

PAC47 – Hall C



Hall C Publications + students

Measurements of Non-Singlet Moments of the Nucleon SF and Comparison to ... LQCD for $Q^2=4 \text{ GeV}^2$

Phys. Rev. Lett 123, 022501 (2019) (I. Albayrak et al.)

Revealing Color Forces with Transverse Polarized Electron Scattering (SANE)

Phys. Rev. Lett. 122, 022002 (2019) (W. Armstrong et al.)

Technical Supplement to “Polarization Transfer Observables ...” (GEP-III, GEP-2 γ)

Nucl Inst Meth A 910, 54 (2018) (A.J.R. Puckett et al.)

Experimental techniques and performance of Λ -hypernuclear spectroscopy (HKS)

Nucl Inst Meth A 900, 69 (2018) (T. Gogami et al.)

Determination of the Proton’s Weak Charge and its Constraints on the Standard Model

Annual Review of Nuclear and Particle Science – 2019 (Carlini, W. van Oers, M. Pitt, and G. Smith)

Drafts

Backward ω production, -t dependence of exclusive π^+ electroproduction – from 6 GeV F π data

Testing the Standard Model at the Precision Frontier with the Qweak Experiment

(To be submitted to *Nuclear Physics News International*)

Qweak ancillary measurements: Inelastic PV ep scattering, ^{27}Al Neutron Distribution radius, Beam normal spin asymmetries on ^{27}Al and the proton

Graduated Students: Kurtis Bartlett, James Dowd, Sheren Alsalmi

Hall C – 2019

Spring 2019

E12-16-007 LHCb charmed pentaquark via J/ψ production

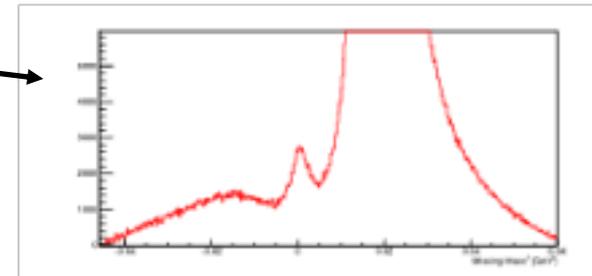
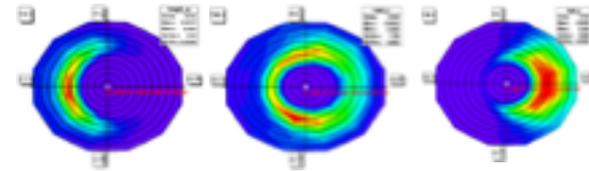
E12-09-002 Completed SIDIS-CSV

E12-09-011 (e,e'K) Completed data need for L/T separations

Now

E12-06-101/E12-07-105 Short low energy run for pion form factor + exclusive pi production scaling

E12-15-001 Generalized polarizabilities of the proton in VCS $p(e,e'p)\gamma$



Late 2019-Early 2020

E12-06-110 $A1n$

E12-06-121 $g2n/d2n$

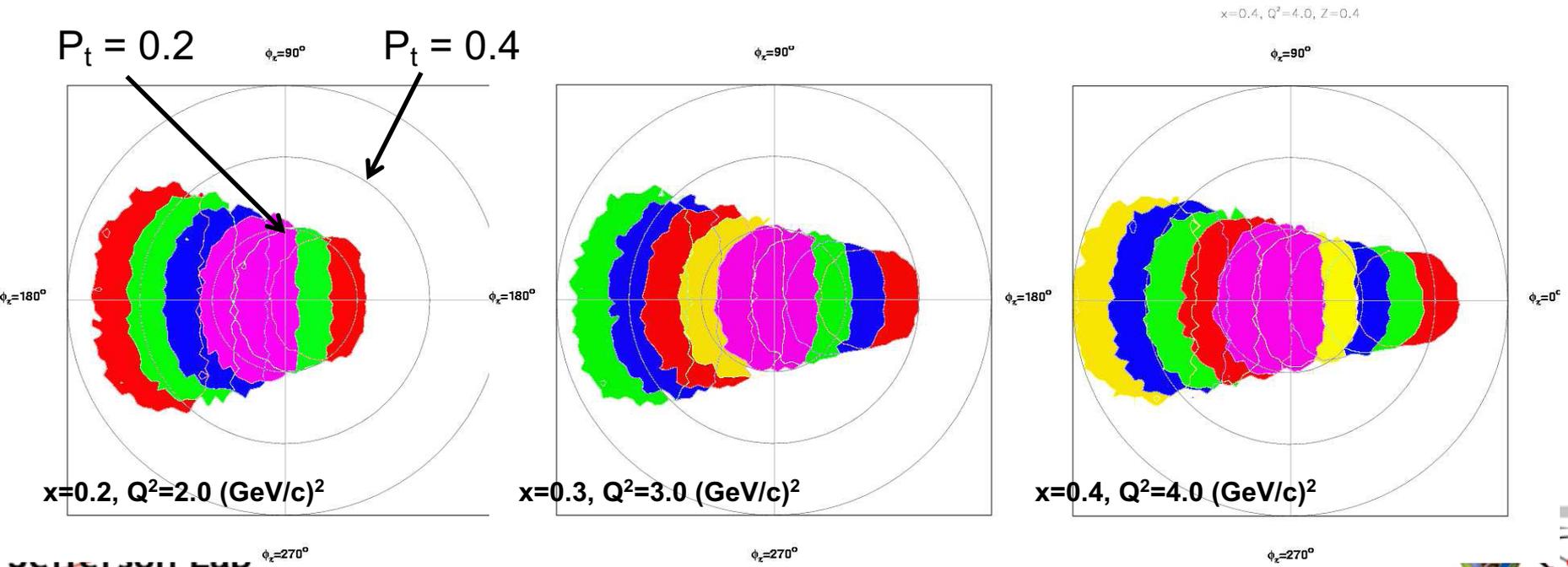
Map transverse momentum dependence of $(e, e'\pi)$ over range:

$$0.2 < x < 0.5, 2 < Q^2 < 5 \text{ GeV}^2, 0.3 < z < 0.5 \text{ and } P_t < 0.5 \text{ GeV}$$

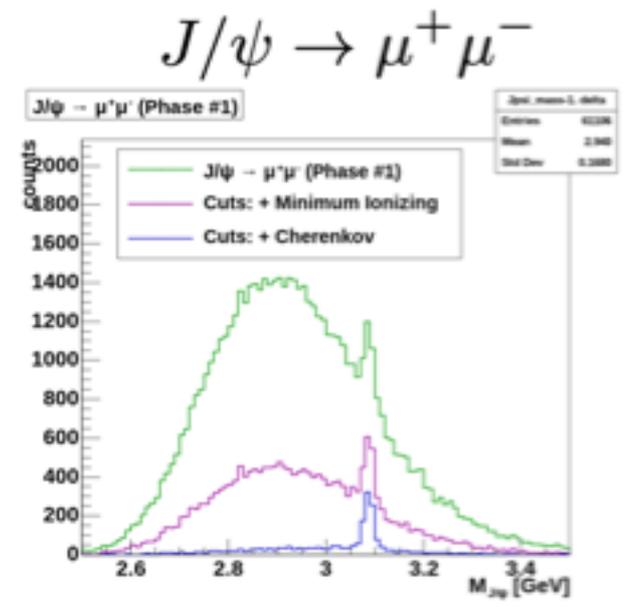
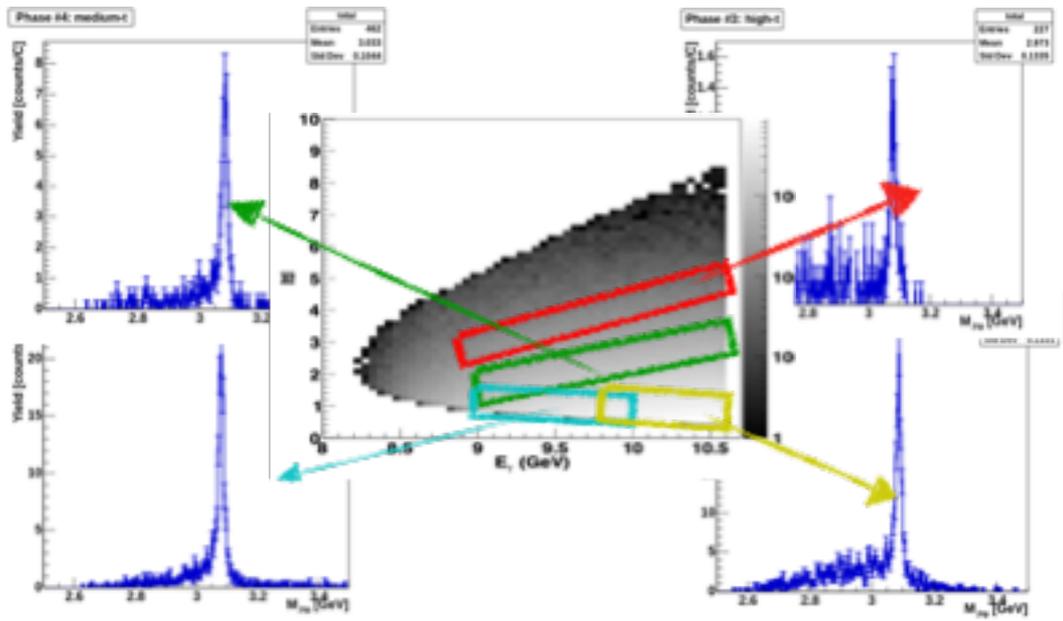
Combine with CLAS12 data to constrain transverse widths of u/d quarks and fragmentation functions

Obtain some statistics on transverse momentum dependence of $(e, e'K^+)$

Data taking completed in Fall 2018



Recent running – LHCb Pentaquark search



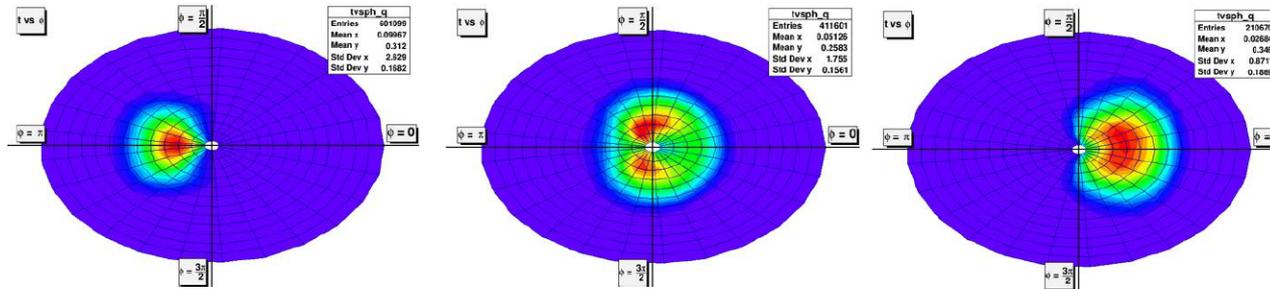
LHCb Pentaquark search.
 Largest data set of
 photoproduced J/ψ 's.
 Preliminary results soon.

Double statistics with $\mu^+\mu^-$
 channel?

Recent Running E12-09-011 (KaonLT)

Spokespersons: T. Horn (CUA), G. Huber (URegina), P. Markowitz (FIU)

Grad. Students: R. Ambrose (URegina, M.S. 2018), V. Kumar (URegina), M. Muhoza (CUA), R. Trotta (CUA)



Three SHMS angles

Two beam energies

$$2\pi \frac{d^2\sigma}{dt d\phi} = \epsilon \frac{d\sigma_L}{dt} + \frac{d\sigma_T}{dt} + \sqrt{2\epsilon(\epsilon+1)} \frac{d\sigma_{LT}}{dt} \cos\phi + \epsilon \frac{d\sigma_{TT}}{dt} \cos 2\phi$$

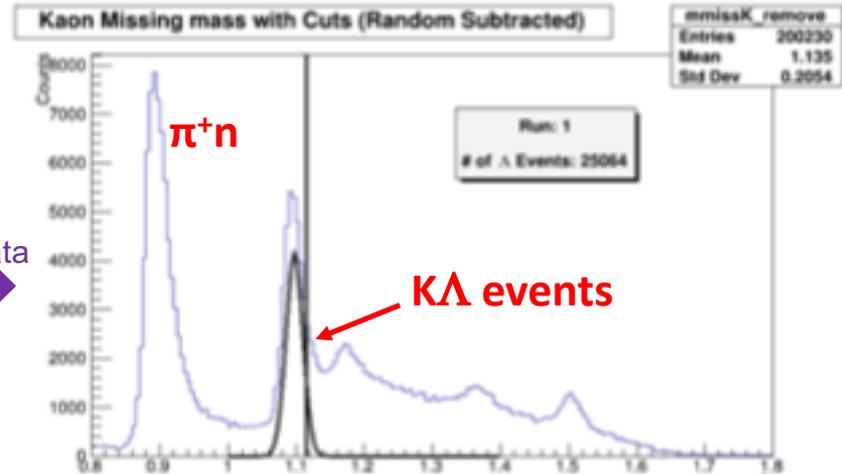
Physics cross section

Polarized beam
FREE

$$+ h \frac{d\sigma_{LT}}{dt} \sin\phi$$

Setting	Low ϵ data	High ϵ data
Q ² =0.50 W=2.40	✓	✓
Q ² =2.1 W=2.95	✓	✓
Q ² =3.0 W=2.32	✓	✓
Q ² =3.0 W=3.14	✓	✓
Q ² =4.4 W=2.74	✓	✓
Q ² =5.5 W=3.02	✓	✓

Spring 2019

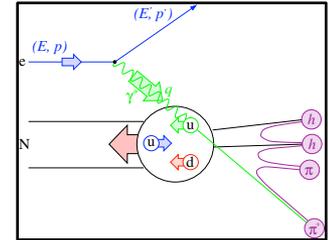


Online data

Thomas Jefferson National Accelerator See R. Trotta talk

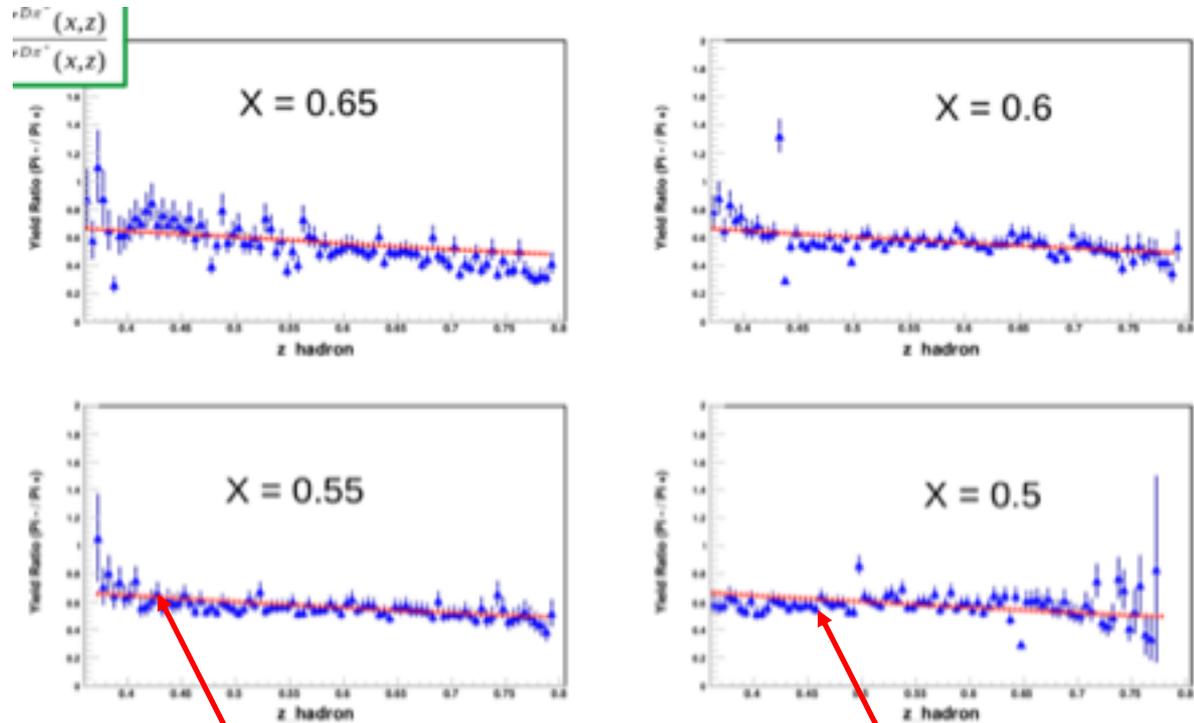
Charge Symmetry Violation - SIDIS

Measurement ratio of semi inclusive yields Y_{π^-} and Y_{π^+} of $d(e, e' \pi^-)$ and $d(e, e' \pi^+)$ to test charge symmetry

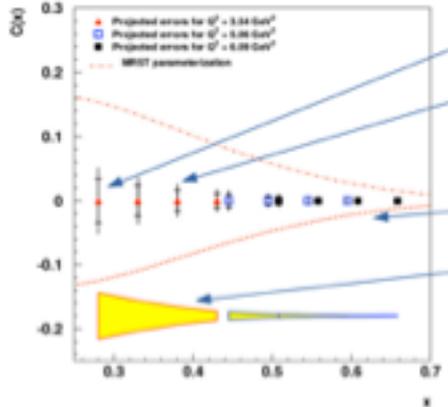


Yield ratios: Calibrations completed.
No corrections.

$$R_y(x, z) = \frac{Y_{\pi^+}(x, z)}{Y_{\pi^-}(x, z)}$$



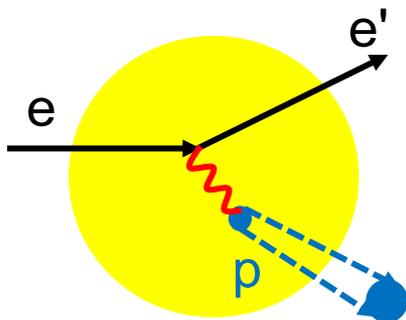
Ratio predictions from HERMES data (no CSV)



E12-09-002

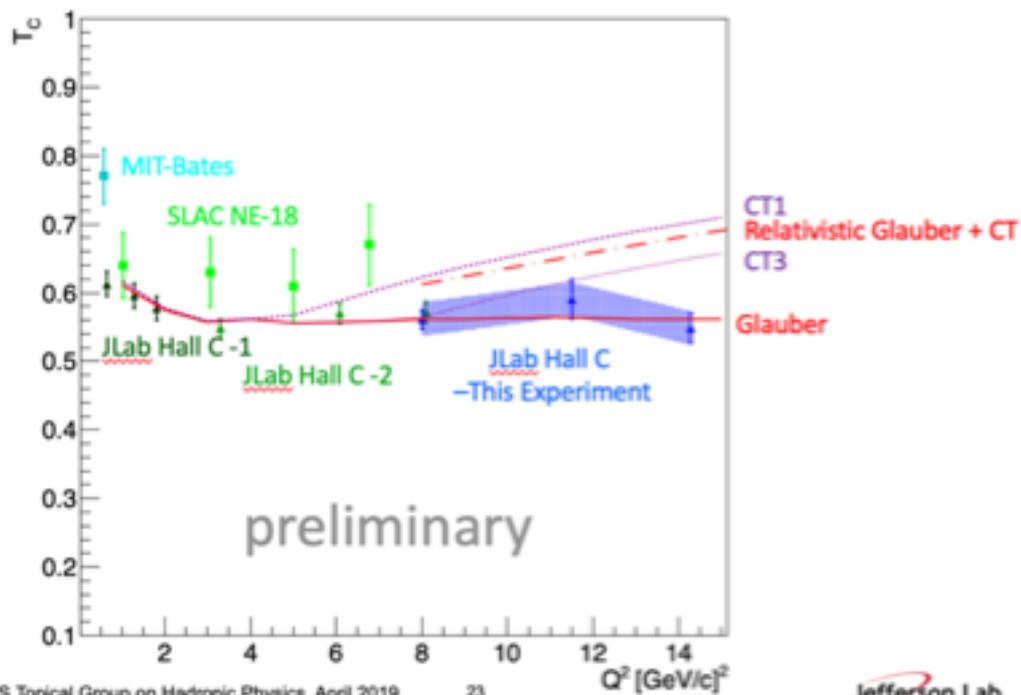
E12-06-107 Color Transparency

$$T_A = \frac{\sigma_{A(e,e'p)}}{Z \sigma_{p(e,e'p)}}$$

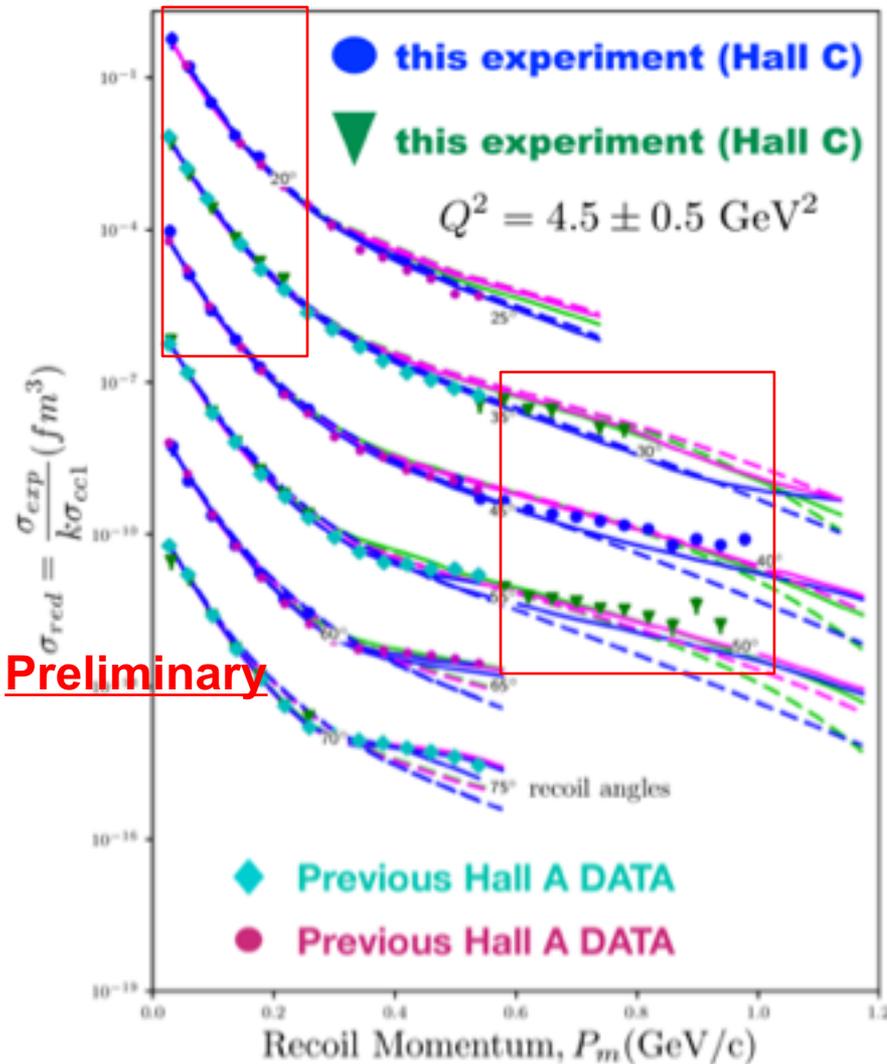


First commissioning experiment

Preliminary $^{12}\text{C}(e,e'p)$ Color Transparency results shown at APS meeting and User Group Meeting.



E12-10-003 $d(e,e'p)$



Preliminary

Commissioning experiment

Preliminary results matching to previous Hall A data.

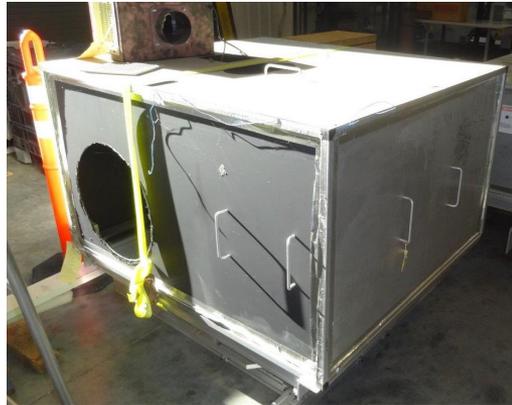
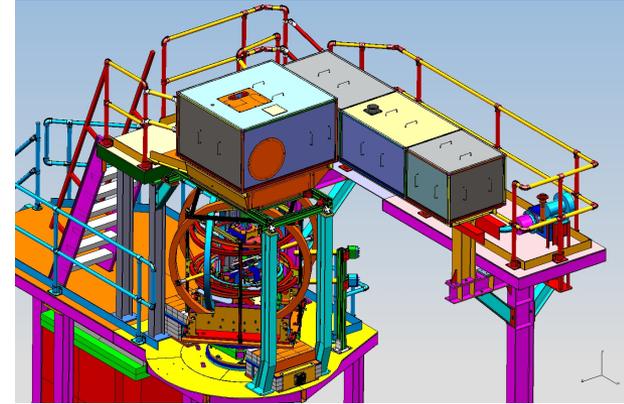
Extends P_m to 1000 MeV/c.

Polarized ^3He target

Preparing for A_1^n / d_2^n (E12-06-110, E12-06-121) in late 2019.

Design complete. Parts fabricated.

Ready to install.



NEUTRAL PARTICLE SPECTROMETER

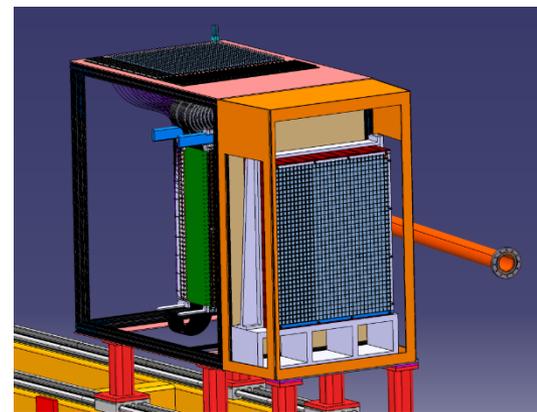
❑ NPS passed ERR

- Experiments: E12-13-010/007, E12-14-003/005

❑ NPS 12x12 prototype test successfully completed

❑ NPS subsystem status

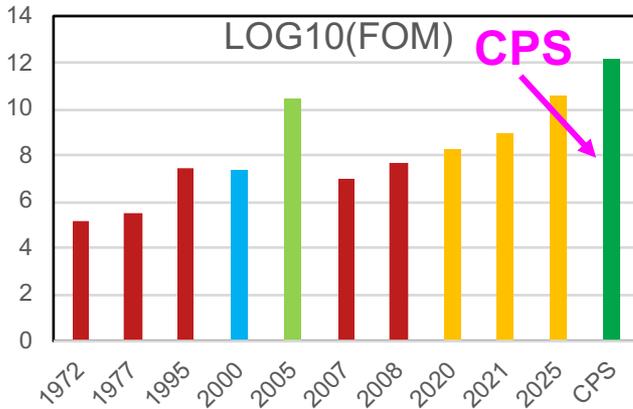
- Magnet provided by CUA and ODU (NSF MRI) - ready for mapping



- Detector frame designed (IPN-Orsay)
- Crystal testing ongoing (CUA), final procurement underway
- PMTs on-site, HV base fabrication near completion (OU)
- Software development ongoing (IPN-Orsay, JMU, U. Glasgow, JLab)
- Trigger/Electronics/DAQ - (JLab)
- Mechanical – systems identified, e.g. SHMS platform extension designed, installation plan being developed and tuned (Jlab)



NEW INSTRUMENT: INTENSE COLLIMATED PHOTON SOURCE FOR USE WITH DYNAMICALLY POLARIZED SOLID-STATE TARGETS

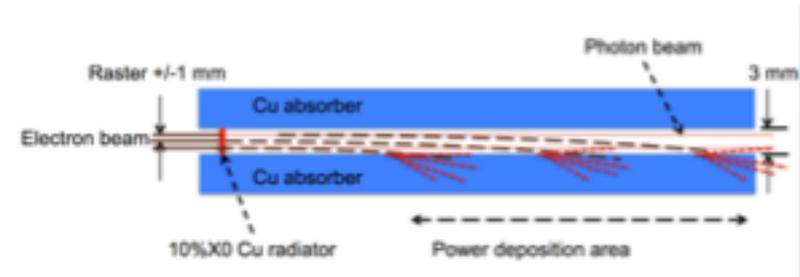
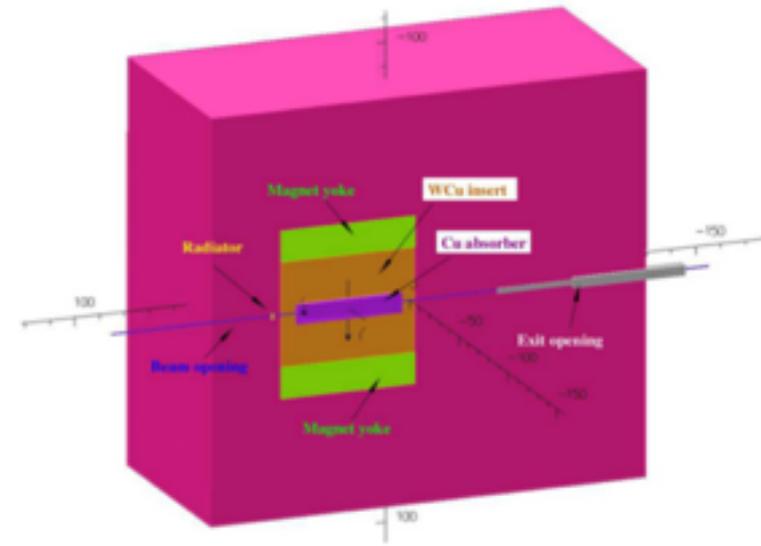


Unique Science – gain in FOM = 30

High-energy photoproduction in 3D dynamic proton structure – **two experiments at JLab to date and additional ideas**

Compact Photon Source (CPS) Concept

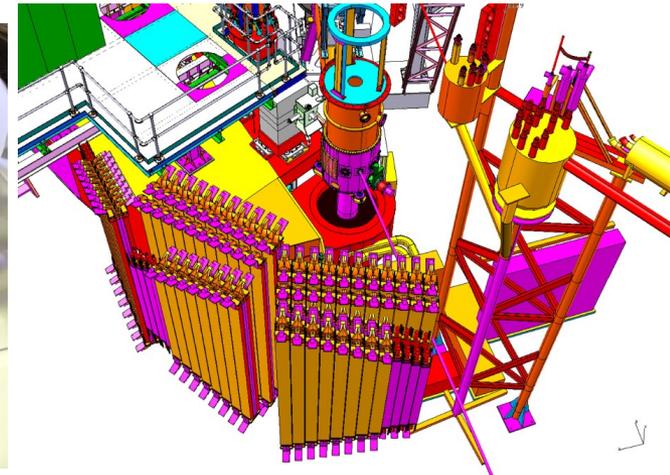
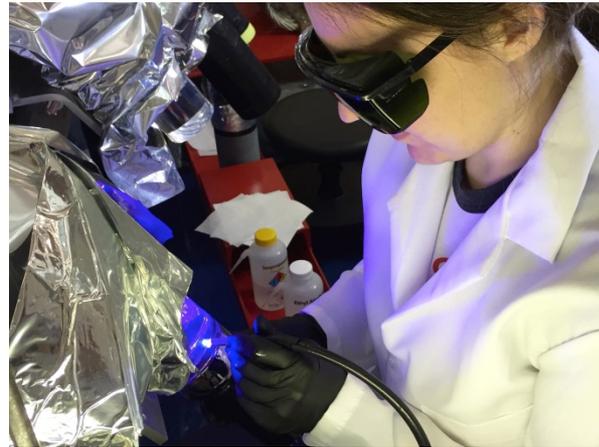
- ❑ Combines in a single shielded assembly all elements necessary for the production of high-intensity photon beams and ensures that the operational dose rates are acceptable
- ❑ Features: magnet, central Cu absorber to handle power deposition, W powder and borated plastic to shield induced radiation dose
- ❑ Mechanism: electrons interact with radiator creating photons; electrons dumped in magnet; photons escape thru small collimator w/out loss of intensity



CPS concept successfully passed a Technical Review in 2018

LAD – LARGE ACCEPTANCE DETECTOR

- E12-11-007: Deuteron EMC – d(e,e' backward p)
- Very large solid angle for $L = 10^{36} \text{ cm}^{-2} \text{ s}^{-1}$ and $\theta > 90^\circ$
- Optimized for medium momentum nucleons
$$0.3 \leq p_N \leq 0.7 \text{ GeV}/c$$
- Needs 5 scintillator planes which are built from old CLAS-6 TOF scintillators.
- Five planes refurbished @ODU by ODU, KSU, TAU, MIT, GWU and back at JLab.



Standard Equipment upgrades - 2020

HMS Q2 power supply reversing switch burned up in 2018.

Have been successfully running with a spare supply (with no remote polarity reverse.)

Three quadrupole supplies ordered. Delivery in 2020.

New beam pipe design to allow SHMS \rightarrow 5.5° and HMS \rightarrow 10.5°.

Capital equipment plan to upgrade and harmonize Hall A and C polarimeters.

New SC magnet for Hall C Moller

New Moller target ladder



Hall C after 12 GeV Upgrade

- Beam Energy: 2 – 11 GeV/c
- **NEW** Super High Momentum Spectrometer (SHMS)
 - $P \leq 11$ GeV/c (replaces ≤ 2 GeV/c)
 - Horizontal Bender, 3 Quads, Dipole
 - dP/P $0.5 - 1.0 \times 10^{-3}$
 - Acceptance: 4msr, $\Delta P/P = 30\%$
 - $5.5^\circ < \theta < 40^\circ$
 - Good e^-/π^- $e^+/\pi^+/K^+/p$ PID
- High Momentum Spectrometer (HMS)
 - $P \rightarrow 7.5$ GeV/c
 - dP/P $0.5 - 1.0 \times 10^{-3}$
 - Acceptance: 6.5msr, $\Delta p/p = 18\%$
 - $10.5^\circ < \theta < 90^\circ$
 - Good e^-/π^- $e^+/\pi^+/K^+/p$ PID
- Minimum opening angle: $\sim 18.5^\circ$
- Well shielded detector huts
- 2 beamline polarimeters
- Ideal facility for:
 - Rosenbluth (L/T) separations
 - Exclusive reactions
 - Low cross sections (neutrino level)

