

# NMSU 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

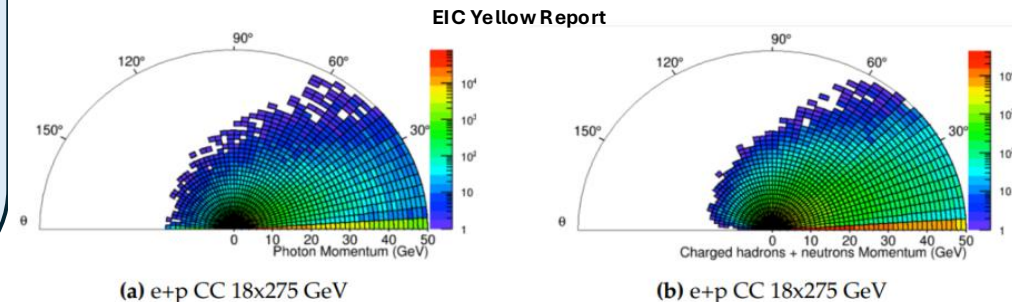
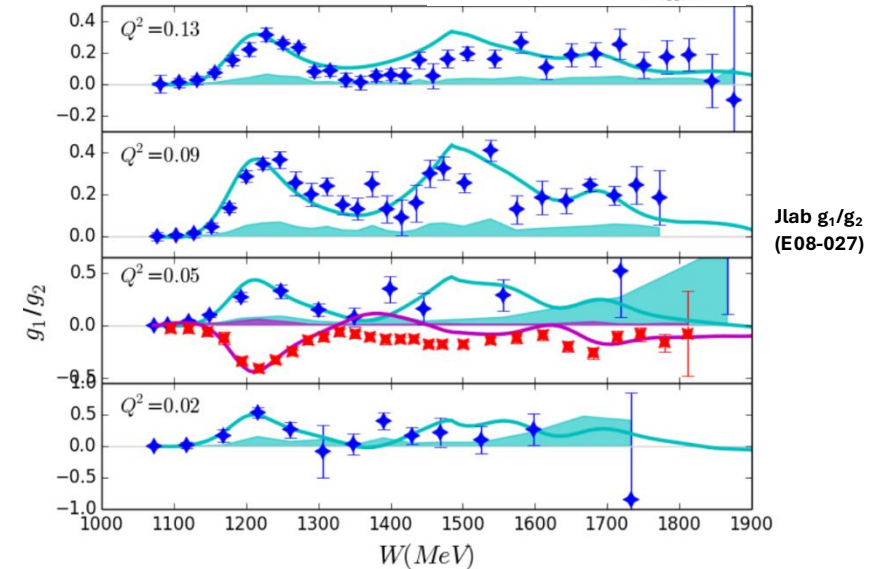
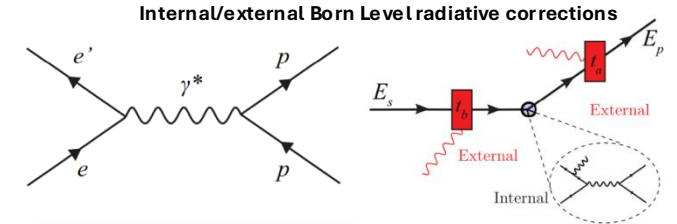
- **3 Tenure-Track Faculty**
- **8 Graduate Students**
- **1 Postdoctoral Associate**

- **Current Focus:** Medium Energy Nuclear Physics at 
- 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

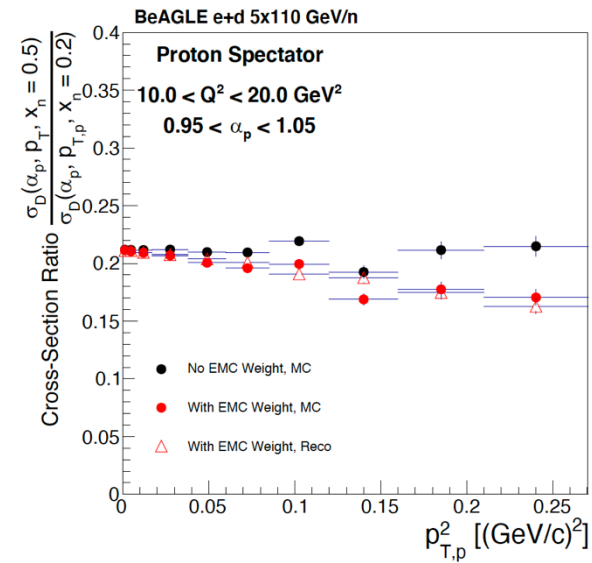
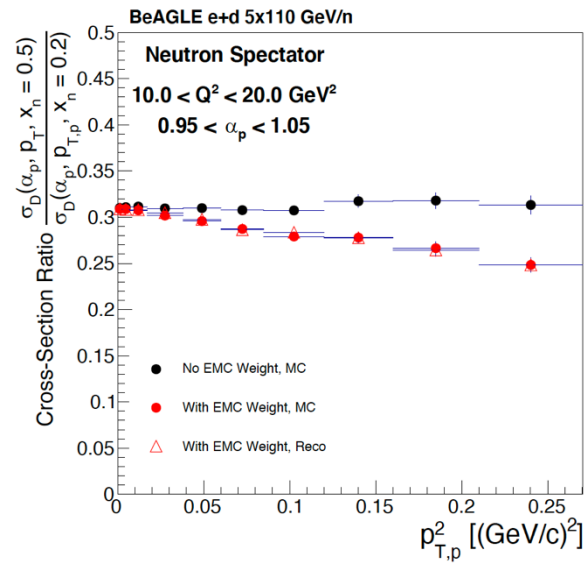
- D. Ruth primary interest: **spin-dependent structure** of nucleons ( $g_1$  and  $g_2$  SSF at Jlab)
- Want to work with *Inclusive DIS WG* to extend to EIC!
- **Systematics study** and **radiative corrections**

- 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



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

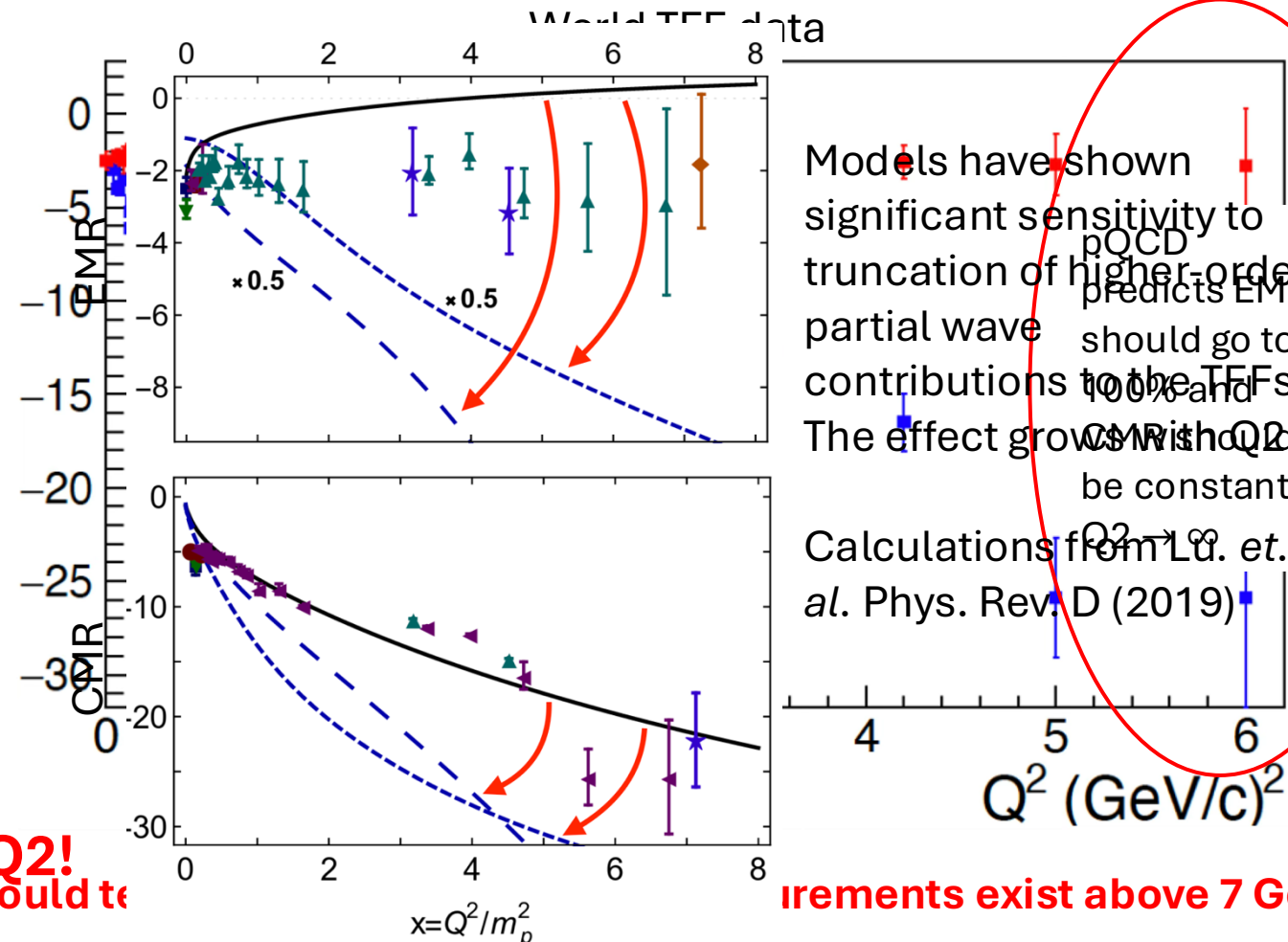
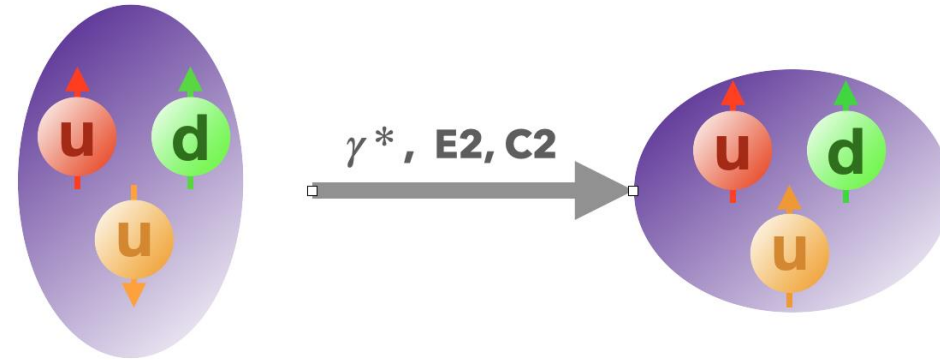
# N-Delta Transition

- 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- $Q^2$ , pion cloud dynamics dominate. At high- $Q^2$ , 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  $Q^2$ !**  
 Even very large  $Q^2$  bins at high  $Q^2$  could te

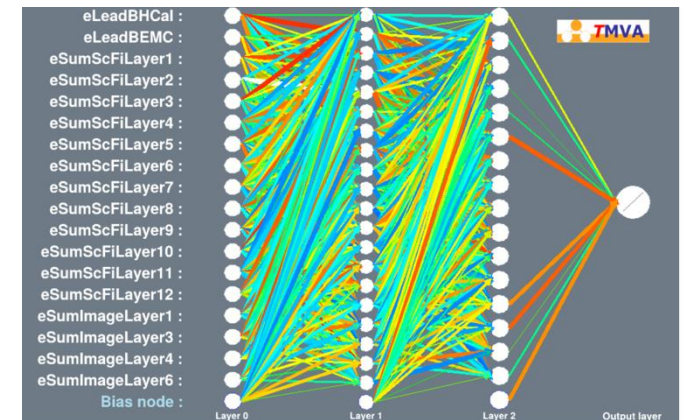
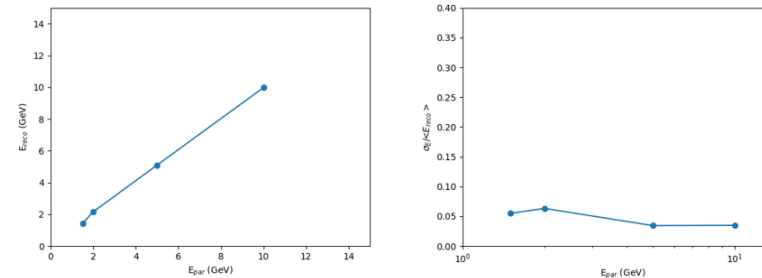
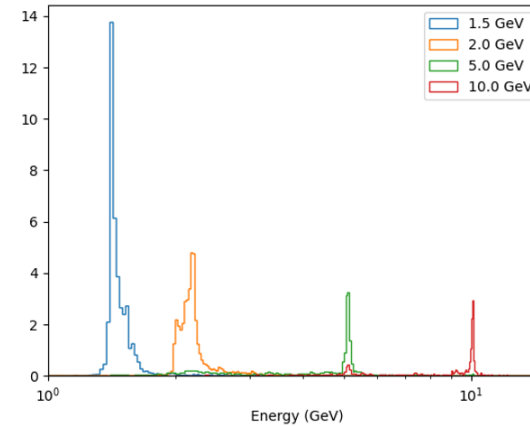
Proton (938 MeV)

Delta (1232 MeV)

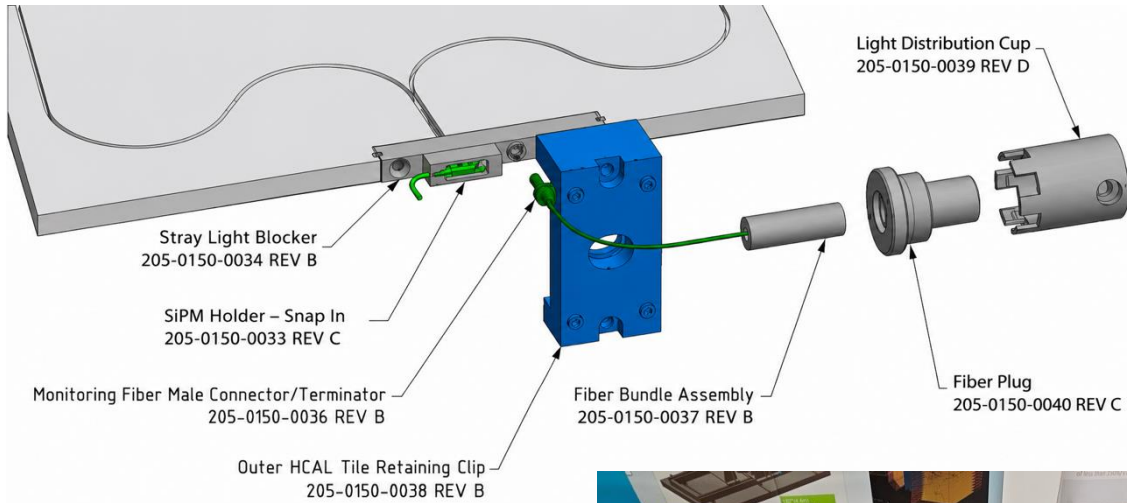


# Barrel HCal Machine Learning Energy Calibration

- 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

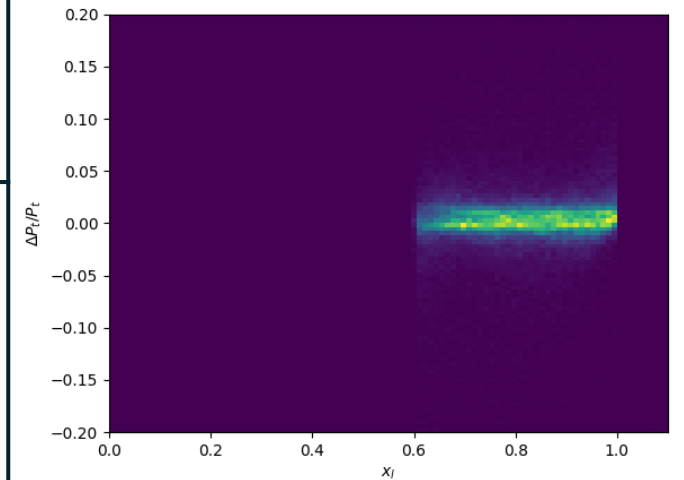
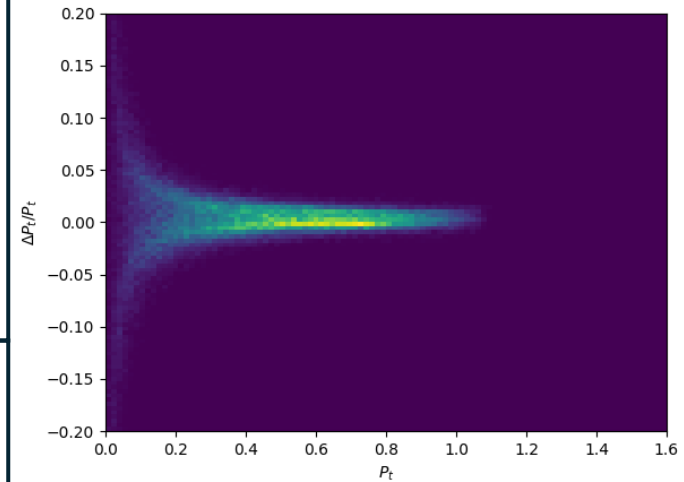
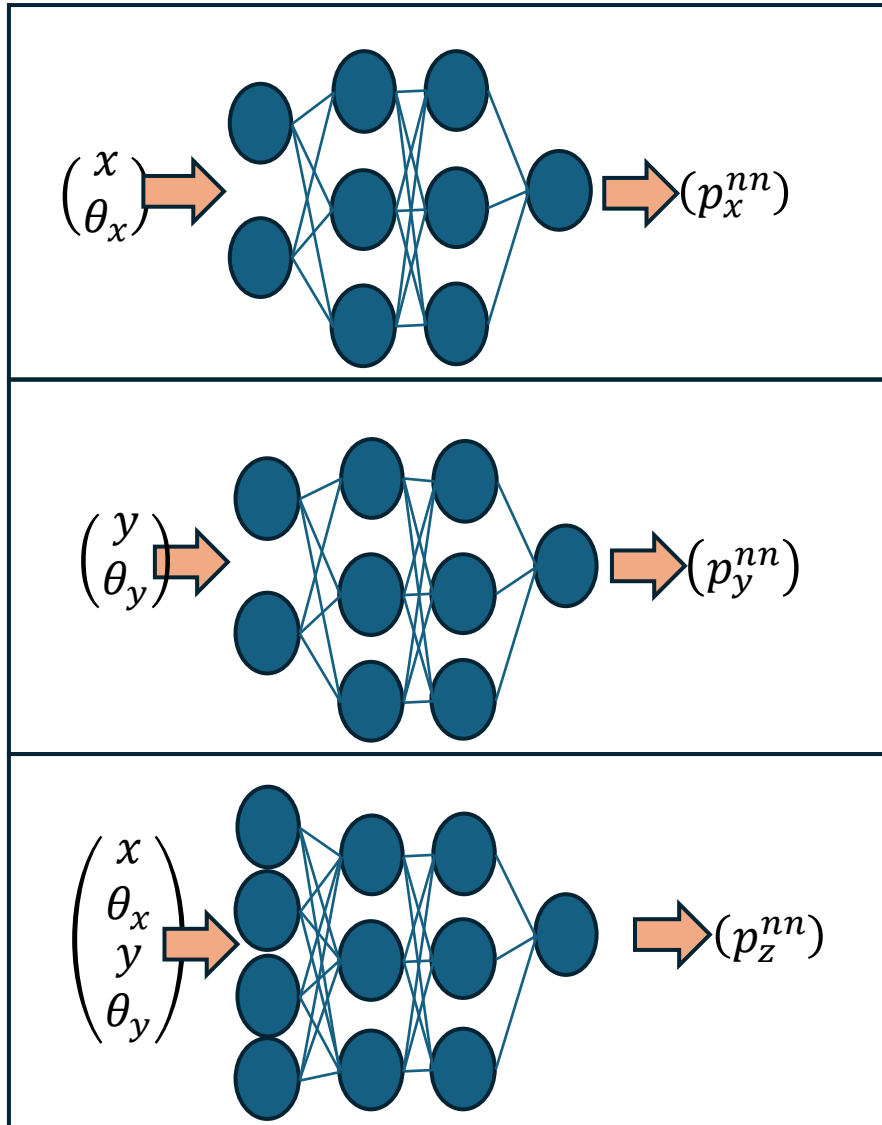


- sPHENIX oHCAL System – for monitoring of tile & SiPM stability and performance
- ePIC system – also for calibration
- ePIC reads out every tile independently instead of using towers of 5 tiles
- **R&D on LED system design and logistics needed – prototype will be constructed at NMSU**

# Roman Pots Machine Learning Momentum

## Reconstruction

- Worked with A. Jentsch on a machine learning solution to momentum reconstruction for ePIC Far Forward Region Roman Pots
- Promising results w/out assumptions: Linearity, IP Interaction, etc.
- Easy to retrain if geometry changes
- **Needs to be integrated into EICRecon and extended to Off-Momentum Detectors**



# Work Allocation Plans

- 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)
  - NSF 24-528 (4 months at BNL for D. Ruth and 1 Student to help commissioning of BHCaI)

## Working Groups:

- Barrel HCal WG
- Far Forward WG
- Inclusive WG

EPSCoR RESEARCH FELLOWS:  
FORGING A LASTING COLLABORATION  
BETWEEN NEW MEXICO STATE UNIVERSITY  
AND THE ELECTRON-ION COLLIDER

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)

New Mexico State University Administration Services

# 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!**