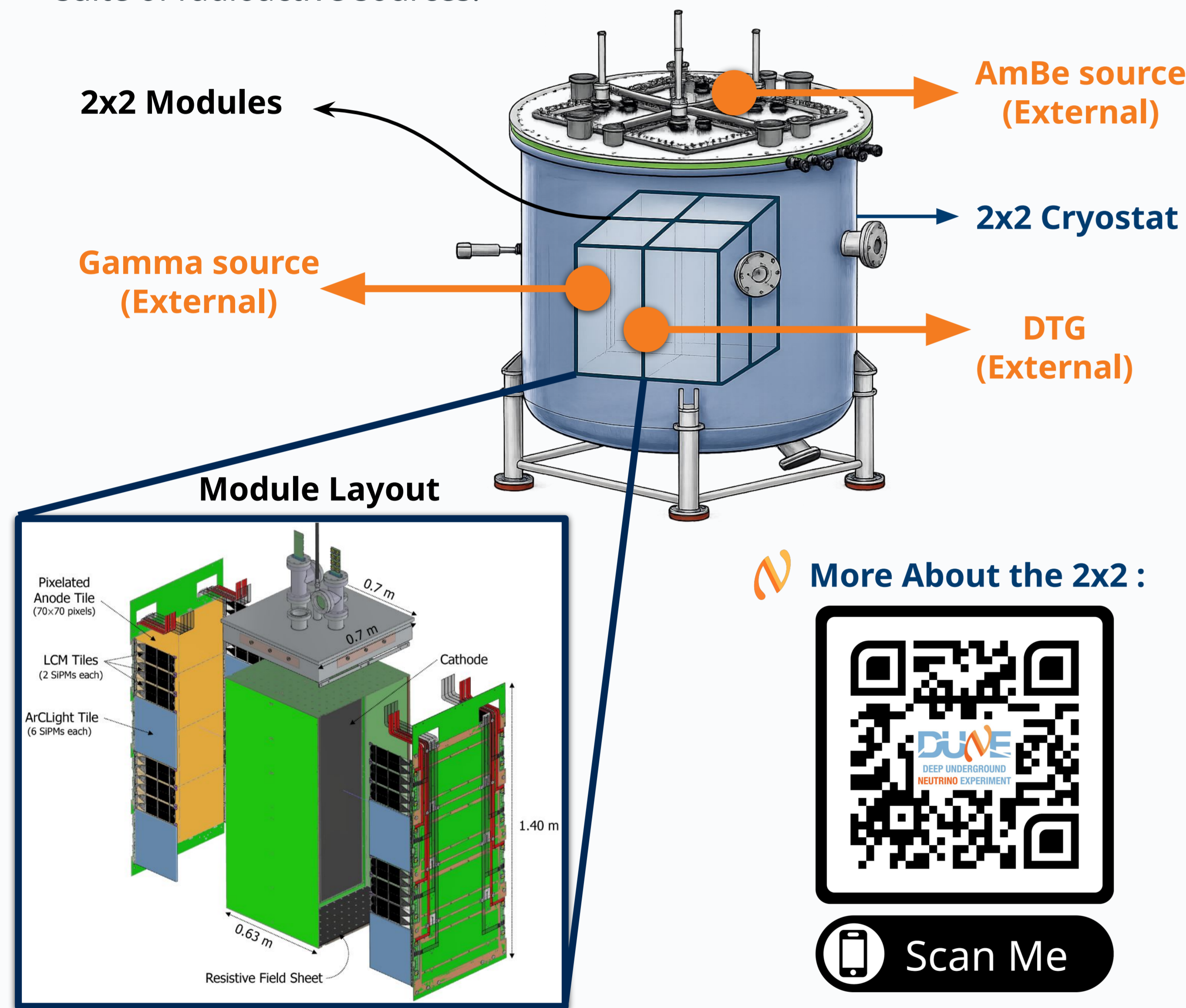


1. Introduction: The 2x2 Demonstrator

- It is a prototype of the future DUNE Near Detector liquid argon time projection chamber (ND-LAr) at Fermilab. It comprises four detector modules, each containing two time projection chambers (TPCs).
- Novel technology:** It has a pixelated charge readout, and arrays of light traps on each TPC enabling excellent spatial and temporal resolution.
- This poster presents preliminary results from **Run 2** data collected with a suite of radioactive sources.



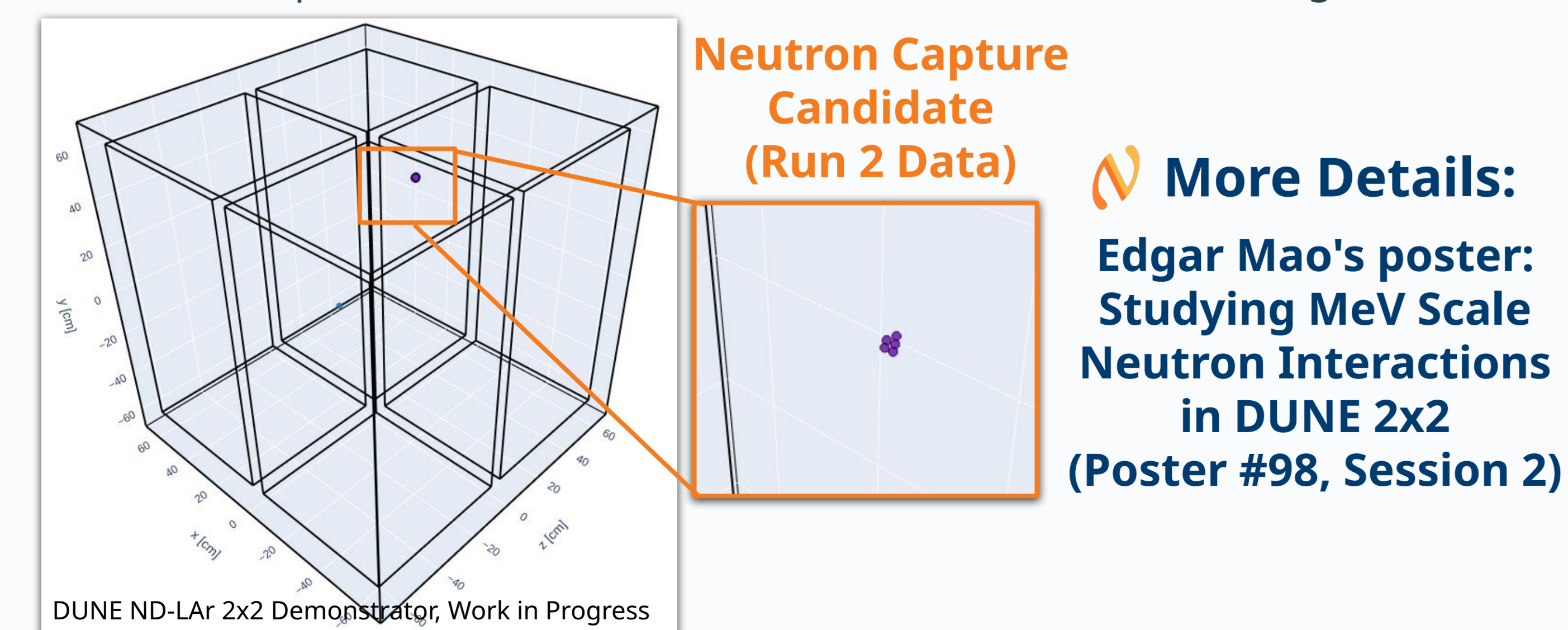
More About the 2x2 :



Scan Me

2. AmBe Source: Neutron Captures

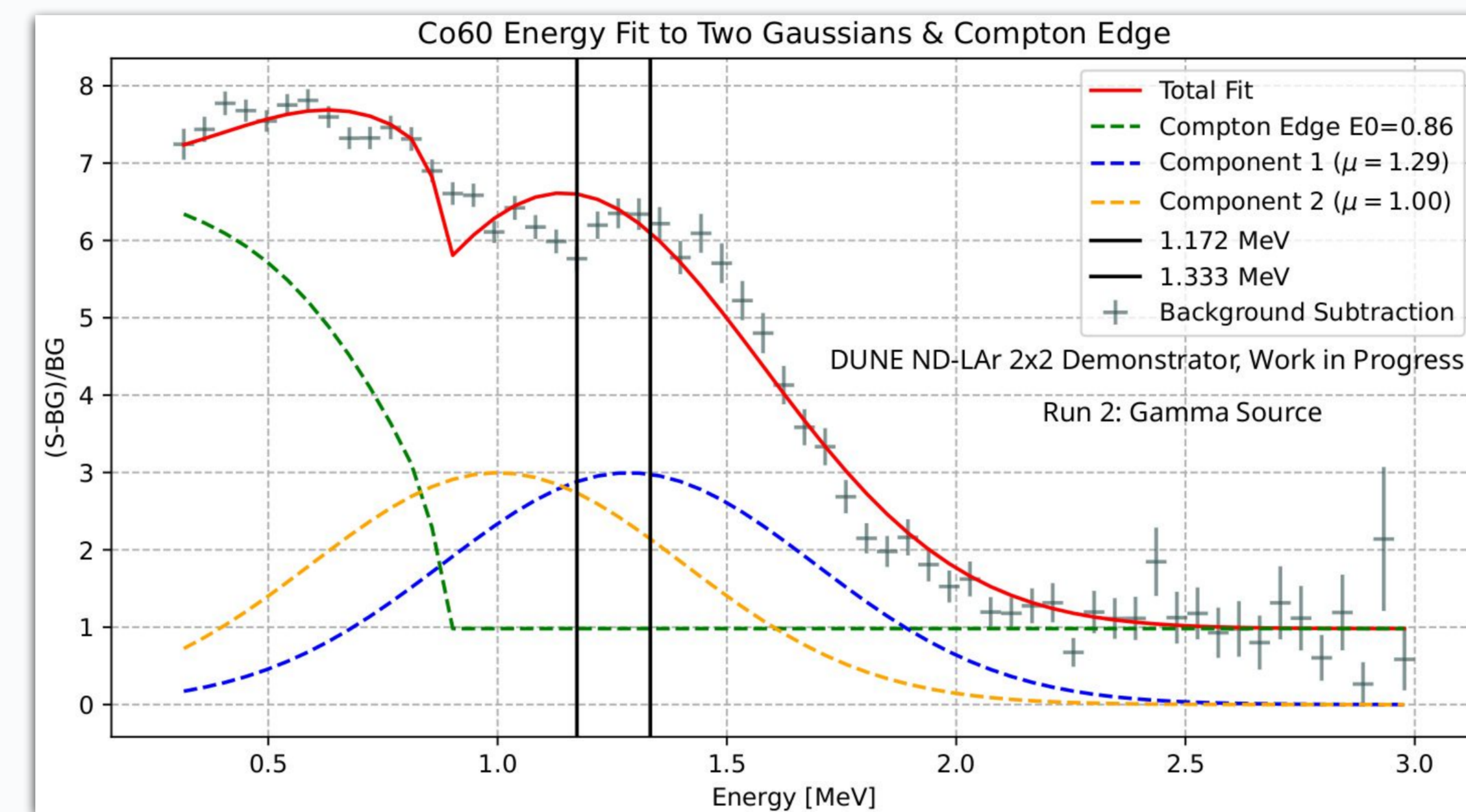
- An Americium-Beryllium (AmBe) source was deployed on top of the 2x2 cryostat. This source produces tagged neutrons.
- Neutron Captures in Ar-40 are reconstructed as clusters of charge hits



More Details:
Edgar Mao's poster:
Studying MeV Scale
Neutron Interactions
in DUNE 2x2
(Poster #98, Session 2)

3. Gamma Sources: Probing Low Thresholds

- A set of gamma sources was deployed externally: Na-22, Co-60 and Y-88.
- Reconstruction of signals produced by Compton scattered electrons.
- In the figure below: Reconstructed energy of Co-60 gammas using the 2x2 charge readout. Co-60 produces two gammas of 1.17 MeV and 1.33 MeV.

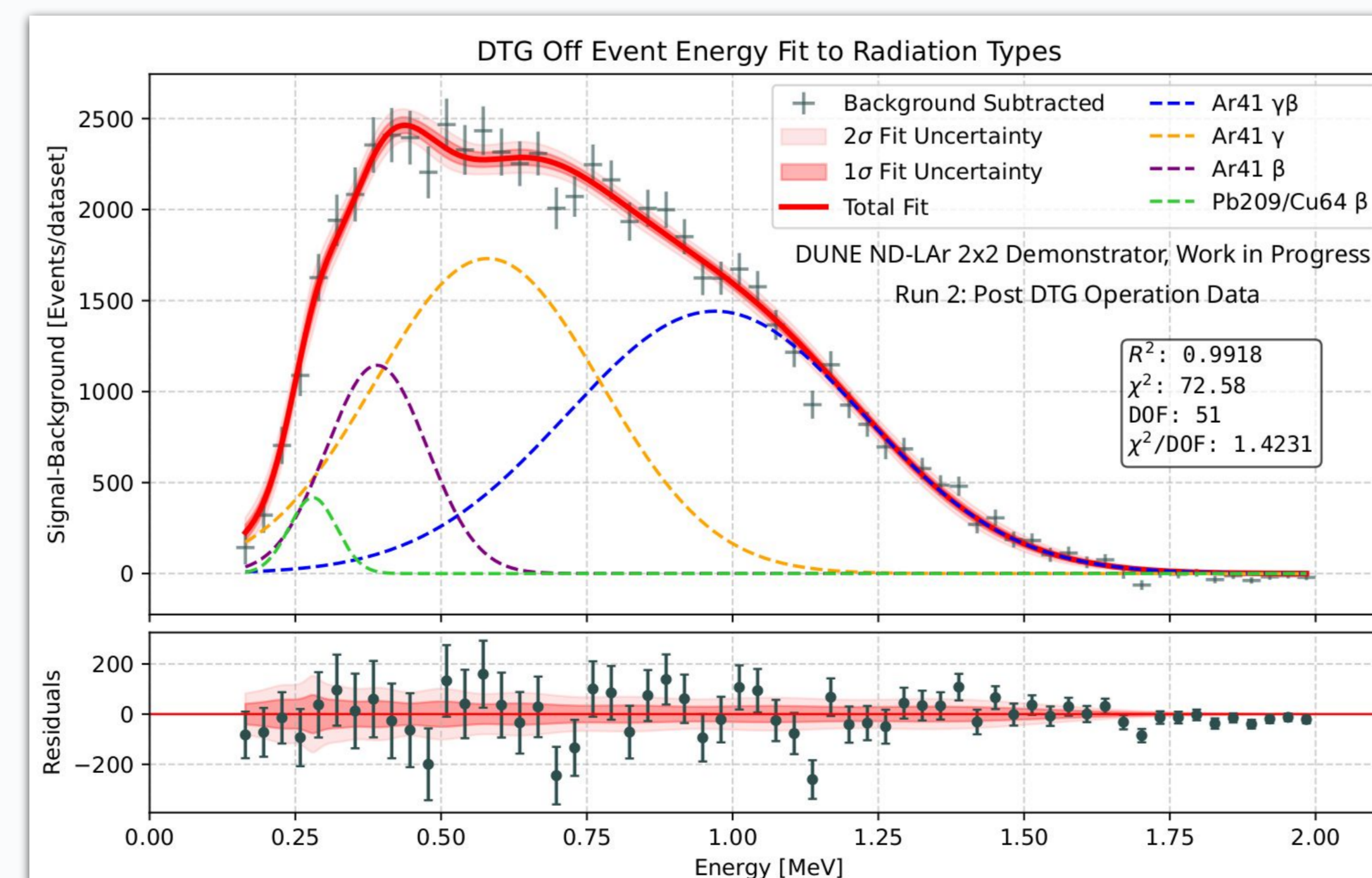


Key takeaways:

- This study allowed the reconstruction of signals down to 500 keV.
- Useful for detector calibration and has the potential to **improve neutrino energy reconstruction** and sensitivity to **low-energy BSM** signals.

4. Neutron Irradiation: Nuclear Activation

- The 2x2 was exposed to a high-intensity beam of neutrons from a Deuterium-Tritium Generator (DTG).
- In the figure below: The reconstructed charge readout energy spectrum of activity observed after the DTG run. Several **radioisotopes were identified**.

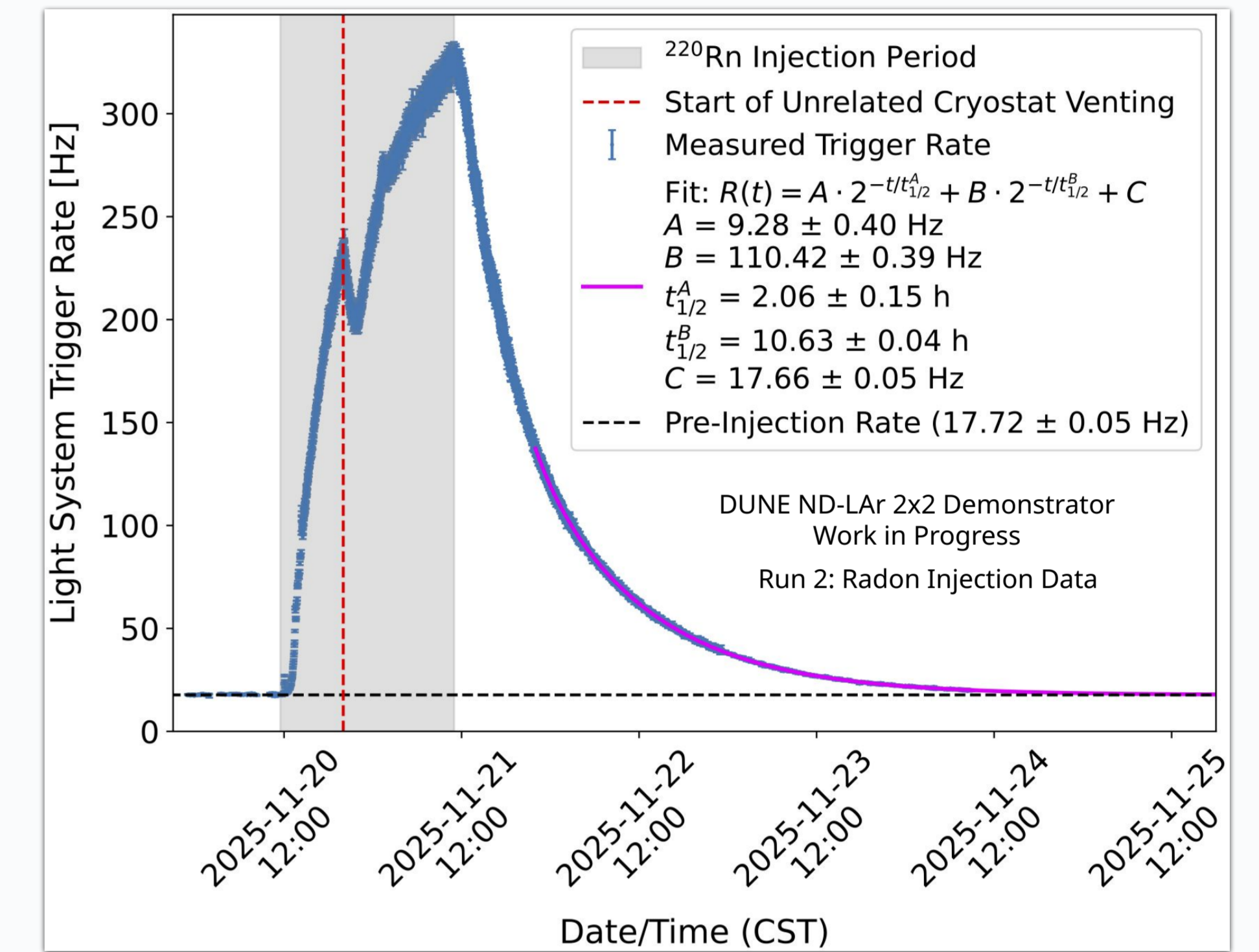


Key takeaway:

- This study provides complementary **evidence** of the 2x2 capabilities to reconstruct **low-energy signals**.

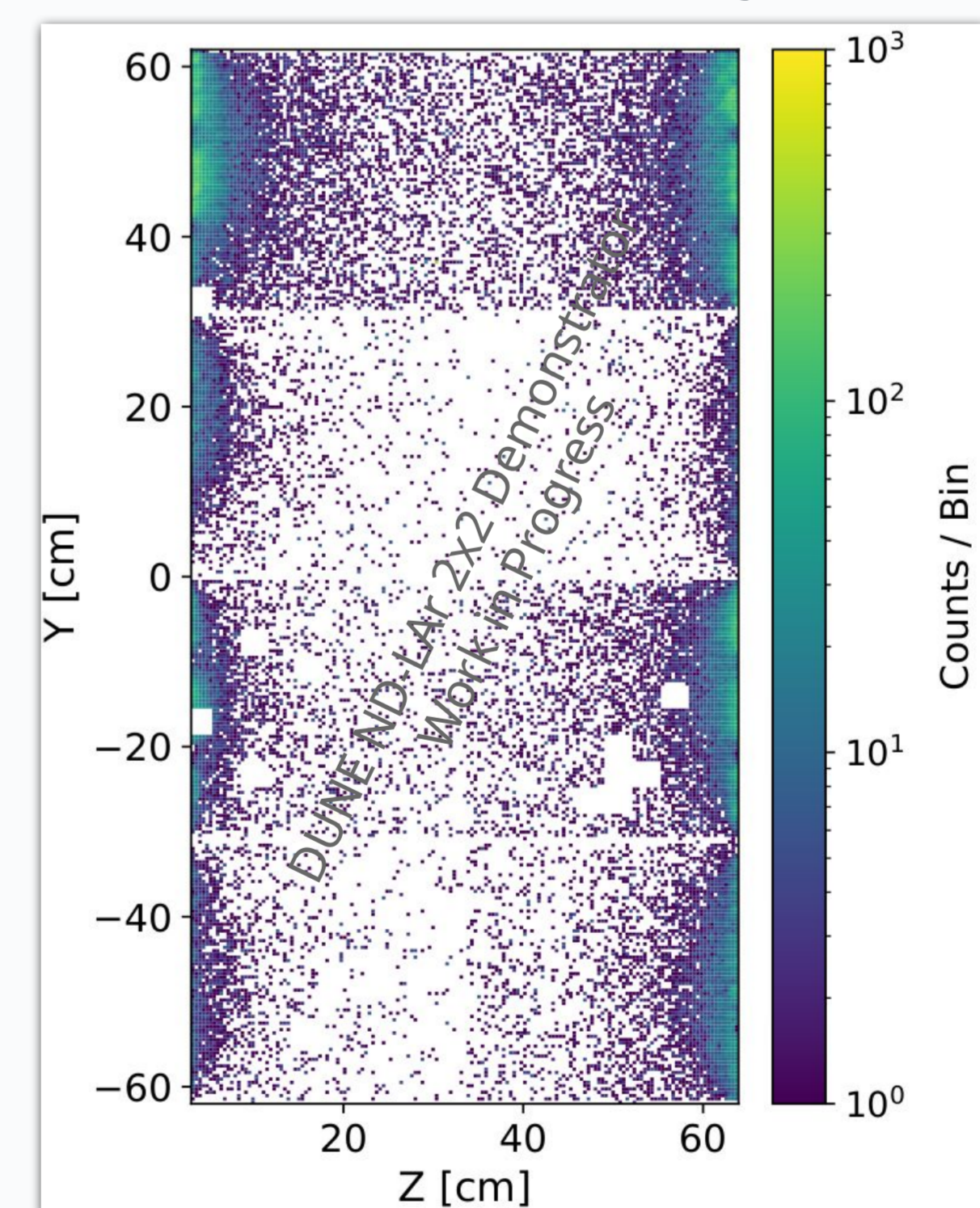
5. Radon Injection: Reliable Calibration Method

- The 2x2 liquid argon volume was injected with Rn-220.
- The figure below depicts the increase in the rate of self-triggers recorded with the 2x2 light readout system during the injection period.

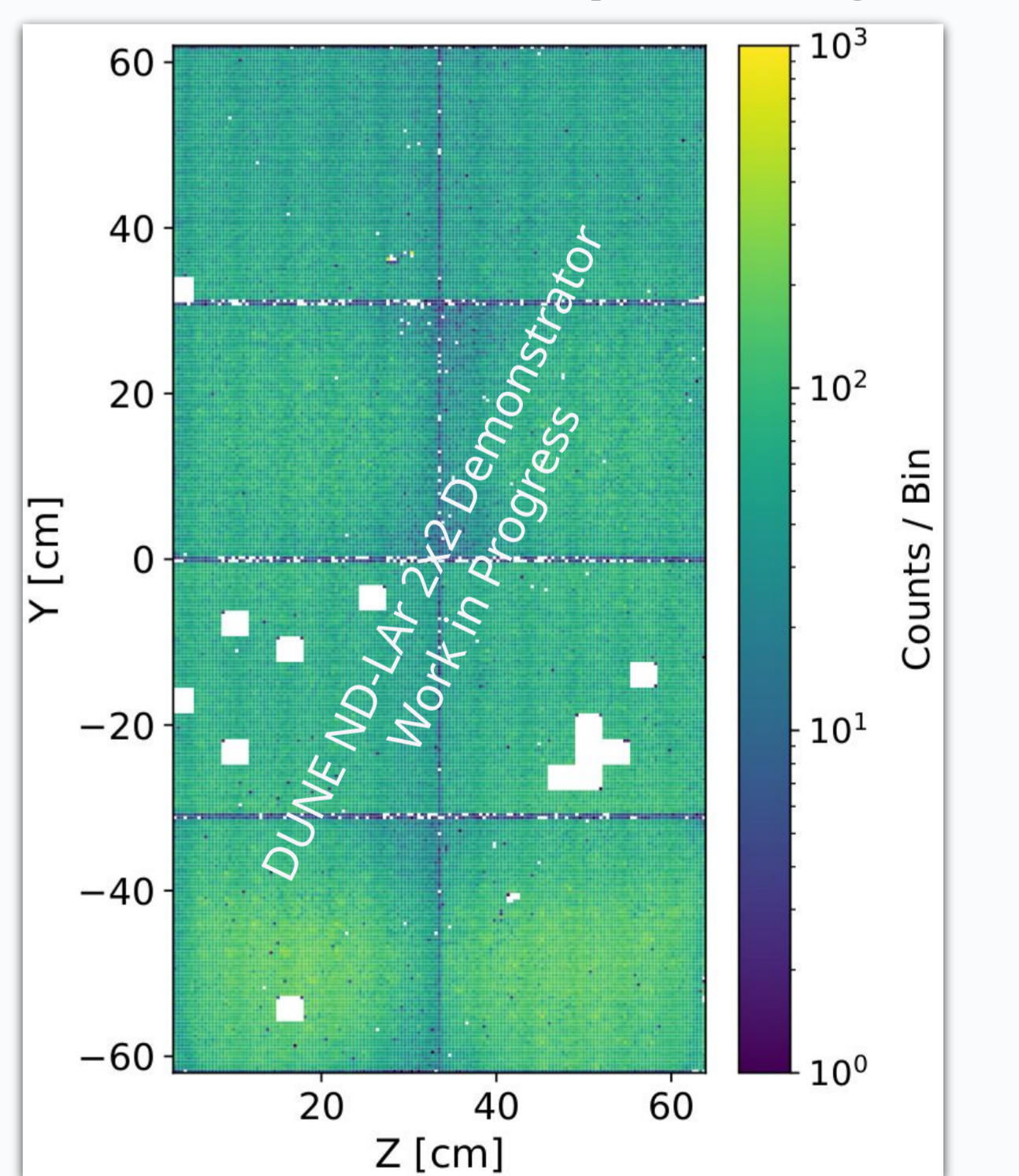


- The ratio of the prompt to the total scintillation light (**fprompt**) is useful to distinguish electron recoils from alpha particles produced by Rn-220.

Low fprompt Events
(Consistent with Pre-injection)



High fprompt Events
(Consistent with alpha decays)



Key takeaways:

- This calibration method provides signals uniformly distributed throughout the detector volume, enabling detailed measurements of the **electron lifetime**, **space charge distortion** and **drift velocity**.
- A paper on this analysis is in preparation, **stay tuned!**