NMSU ePIC Collaboration Membership Application

David Ruth
Burcu Duran
Michael Paolone

ePIC Collaboration Council Meeting

5/29/2026

New Mexico State University Experimental Nuclear Physics Group

David Ruth
Assistant Professor

Burcu Duran
Assistant Professor

Michael Paolone
Associate Professor

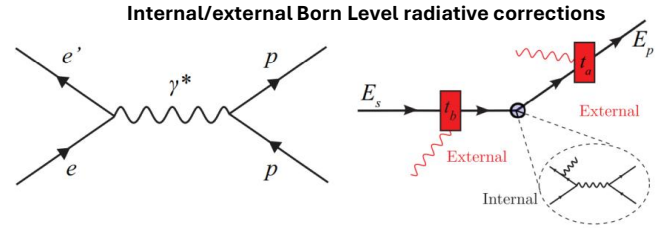
- **3 Tenure-Track Faculty**
- **8 Graduate Students**
- **1 Postdoctoral Associate**

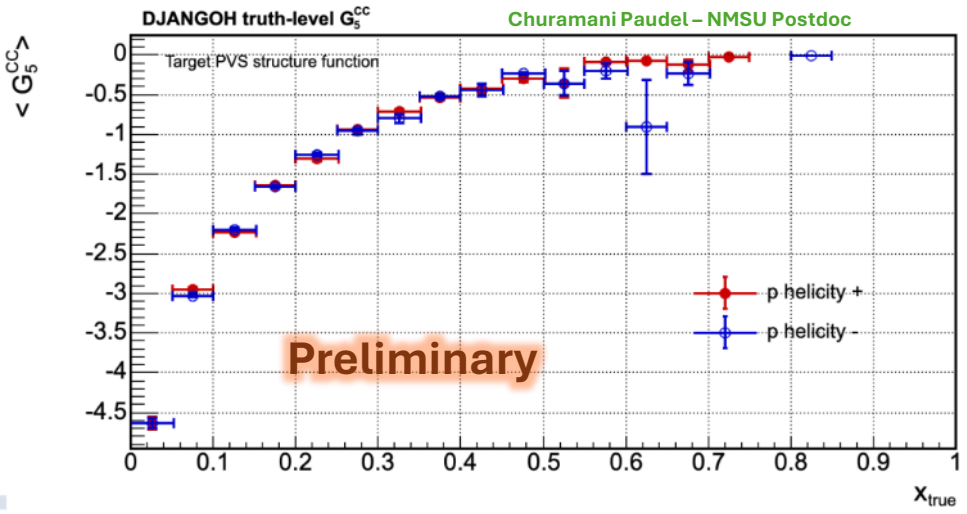
- **Current Focus:** Medium Energy Nuclear Physics at Jefferson Lab
- Departmental Theory Support from **3 Theory Faculty** (R. Sufian, M. Sievert, M. Engelhardt)
- D. Ruth has some past and current ePIC involvement (Barrel HCal WG, Far Forward WG)

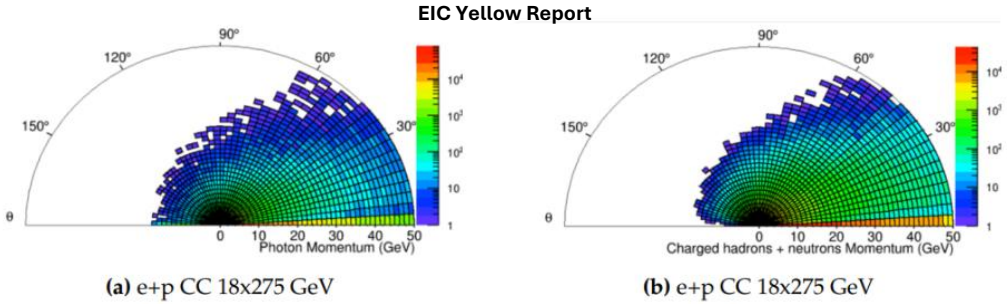
Spin Structure Function Studies with ePIC

- D. Ruth primary interest: **spin-dependent structure** of nucleons (g_1 and g_2 SSF at Jlab)
- Want to work with *Inclusive DIS WG* to extend to EIC!
- **Systematics study** and **radiative corrections**

- Parity violating structure functions g_3, g_4, g_5: Never measured, available in EIC w/ **Charged Current DIS**
- Need impact study on $g_{3,4,5}$ in anticipation of a world first measurement!!
- Unique potential for quark flavor separation
- Impact study underway (C. Paudel, D. Ruth)

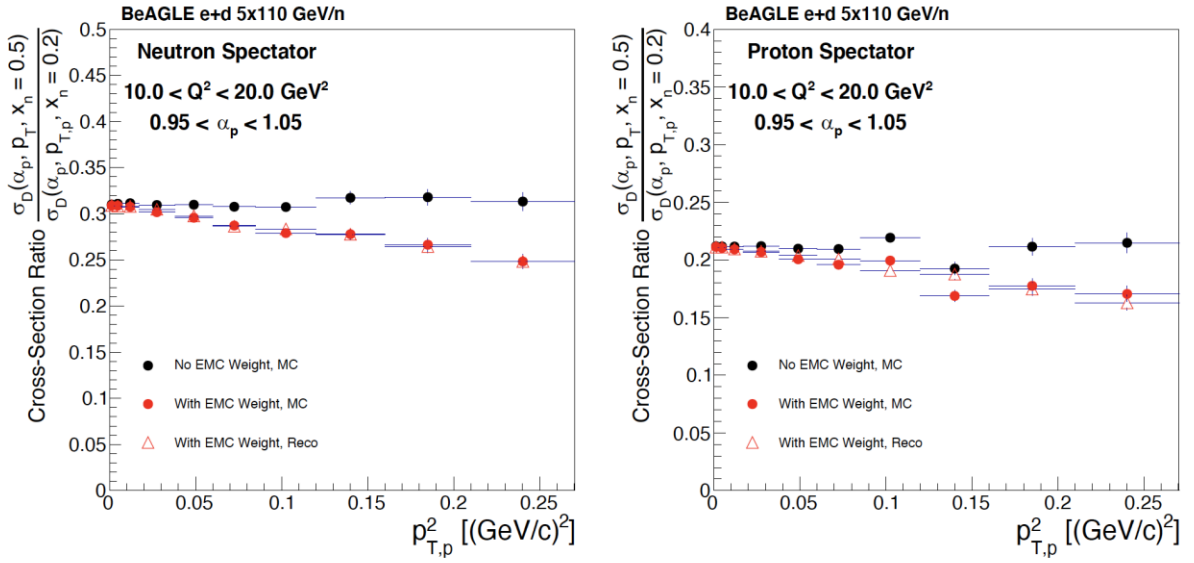






The EMC Effect at the EIC via Tagged DIS

- Measure deuteron reduced cross section inside and outside the EMC effect region
- Ratio allows direct comparison of the xsec with and without the EMC effect
- Establish the required luminosity
- Needs to be redone with the updated simulation framework
- FSIs expected to dominate at these kinematics – important to separate them from initial modifications!



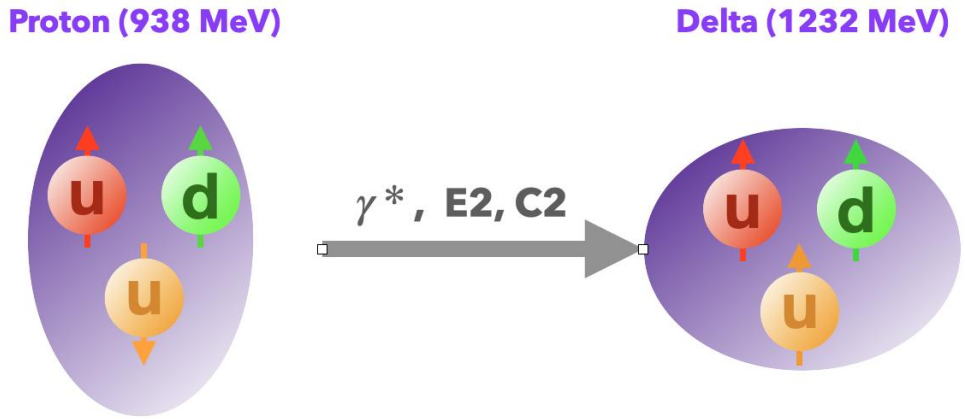
Study done by *Alex Jentsch et al*

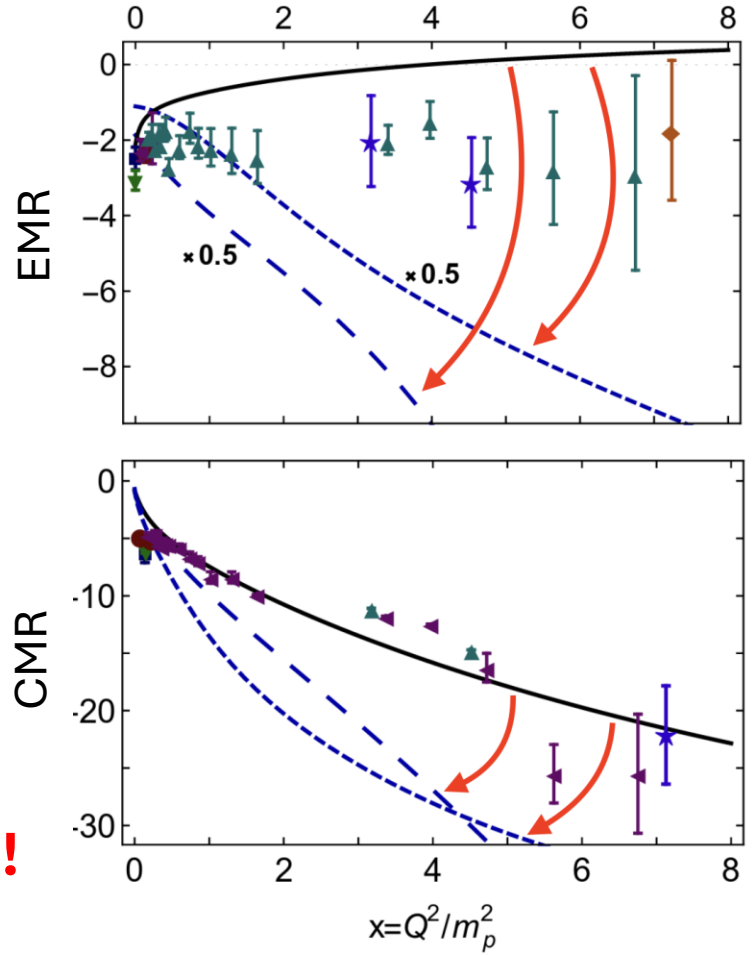
(https://indico.cern.ch/event/1199314/contributions/5216823/attachments/2620644/4531026/tagged_dis_EIC_DIS_2023_v2.pdf)

N-Delta Transition

- The ratio of the electric/coulomb-quadrupole to magnetic-dipole transition amplitudes define the N-to-Delta transition form factors (EMR and CMR TFFs).
- At low-Q2, pion cloud dynamics dominate. At high-Q2, TFFs are extremely sensitive to higher order partial waves. TFFs should also converge to perturbative predictions.

The EIC provides a unique opportunity to study TFFs at large Q2!



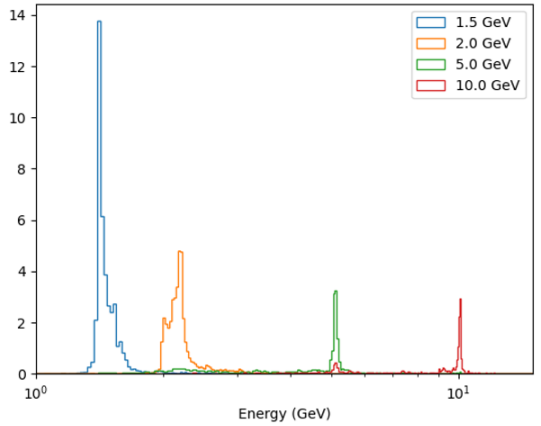


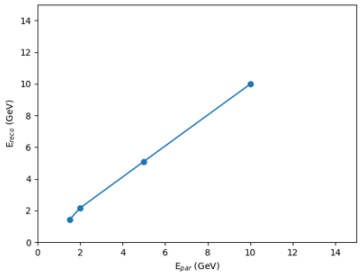
Models have shown significant sensitivity to truncation of higher-order partial wave contributions to the TFFs. The effect grows with Q2.

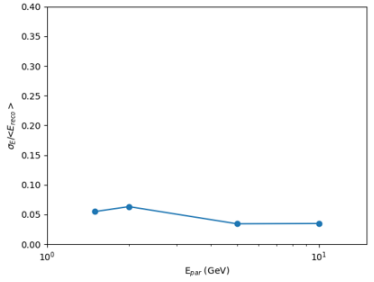
Calculations from Lu. *et. al*. Phys. Rev. D (2019)

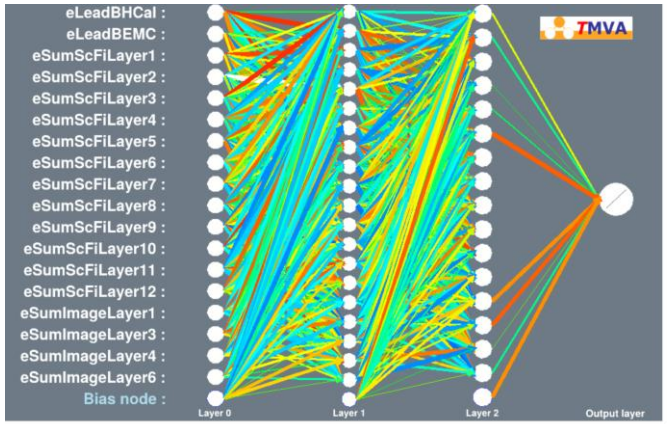
Barrel HCal Machine Learning Energy Calibration

- Barrel Hadron Calorimeter – Good Energy Resolution needed for desired physics!
- In Progress: Neural Network (MLP) based calibration!
- Overfitting with single particle training data, but promising potential
- Working on changing to continuous energy spectra training data



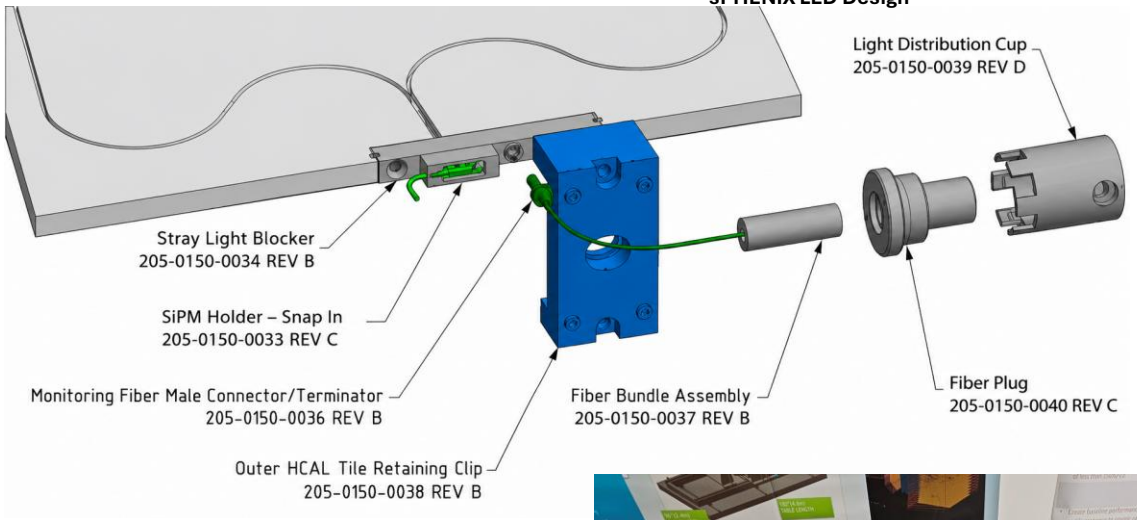






BHCal LED System

sPHENIX LED Design

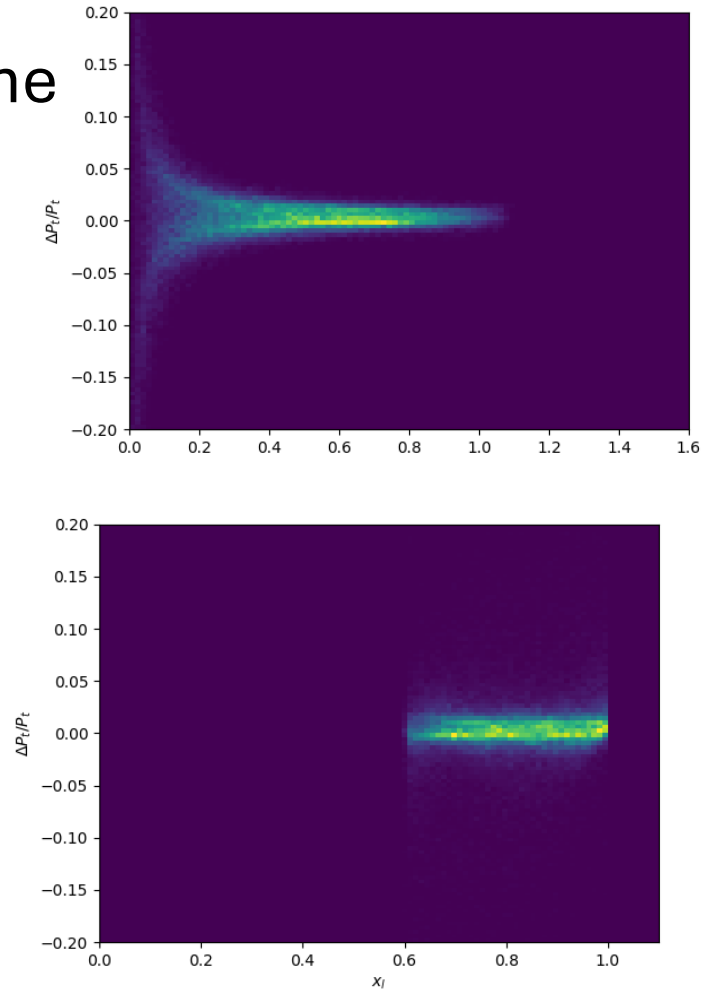


GSU Tile Testing Stand (M. Connors Lab)

- sPHENIX oHCal System – for monitoring of tile & SiPM stability and performance
- ePIC system – also for calibration
- ePIC reads out every tile independently instead of using towers of 5 tiles
- **R&D on LED system design and logistics needed – prototype will be constructed at NMSU**

Far Forward Regime – Momentum Reconstruction & ZDC

- Worked with A. Jentsch on a machine learning solution to momentum reconstruction for ePIC Far Forward Region Roman Pots
- **Needs to be integrated into EICRecon and extended to Off-Momentum Detectors**



More Recent: ZDC Involvement

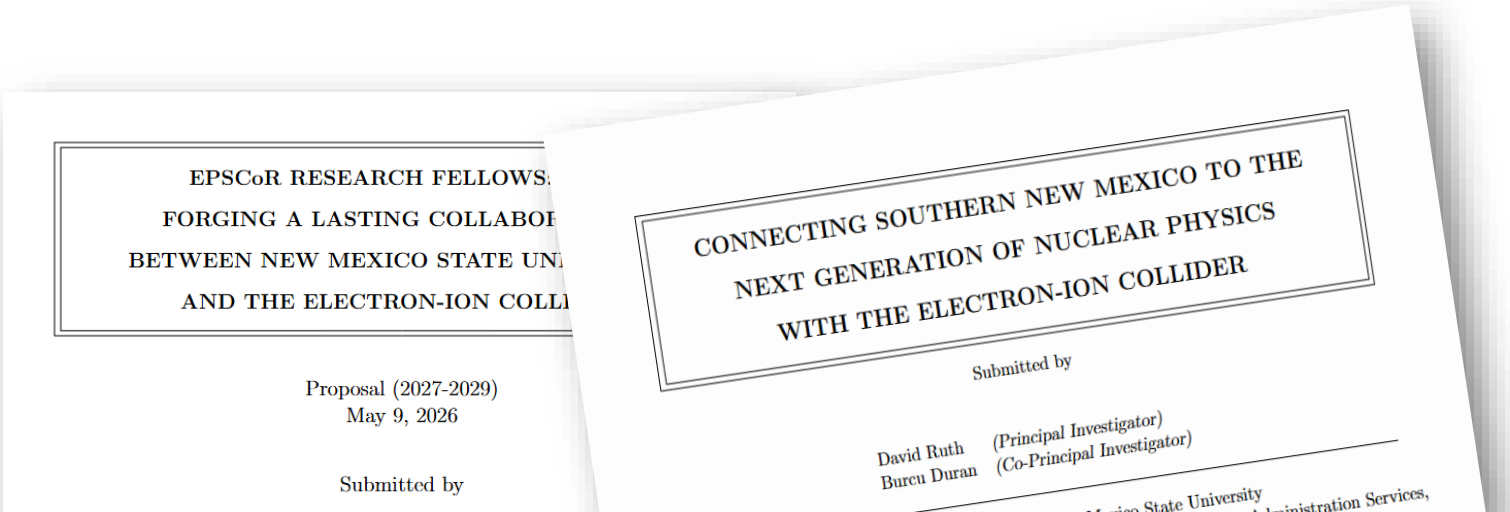
- **NMSU** is helping to keep the ZDC effort moving forward in the wake of Miguel Arratia's departure
- D. Ruth working to help organize ZDC meeting and general efforts
- B. Duran and D. Ruth will learn from UCR (Sean Preins, Ken Barish) and participate in tile testing and simulation
- We will also develop and test an LED calibration system for the ZDC!

Work Allocation Plans

Working Groups:

- Barrel HCal WG
- Far Forward WG
- Inclusive WG

- Recently submitted two EPSCoR grant proposals to try and get funding to participate in ePIC:
  - DE-FOA-0003615 (4yrs support for 1 Postdoc, 2 Grad Students, D. Ruth, B. Duran)
  - NSF 24-528 (4 months at BNL for D. Ruth and 1 Student to help commissioning of BHCal)



EPSCoR RESEARCH FELLOWS
FORGING A LASTING COLLABOR
BETWEEN NEW MEXICO STATE UN
AND THE ELECTRON-ION COLL

Proposal (2027-2029)
May 9, 2026

Submitted by

CONNECTING SOUTHERN NEW MEXICO TO THE NEXT GENERATION OF NUCLEAR PHYSICS WITH THE ELECTRON-ION COLLIDER

Submitted by

David Ruth (Principal Investigator)
Burcu Duran (Co-Principal Investigator)

Conclusion

- NMSU has a strong and energetic Exp. Nucl Physics group interested in extending from JLab work into helping with ePIC!
- Lots of expertise on nucleon structure analysis and simulation
- Clear plan for WG involvement, hardware and software work, and impact studies

- Please allow us to officially join ePIC: **we are ready to get to work!**