E93-018 Analysis Status Report

$p(e,e'K^+)\Lambda,\Sigma^0$ $0.5 < Q^2 < 2\ (GeV/c)^2$ and $W = 1.84$ GeV

(K. Baker, spokesman)

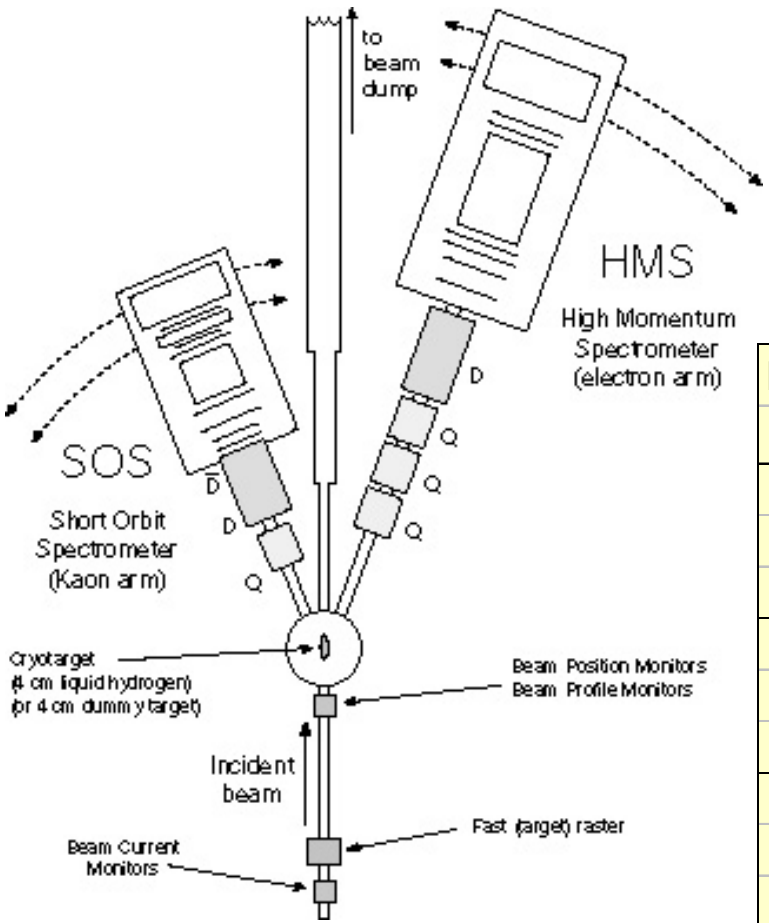
Physics Goals: L/T separation of cross section
Σ/Λ channels in separated cross sections
t-dependence and Kaon form factor extraction

Λ results published in G. Niculescu *et al.*, PRL 81 (1998) 1805.

Σ/Λ analysis: R. Mohring, U Md Ph.D. Thesis (1999).
PRC draft nearly ready for submission.

Analyses do not agree on Λ cross sections. Primary difference is in method to determine experimental acceptance.

E93-018 Layout and Kinematics



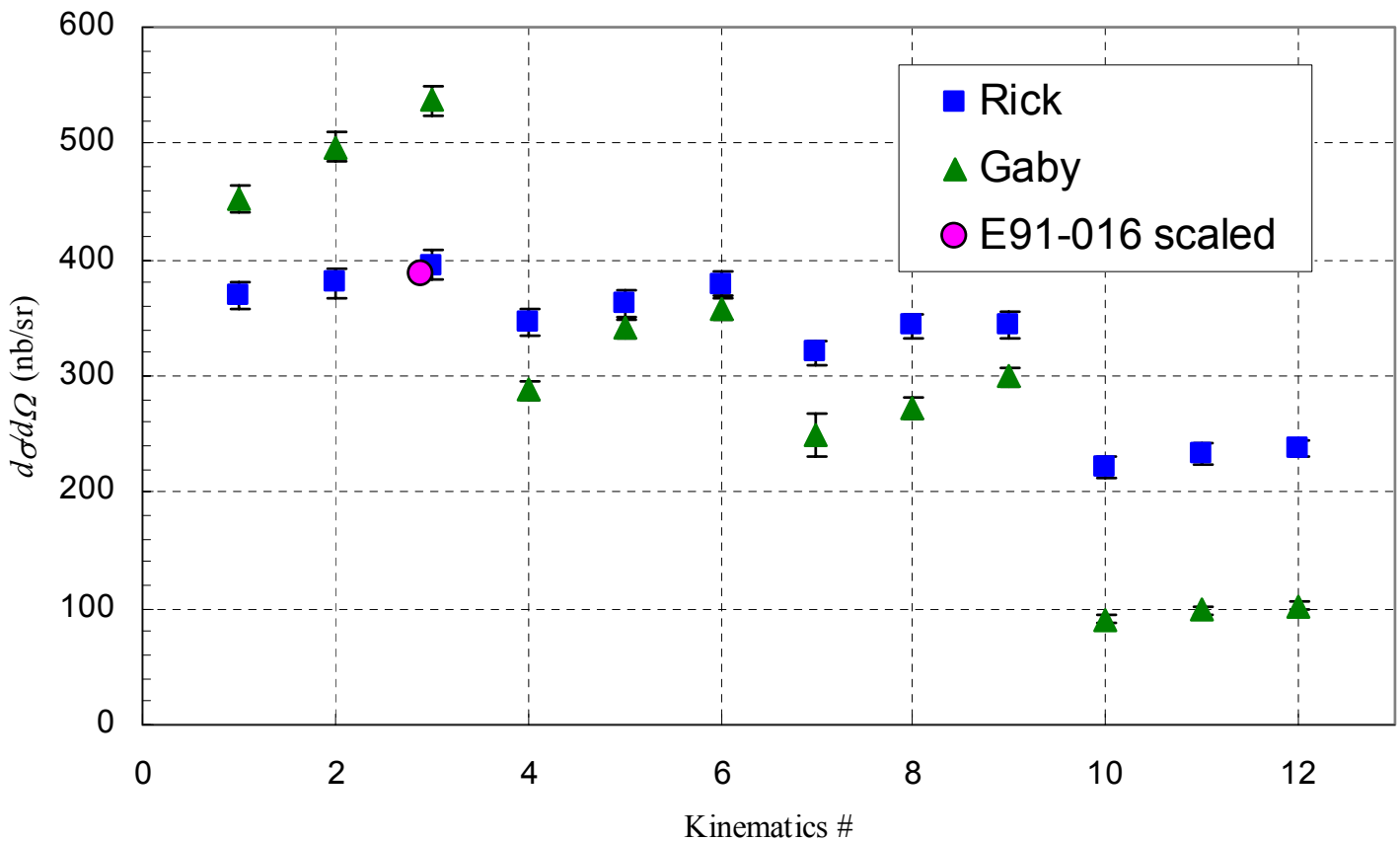
"nearly" parallel kinematics

$(\theta_K \to 0,\ t \to t_{min})$

kin	Q^2	W	ε	E	P_{HMS}	θ_{HMS}	P_{SOS}	θ_{SOS}
	$(GeV/c)^2$	GeV		GeV	GeV/c	deg	GeV/c	deg
1	0.52	1.84	0.552	2.445	0.833	29.27	1.126	13.40
2			0.771	3.245	1.633	18.03	1.126	16.62
3			0.865	4.045	2.433	13.20	1.126	18.34
4	0.75	1.84	0.462	2.445	0.725	37.95	1.188	13.42
5			0.724	3.245	1.526	22.44	1.188	17.62
6			0.834	4.045	2.326	16.23	1.188	19.75
7	1.00	1.81	0.380	2.445	0.635	47.30	1.216	13.40
8			0.678	3.245	1.435	26.80	1.216	18.20
9			0.810	4.045	2.236	19.14	1.216	20.78
10	2.00	1.84	0.363	3.245	0.844	50.59	1.634	13.42
11			0.476	3.545	1.145	41.11	1.634	15.67
12			0.613	4.045	1.645	31.83	1.634	18.14

Λ unseparated cross section comparison

$$\frac{d\sigma}{d\Omega_K^*} = \frac{1}{\Gamma}\left(\frac{d^5\sigma}{d\Omega_e d\Omega_K^* dE_e}\right) = \sigma_T + \varepsilon\sigma_L + \sqrt{2\varepsilon(\varepsilon+1)}\sigma_{LT}\cos\phi + \varepsilon\sigma_{TT}\cos 2\phi$$



Differences in Analyses

All experimental factors are the same *(N_K, efficiency, luminosity, cuts, etc…)*

1) W scaling function

Gaby: $$f(W) = f_{Bebek}(W) = \frac{|p_K^*|}{W(W^2 - m_p^2)}$$

Rick: $$f(W) = C_1 f_{Bebek}(W) + C_2 \frac{A^2 B^2}{(W^2 - A^2)^2 + A^2 B^2}$$

$< 3\%$

2) value of t (or θ_K)

Gaby: at central *<t>* of data

Rick: data scaled to $t = t_{min}$ (θ_K=0)

~ 1%

3) Radiative corrections

Gaby: no ε dependence

Rick: built into SIMC, varies with ε

? ~5 % ?

4) ϕ acceptance

Gaby: no cut applied

Rick: cut on θ_K to require complete ϕ acceptance (20-50 % of data thrown away)

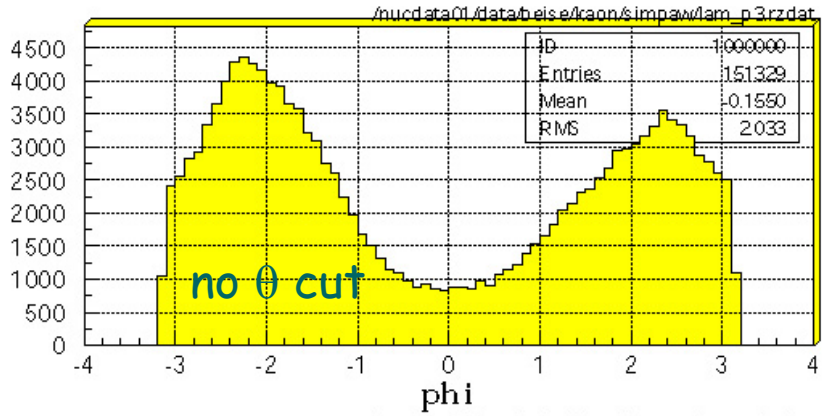
5) Cross section extraction

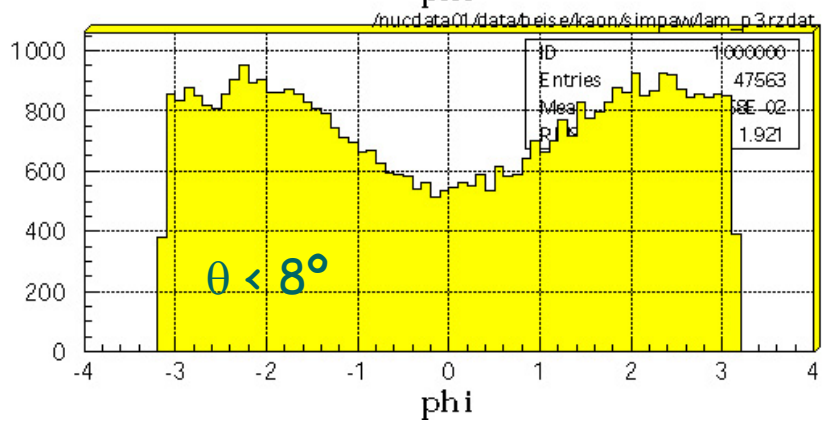
Gaby: calculated acceptance function

Rick: Data/SIMC ratio

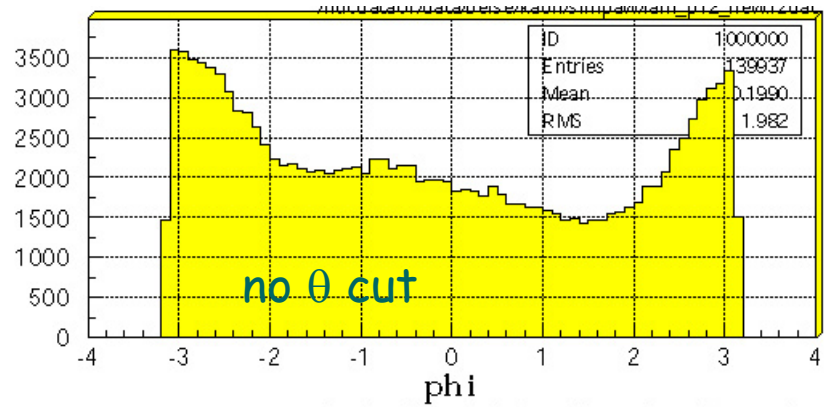
ϕ acceptance

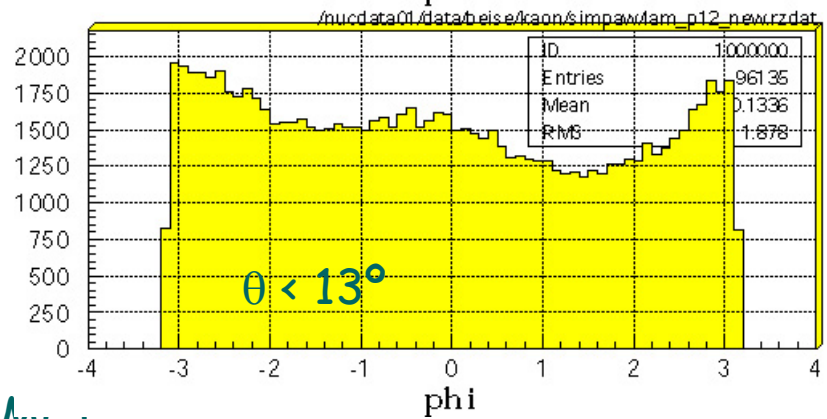
kinematics 3





kinematics 12





(SIMC)

From U Md analysis, σ_{LT} and σ_{TT} consistent w/ 0…

U Md analysis

Data/MC ratio using SIMC modified for K production

$$Y_{MC} = L_H \times \int \left[\Gamma(Q^2, W) \left(\frac{d\sigma}{d\Omega_K^*} \right) \right] \times A(d^5V) R(d^5V) dQ^2 dW d\phi_e d\Omega_K^*$$

MC cross section, event-by-event:

$$\frac{d\sigma}{d\Omega_K^*} = \sigma_0 \frac{f_W(W) f_Q(Q^2) f_t(\theta_K^*)}{f_W(W_0) f_Q(Q_0^2) f_t(\theta_K^* = 0)}$$

Adjust σ_0 until $Y_{DATA} = Y_{MC}$

Cross checks:

1) E91-016 points "0" and "0L" scaled to E93-018 kin 3 (see figure)

2) E91-016 point "0" analyzed:

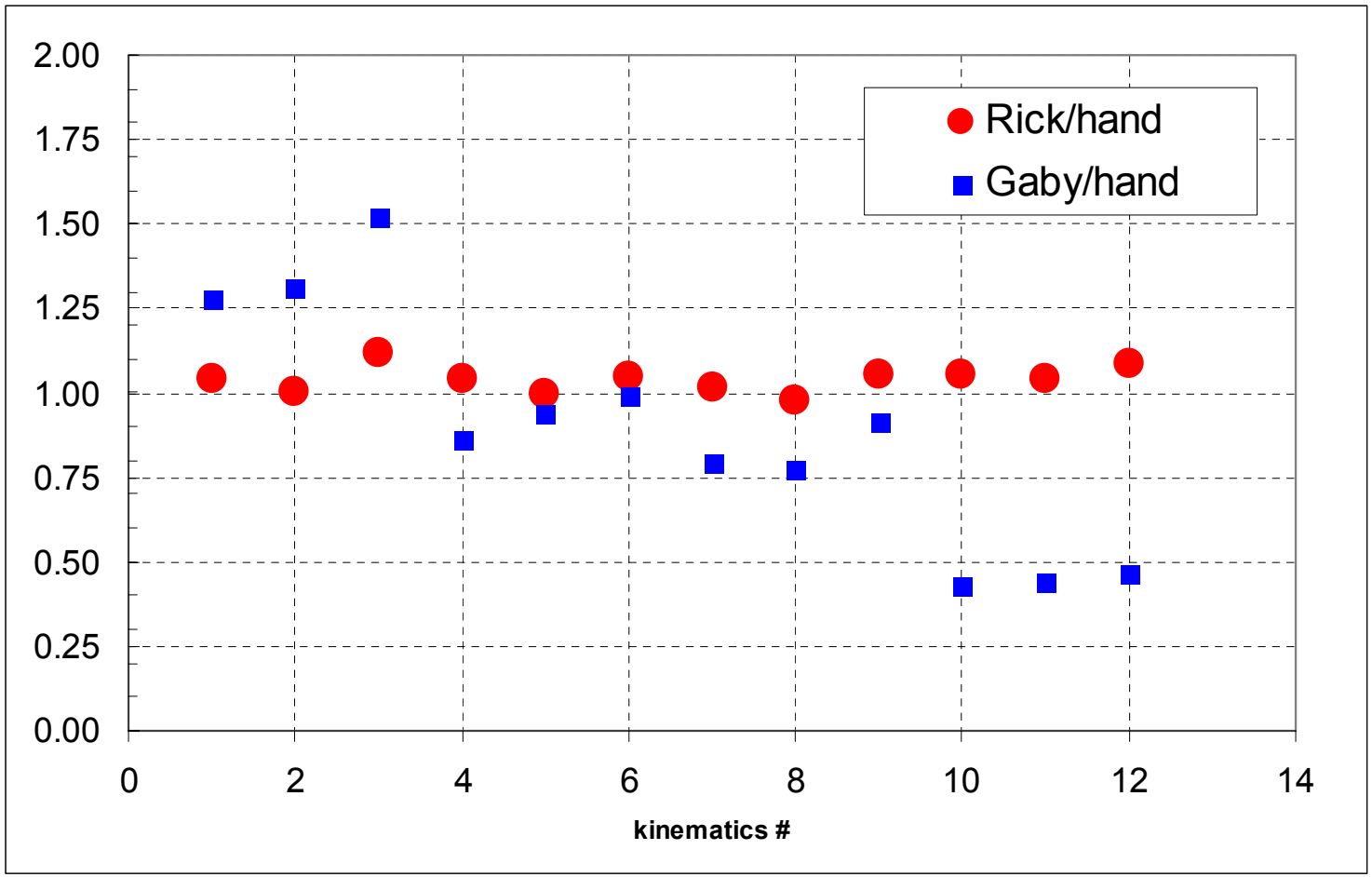
Rick Mohring	426 ± 21 nb/sr
Doug Koltenuk	416 ± 20 nb/sr
Jinsoek Cha	428 ± 28 nb/sr

3) Calculate by hand using SIMC-generated acceptance

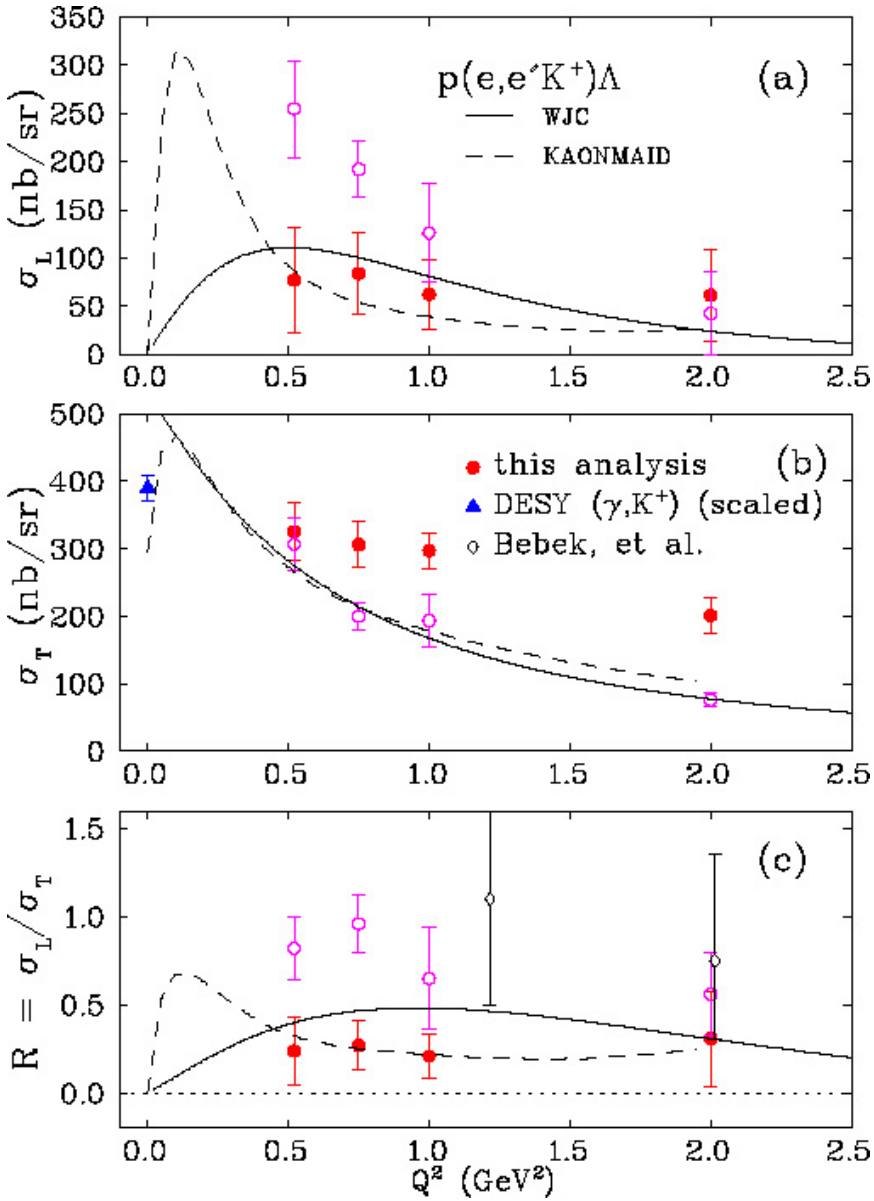
"Hand" Calculation of cross section

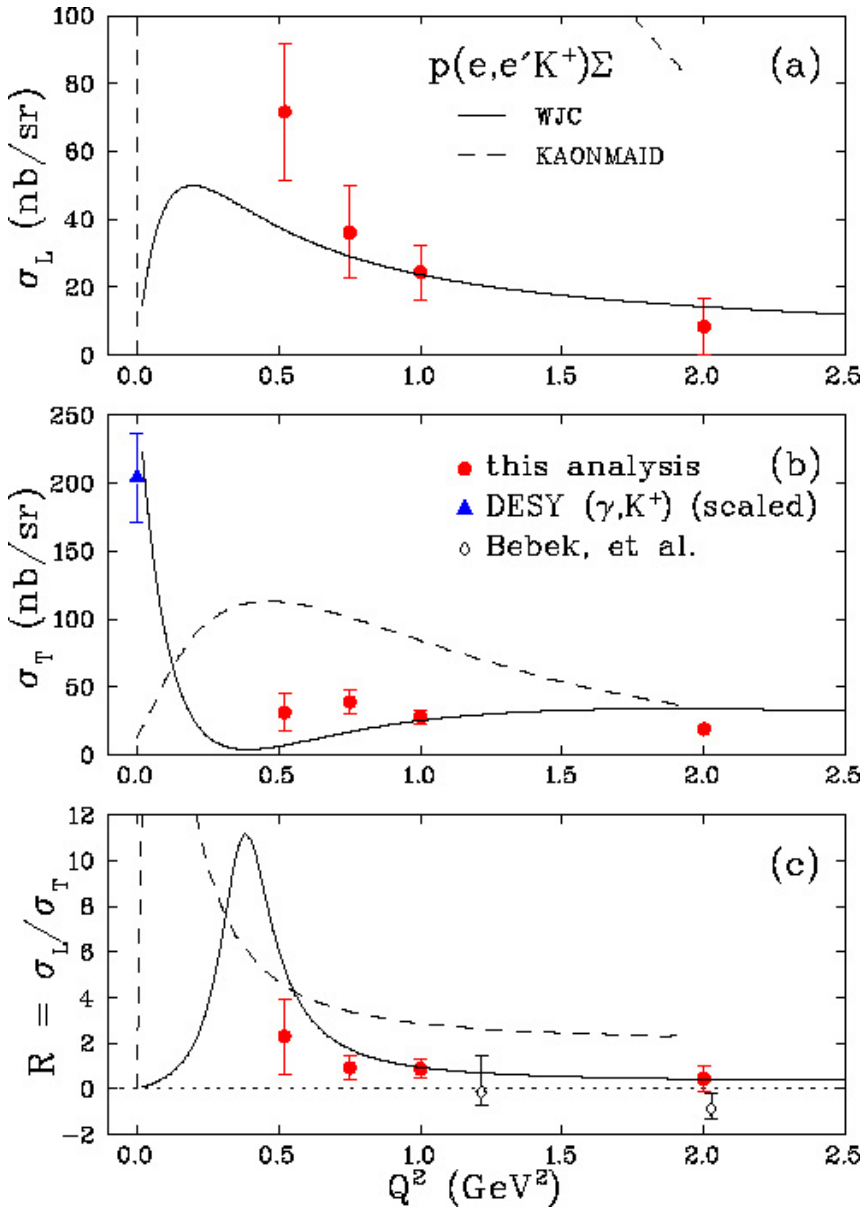
$$\frac{d\sigma}{d\Omega_K^*} = \left(\frac{1}{\Gamma}\right) \times \left(\frac{R_c Y_K}{\varepsilon_{TOF} L}\right) \times \left(\frac{1}{\Delta^5}\right) \times \left(\frac{d\Omega_K}{d\Omega_K^*}\right)$$

Δ^5 from SIMC (from J. Arrington)
R_c = 1.32



Results


p(e,e′K⁺)Λ
(a)
WJC
KAONMAID
σ_L (nb/sr)
(b)
this analysis
DESY (γ,K⁺) (scaled)
Bebek, et al.
σ_T (nb/sr)
(c)
R = σ_L/σ_T
Q² (GeV²)


p(e,e′K⁺)Σ
(a)
WJC
KAONMAID
σ_L (nb/sr)
(b)
this analysis
DESY (γ,K⁺) (scaled)
Bebek, et al.
σ_T (nb/sr)
(c)
R = σ_L/σ_T
Q² (GeV²)

Summary

New Λ analysis has significantly different cross section behavior
both in Q^2 dependence and L/T ratio

Discrepancies not completely resolved but:
likely difference in treatment of experimental acceptance
U Md analysis is self-consistent
Comparison of SIMC vs "Calculated" acceptance in progress
(G. Niculescu + J. Arrington)

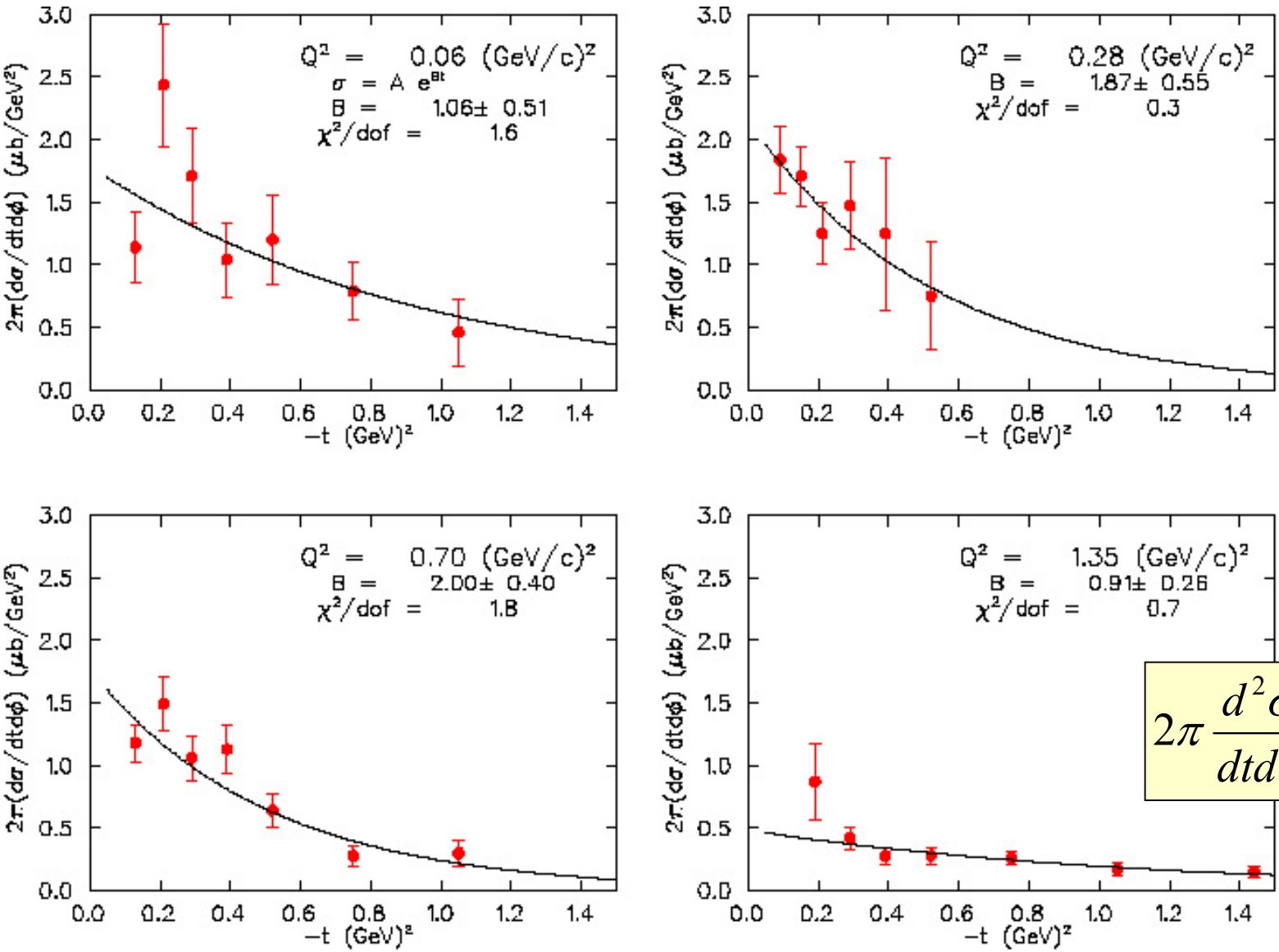
PRC draft ready for submission …
updated Λ L/T separated cross sections
Σ L/T separated cross sections
comparison w/ WJC model and with KAONMAID

Comments on paper are welcome!

Rick Mohring's thesis at http://www.physics.umd.edu/enp/theses/

t-dependence of cross section

Data from Brauel, et al., Z Phys C3 (1979) 101.



$$2\pi \frac{d^2\sigma}{dtd\phi} \propto e^{2.1t}$$

cross section at fixed t