

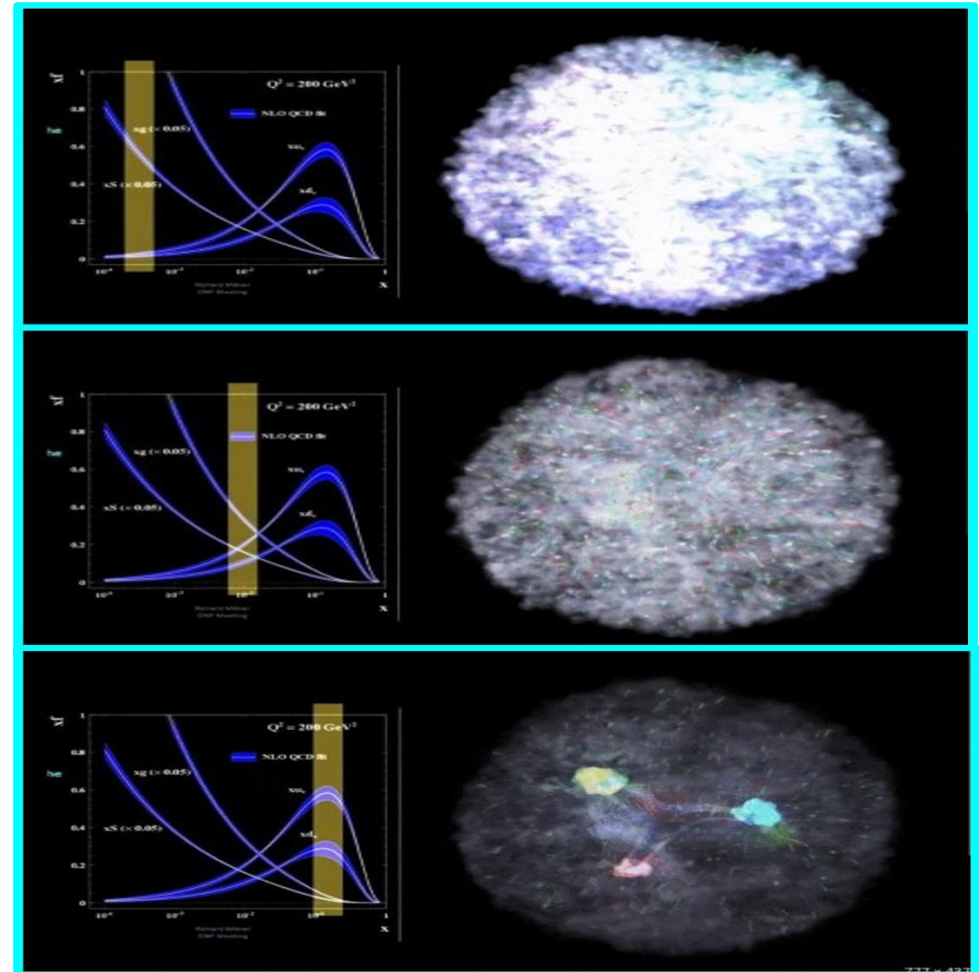
Welcome to the Workshop on the Physics Program with High Luminosity Facilities

Chairpersons :

Jian-ping Chen (JLab)

Mark Jones (JLab)

Stepan Stepanyan (JLab)



Community Standards

Community Standards

Everyone at Jefferson Lab has a responsibility to foster an environment where all employees, users, students, guests, visitors and subcontractors feel welcome and supported in advancing the lab's mission.

We'd like to take a moment to familiarize you with our Community Standards. Jefferson Lab actively promotes a harassment-free experience for all.

Everyone is expected to model professionalism and respectful behavior at all times. Failure to adhere to these Community Standards may result in being barred from further lab events; suspension of site access, including housing at the SURA residence facility; and/or removal from the site.

While it is not possible to provide a complete list of the types of improper behavior below, prohibited conduct includes, but is not limited to:

- *Obscene or abusive language*
- *Bullying or deliberate intimidation*
- *Disrespectful or offensive comments/gestures*
- *Displaying or circulating sexually suggestive materials*
- *Inappropriate physical contact*
- *Stalking/following*
- *Unwelcome sexual attention or advances*
- *Violating security or environment, safety and health rules*

If you or someone else feels uncomfortable in the workplace, or if you believe you have been subjected to a hostile or harassing environment or have any related concerns, please contact the Jefferson Lab Ethics Officer, Rhonda Scales, immediately at scales@jlab.org or via Jefferson Lab's Ethics Hotline at jsaecp.ethicspoint.com. Alternately, you may contact your sponsor.



Workshop Organized by physics topics

- Thanks to conveners for arranging speakers on the short time scale
- Three 1.5 hour sessions per topic with joint sessions for Charmonium/GPD and GPD/TMD
- Have time (5-10 minutes) after each talk for discussion
- Each topic will have dedicated 30 minute discussion period
- Friday morning, conveners present summary talk and led discussion for white paper

Charmonium Working Group Conveners:

Sylvester Joosten (ANL)
Pierre Chatagnon (CEA Saclay)
Yuxun Guo (BNL)

TMD Working Group Conveners:

Haiyan Gao (Duke U)
Harut Avagyan (JLab)
Vladimir Khachatryan (MSSU)

GPD Working Group Conveners:

Garth Huber (Regina U)
Volker Burkert (JLab)
Zhiwen Zhao (Duke U)

BSM Working Group Conveners:

Xiaochao Zheng (UVA)
Rafayel Paremuzyan (JLab)
Ciprian Gal (JLab)

Goal of the workshop

- Determine the physics goals that can be achieved with high luminosity and high acceptance detectors.
- The workshop will highlight the scientific opportunities at the luminosity frontier, with a particular focus on the key physics programs enabled by the proposed upgrades to Halls.
- Dedicated time for discussion
- Coherent program in all halls that maximizes the physics results that are produced at Jefferson Lab.
- Emphasize the combined EIC and high luminosity JLab program will lead to new insights into hadron structure.
- The outcome of the workshop will be summarized in a white paper
 - ❖ Will serve as input to Jefferson Lab and the nuclear physics community for future planning in maximizing scientific achievements.
 - ❖ For example, CEBAF ADL Fernanda Garcia is in charge of developing the *“JLab 2037 plan”*.

Review of Hall upgrades in luminosity and acceptance at JLab

- **Hall A**

- ❖ Future Large acceptance spectrometer using the CLEO magnet to reach 10^{37} luminosity
 - Given present DOE budget realities, a SoLID CD0 is not possible at this time.
 - Need to focus on modifications to the CLEO magnet with detectors which can be funded through CEBAF operations and capitol.
- ❖ BigBite and SuperBigBite spectrometers.
 - Successful nucleon electric and magnetic elastic form factor measurements.
 - PAC approved, A rated, polarized ^3He SIDIS experiment using the BigBite and SuperBigBite spectrometers.
 - Other experiments possible with existing and modified BigBite and SuperBigBite spectrometers.

- **Hall B**

- Improvement in the luminosity reach of CLAS12 using AI for tracking and denoising in drift chambers
- Upgrade plan for CLAS12 with μRwell MPGD to reach 2×10^{35} luminosity
- Major configuration change to construct μCLAS12 to reach 10^{37} luminosity

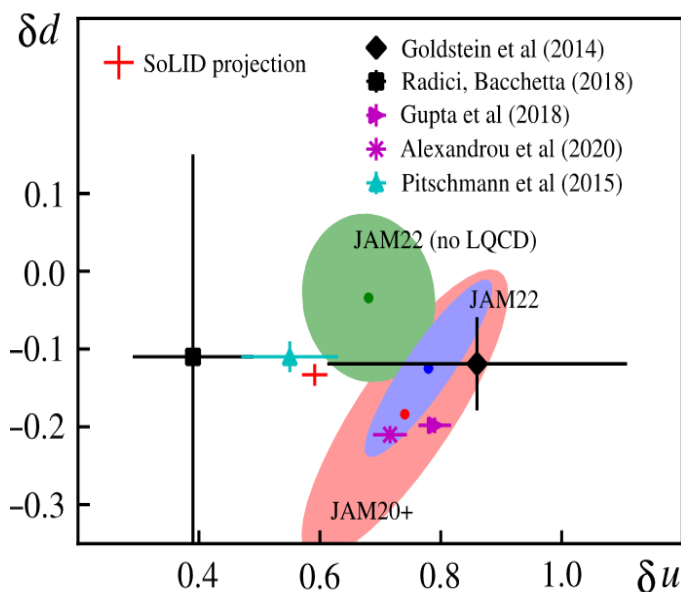
- **Hall C**

- Neutral Particle spectrometer with Calorimeter performed successfully in combination with HMS
 - Measure proton and neutron DVCS and π^0 SIDIS cross sections with high precision.

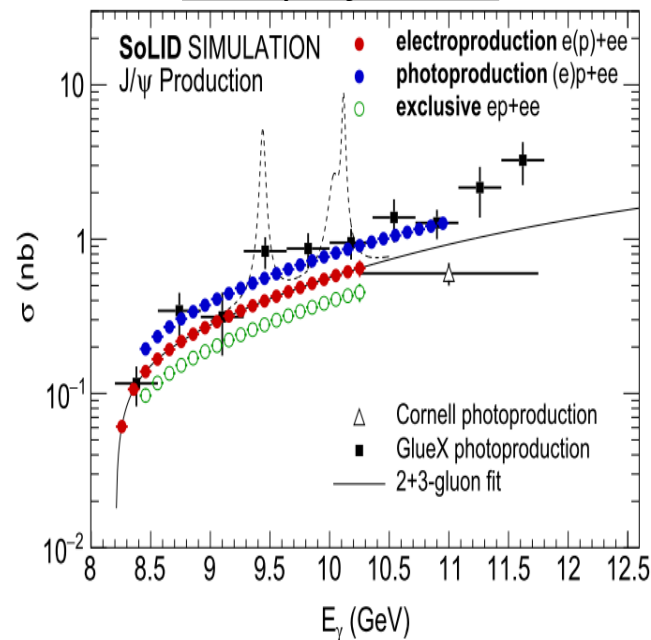
SoLID Physics

- SoLID has a diverse and deep physics program with 6 experiments approved by PAC with high rating (5 A, 1 A-)
 - 3 SIDIS (3d structure), 1 PVDIS (search for new physics),
 - 1 threshold J/ψ (gluon force), 1 A_γ^n (new phenomena)
 - In addition:
 - 1 conditional approval + 6 run-group experiments (3d/spin structure)
- Strong collaboration with 270+ members , 70+ institutions from 13 countries. **Want to keep this collaboration going.**
- For workshop,
 - determine the physics measurements possible with a reduced version of SoLID.

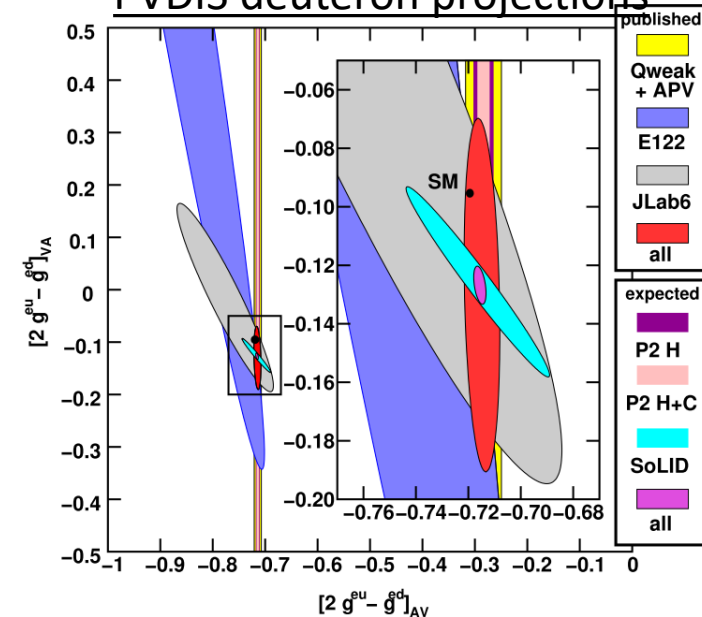
SIDIS projections for tensor charge



J/Psi projections



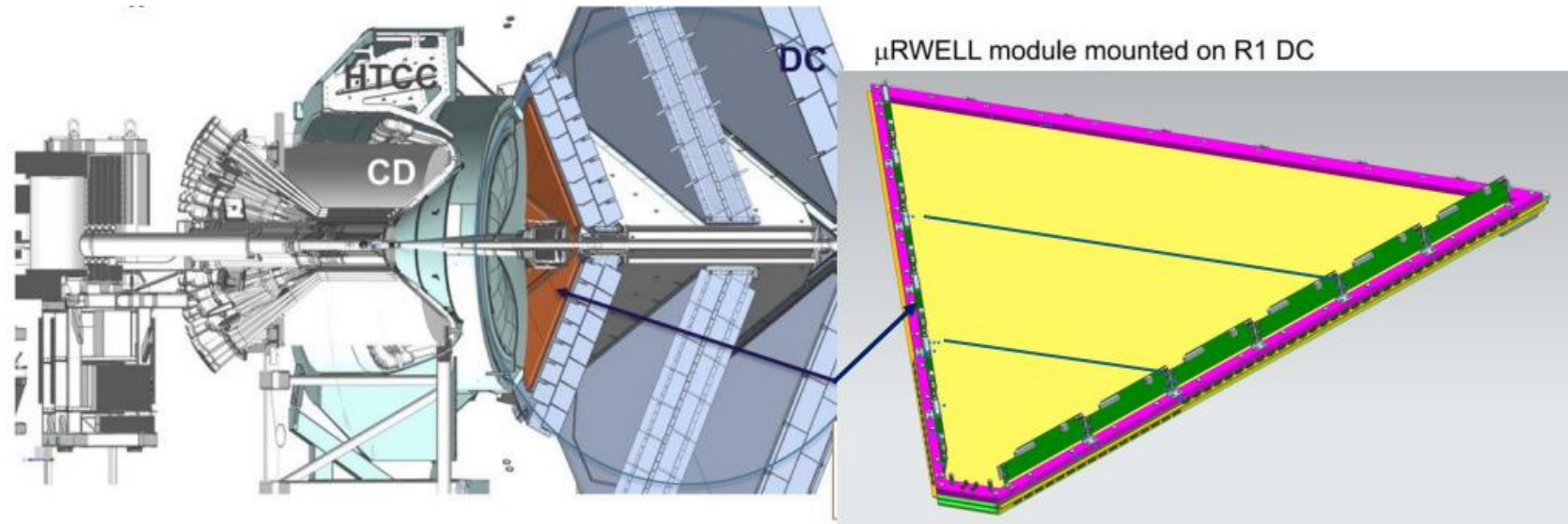
PVDIS deuteron projections



Hall B luminosity upgrades

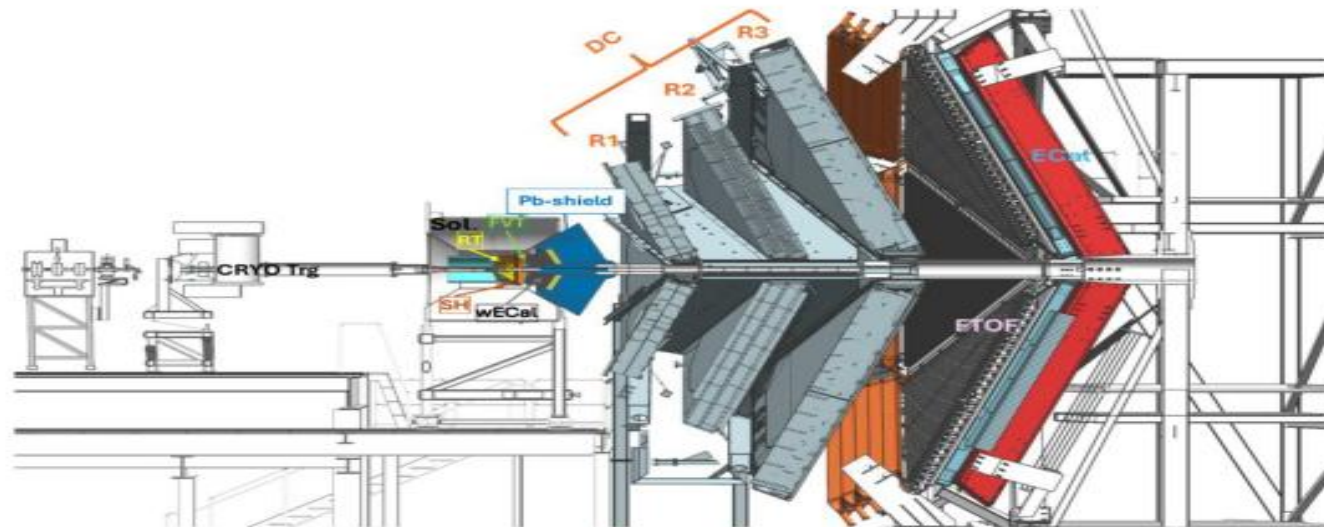
Upgrade with uRwell will allow
improvement to $2 \times 10^{35} \text{ cm}^{-2} \text{ sec}^{-1}$

Gain for all types of physics:
GPD, TMD, J/psi



Configuration change to μ CLAS12 with removal of HTCC, add 60cm lead shielding, etc will allow improvement to $10^{37} \text{ cm}^{-2}\text{sec}^{-1}$

Focus of physics with the detection of muons for DDVCS, Time-like Compton Scattering and J/psi. PAC approved , A rated experiment



TMDs and GPDS

- For TMDs, high precision cross sections with binning in x, Q^2, P_T and Z with SoLID at luminosity of $10^{37} \text{ cm}^{-2}\text{sec}^{-1}$

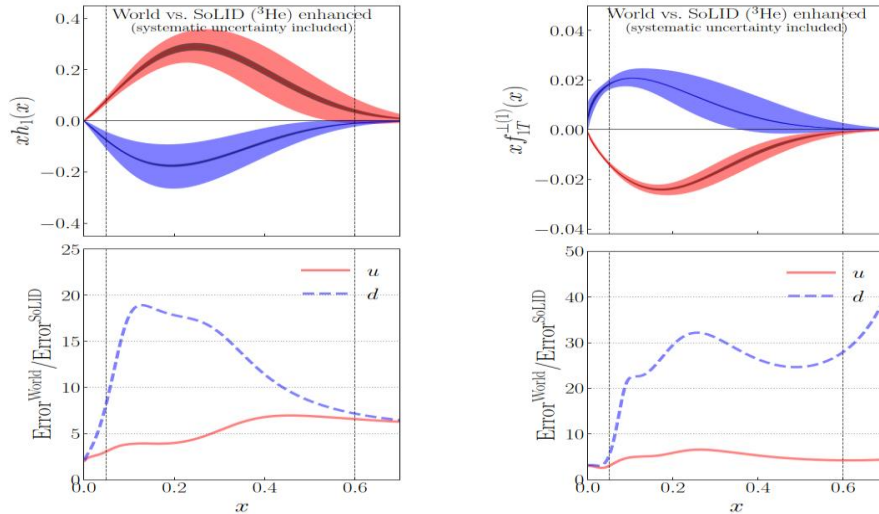
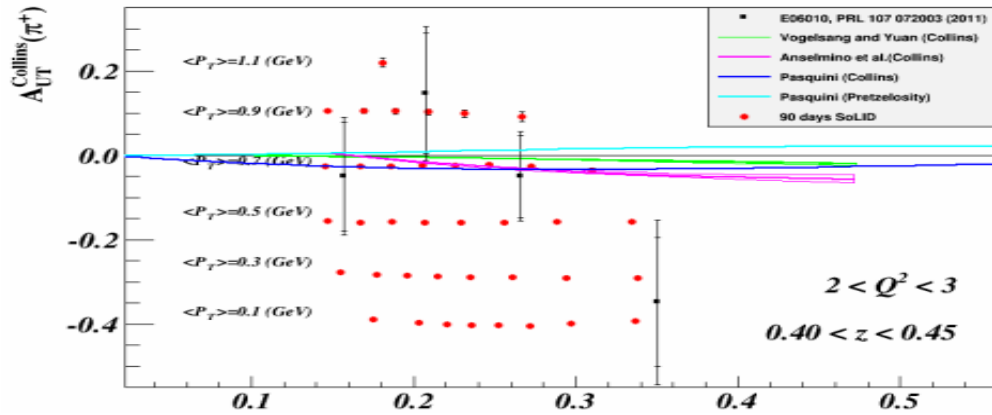


Figure 3: (Left panel) SoLID impact on the u and d quarks' Transversity TMD extractions from the SoLID experiment E12-10-006 compared with the world data (see text for details). (Right panel) SoLID impact on the u and d quarks' Sivers TMD extractions compared with the world data. The SoLID projections are obtained at the scale $Q^2 = 2.4 \text{ GeV}^2$.

- GPDs with DDVCS and TCS using μCLAS and μSoLID

BSA predictions with μCLAS

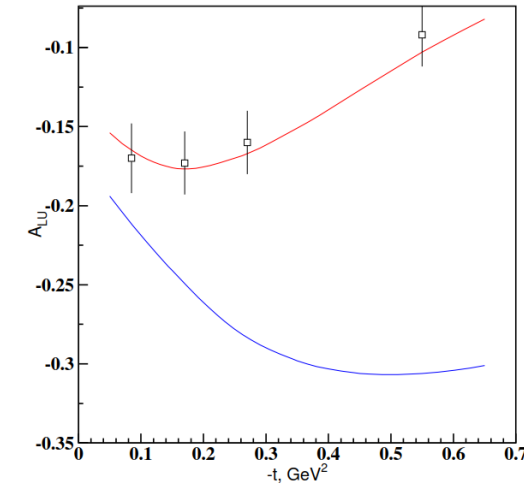
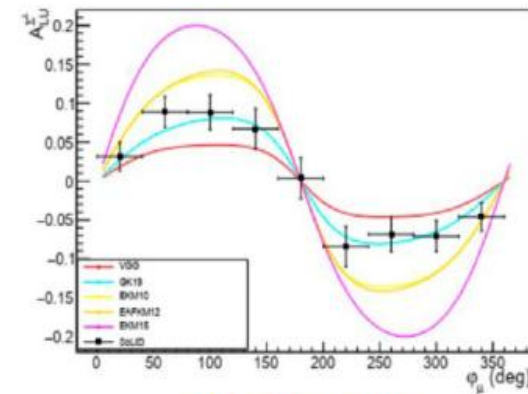


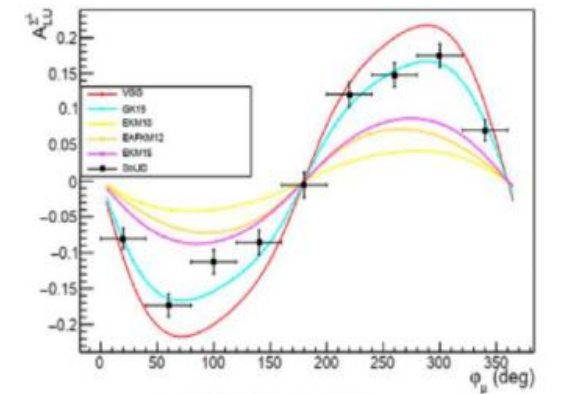
Fig. 25: Projected DDVCS A_{LU} as a function of $-t$. The extracted asymmetries from 1000 pseudo-experiments are shown by the black points. The RMS of the extracted asymmetries is taken as the uncertainty on the measurement. The red and blue lines correspond to predictions from the VGG and the GK19 models, respectively.

Eur. Phys. J. A 62, 157 (2026)

BSA predictions with μSoLID



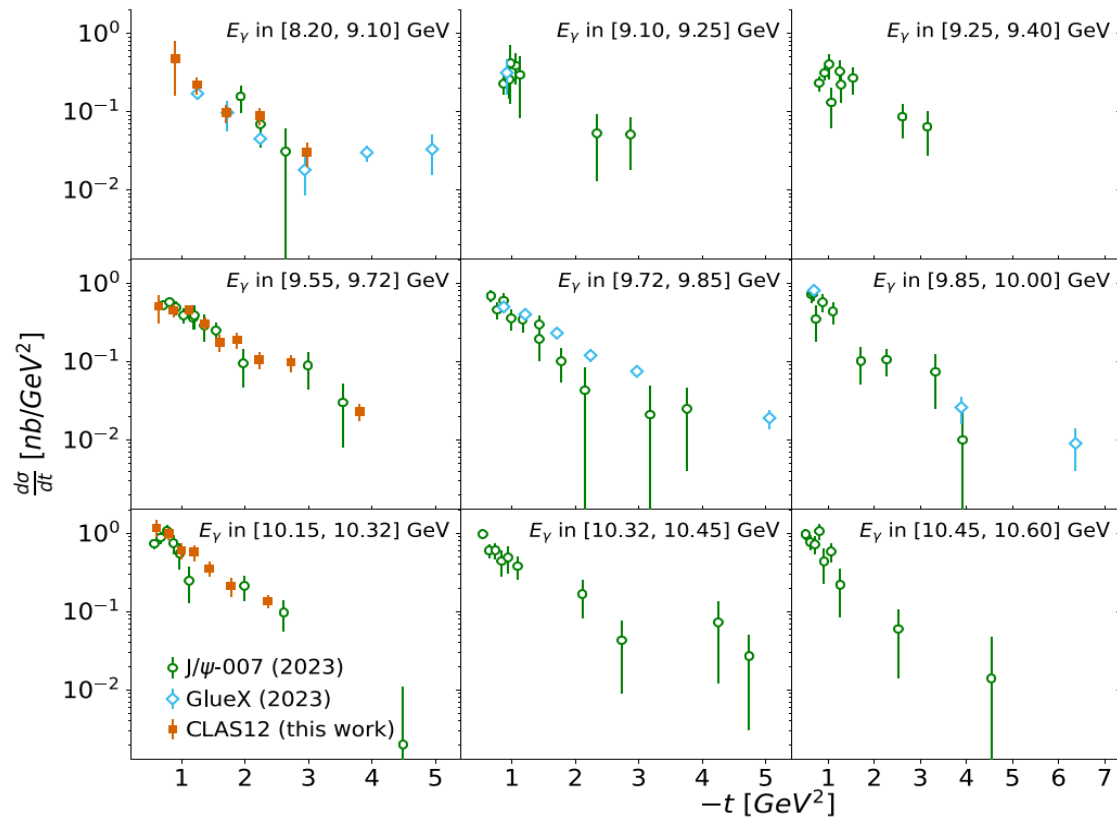
DVCS-like region



TCS-like region

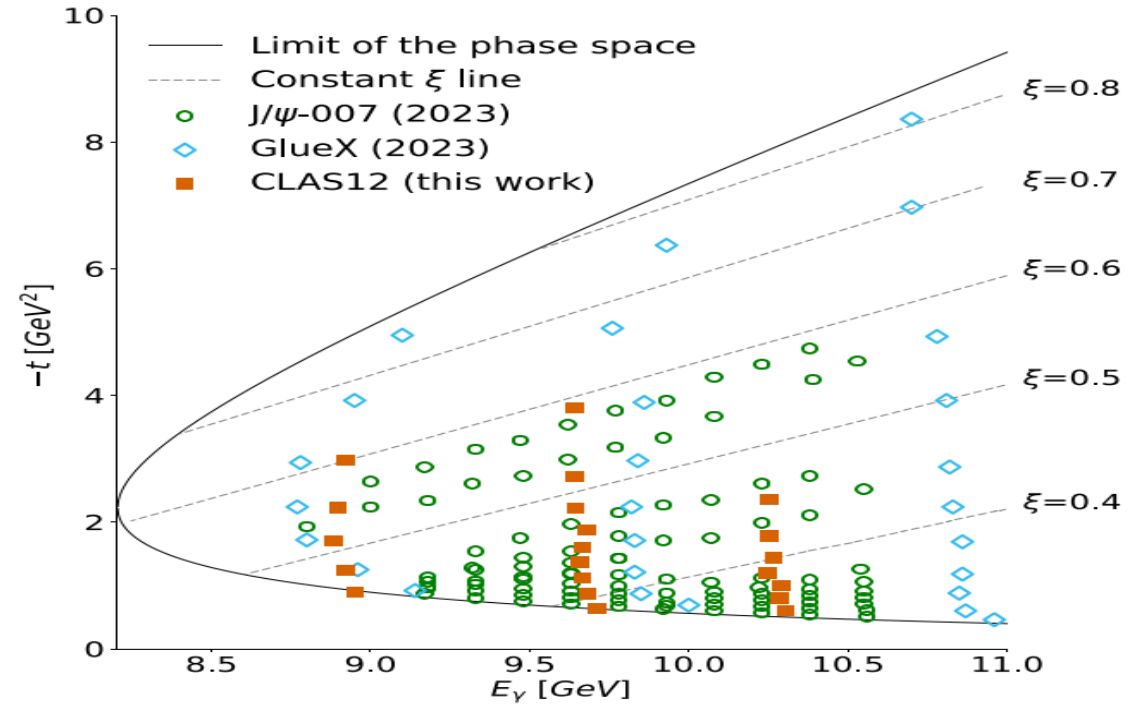
J/psi production at Jefferson Lab

- Need high luminosity, large acceptance to measure the cross section as function of t and E_γ .
- Measurements with GlueX, CLAS12 and SHMS/HMS
- Comparisons to a wide variety of theoretical approaches.
Need to understand the mechanism at threshold.

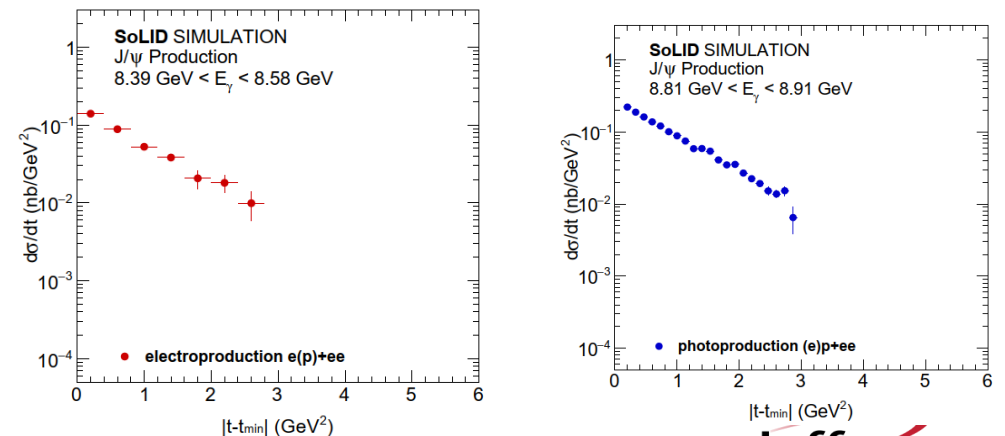


P. Chatagnon, et al. (CLAS Collaboration) Phys. Rev. C 113, 065203 (2026).

P. Chatagnon, et al. (CLAS Collaboration) Phys. Rev. C 113, 065203 (2026).



Selection of proposed SoLID J/psi measurements



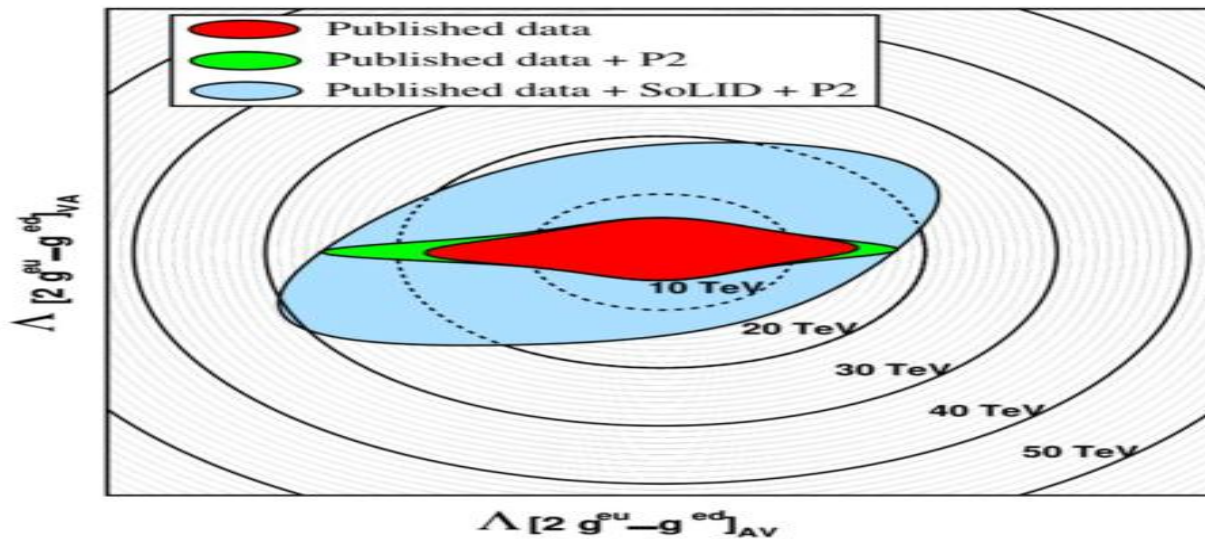
Jefferson Lab

Physics beyond the standard model

- Measurement of PVDIS on the deuteron was one of the primary motivations for SoLID.

➤ Need to reach $10^{39} \text{ cm}^{-2}\text{sec}^{-1}$

Improved energy reach for eq couplings



- Additional avenues to search for physics beyond the standard model
 - Charged Lepton Flavor Violation (CLFV)
 - Lepton Number Violating ($A(e^-,e^+)X$) in lepton double charge exchange

Thursday afternoon session to recognize the 50 year career of Paul Souder



Mr. Lou Buda, Prof. Paul Souder, and Mr. Charles Brown working on final assembly of the Møller and ep detectors for experiment E-158 at the Stanford Linear Accelerator.

Specials events

- On Wednesday starting at 6:00, join us for an informal Workshop gathering at Chef's Market Food Hall & Entertainment Venue, offering a variety of food options as well as games and entertainment in an informal setting.
- Eric Brown, Deputy Lab Director for Science & Technology and the Chief Research Officer, will come to the workshop from 1:45-2pm on Thursday to introduce himself and answer questions.
- Special session on Thursday from 4-5:30 to recognize the outstanding career of Paul Souder.

Summary

- Have three 1.5 hours sessions on GPD, TMD, Charmonium and BSM with discussion sessions.
- On Friday morning , the conveners for each topic present summary and then discussions to prepare for White Paper.
- Primary goal of the workshop is to write a White Paper which highlights the scientific opportunities at the luminosity frontier, with a particular focus on the key physics programs enabled by the proposed upgrades to Halls. What are the key areas for potential discovery in QCD and BSM science.
- White Paper will serve as input to Jefferson Lab and the nuclear physics community for future planning in maximizing scientific achievements.
- Emphasis on interaction between gains in physics knowledge from EIC and high luminosity JLab experiments which cover separate kinematic regions.
- How does the JLab high intensity program fit into the global science program for understanding QCD and the search for BSM physics?

SoLID SIDIS projections of the π^+ SSA A_{UT} in various 4-D (x, P_T, z, Q^2) bins (shown in the figure)

