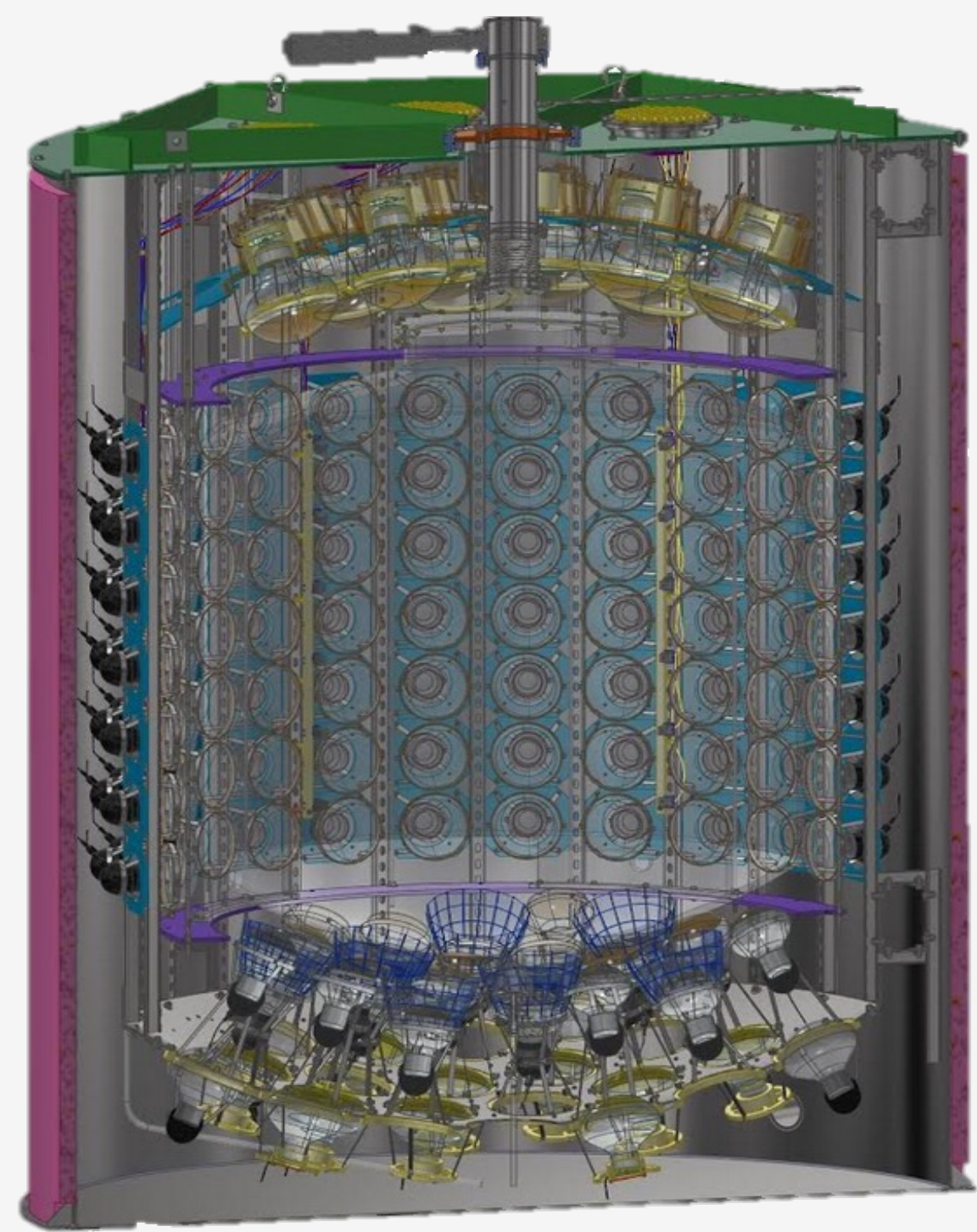
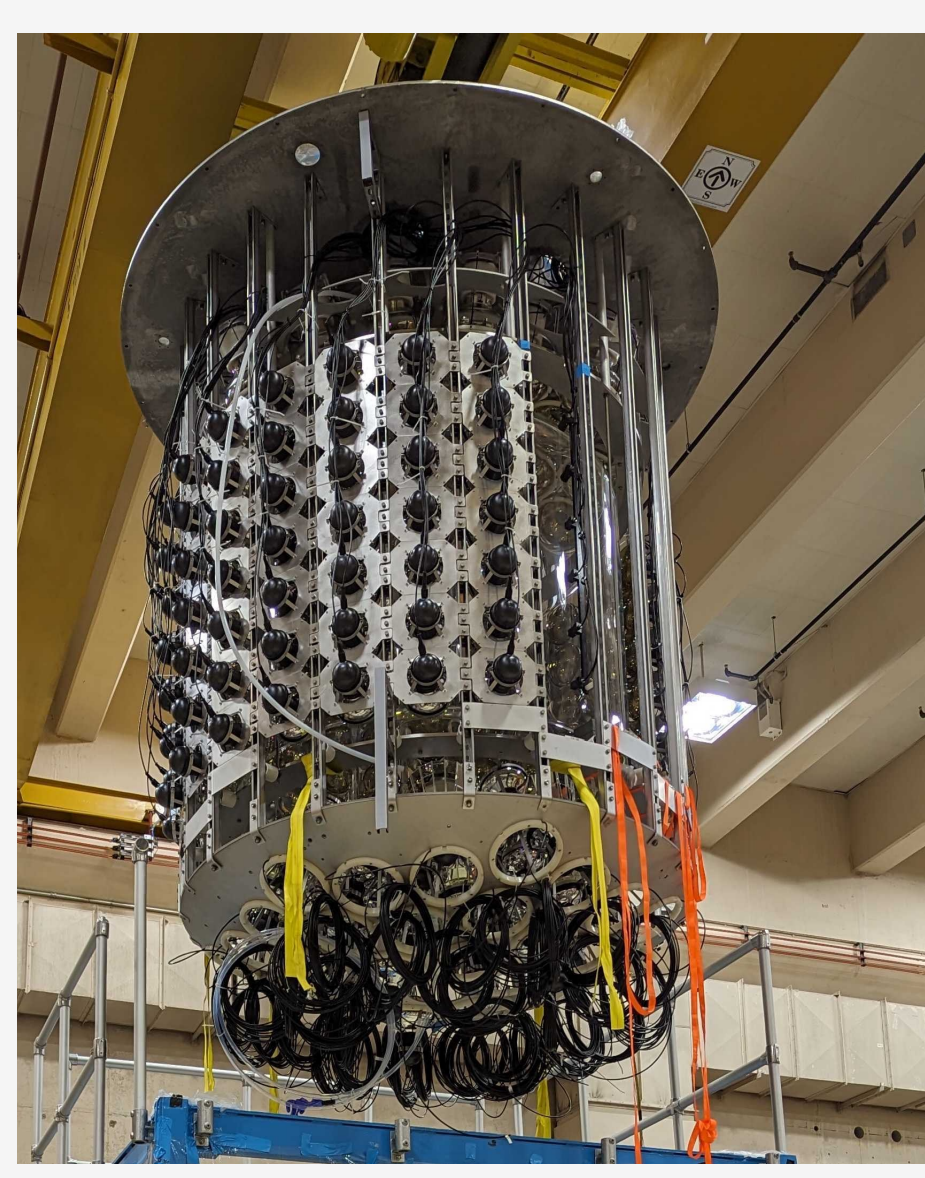
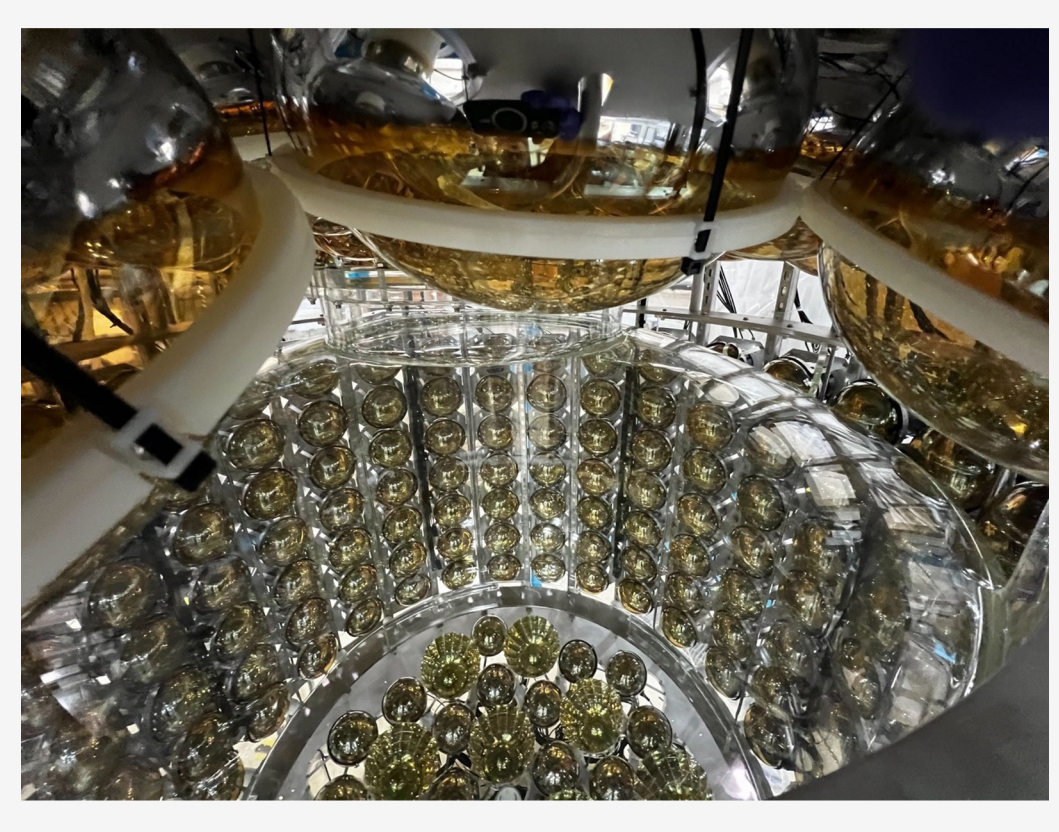


Eos Experiment

Eos is a flexible, multi-ton scale testbed to demonstrate the performance of novel hybrid detection technology

Highlighted technologies

- 4 ton inner vessel with flexible fill options
Water, WbLS, LS, Fast LS
- Fast PMTs (FWHM 1ns)
- Chromatic sorting of individual photons (dichroicons)
- Large array of calibration sources

Deployment at the Spallation Neutron Source at Oak Ridge National Lab from 2027 – 2032

Plutonium Beryllium (PuBe) Calibration

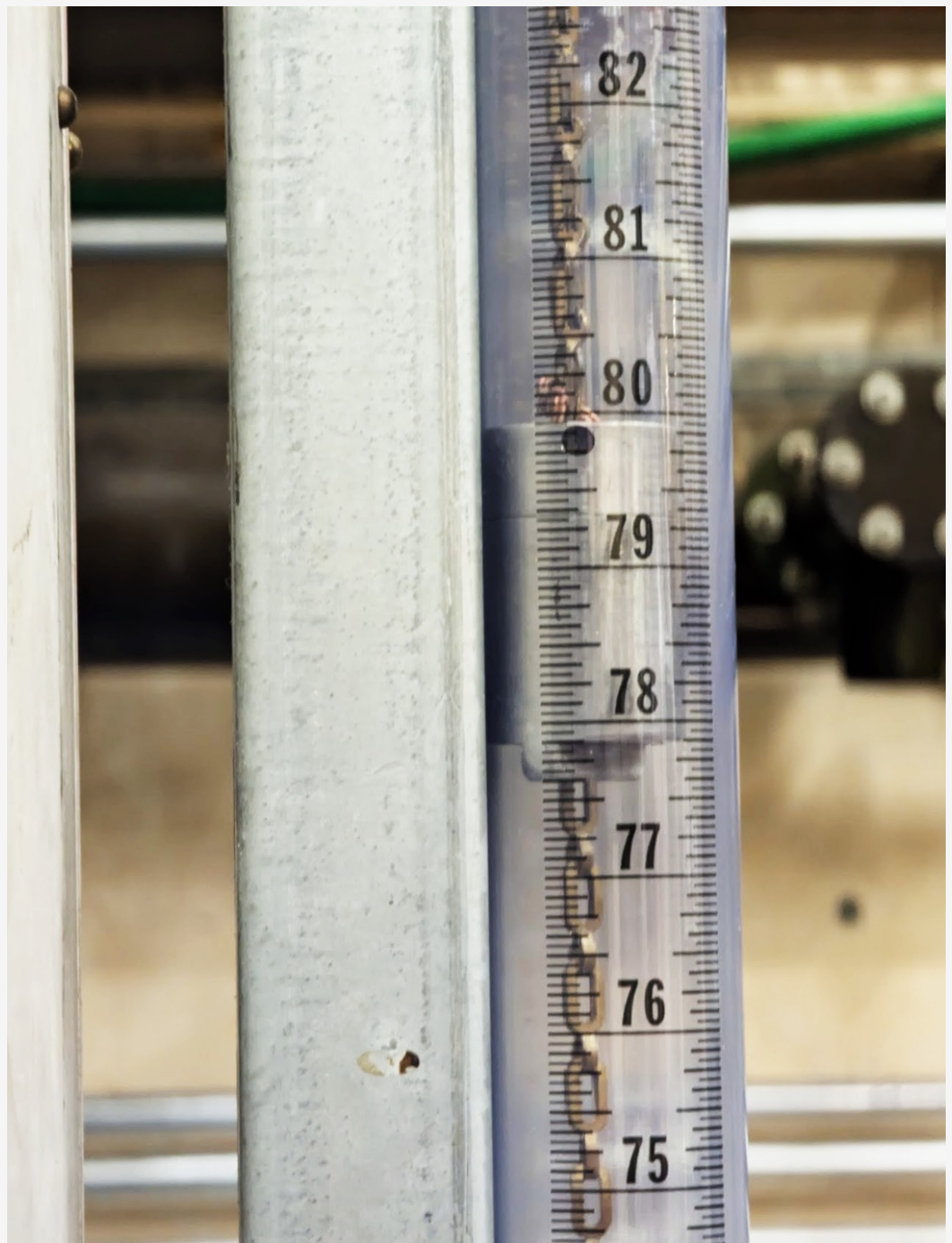
$$^{238}\text{Pu} \rightarrow \alpha + ^{234}\text{U}$$

High activity of 39 Gbq permits external deployment

$$^9\text{Be} + \alpha \rightarrow ^{12}\text{C}^* + n$$

Releases 4.4 MeV γ on de-excitation

Neutron capture after thermalization



Goals

- 1) Validate the simulated geometry
- 2) Demonstrate accurate reconstruction of external backgrounds
- 3) Develop techniques to identify/cut backgrounds in data

Reconstruction Validation

In simulation, determine reconstruction resolution

Build distribution $g: g(x_{recon} - x_{truth})$

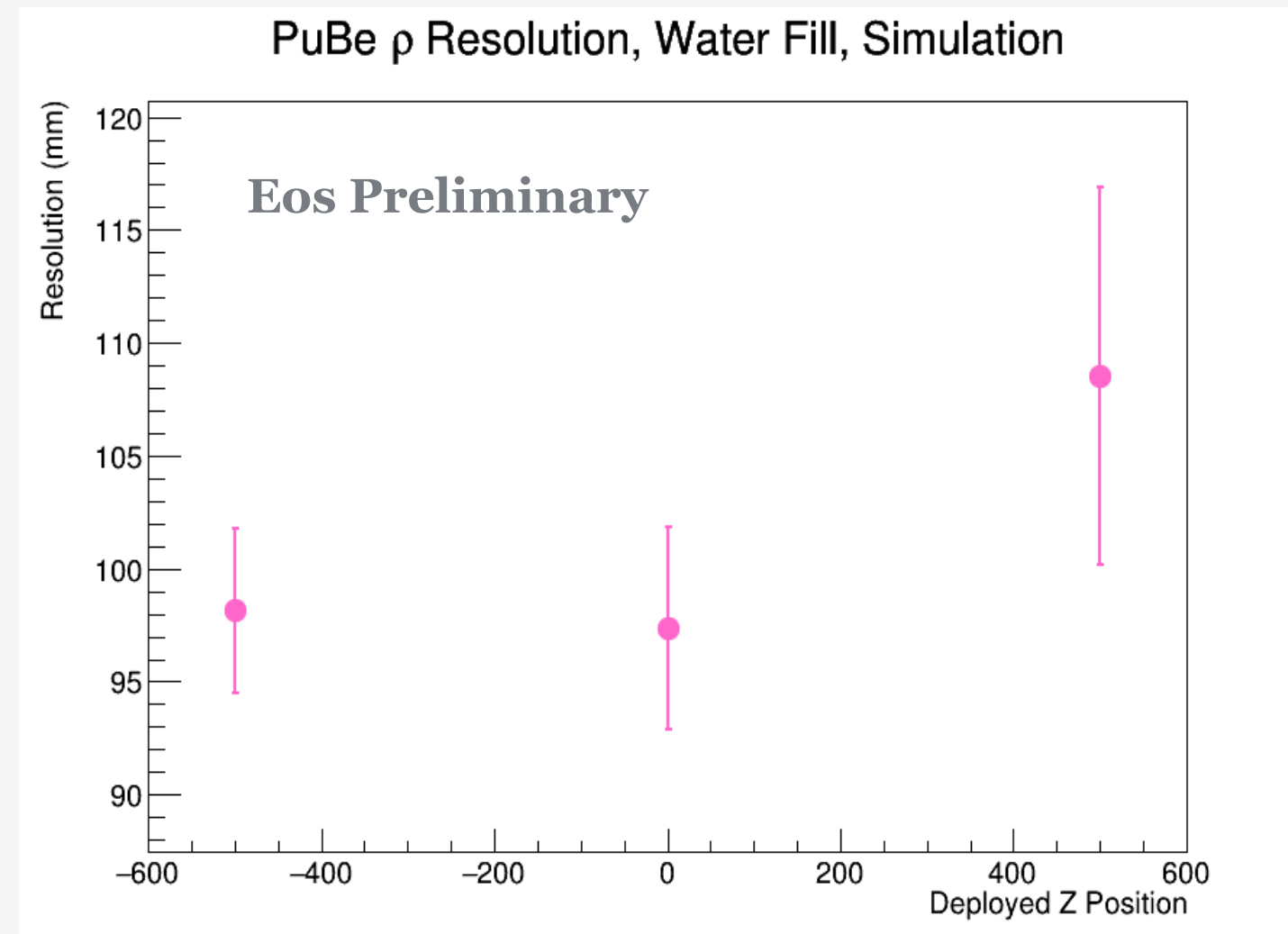
Simulations performed with RAT-PAC2, Geant-4 wrapper

$\bar{g} \rightarrow$ bias in Eos
 $\sigma_g \rightarrow$ resolution in Eos

Compare Data/MC distribution

Reconstruction Performance

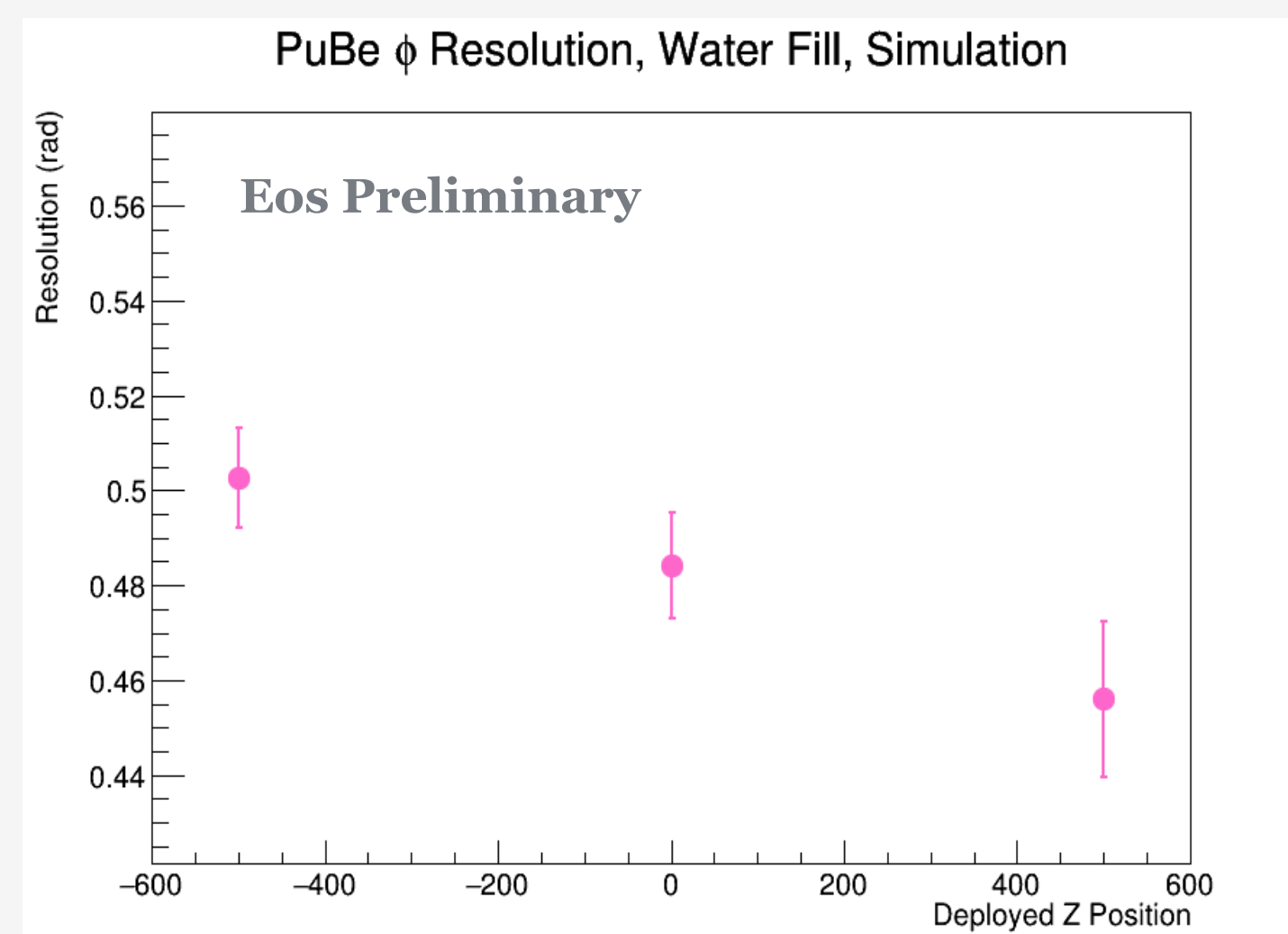
Likelihood Position Reconstruction



Eos Preliminary

Resolution of ~100 mm from simulations

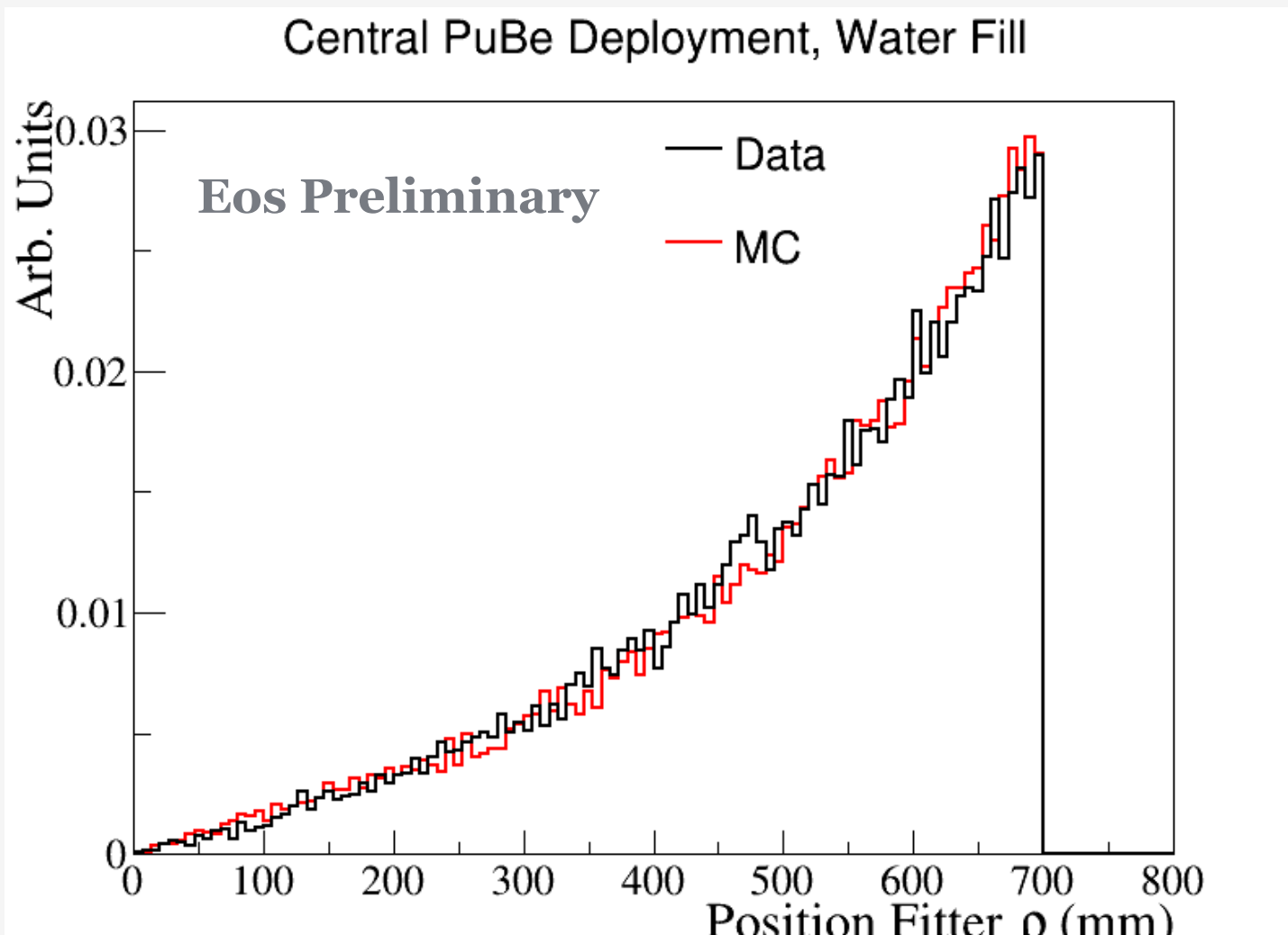
Likelihood Direction Reconstruction



Eos Preliminary

Resolution of ~30° from simulations

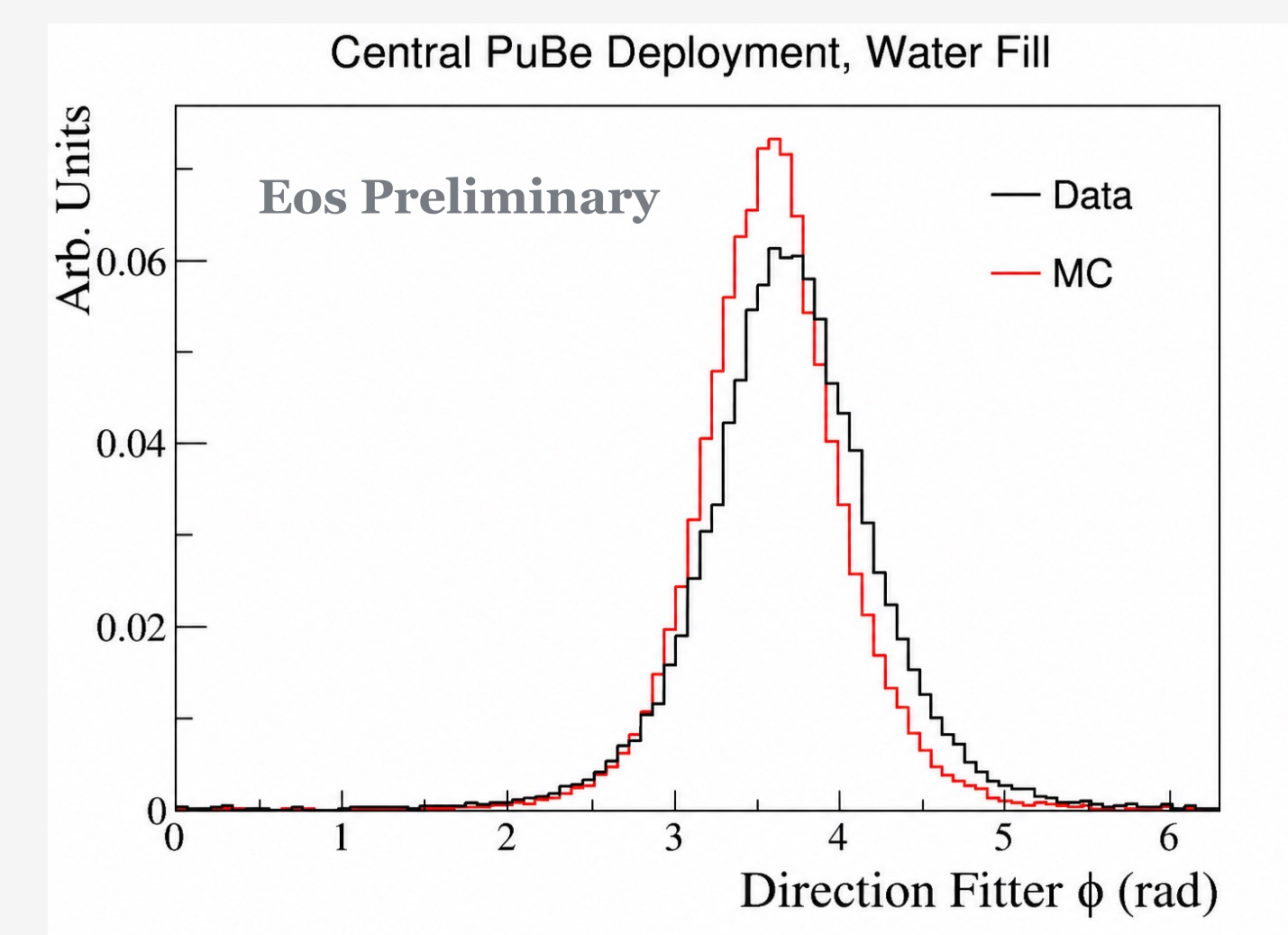
Central PuBe Deployment, Water Fill



Eos Preliminary

Excellent Data-MC agreement

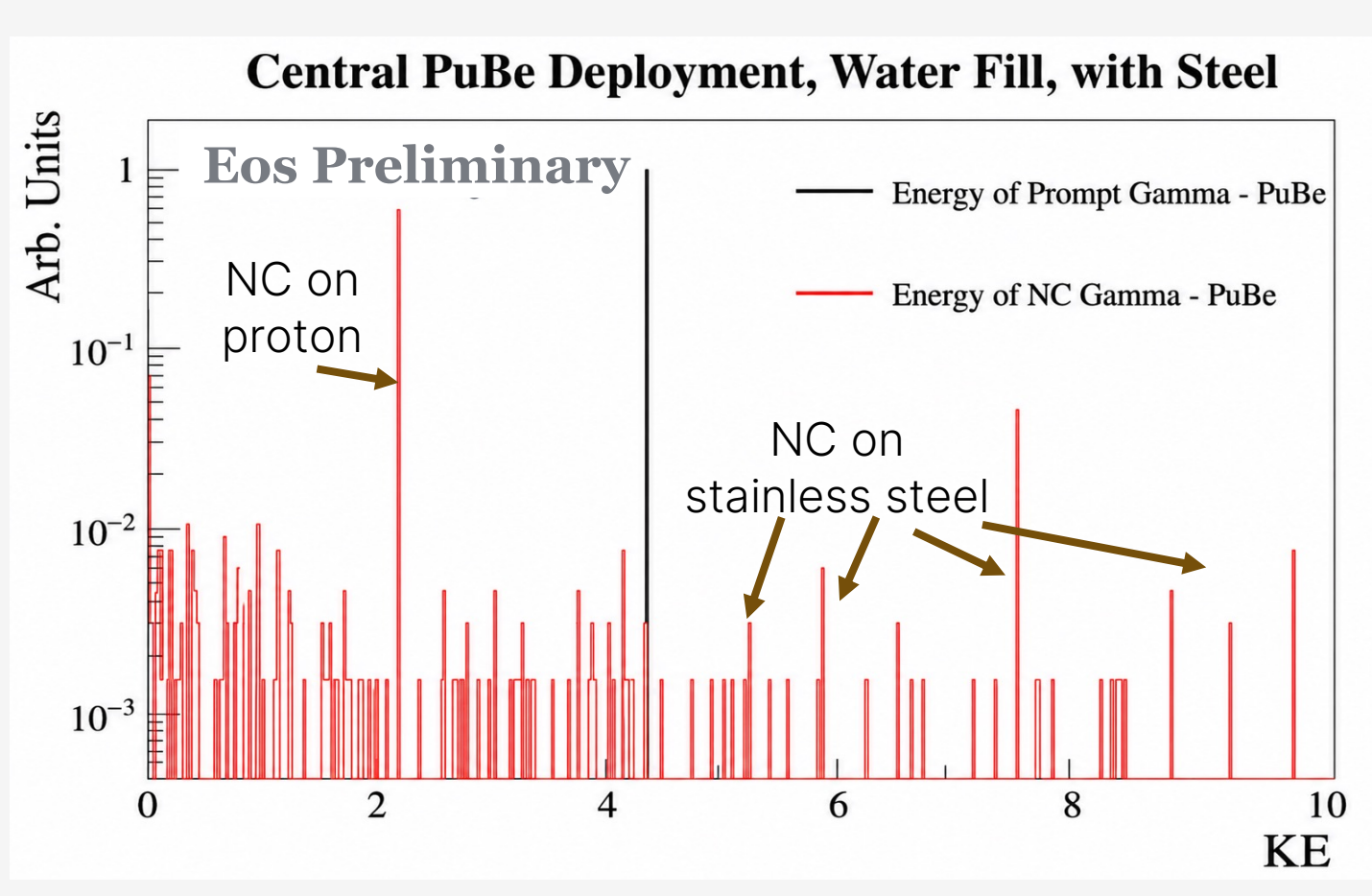
Central PuBe Deployment, Water Fill



Eos Preliminary

Offset in ϕ peak \rightarrow identified unmodeled detector rotation

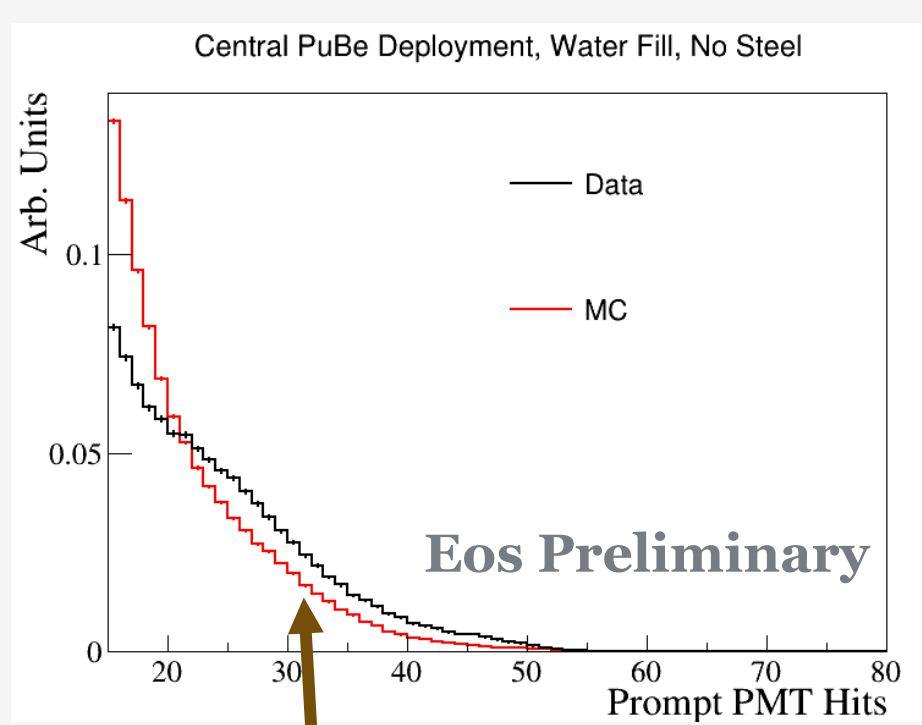
Simulated Geometry



Central PuBe Deployment, Water Fill, with Steel

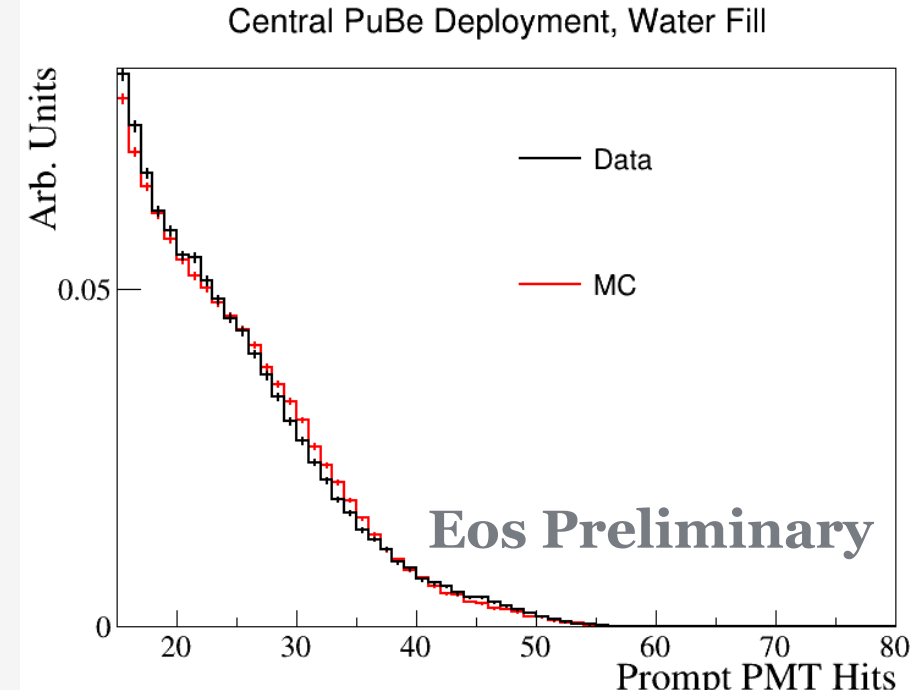
Free neutron captures on materials from deployment rod to IV \rightarrow probes detector geometry

Under-prediction of 4-10 MeV γ -rays



Central PuBe Deployment, Water Fill, No Steel

Including PMT support structures

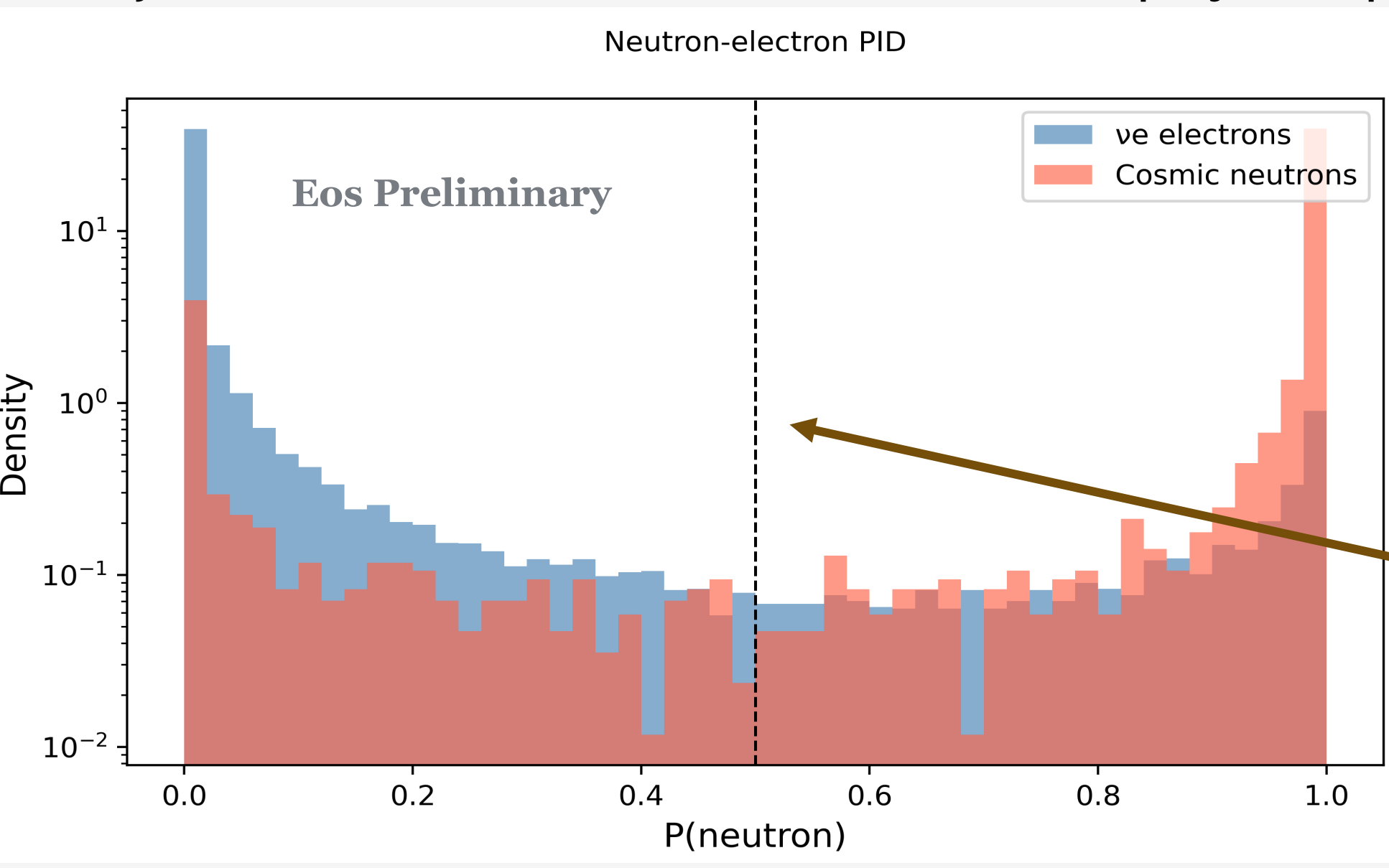


Central PuBe Deployment, Water Fill

Removing Backgrounds at the SNS

Capable background rejection enables broad surface-level physics program

- Demonstration of hybrid technology
- First-ever CC ν_e O16 cross-section measurements at SN energies
- BSM physics at O(10 MeV) regime



Preliminary ML-based PID model

Cut yields 96% accuracy

See for more info: Eos at the Spallation Neutron Source – Jason Newby
Background Rejection for Eos@SNS – Hasung Song

Acknowledgements

Eos is supported by the U.S. Department of Energy under Contract DE-AC02-05CH11231. Funded by the National Nuclear Security Administration, Office of Defense Nuclear Nonproliferation Research and Development (DNN R&D).

The author is supported by the U.S. DOE Office of High-Energy Physics under award DE-SC-0023527.

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