E12-11-108 Jeopardy Update to PAC50

Target Single Spin Asymmetry in Semi-Inclusive Deep-Inelastic $(e, e'\pi^{\pm})$ Reaction on a Transversely Polarized Proton Target

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1 Introduction

Experiment E12-11-108 [1], a semi-inclusive deep inelastic scattering (SIDIS) measurement, was approved by PAC 39 with A rating at incident electron beam energies of 8.8 and 11 GeV by employing a transversely polarized NH_3 target. This experiment will measure three target single-spin asymmetries (SSAs) of π^+/π^- particles produced in SIDIS processes using the proposed Solenoidal Large Intensity Device (SoLID) apparatus [2, 3]. Since the approval of E12-11-108, there have been two run-group experiments approved, which are E12-11-108A on A_y measurement and E12-11-108B on SIDIS kaon production. High-precision results to be obtained will provide essential "proton" information to the world data together with the upcoming results from the SoLID SIDIS experiment E12-10-006 [4] on a transversely polarized ^{3}He target and its related run-group experiments. Moreover, the combination of the results from both E12-11-108 and E12-10-006 experiments will render smaller overall uncertainties in the extraction of the transverse-momentum-dependent PDFs (TMDs), and allow for flavor separation of the TMDs. We first describe the latest design of the SoLID apparatus and the SoLID status. Then we present an update on E12-11-108 experiment, followed by brief updates on the associated two run-group experiments.

2 Progress on the SoLID Apparatus

Since the approval of five SoLID experiments with beam time and high rating by the JLab PAC, the collaboration has developed a Pre-CDR [3], which gives details on the SoLID apparatus as well as a cost estimate. In 2015, SoLID together with the approved experiments received a strong endorsement from the Nuclear Physics Long Range Plan. In September of 2019, the Pre-CDR successfully passed the second of two JLab Director's Reviews. The latter review covered a detailed cost estimate and detailed analysis, which concluded that all critical items were low risk. The Pre-CDR was the basis of the SoLID MIE submitted to the DOE in February of 2020. In 2020, the DOE funded a Pre-R&D plan, which has demonstrated that there are no show-stoppers in the design of SoLID. In March of 2021, the DOE performed the Science Review of SoLID. We give a brief overview of the features of the SoLID apparatus and Pre-R&D progress below.

In the Pre-CDR, we have demonstrated that the apparatus can achieve the following goals:

1. High luminosity (10^{37} cm^{-2}s^{-1} for SIDIS and J/ψ, 10^{39} cm^{-2}s^{-1} for PVDIS with baffles);
2. Large acceptance: 2π in azimuthal angle ϕ; in polar angle θ: $8^\circ - 24^\circ$ for SIDIS and J/ψ, $22^\circ - 35^\circ$ for PVDIS; momentum range: $1 - 7$ GeV/c;
3. High rates (trigger rate limit 100 KHz for SIDIS and J/ψ, 600 KHz of the 30 sectors for PVDIS);
4. High background tolerance ($\sim$1 GHz, dominated by low energy photons/electrons);
5. High radiation environment tolerance (10^{2-3} krad);
6. Moderate resolutions ($1 - 2\%$ in momentum, $1 - 2$ mrad in θ, 6 mrad in ϕ);
7. Good electron PID, moderate pion PID (SIDIS), and demanding Kaon PID (SIDIS-Kaon, enhanced configuration);
8. High precision with low systematic effects.

• The SoLID apparatus in its SIDIS configuration with NH_3 target is shown in Fig. 1. Since the SoLID experiments were approved, the CLEOII magnet was chosen. It was moved to JLAB in

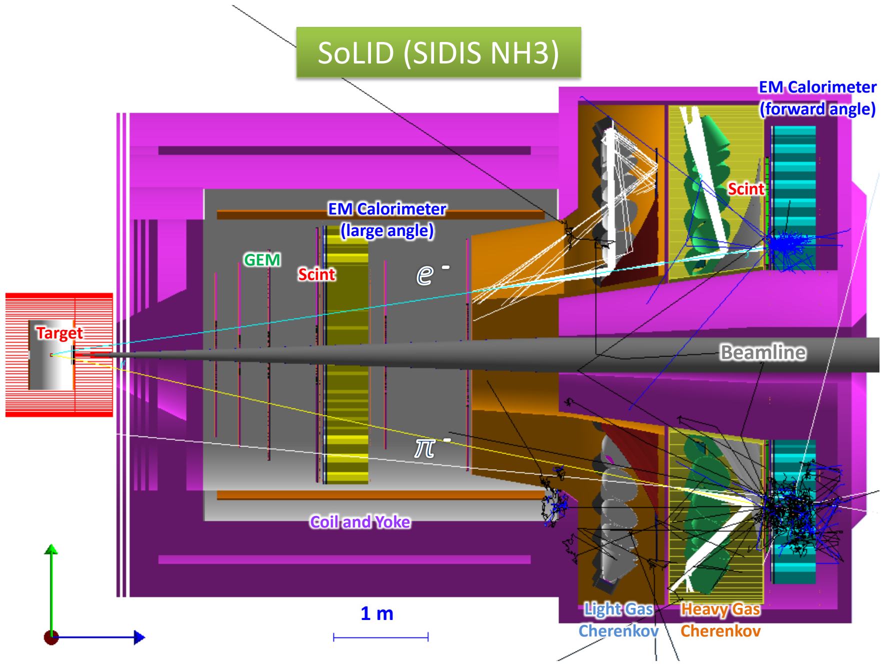

Figure 1: SoLID SIDIS Setup with NH_3 target.

2016. JLAB is currently performing refurbishment of the magnet and preparing for a cold test to establish the magnet's operational condition. The cold test is scheduled to be completed before the end of 2022.

• Significant progress has been made in all subsystems, and many components have been tested and shown to meet specifications. UVa group has built large GEM chambers with sizes what SoLID needs. They also successfully built and operated GEM detectors for the PRad experiment and SBS experiment. During our recent execution of the Pre-R&D plan, we have tested new VMM3 GEM readout chips, which we plan to use instead of the obsolete APV25 chips listed in the original proposals. We have demonstrated that with the VMM3 chips operated in a mode with a 25 ns shaping time, the readout can handle the high rates required for SoLID.

• A prototype Čerenkov was tested with a beam at JLab Hall C in 2020, both at low rates and also at high rates equal to those expected in the SoLID spectrometer. In both the low- and high-rate configurations, clean signals could be identified and Čerenkov with its readout system performed very well.

• The ECal prototype modules were successfully tested at the Fermilab Test Beam Facility in January of 2021. Data showed that the energy resolution of the 3-module setup reached the SoLID requirement of $\delta E/E = \sqrt{10\%}/\sqrt{E}$ and the position resolution exceeded the required 1 cm specification.

• The SoLID DAQ system is based on the JLab 12 GeV FADC base pipelined electronics, which now has been successfully used in Halls B and D. Special features of the JLab FADC required for SoLID, which were built into the JLab design but never used in previous applications, have now been successfully tested for all systems as part of the SoLID Pre-R&D plan.

• Currently, a beam test of a full set of the SoLID detector prototypes – GEM, LGC, ECal, DAQ and associated electronics – is in preparation. The goal of the test is to fully characterize the functionality of the detector system under a high-rate, high-radiation environment that is similar to SoLID operation.

• The SoLID simulation software, based on GEMC/GEANT4, is a single package that is used to model all approved experiments and run-group experiments. It is being used to optimize the design and evaluate the impact of the results from the past and ongoing tests. A Kalman Filter based track finding and fitting algorithm has been developed and tested with fully digitized GEM simulation data. Tracking resolutions with a good tracking efficiency have been obtained with the background taken into account. We are actively working on assembling simulation, reconstruction, and analysis into one software framework.

• The NH_3 target magnet arrived at JLab in late 2021 from Scientific Magnetics in UK and has been successfully tested to 5T field as shown in Fig. 2. It is anticipated to be used by Hall C and CLAS12 before SoLID.

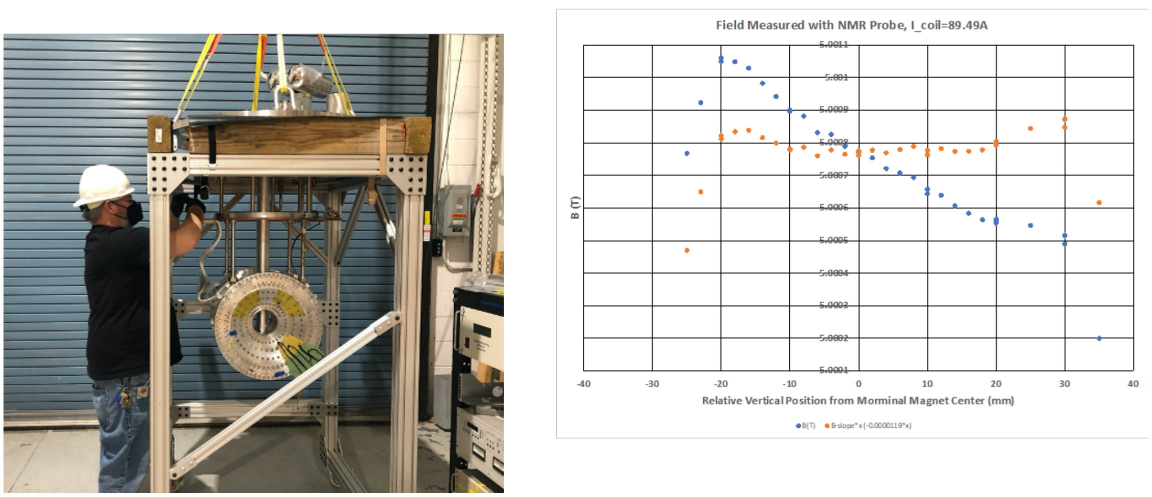

Figure 2: Left: JLab target group working on the newly arrived target magnet. Right: off-axis (vertical) field map at 5T with field uniformity < 100 ppm.

3 Update on Experiment E12-11-108

TMDs provide three-dimensional tomography of the nucleon structure in momentum space. The SIDIS process is a golden channel to study TMDs. For a precise determination of TMDs, measuring SIDIS processes in a wide kinematic range with high luminosity and large-acceptance is required for sophisticated multidimensional-binning analyses. SoLID is capable of handling high luminosity and large acceptance simultaneously aiming at unprecedentedly precise measurements of TMDs in the valence quark region through a slate of SIDIS measurements using transversely or longitudinally polarized ^{3}He, and transversely polarized NH_3 targets.

In general, the SoLID SIDID program (Experiments: E12-10-006, E12-11-007 and E12-11-108) aims at addressing the following science questions: (i) How to quantify the quark transverse motion inside the nucleon and observe spin-orbit correlations ? (ii) Is the confined motion in the transverse plane dependent on Bjorken x ? (iii) Is it possible to provide quantitative information on the quark orbital angular momentum (OAM) contribution to the nucleon spin ? (iv) Are there clear signatures for relativity inside the nucleon, and is it possible to provide a high precision test for lattice QCD predictions ?

In Experiment E12-11-108, three SSAs of π^+/π^- will be measured, and they are in the leading twist formalism shown below:

$$A_{UT} = A_{UT}^{\text{Collins}} \sin(\phi_h + \phi_S) + A_{UT}^{\text{Pretzelosity}} \sin(3\phi_h - \phi_S) + A_{UT}^{\text{Sivers}} \sin(\phi_h - \phi_S), \quad (1)$$

given by different angular modulations via the hadron azimuthal angle (ϕ_h) and the spin azimuthal angle (ϕ_S), both defined relative to the lepton scattering plane in the target rest frame. A_{UT} is the non-separated transverse SSA standing in the left hand side of Eq. (1). Three TMDs (Transversity, Pretzelosity and Sivers) can be extracted with high precision from these three SSAs, in combination with the world data, with a global analysis. Tensor charge, a fundamental quantity of the nucleon that can be calculated in Lattice QCD, can be determined in the following:

$$g_T^q = \int_0^1 \left[h_1^q(x) - h_1^{\bar{q}}(x)\right] dx, \quad (2)$$

where h_1 is the Transversity TMD. The lowest moment of Transversity defines the tensor charge, providing a benchmark testing for Lattice QCD predictions.

The experiment has been approved for 94 days of total beam time with 100 nA, 11/8.8 GeV electron beams on a 3-cm long, polarized NH_3 target. The projected data from E12-11-108 are binned into 4-D (x, P_T, z, Q^2) bins. The table shown in Fig. 3 summarizes the budget for systematic uncertainties. Detailed information on how the systematic uncertainty was determined was in Sec. 5 of Submission at PAC 38 of the original proposal [1]. The average statistical uncertainty on these separated SSAs is around $\sim 1.4 \times 10^{-2}$ (absolute) for the total 674 4-D bins. A detailed procedure on statistical uncertainty estimation is provided in Appendix B of Update at PAC 39 of [1].

Source (Type): NH_3 (E12-11-108)	Collins π^+	Collins π^-	Sivers π^+	Sivers π^-
Raw asymmetry (Abs.) / Detector resolution (Abs.)	6.5×10^{-3} / < 10^{-4}	6.5×10^{-3} / < 10^{-4}	6.5×10^{-3} / < 10^{-4}	6.5×10^{-3} / < 10^{-4}
Target polarization (Rel.)	3% + 0.5%	3% + 0.5%	3% + 0.5%	3% + 0.5%
Random coincidence (Rel.)	0.2%	0.2%	0.2%	0.2%
Dilution (Rel.)	5%	5%	5%	5%
Diffractive meson (Rel.)	3%	2%	3%	2%
Radiative corrections (Rel.)	2%	2%	3%	3%
Total (Abs.) / Total (Rel.)	6.5×10^{-3} / 6.9%	6.5×10^{-3} / 6.5%	6.5×10^{-3} / 7.2%	6.5×10^{-3} / 6.9%

Figure 3: The budget for the absolute and relative systematic uncertainties of the π^+/π^- Collins and Sivers SSAs under consideration. The proposed experiment will have excellent systematic uncertainty determination, with the fast spin flip of the target (≤ 20 mins for the ^{3}He target), the full (2π) coverage in the spin azimuthal angle and the large coverage in the hadron azimuthal angle. Additional reduction of the systematic uncertainties is possible, if the SSAs measured for both π^+ and π^- particles are combined for a flavor separation of u and d quarks.

For a typical z and Q^2 bin ($0.40 < z < 0.45$, 2 GeV^2 < Q^2 < 3 GeV^2), data projection examples for the Collins and Pretzelosity/Sivers SSAs are shown in Figs. 4 and Fig. 5. The center of each red projection point corresponds to the kinematic center of each x and P_T bin, and the error bar corresponds to the statistical uncertainty for each (x, P_T, z, Q^2) bin's asymmetry. The scale of the asymmetries and uncertainties is shown on the right-side axes of the figures. For the complete projections consisting of 674 data points, we refer to Sec. 2.24 of Update at PAC 39 of [1].

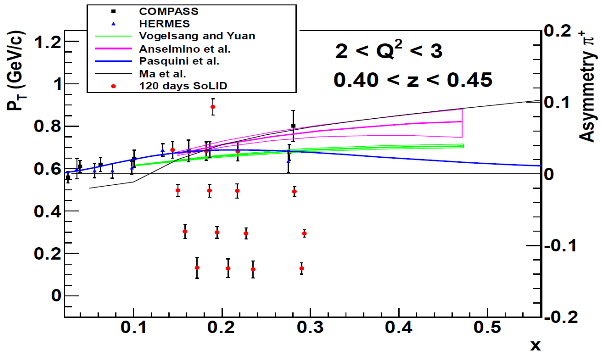

Figure 4: SoLID SIDIS projections in a typical z and Q^2 bin ($0.40 < z < 0.45$, $2\ \mathrm{GeV}^2 < Q^2 < 3\ \mathrm{GeV}^2$) for the π^+ Collins SSA measurements as a function of x, with different ranges of the hadron P_T labeled. The green curve is a theoretical prediction from Vogelsang and Yuan [5, 6], the magenta curve from Anselmino, *et. al.* [7], the blue curve from Pasquini, *et. al.* [8], and the gray curve from Ma and She [9].

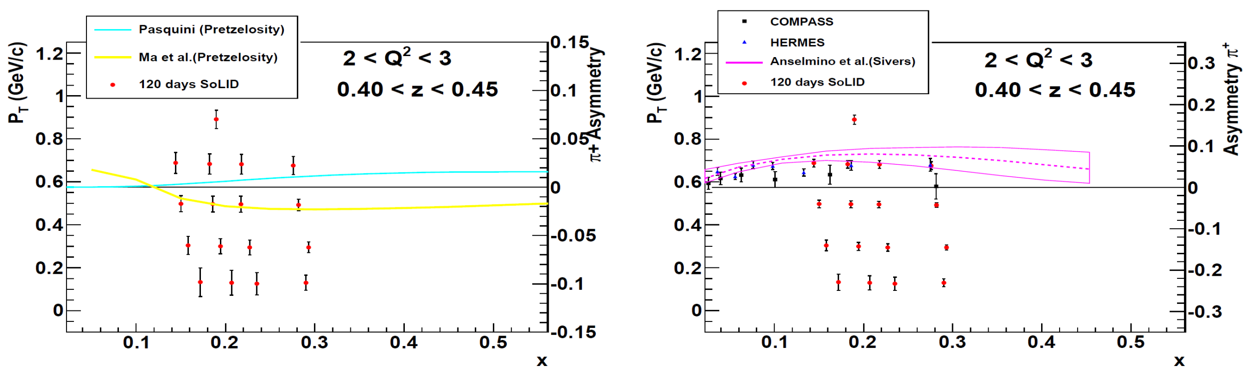

Figure 5: SoLID SIDIS projections in a typical z and Q^2 bin ($0.40 < z < 0.45$, $2\ \mathrm{GeV}^2 < Q^2 < 3\ \mathrm{GeV}^2$) for the π^+ Pretzelosity SSAs (left) and the π^+ Sivers SSA (right) measurements as a function of x, with different ranges of the hadron P_T labeled. In the left plot, the cyan curve is a theoretical prediction from Pasquini, *et. al.* [8], the yellow curve is from Ma, *et. al.* [10]. In the right plot, the magenta curves is a prediction from Anselmino, *et. al.* [11, 12].

In this section, we present some of the updated projections presented to the DOE science review committee in March 2021. The sample projected E12-11-108 SSA results are presented in 4-D for π^+ in Fig. 6 together with the EIC projections at a center-of-mass energy of 29 GeV for e-p collisions. The center of each projection point corresponds to the kinematic center of each x and Q^2 bin, and the error bar corresponds to the statistical uncertainty of the asymmetry for each (x, P_T, z, Q^2) bin. The scale of the asymmetries and uncertainties is shown on the right-side axes of the figure, similar to what is shown in Figs. 4 and 5. The complementarity between JLab SoLID and the EIC is clear, and projected results also highlight the precision of SoLID measurements.

The upper panel of the left plot in Fig. 7 presents the combined impact of E12-11-108 and E12-10-006 on the extracted Transversity TMDs for the u and d quarks based on the transversely polarized NH_3 and ^{3}He targets for the SoLID enhanced configuration, where the enhanced configuration is obtained when the SoLID baseline configuration is added by the Multigap Resistive Plate Chambers (MRPCs) giving better PID capabilities [3]. The enhanced configuration is the proposed configuration in the original PAC approved experiments (E12-10-006, E12-11-007 and E12-11-108). The projected SoLID impact is shown by dark bands, while the current knowledge ("World") from a global analysis is shown as light colors for both the u (red) and the d quark (blue). The "World" represents all available SIDIS data from the COMPASS, HERMES experiments, JLab 6-GeV measurements, as well as e^+e^- annihilation data from the BELLE, BABAR, and BESIII experiments. The lower panel shows the improvements, manifested as the ratios between the uncertainties of the current world data and the SoLID projected uncertainties. All the results are plotted at a typical

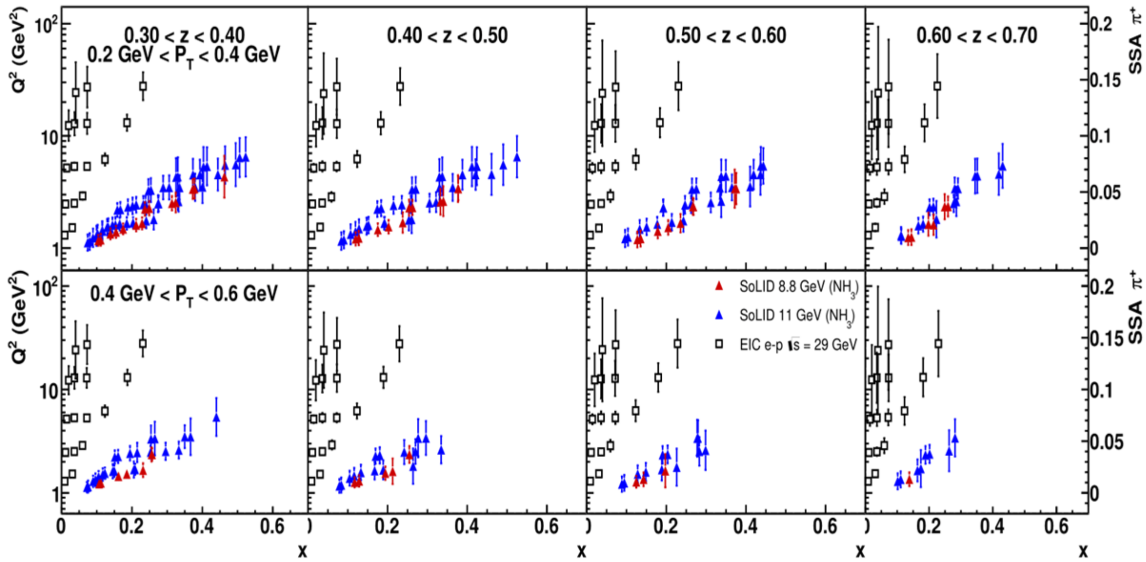

Figure 6: SoLID SIDIS projections of the π^+ SSA A_{UT} in various 4-D (x, P_T, z, Q^2) bins (shown in the figure) from the trans.-pol. NH_3 target. Also shown are projections at EIC kinematics with 29 GeV center-of-mass energy. The scale of the SSA and uncertainties is shown on the right-side axes of the figure. All the plots show how well both SoLID and EIC projections are synergistic towards each other, by covering different x and Q^2 ranges.

JLab12 scale $Q^2 = 2.4$ GeV^2, including both systematic and statistical uncertainties. The x-range between the two vertical dashed lines is directly measurable by SoLID. Similarly, the projected SoLID impact from both E12-11-108 and E12-10-006 on Sivers TMDs for the u and d quarks is shown in the right plot of Fig. 7. The impact on the quark tensor charge determination from combined E12-11-108 and E12-10-006 including systematic uncertainties compared with that from a global fit of existing World data is shown in Fig 8. The corresponding tensor charge numbers are provided as $g^u_{T,\text{world}} = 0.548 \pm 0.112$, $g^d_{T,\text{world}} = -0.382 \pm 0.177$, $g^u_{T,\text{enhan.}} = 0.547 \pm 0.021$, $g^d_{T,\text{enhan.}} = -0.376 \pm 0.014$. Significant improvement will be achieved, especially in the case of the d quark utilizing transversely polarized NH_3 and ^{3}He targets. They represent less than 4% relative uncertainty for the SoLID extraction of the u and d quark tensor charge, and should be compared to the 2019 FLAG review [13] of the Lattice QCD calculations where the corresponding numbers are 4% and 7% for u and d quark, respectively. Therefore, these results will provide a benchmark test of precise LQCD calculations.

Quark tensor charges are also directly connected to quark electric dipole moments (EDM), and as such they are also connected to nucleon EDMs. The precise determination of the tensor charge from the SoLID SIDIS program when combined with the next generation of the nucleon electric dipole moment (EDM) searches will provide constraints on quark EDMs, and consequently will render an opportunity to search for new physics [14] beyond the Standard Model.

Fig. 9 demonstrates another update, which shows the ratio of the Transversity error to its central value for u, d, and $u - d$ as a function of x, as well as the ratio of the error of the Collins structure function to its central value as a function of Q^2 for the "proton" (NH_3) and "neutron" (^{3}He) targets. The studies of [15] show that SoLID will provide precision measurements of transversity in a kinematic region complementary to EIC.

We also show an update on the study of the Pretzelosity TMD distribution which are related

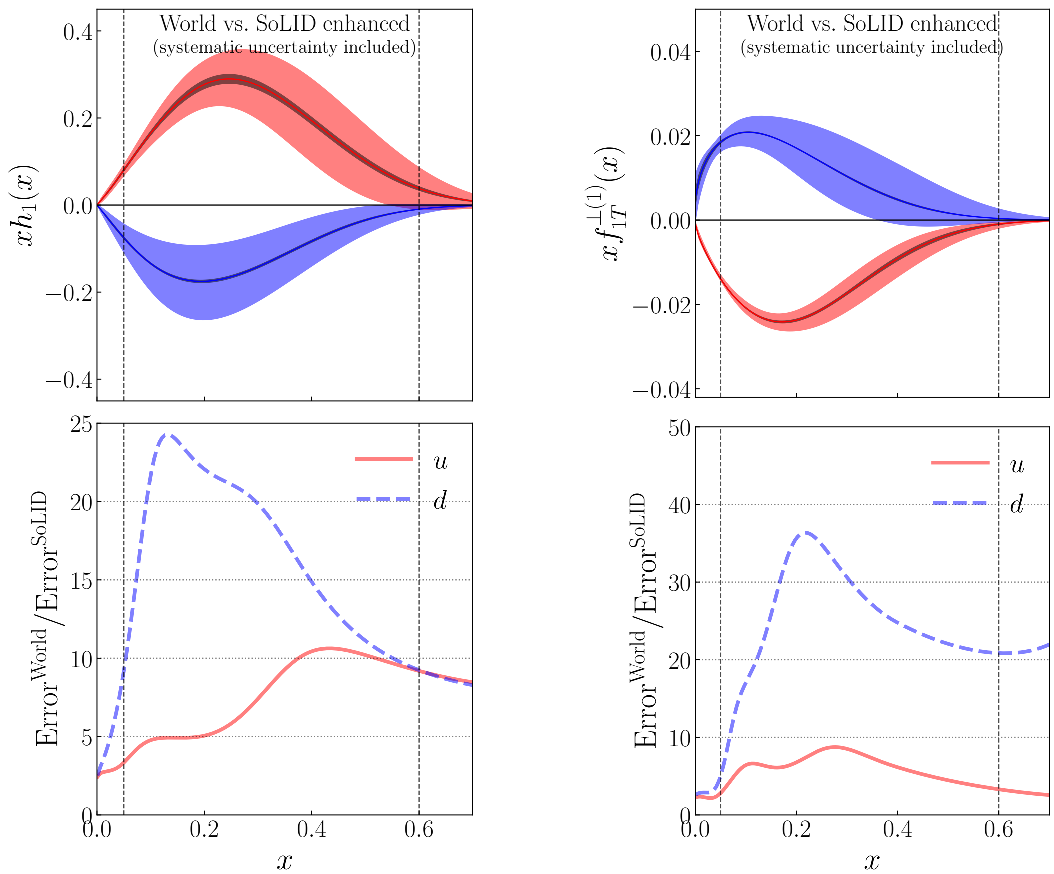

Figure 7: (Left panel) SoLID impact on the u and d quarks' Transversity TMD extractions from the combined SoLID experiments E12-11-108 and E12-10-006 compared with the World data (see text for details). (Right panel) SoLID impact on the u and d quarks' Sivers TMD extractions, again from the combined E12-11-108 and E12-10-006, compared with the World data. The SoLID projections are obtained at the scale $Q^2 = 2.4$ GeV^2.

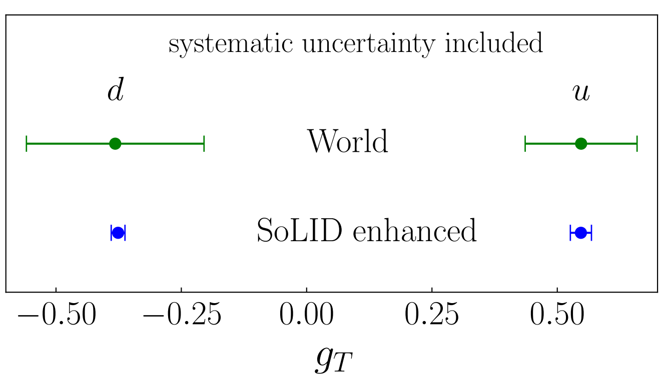

Figure 8: The impact on the quark tensor charge from the combined SoLID experiments E12-11-108 and E12-10-006 compared with the World data. The SolID points are obtained at the scale $Q^2 = 2.4$ GeV^2.

to the quark OAM. The first extraction of the Pretzelosity TMD distribution has been carried out from preliminary COMPASS, HERMES, and JLab experimental data as of 2015, based on

$$\mathcal{L}_z^q = -\int dx\, d^2\mathbf{k}_\perp \frac{\mathbf{k}_\perp^2}{2M^2} h_{1T}^{\perp q}(x, \mathbf{k}_\perp^2) = -\int dx\, h_{1T}^{\perp(1)q}(x). \tag{3}$$

Fig. 10 shows the comparison of the $\mathcal{L}_z^q$ extractions by Lefky and Prokudin with the SoLID pro-

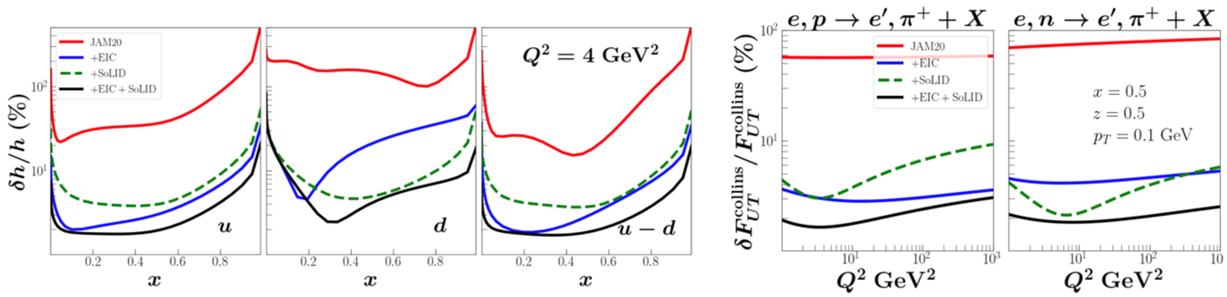

Figure 9: Several results from [15, 16]. (i) Left three plots: the ratio of the error of Transversity to its central value for u, d, and $u-d$ as a function of x at $Q^2 = 4$ GeV^2 for JAM20 [17] (red line), JAM20+EIC projection data (blue line), JAM20+SoLID projection data (green dashed line), and JAM20+EIC+SoLID projection data (black line). (ii) Right two plots: The ratio of the error of the Collins structure function to its central value as a function of Q^2 for the "proton" and "neutron" targets.

jections obtained from transversely polarized "proton" and "neutron" targets. The SoLID impact is very significant.

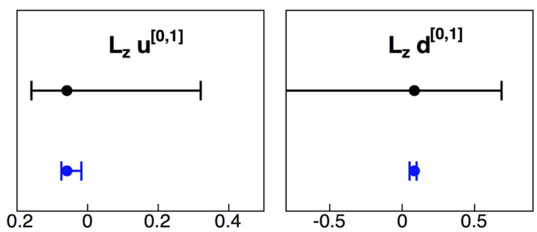

Figure 10: The relation of the Pretzelosity TMD distribution to the OAM of quarks. The top black points are the results obtained by Lefky and Prokudin [18], by integrating Eq. (3) over the entire kinematic region of $0 < x < 1$. The bottom blue points are the SoLID projections obtained based on using NH_3 and ^{3}He targets. All the results are produced at the scale $Q^2 = 2.4$ GeV^2.

4 Run group experiment on SIDIS Kaon: E12-11-108B

(**Spokespersons:** Tianbo Liu, Sanghwa Park, Yi Wang, Zhihong Ye (contact), Zhiwen Zhao)

This run-group addition, measuring the kaon-SIDIS with polarized proton targets, was part of the run-group proposal [19] which also include the kaon-SIDIS measurement with polarized ^{3}He. High quality kaon-SIDIS data are not only important for the extraction of the valance-quark TMDs in a combined global analysis with pion-SIDIS data, but also provide crucial information about the contribution from sea-quarks. Early measurements from HERMES [20], COMPASS [21] and JLab Hall A collaborations [22] provided very limited kaon-SIDIS data with poor precision. There are only two other planned experiments at JLab that could provide kaon-SIDIS data, including E12-09-018 approved to run on SBS using a transverse polarized ^{3}He target [23] and C12-11-111 [24] conditionally approved to run on CLAS12 using a HDice (proton) target. With this approved kaon-SIDIS run-group proposal, the SoLID SIDIS program will provide a complete data with both pion and kaon SIDIS events measured systematically from polarized proton and ^{3}He target which are essential for the flavor-separation of light-quark TMDs with great precision.

The measurement does not require any additional beam-time or detector modification, but expect a new 30 ps MRPC detector included in the enhanced SIDIS configuration. We will apply the same offline data analysis strategy to identify kaon-events from the E12-11-108 data using the combination of the HGC veto-signal and the TOF information from the 30 ps time-resolution MRPC. Fig. 11 shows one of the projection results that reveals high-quality kaon asymmetries can be obtained from the parallel data-analysis.

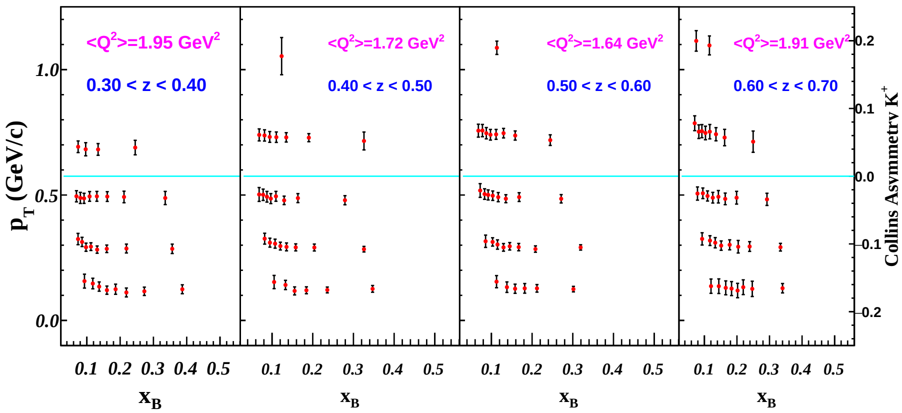

Figure 11: The 4D (Q^2, z, p_T, x_B) binning projection and statistical uncertainties of the Collins asymmetry ($A_{UT}^{sin(\phi+\phi_S)}$) in $\vec{n}(e, e'K^+)$X after combining the 11 GeV and 8.8 GeV simulation data with transversely polarized NH3 (proton) target on SoLID. The sizes of the uncertainties are indicated by the Y axis on the right. See the original proposal for similar projections on Collins and Sivers asymmetries in $\vec{p}(e, e'K^\pm)$X

5 Run group experiment A_y: E12-11-108A

(**Spokespersons:** Todd Averett (contact), Alexandre Camsonne, Nilanga Liyanage)

The single spin asymmetry, A_{UT}, will be obtained by scattering unpolarized electrons from a transversely polarized proton (NH_3) target in the DIS. This experiment will run in parallel with the SIDIS experiment above by collecting singles electron triggers. As the precision of nucleon structure measurements improves, it is important to understand the dynamics of the two-photon exchange (TPEX) process. This first became clear in measurements of the proton form factor ratio, $\mu_p G_E^p/G_M^p$ as a function of Q^2 at Jefferson Lab [25]. In the experiment described here, the asymmetry is identically zero at Born level, but can be non-zero when two photons are exchanged [26] and thus provides a clean opportunity to study this important process.

Consider the inelastic scattering of an unpolarized electron from a target nucleon with vector spin $\vec{S}$, oriented perpendicular (transversely polarized) to the incident electron 3-momentum $\vec{l}$, with normalization $|\vec{S}| = 1$. Requiring conservation of the electromagnetic current and parity, the differential cross section, $d\sigma$, for inclusive scattering is written as [26–28]

$$d\sigma(\phi_S) = d\sigma_{UU} + \frac{\vec{S} \cdot (\vec{l} \times \vec{l'})}{|\vec{l} \times \vec{l'}|} d\sigma_{UT} = d\sigma_{UU} + d\sigma_{UT} \sin\phi_S, \tag{4}$$

where $\vec{l'}$ is the 3-momentum of the scattered electron, the angle ϕ_S is measured between the lepton plane and $\vec{S}$, and $d\sigma_{UU}$ and $d\sigma_{UT}$ are the cross sections for an unpolarized electron scattered from an unpolarized and transversely polarized target, respectively. We define the SSA as

$$A_{UT}(\phi_S) = \frac{d\sigma(\phi_S) - d\sigma(\phi_S + \pi)}{d\sigma(\phi_S) + d\sigma(\phi_S + \pi)} = A_y \sin\phi_S. \tag{5}$$

The quantity $A_y \equiv \frac{d\sigma_{UT}}{d\sigma_{UU}}$ can be extracted by measuring the ϕ_S-dependence of $A_{UT}(\phi_S)$.

A_{UT} is proportional to the imaginary part of the interference of the 1- and 2-photon exchange amplitudes. Time-reversal invariance requires the one-photon-exchange amplitude must be real and thus $d\sigma_{UT}$ must be zero. When one includes the (complex) two-photon-exchange amplitude the contribution, the asymmetry can be non-zero. The TPEX diagram forms a loop with the nucleon intermediate state that contains the full response of the nucleon. It must be modeled using e.g. parton-model predictions in the DIS. Predictions range from 10^{-4} to 10^{-2} with a positive or negative sign depending on model input and target nucleon.

In this experiment we will measure A_y with statistical uncertainties of $\sim 10^{-4}$ at $Q^2 = 1.5$ GeV^2 up to $\sim 10^{-3}$ at $Q^2 = 7.5$ GeV^2 with $W > 2$ GeV and $0.05 < x < 0.65$, a factor of up to 100 improvement over previous measurement at HERMES. See Fig. 12.

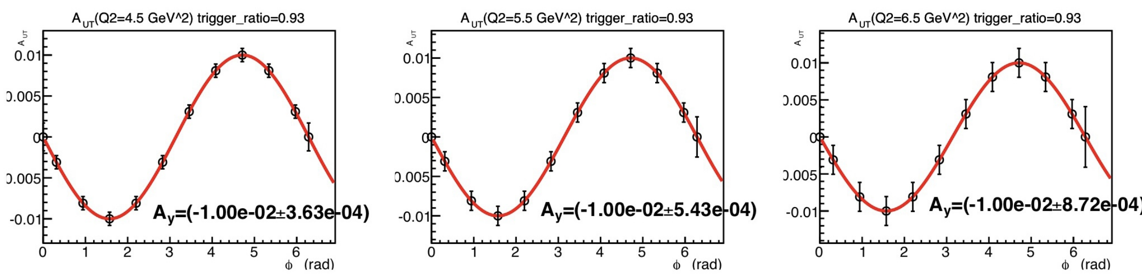

Figure 12: Expected uncertainties in A_{UT} vs. ϕ_S at different Q^2 at 11 GeV for the NH_3 target. For each plot, the data over all values of x was combined. An arbitrary amplitude of 10^{-2} was chosen for the asymmetry.

6 Summary

With SoLID SIDIS experiment E12-11-108, precision data in 4-D kinematic bins will be obtained on the Collins, Pretzelosity, and Sivers SSAs for the proton using a transversely polarized NH_3 target through azimuthal angular dependence, allowing for access of transversity, Sivers and Pretzelocity TMDs, uncovering orbital angular motion of the quarks inside in the nucleon, and the rich QCD dynamics. The data from this experiment, when combined with data from the "neutron" Collins asymmetry measurements (in the SIDIS experiment E12-10-006) and more precise data on the Collins fragmentation from upcoming e^+e^- collision experiments, will allow for a significantly improved flavor separation of the Transversity and quark tensor charge. These quark tensor charges will directly confront the Lattice QCD predictions. The run group experiments will significantly enhance the broad impact in QCD physics related to the structure of the nucleon.

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