

# The Deployment and Performance of COHERENT D2O Detectors

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on behalf of the COHERENT collaboration

## Precision CEvNS

*a key to opening new physics*

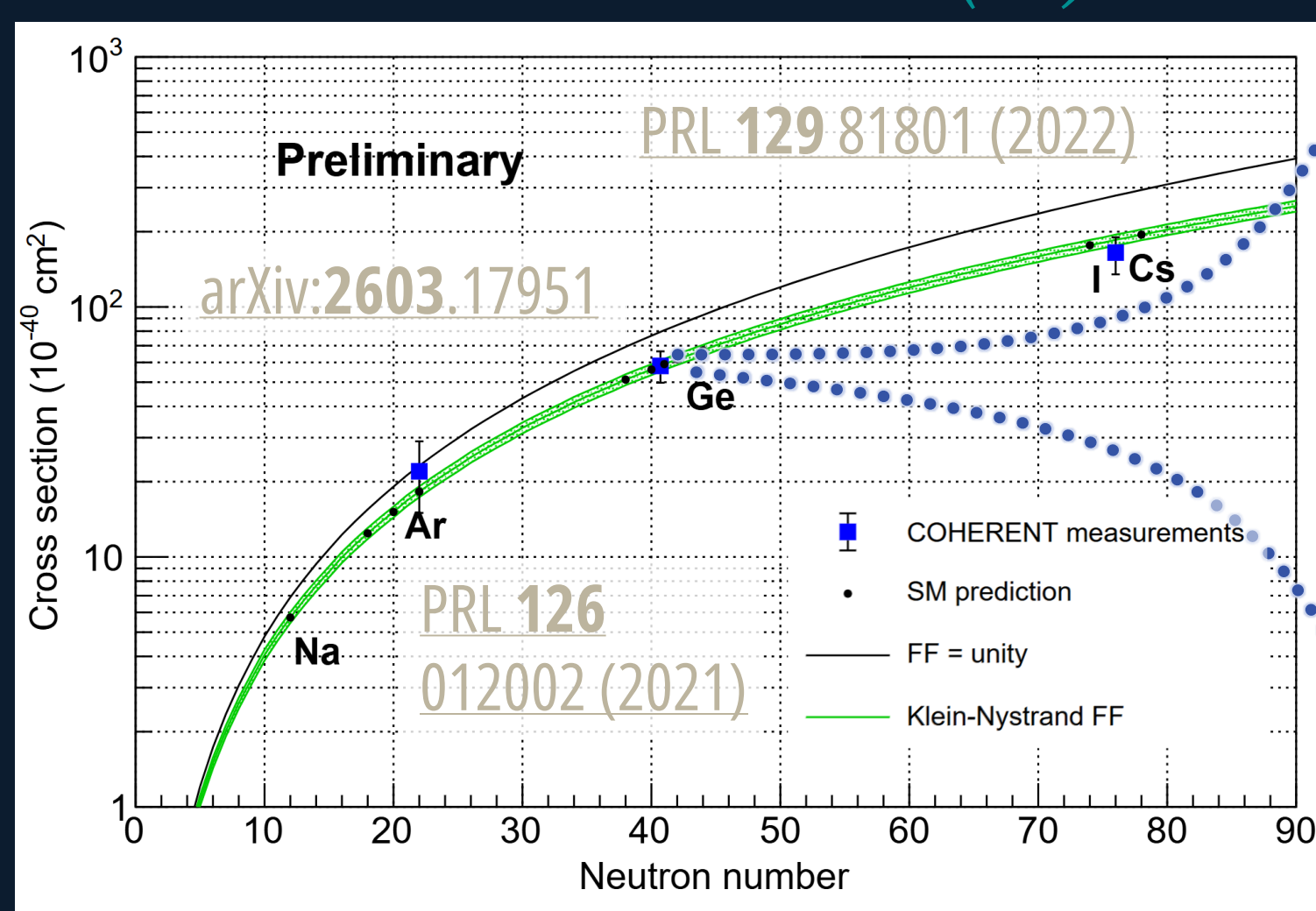


- For the first time, COHERENT detected CEvNS events

*coherent elastic  $\nu$ -nucleus scattering*

- using the pulsed  $\nu$  source from SNS at ORNL.

*$O(10)$  MeV spallation neutron source*



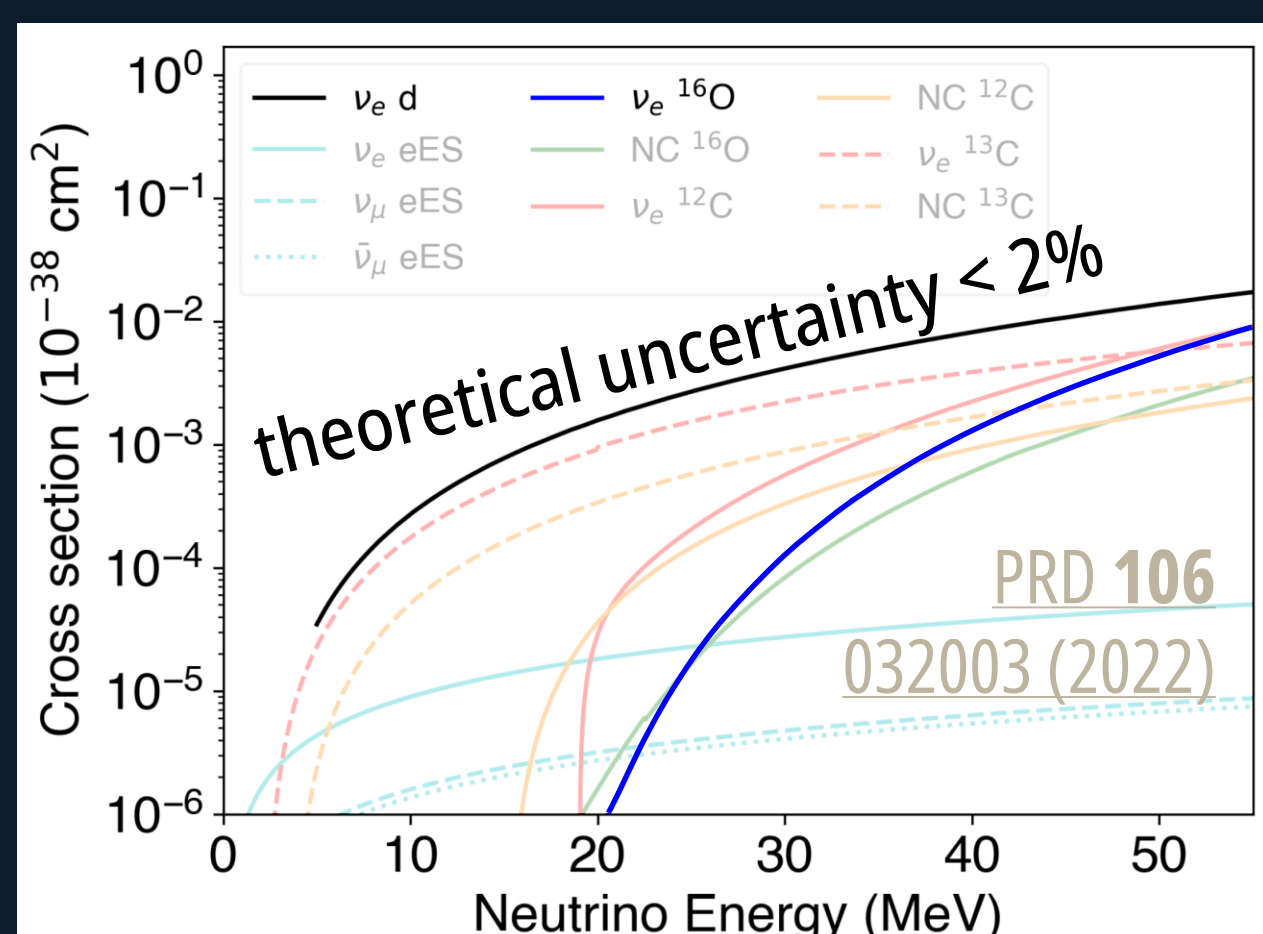
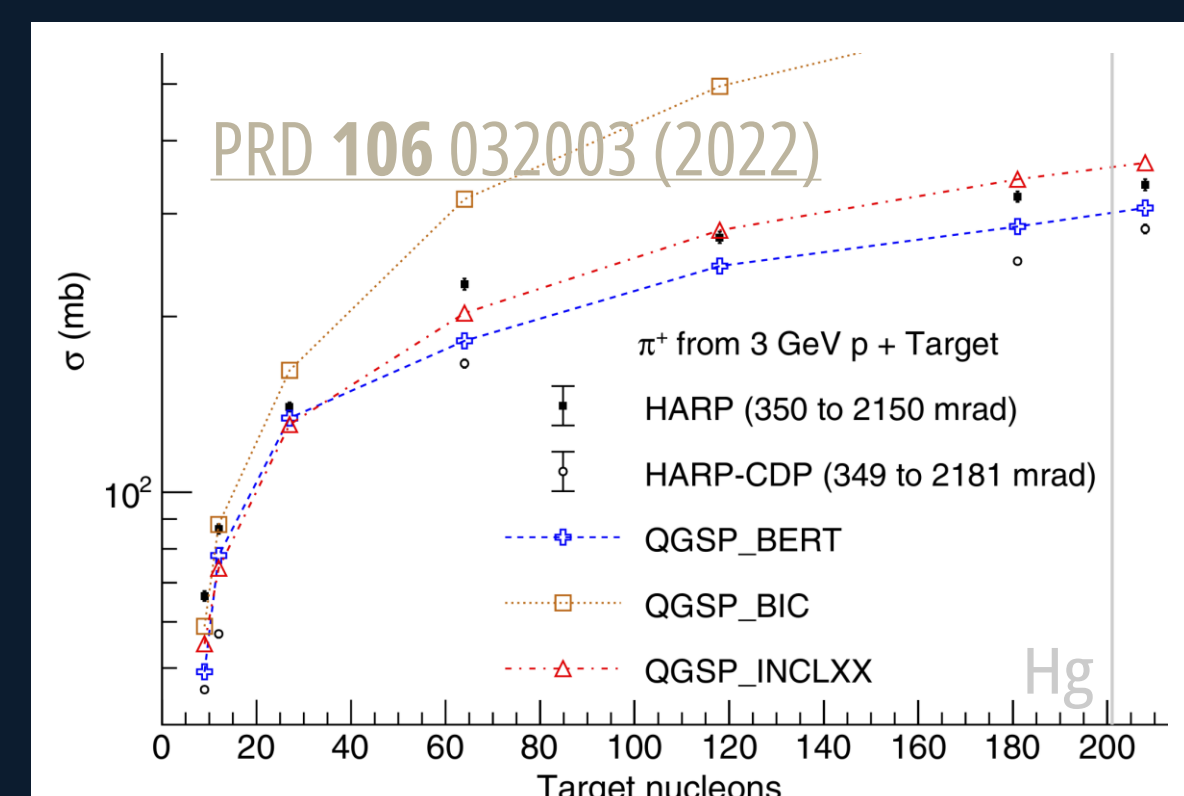
$\sigma_{Ge}^{CEvNS}$ uncertainty	effect
statistical error	10%
baseline distance	0.5%
energy calibration	0.8%
active detector mass	2.0%
nuclear form factor	0.8%
quenching factor	0.7%
<b>Neutrino Flux</b>	<b>10%</b>

**BOTTLENECK**

## Flux Normalization

*missing piece for precise CEvNS*

- SNS  $\nu$  flux is estimated by Geant4, which relies on hadronic physics. *uncertain for 1 GeV protons*
- Want to measure the flux directly, but how?



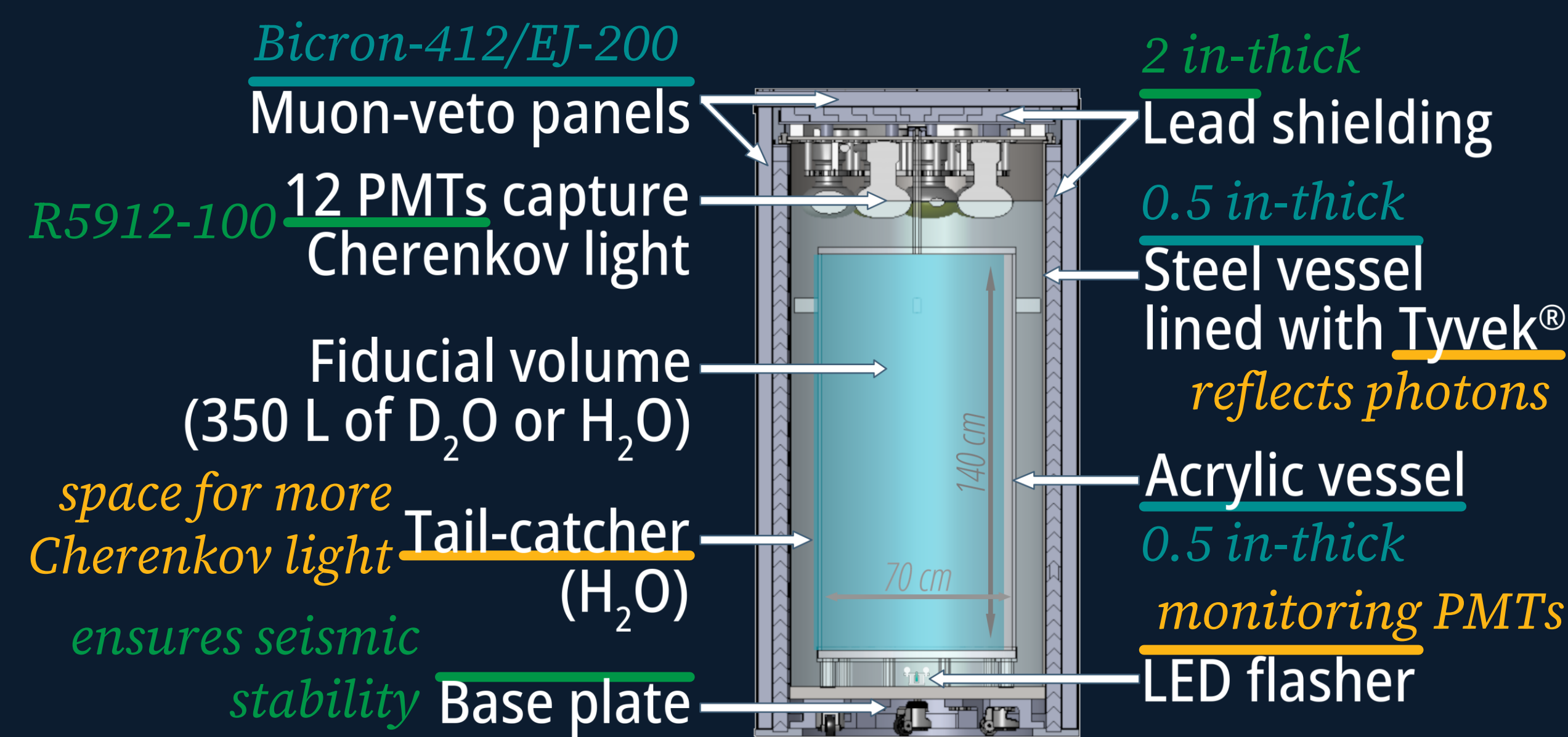
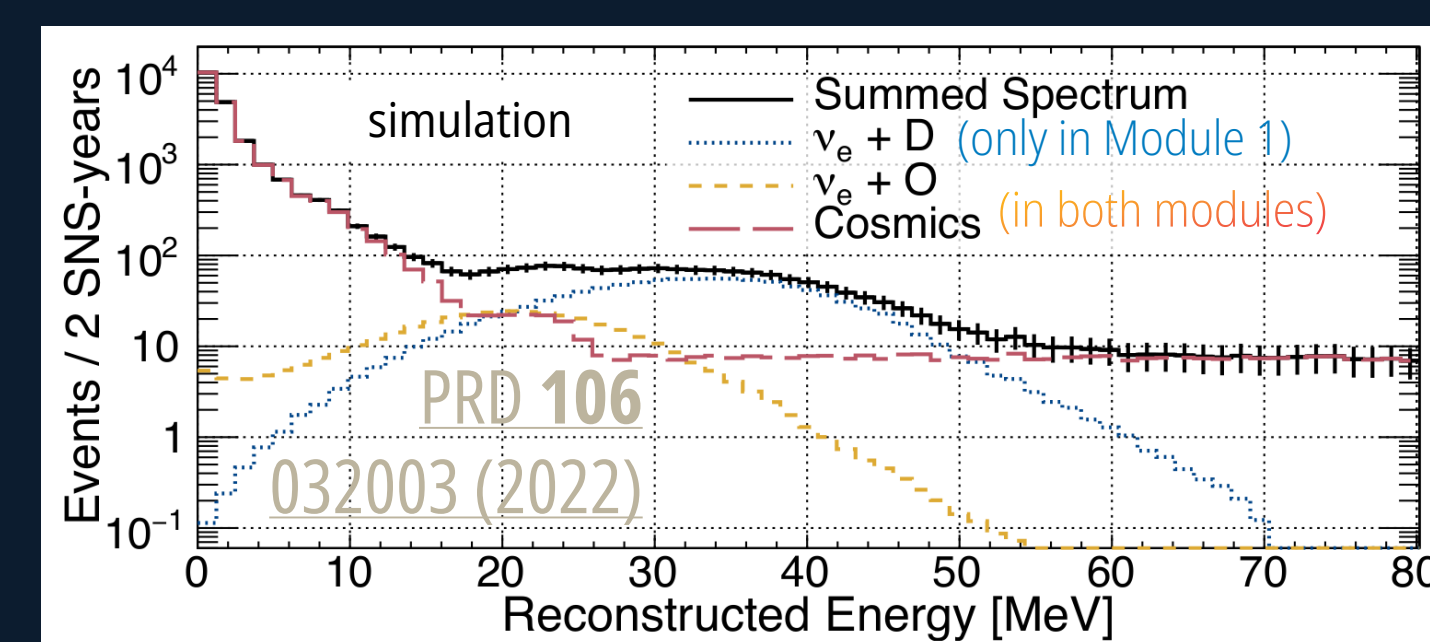
- D<sub>2</sub>O is promising!
- Use the well-studied  $\nu_e + d \rightarrow p + p + e^-$  interaction.
- Also detect  $\nu$ -O CC events,  $\nu_e + {}^{16}\text{O} \rightarrow {}^{16}\text{F}^* + e^-$  which will be useful for supernova detection. *arXiv:1805.04163*

**Let's Turn Uncertainty into Certainty!**

## D2O Detectors

*two twins at Neutrino Alley*

- Two heavy/light water Cherenkov detectors have been deployed at Neutrino Alley, ORNL. *home of COHERENT*
- They are mechanically identical, so they share the background.
- Only the material in the fiducial volume is different.



## Installation

*the precision era just started*

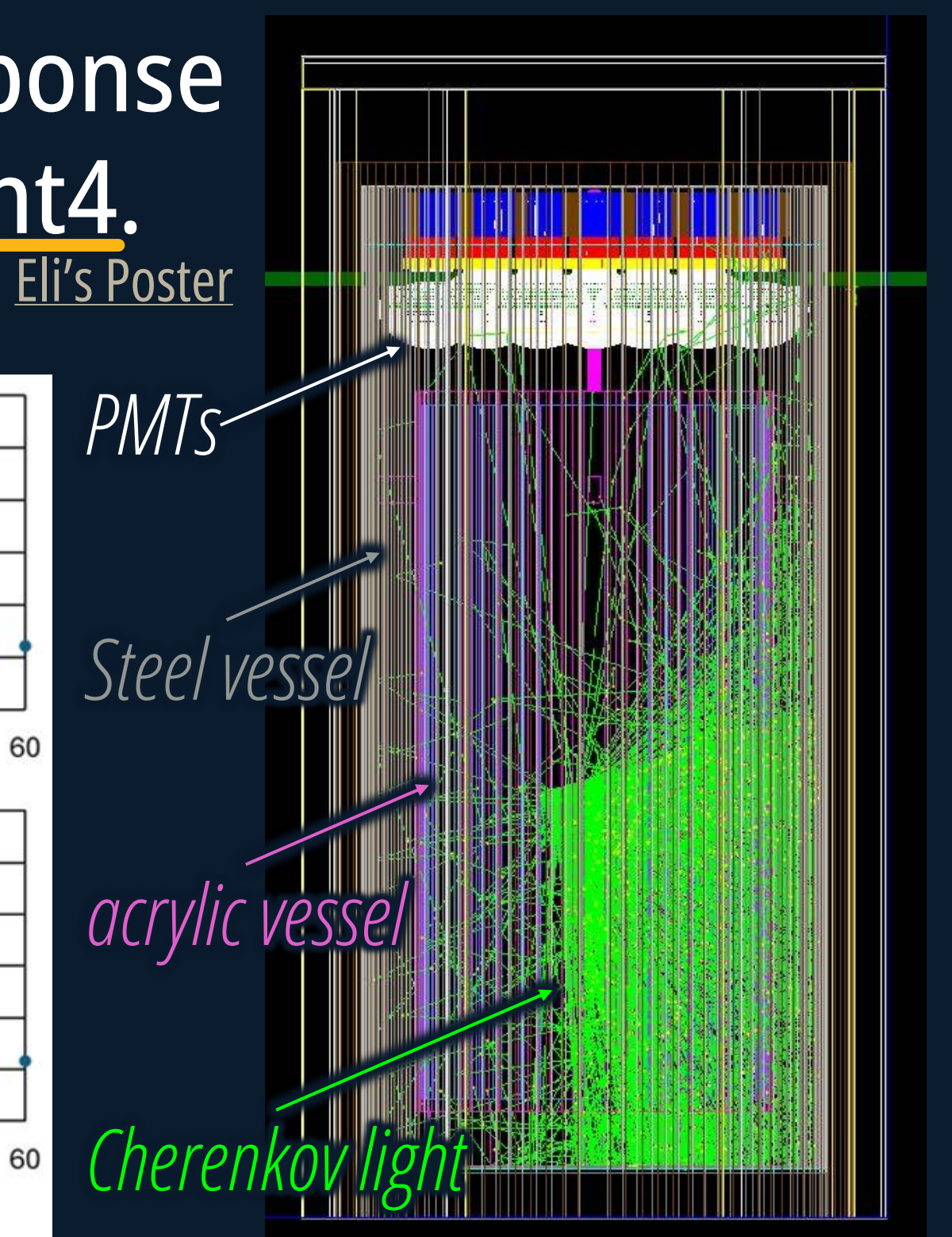
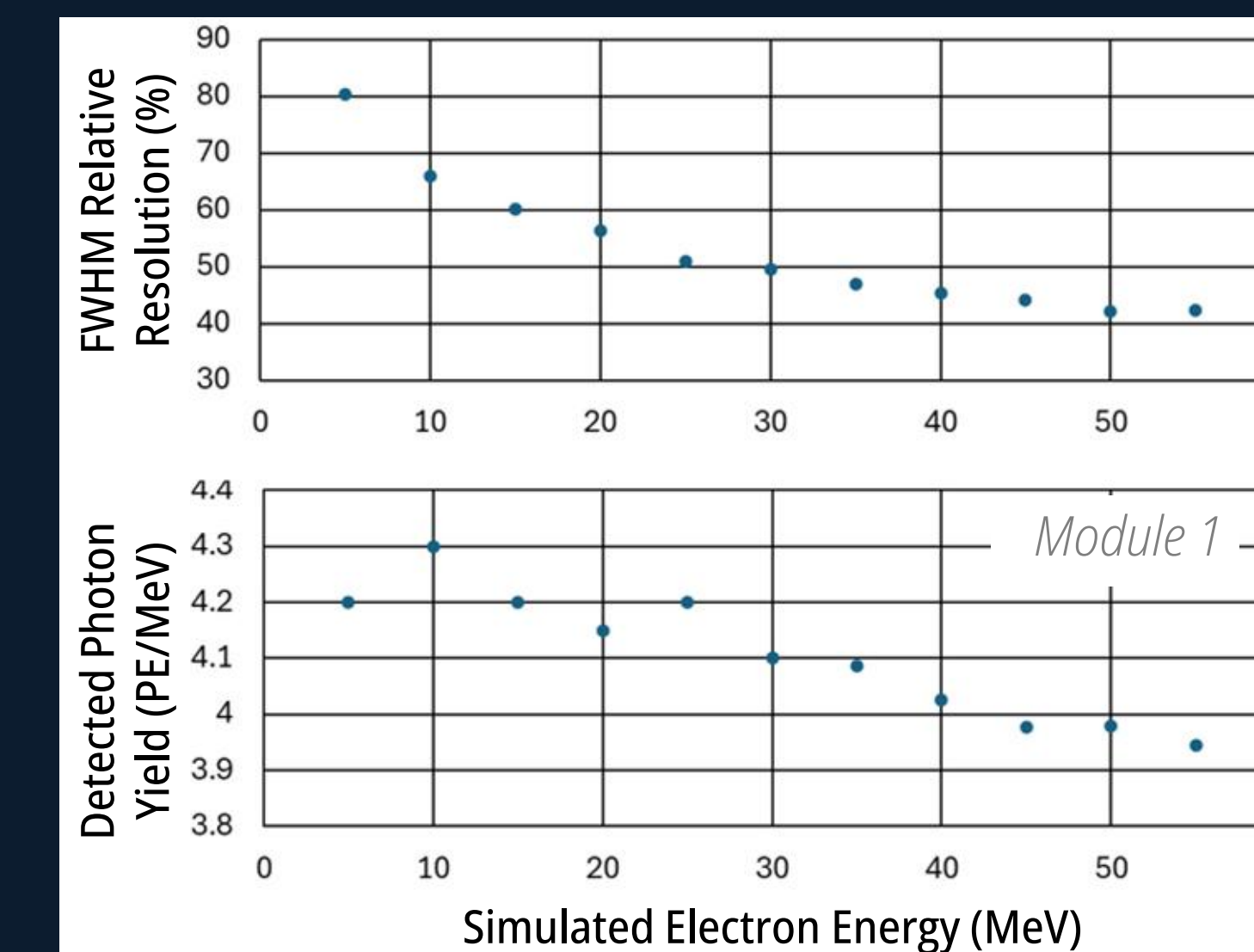
- Installation is complete!
- They have been taking data stably.
  - Module 1 since July 13, 2023, with more than 75% uptime.
  - Module 2 since January 21, 2026! *very new!*



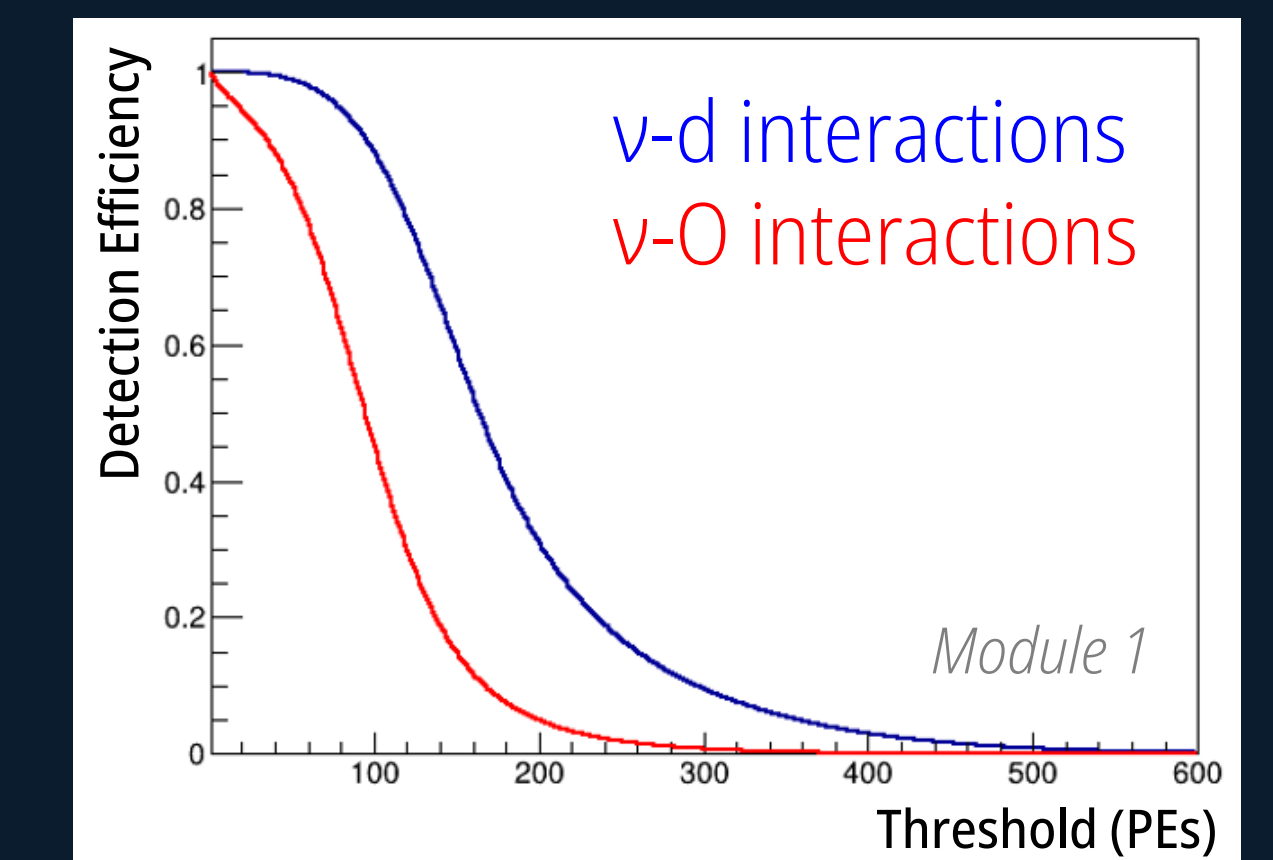
## Initial Performance

*resolution, efficiency, & muon-veto*

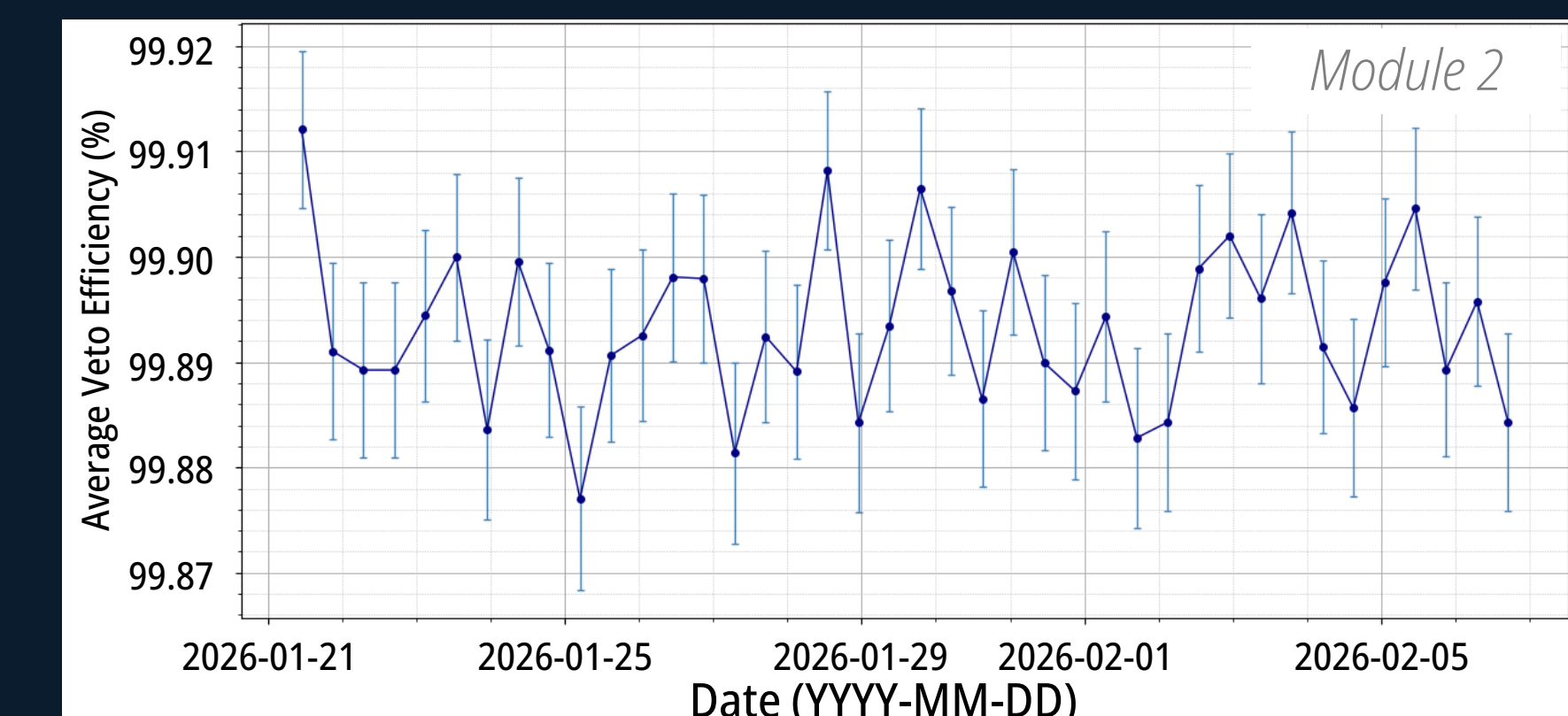
- The detector energy response was estimated with Geant4. *tuned using Michel electrons Eli's Poster*



- High efficiencies are expected for  $\nu$ -d and  $\nu$ -O interactions.
- Energy linearity, resolution, and efficiency meet the design-level goal!



- Cosmic muon rejection is efficient and stable.



- The muon-veto efficiency is stable at ~99.9%. Great!
- Hardware paper is in preparation.

**For the Module 1 First-Year Data Analysis, See Eli Ward's Poster #179!**