1.4875	1.8666	1.8915	1.8894	1.9162	-0.65	-0.55	-0.45	0.954	0.117
1.3875	1.4375	1.4331	1.4875	1.8666	1.8915	1.8894	1.9162	-0.45	-0.35	-0.25	1.203	0.101
1.3875	1.4375	1.4331	1.4875	1.8666	1.8915	1.8894	1.9162	-0.25	-0.15	-0.05	1.044	0.086
1.3875	1.4375	1.4331	1.4875	1.8666	1.8915	1.8894	1.9162	-0.05	0.05	0.15	0.900	0.080
1.3875	1.4375	1.4331	1.4875	1.8666	1.8915	1.8894	1.9162	0.15	0.25	0.35	1.076	0.069
1.3875	1.4375	1.4331	1.4875	1.8666	1.8915	1.8894	1.9162	0.35	0.45	0.55	0.881	0.066
1.3875	1.4375	1.4331	1.4875	1.8666	1.8915	1.8894	1.9162	0.55	0.65	0.75	0.966	0.063
1.3875	1.4375	1.4331	1.4875	1.8666	1.8915	1.8894	1.9162	0.75	0.85	0.95	1.075	0.076
1.4875	1.5375	1.5339	1.5875	1.9162	1.9405	1.9388	1.9645	-0.85	-0.75	-0.65	0.914	0.124
1.4875	1.5375	1.5339	1.5875	1.9162	1.9405	1.9388	1.9645	-0.65	-0.55	-0.45	0.723	0.105
1.4875	1.5375	1.5339	1.5875	1.9162	1.9405	1.9388	1.9645	-0.45	-0.35	-0.25	1.062	0.096
1.4875	1.5375	1.5339	1.5875	1.9162	1.9405	1.9388	1.9645	-0.25	-0.15	-0.05	0.928	0.084
1.4875	1.5375	1.5339	1.5875	1.9162	1.9405	1.9388	1.9645	-0.05	0.05	0.15	0.910	0.074
1.4875	1.5375	1.5339	1.5875	1.9162	1.9405	1.9388	1.9645	0.15	0.25	0.35	0.886	0.063
1.4875	1.5375	1.5339	1.5875	1.9162	1.9405	1.9388	1.9645	0.35	0.45	0.55	0.853	0.058
1.4875	1.5375	1.5339	1.5875	1.9162	1.9405	1.9388	1.9645	0.55	0.65	0.75	1.011	0.054
1.4875	1.5375	1.5339	1.5875	1.9162	1.9405	1.9388	1.9645	0.75	0.85	0.95	1.051	0.066
1.5875	1.6375	1.6355	1.6875	1.9645	1.9883	1.9873	2.0117	-0.85	-0.75	-0.65	0.554	0.141
1.5875	1.6375	1.6355	1.6875	1.9645	1.9883	1.9873	2.0117	-0.65	-0.55	-0.45	0.632	0.129
1.5875	1.6375	1.6355	1.6875	1.9645	1.9883	1.9873	2.0117	-0.45	-0.35	-0.25	0.731	0.123
1.5875	1.6375	1.6355	1.6875	1.9645	1.9883	1.9873	2.0117	-0.25	-0.15	-0.05	0.897	0.097
1.5875	1.6375	1.6355	1.6875	1.9645	1.9883	1.9873	2.0117	-0.05	0.05	0.15	1.001	0.078
1.5875	1.6375	1.6355	1.6875	1.9645	1.9883	1.9873	2.0117	0.15	0.25	0.35	0.829	0.062
1.5875	1.6375	1.6355	1.6875	1.9645	1.9883	1.9873	2.0117	0.35	0.45	0.55	0.925	0.053
1.5875	1.6375	1.6355	1.6875	1.9645	1.9883	1.9873	2.0117	0.55	0.65	0.75	0.941	0.054
1.5875	1.6375	1.6355	1.6875	1.9645	1.9883	1.9873	2.0117	0.75	0.85	0.95	0.893	0.107
1.6875	1.7375	1.7368	1.7875	2.0117	2.0349	2.0346	2.0578	-0.85	-0.75	-0.65	0.472	0.136
1.6875	1.7375	1.7368	1.7875	2.0117	2.0349	2.0346	2.0578	-0.65	-0.55	-0.45	0.229	0.149
1.6875	1.7375	1.7368	1.7875	2.0117	2.0349	2.0346	2.0578	-0.45	-0.35	-0.25	0.554	0.163
1.6875	1.7375	1.7368	1.7875	2.0117	2.0349	2.0346	2.0578	-0.25	-0.15	-0.05	0.608	0.115

1.6875	1.7375	1.7368	1.7875	2.0117	2.0349	2.0346	2.0578	-0.05	0.05	0.15	0.801	0.089
1.6975	1.7375	1.7368	1.7875	2.0117	2.0349	2.0346	2.0578	0.15	0.25	0.35	0.843	0.064
1.6875	1.7375	1.7368	1.7875	2.0117	2.0349	2.0346	2.0578	0.35	0.45	0.55	1.022	0.057
1.6875	1.7375	1.7368	1.7875	2.0117	2.0349	2.0346	2.0578	0.55	0.65	0.75	0.886	0.047
1.6875	1.7375	1.7368	1.7875	2.0117	2.0349	2.0346	2.0578	0.75	0.85	0.95	0.942	0.090
1.7875	1.8375	1.8378	1.8875	2.0578	2.0805	2.0807	2.1029	-0.85	-0.75	-0.65	0.422	0.174
1.7875	1.8375	1.8378	1.8875	2.0578	2.0805	2.0807	2.1029	-0.65	-0.55	-0.45	0.207	0.192
1.7875	1.8375	1.8378	1.8875	2.0578	2.0805	2.0807	2.1029	-0.45	-0.35	-0.25	0.469	0.189
1.7875	1.8375	1.8378	1.8875	2.0578	2.0805	2.0807	2.1029	-0.25	-0.15	-0.05	0.489	0.150
1.7875	1.8375	1.8378	1.8875	2.0578	2.0805	2.0807	2.1029	-0.05	0.05	0.15	0.989	0.112
1.7875	1.8375	1.8378	1.8875	2.0578	2.0805	2.0807	2.1029	0.15	0.25	0.35	0.850	0.080
1.7875	1.8375	1.8378	1.8875	2.0578	2.0805	2.0807	2.1029	0.35	0.45	0.55	0.946	0.068
1.7875	1.8375	1.8378	1.8875	2.0578	2.0805	2.0807	2.1029	0.55	0.65	0.75	0.831	0.103
1.7875	1.8375	1.8378	1.8875	2.0578	2.0805	2.0807	2.1029	0.75	0.85	0.95	0.870	0.063
1.8875	1.9375	1.9385	1.9875	2.1029	2.1251	2.1256	2.1471	-0.85	-0.75	-0.65	0.778	0.174
1.8875	1.9375	1.9385	1.9875	2.1029	2.1251	2.1256	2.1471	-0.65	-0.55	-0.45	0.499	0.177
1.8875	1.9375	1.9385	1.9875	2.1029	2.1251	2.1256	2.1471	-0.45	-0.35	-0.25	0.352	0.205
1.8875	1.9375	1.9385	1.9875	2.1029	2.1251	2.1256	2.1471	-0.25	-0.15	-0.05	0.786	0.149
1.8875	1.9375	1.9385	1.9875	2.1029	2.1251	2.1256	2.1471	-0.05	0.05	0.15	0.743	0.125
1.8875	1.9375	1.9385	1.9875	2.1029	2.1251	2.1256	2.1471	0.15	0.25	0.35	0.922	0.083
1.8875	1.9375	1.9385	1.9875	2.1029	2.1251	2.1256	2.1471	0.35	0.45	0.55	1.048	0.272
1.8875	1.9375	1.9385	1.9875	2.1029	2.1251	2.1256	2.1471	0.55	0.65	0.75	0.726	0.239
1.8875	1.9375	1.9385	1.9875	2.1029	2.1251	2.1256	2.1471	0.75	0.85	0.95	0.691	0.068
1.9875	2.0375	2.0389	2.0875	2.1471	2.1688	2.1695	2.1903	-0.85	-0.75	-0.65	0.469	0.171
1.9875	2.0375	2.0389	2.0875	2.1471	2.1688	2.1695	2.1903	-0.65	-0.55	-0.45	0.533	0.175
1.9875	2.0375	2.0389	2.0875	2.1471	2.1688	2.1695	2.1903	-0.45	-0.35	-0.25	0.486	0.220
1.9875	2.0375	2.0389	2.0875	2.1471	2.1688	2.1695	2.1903	-0.25	-0.15	-0.05	0.621	0.175
1.9875	2.0375	2.0389	2.0875	2.1471	2.1688	2.1695	2.1903	-0.05	0.05	0.15	0.908	0.141
1.9875	2.0375	2.0389	2.0875	2.1471	2.1688	2.1695	2.1903	0.15	0.25	0.35	1.045	0.092
1.9875	2.0375	2.0389	2.0875	2.1471	2.1688	2.1695	2.1903	0.35	0.45	0.55	1.045	0.196
1.9875	2.0375	2.0389	2.0875	2.1471	2.1688	2.1695	2.1903	0.55	0.65	0.75	0.834	0.061
1.9875	2.0375	2.0389	2.0875	2.1471	2.1688	2.1695	2.1903	0.75	0.85	0.95	0.655	0.071
2.0875	2.1375	2.1391	2.1875	2.1903	2.2117	2.2123	2.2328	-0.85	-0.75	-0.65	0.987	0.204
2.0875	2.1375	2.1391	2.1875	2.1903	2.2117	2.2123	2.2328	-0.65	-0.55	-0.45	0.760	0.197
2.0875	2.1375	2.1391	2.1875	2.1903	2.2117	2.2123	2.2328	-0.45	-0.35	-0.25	0.569	0.198
2.0875	2.1375	2.1391	2.1875	2.1903	2.2117	2.2123	2.2328	-0.25	-0.15	-0.05	0.425	0.231
2.0875	2.1375	2.1391	2.1875	2.1903	2.2117	2.2123	2.2328	-0.05	0.05	0.15	0.858	0.158
2.0875	2.1375	2.1391	2.1875	2.1903	2.2117	2.2123	2.2328	0.15	0.25	0.35	0.886	0.106
2.0875	2.1375	2.1391	2.1875	2.1903	2.2117	2.2123	2.2328	0.35	0.45	0.55	1.042	0.099
2.0875	2.1375	2.1391	2.1875	2.1903	2.2117	2.2123	2.2328	0.55	0.65	0.75	0.761	0.074
2.0875	2.1375	2.1391	2.1875	2.1903	2.2117	2.2123	2.2328	0.75	0.85	0.95	0.676	0.074
2.1875	2.2375	2.2402	2.2875	2.2328	2.2537	2.2548	2.2744	-0.85	-0.75	-0.65	0.674	0.228
2.1875	2.2375	2.2402	2.2875	2.2328	2.2537	2.2548	2.2744	-0.65	-0.55	-0.45	0.962	0.231
2.1875	2.2375	2.2402	2.2875	2.2328	2.2537	2.2548	2.2744	-0.45	-0.35	-0.25	0.872	0.278
2.1875	2.2375	2.2402	2.2875	2.2328	2.2537	2.2548	2.2744	-0.25	-0.15	-0.05	0.365	0.229
2.1875	2.2375	2.2402	2.2875	2.2328	2.2537	2.2548	2.2744	-0.05	0.05	0.15	0.576	0.213
2.1875	2.2375	2.2402	2.2875	2.2328	2.2537	2.2548	2.2744	0.15	0.25	0.35	1.080	0.138
2.1875	2.2375	2.2402	2.2875	2.2328	2.2537	2.2548	2.2744	0.35	0.45	0.55	1.061	0.130
2.1875	2.2375	2.2402	2.2875	2.2328	2.2537	2.2548	2.2744	0.55	0.65	0.75	0.698	0.081
2.1875	2.2375	2.2402	2.2875	2.2328	2.2537	2.2548	2.2744	0.75	0.85	0.95	0.576	0.087
2.2875	2.3375	2.3408	2.3875	2.2744	2.2949	2.2963	2.3153	-0.85	-0.75	-0.65	1.015	0.296
2.2875	2.3375	2.3408	2.3875	2.2744	2.2949	2.2963	2.3153	-0.65	-0.55	-0.45	0.487	0.372
2.2875	2.3375	2.3408	2.3875	2.2744	2.2949	2.2963	2.3153	-0.45	-0.35	-0.25	1.266	0.307
2.2875	2.3375	2.3408	2.3875	2.2744	2.2949	2.2963	2.3153	-0.25	-0.15	-0.05	0.502	0.326
2.2875	2.3375	2.3408	2.3875	2.2744	2.2949	2.2963	2.3153	-0.05	0.05	0.15	1.016	0.322
2.2875	2.3375	2.3408	2.3875	2.2744	2.2949	2.2963	2.3153	0.15	0.25	0.35	0.779	0.189
2.2875	2.3375	2.3408	2.3875	2.2744	2.2949	2.2963	2.3153	0.35	0.45	0.55	1.147	0.128
2.2875	2.3375	2.3408	2.3875	2.2744	2.2949	2.2963	2.3153	0.55	0.65	0.75	0.638	0.099
2.2875	2.3375	2.3408	2.3875	2.2744	2.2949	2.2963	2.3153	0.75	0.85	0.95	0.610	0.121
2.3875	2.4375	2.4427	2.4875	2.3153	2.3355	2.3375	2.3555	-0.85	-0.75	-0.65	0.907	0.402
2.3875	2.4375	2.4427	2.4875	2.3153	2.3355	2.3375	2.3555	-0.65	-0.55	-0.45	1.412	0.416
2.3875	2.4375	2.4427	2.4875	2.3153	2.3355	2.3375	2.3555	-0.45	-0.35	-0.25	1.025	0.472
2.3875	2.4375	2.4427	2.4875	2.3153	2.3355	2.3375	2.3555	-0.25	-0.15	-0.05	0.932	0.429
2.3875	2.4375	2.4427	2.4875	2.3153	2.3355	2.3375	2.3555	-0.05	0.05	0.15	0.866	0.317

2.3875	2.4375	2.4427	2.4875	2.3153	2.3355	2.3375	2.3555	0.15	0.25	0.35	0.499	0.293
2.3875	2.4375	2.4427	2.4875	2.3153	2.3355	2.3375	2.3555	0.35	0.45	0.55	1.439	0.170
2.3875	2.4375	2.4427	2.4875	2.3153	2.3355	2.3375	2.3555	0.55	0.65	0.75	0.508	0.386
2.3875	2.4375	2.4427	2.4875	2.3153	2.3355	2.3375	2.3555	0.75	0.85	0.95	0.360	0.172
2.4875	2.5375	2.5428	2.5875	2.3555	2.3753	2.3774	2.3950	-0.85	-0.75	-0.65	0.396	0.410
2.4875	2.5375	2.5428	2.5875	2.3555	2.3753	2.3774	2.3950	-0.65	-0.55	-0.45	0.281	0.669
2.4875	2.5375	2.5428	2.5875	2.3555	2.3753	2.3774	2.3950	-0.45	-0.35	-0.25	1.102	0.369
2.4875	2.5375	2.5428	2.5875	2.3555	2.3753	2.3774	2.3950	-0.25	-0.15	-0.05	1.170	0.471
2.4875	2.5375	2.5428	2.5875	2.3555	2.3753	2.3774	2.3950	-0.05	0.05	0.15	0.525	0.596
2.4875	2.5375	2.5428	2.5875	2.3555	2.3753	2.3774	2.3950	0.15	0.25	0.35	0.390	0.290
2.4875	2.5375	2.5428	2.5875	2.3555	2.3753	2.3774	2.3950	0.35	0.45	0.55	0.809	0.235
2.4875	2.5375	2.5428	2.5875	2.3555	2.3753	2.3774	2.3950	0.55	0.65	0.75	0.698	0.145
2.4875	2.5375	2.5428	2.5875	2.3555	2.3753	2.3774	2.3950	0.75	0.85	0.95	0.504	0.164
2.5875	2.6375	2.6423	2.6875	2.3950	2.4145	2.4163	2.4338	-0.85	-0.75	-0.65	1.640	0.497
2.5875	2.6375	2.6423	2.6875	2.3950	2.4145	2.4163	2.4338	-0.65	-0.55	-0.45	1.580	0.624
2.5875	2.6375	2.6423	2.6875	2.3950	2.4145	2.4163	2.4338	-0.45	-0.35	-0.25	1.385	0.367
2.5875	2.6375	2.6423	2.6875	2.3950	2.4145	2.4163	2.4338	-0.25	-0.15	-0.05	0.649	0.478
2.5875	2.6375	2.6423	2.6875	2.3950	2.4145	2.4163	2.4338	-0.05	0.05	0.15	0.587	0.459
2.5875	2.6375	2.6423	2.6875	2.3950	2.4145	2.4163	2.4338	0.15	0.25	0.35	-0.369	0.399
2.5875	2.6375	2.6423	2.6875	2.3950	2.4145	2.4163	2.4338	0.35	0.45	0.55	0.887	0.240
2.5875	2.6375	2.6423	2.6875	2.3950	2.4145	2.4163	2.4338	0.55	0.65	0.75	0.548	0.157
2.5875	2.6375	2.6423	2.6875	2.3950	2.4145	2.4163	2.4338	0.75	0.85	0.95	0.397	0.238
2.6875	2.7375	2.7413	2.7875	2.4338	2.4530	2.4545	2.4721	-0.85	-0.75	-0.65	0.667	0.610
2.6875	2.7375	2.7413	2.7875	2.4338	2.4530	2.4545	2.4721	-0.65	-0.55	-0.45	0.000	0.833
2.6875	2.7375	2.7413	2.7875	2.4338	2.4530	2.4545	2.4721	-0.45	-0.35	-0.25	-0.517	1.211
2.6875	2.7375	2.7413	2.7875	2.4338	2.4530	2.4545	2.4721	-0.25	-0.15	-0.05	1.129	0.618
2.6875	2.7375	2.7413	2.7875	2.4338	2.4530	2.4545	2.4721	-0.05	0.05	0.15	-0.171	0.480
2.6875	2.7375	2.7413	2.7875	2.4338	2.4530	2.4545	2.4721	0.15	0.25	0.35	0.117	0.354
2.6875	2.7375	2.7413	2.7875	2.4338	2.4530	2.4545	2.4721	0.35	0.45	0.55	0.906	0.318
2.6875	2.7375	2.7413	2.7875	2.4338	2.4530	2.4545	2.4721	0.55	0.65	0.75	0.809	0.222
2.6875	2.7375	2.7413	2.7875	2.4338	2.4530	2.4545	2.4721	0.75	0.85	0.95	0.283	0.527

Appendix F

Data Table: C_x for $K^+\Sigma^0$

This appendix contains tables of numerical values for C_x for the $K^+\Sigma^0$ analysis. The table consist of thirteen columns, which are interpreted as follows:

1. Column 1: Lower limit of E_γ bin (GeV)
2. Column 2: Nominal midpoint of E_γ bin (GeV)
3. Column 3: Corrected midpoint of E_γ bin (GeV)
4. Column 4: Upper limit of E_γ bin (GeV)
5. Column 5: Lower limit of W bin (GeV)
6. Column 6: Nominal idpoint of W bin (GeV)
7. Column 7: Corrected midpoint of W bin (GeV)
8. Column 8: Upper limit of W bin (GeV)
9. Column 9: Lower limit of $\cos(\theta_{KCM})$ bin
10. Column 10: Midpoint of $\cos(\theta_{KCM})$ bin
11. Column 11: Lower limit of $\cos(\theta_{KCM})$ bin
12. Column 12: C_x . Double polarization observables are unitless.
13. Column 13: Error on datapoint.

F.1 Data Table

1.1875	1.2375	1.2320	1.2875	1.7632	1.7896	1.7867	1.8156	-0.85	-0.70	-0.55	0.000	0.000
1.1875	1.2375	1.2320	1.2875	1.7632	1.7896	1.7867	1.8156	-0.55	-0.40	-0.25	0.000	0.000
1.1875	1.2375	1.2320	1.2875	1.7632	1.7896	1.7867	1.8156	-0.25	-0.10	0.05	0.000	0.000
1.1875	1.2375	1.2320	1.2875	1.7632	1.7896	1.7867	1.8156	0.05	0.20	0.35	0.000	0.000
1.1875	1.2375	1.2320	1.2875	1.7632	1.7896	1.7867	1.8156	0.35	0.50	0.65	0.000	0.000
1.1875	1.2375	1.2320	1.2875	1.7632	1.7896	1.7867	1.8156	0.65	0.80	0.95	0.000	0.000
1.2875	1.3375	1.3324	1.3875	1.8156	1.8413	1.8387	1.8666	-0.85	-0.70	-0.55	0.000	0.000
1.2875	1.3375	1.3324	1.3875	1.8156	1.8413	1.8387	1.8666	-0.55	-0.40	-0.25	-1.348	0.596
1.2875	1.3375	1.3324	1.3875	1.8156	1.8413	1.8387	1.8666	-0.25	-0.10	0.05	-0.227	0.379
1.2875	1.3375	1.3324	1.3875	1.8156	1.8413	1.8387	1.8666	0.05	0.20	0.35	-0.792	0.371
1.2875	1.3375	1.3324	1.3875	1.8156	1.8413	1.8387	1.8666	0.35	0.50	0.65	-0.438	0.305
1.2875	1.3375	1.3324	1.3875	1.8156	1.8413	1.8387	1.8666	0.65	0.80	0.95	-0.286	0.442

1.3875	1.4375	1.4331	1.4875	1.8666	1.8915	1.8894	1.9162	-0.85	-0.70	-0.55	0.000	0.000
1.3875	1.4375	1.4331	1.4875	1.8666	1.8915	1.8894	1.9162	-0.55	-0.40	-0.25	-1.045	0.335
1.3875	1.4375	1.4331	1.4875	1.8666	1.8915	1.8894	1.9162	-0.25	-0.10	0.05	-0.963	0.226
1.3875	1.4375	1.4331	1.4875	1.8666	1.8915	1.8894	1.9162	0.05	0.20	0.35	-0.563	0.193
1.3875	1.4375	1.4331	1.4875	1.8666	1.8915	1.8894	1.9162	0.35	0.50	0.65	-0.756	0.192
1.3875	1.4375	1.4331	1.4875	1.8666	1.8915	1.8894	1.9162	0.65	0.80	0.95	-0.077	0.277
1.4875	1.5375	1.5339	1.5875	1.9162	1.9405	1.9388	1.9645	-0.85	-0.70	-0.55	-0.729	0.670
1.4875	1.5375	1.5339	1.5875	1.9162	1.9405	1.9388	1.9645	-0.55	-0.40	-0.25	-0.007	0.257
1.4875	1.5375	1.5339	1.5875	1.9162	1.9405	1.9388	1.9645	-0.25	-0.10	0.05	-0.437	0.157
1.4875	1.5375	1.5339	1.5875	1.9162	1.9405	1.9388	1.9645	0.05	0.20	0.35	-0.131	0.137
1.4875	1.5375	1.5339	1.5875	1.9162	1.9405	1.9388	1.9645	0.35	0.50	0.65	-0.552	0.139
1.4875	1.5375	1.5339	1.5875	1.9162	1.9405	1.9388	1.9645	0.65	0.80	0.95	-0.074	0.205
1.5875	1.6375	1.6355	1.6875	1.9645	1.9883	1.9873	2.0117	-0.85	-0.70	-0.55	-1.622	0.693
1.5875	1.6375	1.6355	1.6875	1.9645	1.9883	1.9873	2.0117	-0.55	-0.40	-0.25	-0.131	0.238
1.5875	1.6375	1.6355	1.6875	1.9645	1.9883	1.9873	2.0117	-0.25	-0.10	0.05	-0.020	0.156
1.5875	1.6375	1.6355	1.6875	1.9645	1.9883	1.9873	2.0117	0.05	0.20	0.35	-0.227	0.134
1.5875	1.6375	1.6355	1.6875	1.9645	1.9883	1.9873	2.0117	0.35	0.50	0.65	-0.410	0.140
1.5875	1.6375	1.6355	1.6875	1.9645	1.9883	1.9873	2.0117	0.65	0.80	0.95	-0.309	0.218
1.6875	1.7375	1.7368	1.7875	2.0117	2.0349	2.0346	2.0578	-0.85	-0.70	-0.55	-0.115	0.767
1.6875	1.7375	1.7368	1.7875	2.0117	2.0349	2.0346	2.0578	-0.55	-0.40	-0.25	-0.490	0.283
1.6875	1.7375	1.7368	1.7875	2.0117	2.0349	2.0346	2.0578	-0.25	-0.10	0.05	-0.312	0.173
1.6875	1.7375	1.7368	1.7875	2.0117	2.0349	2.0346	2.0578	0.05	0.20	0.35	-0.640	0.147
1.6875	1.7375	1.7368	1.7875	2.0117	2.0349	2.0346	2.0578	0.35	0.50	0.65	-0.362	0.143
1.6875	1.7375	1.7368	1.7875	2.0117	2.0349	2.0346	2.0578	0.65	0.80	0.95	-0.047	0.216
1.7875	1.8375	1.8378	1.8875	2.0578	2.0805	2.0807	2.1029	-0.85	-0.70	-0.55	0.936	0.683
1.7875	1.8375	1.8378	1.8875	2.0578	2.0805	2.0807	2.1029	-0.55	-0.40	-0.25	-0.406	0.341
1.7875	1.8375	1.8378	1.8875	2.0578	2.0805	2.0807	2.1029	-0.25	-0.10	0.05	-0.878	0.195
1.7875	1.8375	1.8378	1.8875	2.0578	2.0805	2.0807	2.1029	0.05	0.20	0.35	-0.731	0.153
1.7875	1.8375	1.8378	1.8875	2.0578	2.0805	2.0807	2.1029	0.35	0.50	0.65	-0.550	0.139
1.7875	1.8375	1.8378	1.8875	2.0578	2.0805	2.0807	2.1029	0.65	0.80	0.95	0.168	0.201
1.8875	1.9375	1.9385	1.9875	2.1029	2.1251	2.1256	2.1471	-0.85	-0.70	-0.55	-0.011	0.644
1.8875	1.9375	1.9385	1.9875	2.1029	2.1251	2.1256	2.1471	-0.55	-0.40	-0.25	-1.000	0.507
1.8875	1.9375	1.9385	1.9875	2.1029	2.1251	2.1256	2.1471	-0.25	-0.10	0.05	-0.891	0.240
1.8875	1.9375	1.9385	1.9875	2.1029	2.1251	2.1256	2.1471	0.05	0.20	0.35	-0.912	0.179
1.8875	1.9375	1.9385	1.9875	2.1029	2.1251	2.1256	2.1471	0.35	0.50	0.65	-0.429	0.164
1.8875	1.9375	1.9385	1.9875	2.1029	2.1251	2.1256	2.1471	0.65	0.80	0.95	-0.745	0.253
1.9875	2.0375	2.0389	2.0875	2.1471	2.1688	2.1695	2.1903	-0.85	-0.70	-0.55	0.782	0.529
1.9875	2.0375	2.0389	2.0875	2.1471	2.1688	2.1695	2.1903	-0.55	-0.40	-0.25	-1.255	0.403
1.9875	2.0375	2.0389	2.0875	2.1471	2.1688	2.1695	2.1903	-0.25	-0.10	0.05	-0.458	0.264
1.9875	2.0375	2.0389	2.0875	2.1471	2.1688	2.1695	2.1903	0.05	0.20	0.35	-0.388	0.176
1.9875	2.0375	2.0389	2.0875	2.1471	2.1688	2.1695	2.1903	0.35	0.50	0.65	-0.601	0.166
1.9875	2.0375	2.0389	2.0875	2.1471	2.1688	2.1695	2.1903	0.65	0.80	0.95	-0.227	0.182
2.0875	2.1375	2.1391	2.1875	2.1903	2.2117	2.2123	2.2328	-0.85	-0.70	-0.55	-1.268	0.480
2.0875	2.1375	2.1391	2.1875	2.1903	2.2117	2.2123	2.2328	-0.55	-0.40	-0.25	-1.606	0.430
2.0875	2.1375	2.1391	2.1875	2.1903	2.2117	2.2123	2.2328	-0.25	-0.10	0.05	-0.629	0.294
2.0875	2.1375	2.1391	2.1875	2.1903	2.2117	2.2123	2.2328	0.05	0.20	0.35	-1.315	0.196
2.0875	2.1375	2.1391	2.1875	2.1903	2.2117	2.2123	2.2328	0.35	0.50	0.65	0.004	0.188
2.0875	2.1375	2.1391	2.1875	2.1903	2.2117	2.2123	2.2328	0.65	0.80	0.95	-0.185	0.216
2.1875	2.2375	2.2402	2.2875	2.2328	2.2537	2.2548	2.2744	-0.85	-0.70	-0.55	-0.019	0.457
2.1875	2.2375	2.2402	2.2875	2.2328	2.2537	2.2548	2.2744	-0.55	-0.40	-0.25	-0.535	0.438
2.1875	2.2375	2.2402	2.2875	2.2328	2.2537	2.2548	2.2744	-0.25	-0.10	0.05	-0.405	0.332
2.1875	2.2375	2.2402	2.2875	2.2328	2.2537	2.2548	2.2744	0.05	0.20	0.35	-0.507	0.214
2.1875	2.2375	2.2402	2.2875	2.2328	2.2537	2.2548	2.2744	0.35	0.50	0.65	-0.029	0.183
2.1875	2.2375	2.2402	2.2875	2.2328	2.2537	2.2548	2.2744	0.65	0.80	0.95	0.002	0.209
2.2875	2.3375	2.3408	2.3875	2.2744	2.2949	2.2963	2.3153	-0.85	-0.70	-0.55	1.186	0.761
2.2875	2.3375	2.3408	2.3875	2.2744	2.2949	2.2963	2.3153	-0.55	-0.40	-0.25	0.134	0.515
2.2875	2.3375	2.3408	2.3875	2.2744	2.2949	2.2963	2.3153	-0.25	-0.10	0.05	-0.920	0.404
2.2875	2.3375	2.3408	2.3875	2.2744	2.2949	2.2963	2.3153	0.05	0.20	0.35	-0.424	0.300
2.2875	2.3375	2.3408	2.3875	2.2744	2.2949	2.2963	2.3153	0.35	0.50	0.65	-0.312	0.203
2.2875	2.3375	2.3408	2.3875	2.2744	2.2949	2.2963	2.3153	0.65	0.80	0.95	-0.521	0.267
2.3875	2.4375	2.4427	2.4875	2.3153	2.3355	2.3375	2.3555	-0.85	-0.70	-0.55	-0.074	0.676
2.3875	2.4375	2.4427	2.4875	2.3153	2.3355	2.3375	2.3555	-0.55	-0.40	-0.25	0.010	0.686
2.3875	2.4375	2.4427	2.4875	2.3153	2.3355	2.3375	2.3555	-0.25	-0.10	0.05	0.970	0.550
2.3875	2.4375	2.4427	2.4875	2.3153	2.3355	2.3375	2.3555	0.05	0.20	0.35	-0.435	0.398

2.3875	2.4375	2.4427	2.4875	2.3153	2.3355	2.3375	2.3555	0.35	0.50	0.65	-0.232	0.240
2.3875	2.4375	2.4427	2.4875	2.3153	2.3355	2.3375	2.3555	0.65	0.80	0.95	-0.042	0.227
2.4875	2.5375	2.5428	2.5875	2.3555	2.3753	2.3774	2.3950	-0.85	-0.70	-0.55	-1.507	0.710
2.4875	2.5375	2.5428	2.5875	2.3555	2.3753	2.3774	2.3950	-0.55	-0.40	-0.25	0.253	0.872
2.4875	2.5375	2.5428	2.5875	2.3555	2.3753	2.3774	2.3950	-0.25	-0.10	0.05	0.956	1.071
2.4875	2.5375	2.5428	2.5875	2.3555	2.3753	2.3774	2.3950	0.05	0.20	0.35	0.137	0.581
2.4875	2.5375	2.5428	2.5875	2.3555	2.3753	2.3774	2.3950	0.35	0.50	0.65	-0.530	0.337
2.4875	2.5375	2.5428	2.5875	2.3555	2.3753	2.3774	2.3950	0.65	0.80	0.95	-0.015	0.327
2.5875	2.6375	2.6423	2.6875	2.3950	2.4145	2.4163	2.4338	-0.85	-0.70	-0.55	-1.474	1.238
2.5875	2.6375	2.6423	2.6875	2.3950	2.4145	2.4163	2.4338	-0.55	-0.40	-0.25	0.080	2.297
2.5875	2.6375	2.6423	2.6875	2.3950	2.4145	2.4163	2.4338	-0.25	-0.10	0.05	-3.047	1.204
2.5875	2.6375	2.6423	2.6875	2.3950	2.4145	2.4163	2.4338	0.05	0.20	0.35	0.014	0.835
2.5875	2.6375	2.6423	2.6875	2.3950	2.4145	2.4163	2.4338	0.35	0.50	0.65	0.459	0.363
2.5875	2.6375	2.6423	2.6875	2.3950	2.4145	2.4163	2.4338	0.65	0.80	0.95	-0.490	0.315
2.6875	2.7375	2.7413	2.7875	2.4338	2.4530	2.4545	2.4721	-0.85	-0.70	-0.55	0.446	1.850
2.6875	2.7375	2.7413	2.7875	2.4338	2.4530	2.4545	2.4721	-0.55	-0.40	-0.25	0.933	1.030
2.6875	2.7375	2.7413	2.7875	2.4338	2.4530	2.4545	2.4721	-0.25	-0.10	0.05	-1.616	1.587
2.6875	2.7375	2.7413	2.7875	2.4338	2.4530	2.4545	2.4721	0.05	0.20	0.35	-1.441	0.948
2.6875	2.7375	2.7413	2.7875	2.4338	2.4530	2.4545	2.4721	0.35	0.50	0.65	-0.975	0.507
2.6875	2.7375	2.7413	2.7875	2.4338	2.4530	2.4545	2.4721	0.65	0.80	0.95	0.587	0.413
2.7875	2.8375	2.8396	2.8875	2.4721	2.4910	2.4918	2.5098	-0.85	-0.70	-0.55	-0.986	1.066
2.7875	2.8375	2.8396	2.8875	2.4721	2.4910	2.4918	2.5098	-0.55	-0.40	-0.25	-1.042	1.022
2.7875	2.8375	2.8396	2.8875	2.4721	2.4910	2.4918	2.5098	-0.25	-0.10	0.05	1.461	1.218
2.7875	2.8375	2.8396	2.8875	2.4721	2.4910	2.4918	2.5098	0.05	0.20	0.35	-0.333	1.151
2.7875	2.8375	2.8396	2.8875	2.4721	2.4910	2.4918	2.5098	0.35	0.50	0.65	0.392	0.692
2.7875	2.8375	2.8396	2.8875	2.4721	2.4910	2.4918	2.5098	0.65	0.80	0.95	-0.743	0.505

Appendix G

Data Table: C_z for $K^+\Sigma^0$

This appendix contains tables of numerical values for C_z for the $K^+\Sigma^0$ analysis. The table consist of thirteen columns, which are interpreted as follows:

1. Column 1: Lower limit of E_γ bin (GeV)
2. Column 2: Nominal midpoint of E_γ bin (GeV)
3. Column 3: Corrected midpoint of E_γ bin (GeV)
4. Column 4: Upper limit of E_γ bin (GeV)
5. Column 5: Lower limit of W bin (GeV)
6. Column 6: Nominal idpoint of W bin (GeV)
7. Column 7: Corrected midpoint of W bin (GeV)
8. Column 8: Upper limit of W bin (GeV)
9. Column 9: Lower limit of $\cos(\theta_{KCM})$ bin
10. Column 10: Midpoint of $\cos(\theta_{KCM})$ bin
11. Column 11: Lower limit of $\cos(\theta_{KCM})$ bin
12. Column 12: C_z . Double polarization observables are unitless.
13. Column 13: Error on datapoint.

G.1 Data Table

1.1875	1.2375	1.2320	1.2875	1.7632	1.7896	1.7867	1.8156	-0.85	-0.70	-0.55	0.000	0.000
1.1875	1.2375	1.2320	1.2875	1.7632	1.7896	1.7867	1.8156	-0.55	-0.40	-0.25	0.000	0.000
1.1875	1.2375	1.2320	1.2875	1.7632	1.7896	1.7867	1.8156	-0.25	-0.10	0.05	0.000	0.000
1.1875	1.2375	1.2320	1.2875	1.7632	1.7896	1.7867	1.8156	0.05	0.20	0.35	0.000	0.000
1.1875	1.2375	1.2320	1.2875	1.7632	1.7896	1.7867	1.8156	0.35	0.50	0.65	0.000	0.000
1.1875	1.2375	1.2320	1.2875	1.7632	1.7896	1.7867	1.8156	0.65	0.80	0.95	0.000	0.000
1.2875	1.3375	1.3324	1.3875	1.8156	1.8413	1.8387	1.8666	-0.85	-0.70	-0.55	0.000	0.000
1.2875	1.3375	1.3324	1.3875	1.8156	1.8413	1.8387	1.8666	-0.55	-0.40	-0.25	0.689	0.519
1.2875	1.3375	1.3324	1.3875	1.8156	1.8413	1.8387	1.8666	-0.25	-0.10	0.05	1.477	0.347
1.2875	1.3375	1.3324	1.3875	1.8156	1.8413	1.8387	1.8666	0.05	0.20	0.35	0.760	0.301
1.2875	1.3375	1.3324	1.3875	1.8156	1.8413	1.8387	1.8666	0.35	0.50	0.65	1.391	0.302
1.2875	1.3375	1.3324	1.3875	1.8156	1.8413	1.8387	1.8666	0.65	0.80	0.95	1.334	0.383

1.3875	1.4375	1.4331	1.4875	1.8666	1.8915	1.8894	1.9162	-0.85	-0.70	-0.55	0.000	0.000
1.3875	1.4375	1.4331	1.4875	1.8666	1.8915	1.8894	1.9162	-0.55	-0.40	-0.25	0.734	0.325
1.3875	1.4375	1.4331	1.4875	1.8666	1.8915	1.8894	1.9162	-0.25	-0.10	0.05	1.092	0.208
1.3875	1.4375	1.4331	1.4875	1.8666	1.8915	1.8894	1.9162	0.05	0.20	0.35	1.019	0.189
1.3875	1.4375	1.4331	1.4875	1.8666	1.8915	1.8894	1.9162	0.35	0.50	0.65	0.744	0.184
1.3875	1.4375	1.4331	1.4875	1.8666	1.8915	1.8894	1.9162	0.65	0.80	0.95	0.585	0.279
1.4875	1.5375	1.5339	1.5875	1.9162	1.9405	1.9388	1.9645	-0.85	-0.70	-0.55	0.171	0.612
1.4875	1.5375	1.5339	1.5875	1.9162	1.9405	1.9388	1.9645	-0.55	-0.40	-0.25	0.475	0.239
1.4875	1.5375	1.5339	1.5875	1.9162	1.9405	1.9388	1.9645	-0.25	-0.10	0.05	0.681	0.156
1.4875	1.5375	1.5339	1.5875	1.9162	1.9405	1.9388	1.9645	0.05	0.20	0.35	0.866	0.138
1.4875	1.5375	1.5339	1.5875	1.9162	1.9405	1.9388	1.9645	0.35	0.50	0.65	0.632	0.135
1.4875	1.5375	1.5339	1.5875	1.9162	1.9405	1.9388	1.9645	0.65	0.80	0.95	0.458	0.220
1.5875	1.6375	1.6355	1.6875	1.9645	1.9883	1.9873	2.0117	-0.85	-0.70	-0.55	1.482	0.619
1.5875	1.6375	1.6355	1.6875	1.9645	1.9883	1.9873	2.0117	-0.55	-0.40	-0.25	0.262	0.267
1.5875	1.6375	1.6355	1.6875	1.9645	1.9883	1.9873	2.0117	-0.25	-0.10	0.05	1.075	0.162
1.5875	1.6375	1.6355	1.6875	1.9645	1.9883	1.9873	2.0117	0.05	0.20	0.35	0.528	0.142
1.5875	1.6375	1.6355	1.6875	1.9645	1.9883	1.9873	2.0117	0.35	0.50	0.65	0.706	0.148
1.5875	1.6375	1.6355	1.6875	1.9645	1.9883	1.9873	2.0117	0.65	0.80	0.95	0.351	0.205
1.6875	1.7375	1.7368	1.7875	2.0117	2.0349	2.0346	2.0578	-0.85	-0.70	-0.55	0.497	0.677
1.6875	1.7375	1.7368	1.7875	2.0117	2.0349	2.0346	2.0578	-0.55	-0.40	-0.25	0.697	0.281
1.6875	1.7375	1.7368	1.7875	2.0117	2.0349	2.0346	2.0578	-0.25	-0.10	0.05	0.744	0.185
1.6875	1.7375	1.7368	1.7875	2.0117	2.0349	2.0346	2.0578	0.05	0.20	0.35	1.022	0.141
1.6875	1.7375	1.7368	1.7875	2.0117	2.0349	2.0346	2.0578	0.35	0.50	0.65	0.379	0.146
1.6875	1.7375	1.7368	1.7875	2.0117	2.0349	2.0346	2.0578	0.65	0.80	0.95	0.697	0.186
1.7875	1.8375	1.8378	1.8875	2.0578	2.0805	2.0807	2.1029	-0.85	-0.70	-0.55	-0.965	0.592
1.7875	1.8375	1.8378	1.8875	2.0578	2.0805	2.0807	2.1029	-0.55	-0.40	-0.25	0.693	0.328
1.7875	1.8375	1.8378	1.8875	2.0578	2.0805	2.0807	2.1029	-0.25	-0.10	0.05	0.854	0.194
1.7875	1.8375	1.8378	1.8875	2.0578	2.0805	2.0807	2.1029	0.05	0.20	0.35	0.419	0.149
1.7875	1.8375	1.8378	1.8875	2.0578	2.0805	2.0807	2.1029	0.35	0.50	0.65	0.149	0.141
1.7875	1.8375	1.8378	1.8875	2.0578	2.0805	2.0807	2.1029	0.65	0.80	0.95	0.097	0.228
1.8875	1.9375	1.9385	1.9875	2.1029	2.1251	2.1256	2.1471	-0.85	-0.70	-0.55	-0.303	0.579
1.8875	1.9375	1.9385	1.9875	2.1029	2.1251	2.1256	2.1471	-0.55	-0.40	-0.25	1.215	0.386
1.8875	1.9375	1.9385	1.9875	2.1029	2.1251	2.1256	2.1471	-0.25	-0.10	0.05	0.319	0.232
1.8875	1.9375	1.9385	1.9875	2.1029	2.1251	2.1256	2.1471	0.05	0.20	0.35	0.524	0.178
1.8875	1.9375	1.9385	1.9875	2.1029	2.1251	2.1256	2.1471	0.35	0.50	0.65	0.048	0.148
1.8875	1.9375	1.9385	1.9875	2.1029	2.1251	2.1256	2.1471	0.65	0.80	0.95	-0.082	0.178
1.9875	2.0375	2.0389	2.0875	2.1471	2.1688	2.1695	2.1903	-0.85	-0.70	-0.55	1.157	0.493
1.9875	2.0375	2.0389	2.0875	2.1471	2.1688	2.1695	2.1903	-0.55	-0.40	-0.25	1.089	0.417
1.9875	2.0375	2.0389	2.0875	2.1471	2.1688	2.1695	2.1903	-0.25	-0.10	0.05	0.397	0.249
1.9875	2.0375	2.0389	2.0875	2.1471	2.1688	2.1695	2.1903	0.05	0.20	0.35	0.111	0.213
1.9875	2.0375	2.0389	2.0875	2.1471	2.1688	2.1695	2.1903	0.35	0.50	0.65	0.159	0.155
1.9875	2.0375	2.0389	2.0875	2.1471	2.1688	2.1695	2.1903	0.65	0.80	0.95	-0.193	0.164
2.0875	2.1375	2.1391	2.1875	2.1903	2.2117	2.2123	2.2328	-0.85	-0.70	-0.55	1.279	0.444
2.0875	2.1375	2.1391	2.1875	2.1903	2.2117	2.2123	2.2328	-0.55	-0.40	-0.25	0.700	0.434
2.0875	2.1375	2.1391	2.1875	2.1903	2.2117	2.2123	2.2328	-0.25	-0.10	0.05	0.958	0.284
2.0875	2.1375	2.1391	2.1875	2.1903	2.2117	2.2123	2.2328	0.05	0.20	0.35	0.235	0.208
2.0875	2.1375	2.1391	2.1875	2.1903	2.2117	2.2123	2.2328	0.35	0.50	0.65	-0.818	0.182
2.0875	2.1375	2.1391	2.1875	2.1903	2.2117	2.2123	2.2328	0.65	0.80	0.95	-0.134	0.170
2.1875	2.2375	2.2402	2.2875	2.2328	2.2537	2.2548	2.2744	-0.85	-0.70	-0.55	0.047	0.429
2.1875	2.2375	2.2402	2.2875	2.2328	2.2537	2.2548	2.2744	-0.55	-0.40	-0.25	0.098	0.471
2.1875	2.2375	2.2402	2.2875	2.2328	2.2537	2.2548	2.2744	-0.25	-0.10	0.05	0.800	0.314
2.1875	2.2375	2.2402	2.2875	2.2328	2.2537	2.2548	2.2744	0.05	0.20	0.35	0.462	0.219
2.1875	2.2375	2.2402	2.2875	2.2328	2.2537	2.2548	2.2744	0.35	0.50	0.65	-0.100	0.188
2.1875	2.2375	2.2402	2.2875	2.2328	2.2537	2.2548	2.2744	0.65	0.80	0.95	-0.041	0.163
2.2875	2.3375	2.3408	2.3875	2.2744	2.2949	2.2963	2.3153	-0.85	-0.70	-0.55	0.828	0.649
2.2875	2.3375	2.3408	2.3875	2.2744	2.2949	2.2963	2.3153	-0.55	-0.40	-0.25	1.377	0.600
2.2875	2.3375	2.3408	2.3875	2.2744	2.2949	2.2963	2.3153	-0.25	-0.10	0.05	0.783	0.440
2.2875	2.3375	2.3408	2.3875	2.2744	2.2949	2.2963	2.3153	0.05	0.20	0.35	0.294	0.310
2.2875	2.3375	2.3408	2.3875	2.2744	2.2949	2.2963	2.3153	0.35	0.50	0.65	-0.526	0.229
2.2875	2.3375	2.3408	2.3875	2.2744	2.2949	2.2963	2.3153	0.65	0.80	0.95	-0.170	0.245
2.3875	2.4375	2.4427	2.4875	2.3153	2.3355	2.3375	2.3555	-0.85	-0.70	-0.55	1.019	0.603
2.3875	2.4375	2.4427	2.4875	2.3153	2.3355	2.3375	2.3555	-0.55	-0.40	-0.25	-0.344	0.869
2.3875	2.4375	2.4427	2.4875	2.3153	2.3355	2.3375	2.3555	-0.25	-0.10	0.05	-0.064	0.565
2.3875	2.4375	2.4427	2.4875	2.3153	2.3355	2.3375	2.3555	0.05	0.20	0.35	-0.227	0.353

2.3875	2.4375	2.4427	2.4875	2.3153	2.3355	2.3375	2.3555	0.35	0.50	0.65	-0.442	0.257
2.3875	2.4375	2.4427	2.4875	2.3153	2.3355	2.3375	2.3555	0.65	0.80	0.95	-0.418	0.366
2.4875	2.5375	2.5428	2.5875	2.3555	2.3753	2.3774	2.3950	-0.85	-0.70	-0.55	0.922	0.979
2.4875	2.5375	2.5428	2.5875	2.3555	2.3753	2.3774	2.3950	-0.55	-0.40	-0.25	0.732	0.951
2.4875	2.5375	2.5428	2.5875	2.3555	2.3753	2.3774	2.3950	-0.25	-0.10	0.05	-1.261	0.881
2.4875	2.5375	2.5428	2.5875	2.3555	2.3753	2.3774	2.3950	0.05	0.20	0.35	-0.738	0.562
2.4875	2.5375	2.5428	2.5875	2.3555	2.3753	2.3774	2.3950	0.35	0.50	0.65	-0.308	0.383
2.4875	2.5375	2.5428	2.5875	2.3555	2.3753	2.3774	2.3950	0.65	0.80	0.95	-0.348	0.341
2.5875	2.6375	2.6423	2.6875	2.3950	2.4145	2.4163	2.4338	-0.85	-0.70	-0.55	3.243	1.021
2.5875	2.6375	2.6423	2.6875	2.3950	2.4145	2.4163	2.4338	-0.55	-0.40	-0.25	2.293	0.819
2.5875	2.6375	2.6423	2.6875	2.3950	2.4145	2.4163	2.4338	-0.25	-0.10	0.05	1.311	1.325
2.5875	2.6375	2.6423	2.6875	2.3950	2.4145	2.4163	2.4338	0.05	0.20	0.35	-1.254	0.847
2.5875	2.6375	2.6423	2.6875	2.3950	2.4145	2.4163	2.4338	0.35	0.50	0.65	-0.869	0.394
2.5875	2.6375	2.6423	2.6875	2.3950	2.4145	2.4163	2.4338	0.65	0.80	0.95	0.727	0.446
2.6875	2.7375	2.7413	2.7875	2.4338	2.4530	2.4545	2.4721	-0.85	-0.70	-0.55	0.072	1.251
2.6875	2.7375	2.7413	2.7875	2.4338	2.4530	2.4545	2.4721	-0.55	-0.40	-0.25	2.485	0.890
2.6875	2.7375	2.7413	2.7875	2.4338	2.4530	2.4545	2.4721	-0.25	-0.10	0.05	-2.157	1.191
2.6875	2.7375	2.7413	2.7875	2.4338	2.4530	2.4545	2.4721	0.05	0.20	0.35	-0.382	0.883
2.6875	2.7375	2.7413	2.7875	2.4338	2.4530	2.4545	2.4721	0.35	0.50	0.65	-0.207	0.476
2.6875	2.7375	2.7413	2.7875	2.4338	2.4530	2.4545	2.4721	0.65	0.80	0.95	0.181	0.797
2.7875	2.8375	2.8396	2.8875	2.4721	2.4910	2.4918	2.5098	-0.85	-0.70	-0.55	0.999	1.074
2.7875	2.8375	2.8396	2.8875	2.4721	2.4910	2.4918	2.5098	-0.55	-0.40	-0.25	1.256	1.224
2.7875	2.8375	2.8396	2.8875	2.4721	2.4910	2.4918	2.5098	-0.25	-0.10	0.05	0.891	1.477
2.7875	2.8375	2.8396	2.8875	2.4721	2.4910	2.4918	2.5098	0.05	0.20	0.35	-0.899	1.118
2.7875	2.8375	2.8396	2.8875	2.4721	2.4910	2.4918	2.5098	0.35	0.50	0.65	-1.106	0.504
2.7875	2.8375	2.8396	2.8875	2.4721	2.4910	2.4918	2.5098	0.65	0.80	0.95	-0.147	0.543