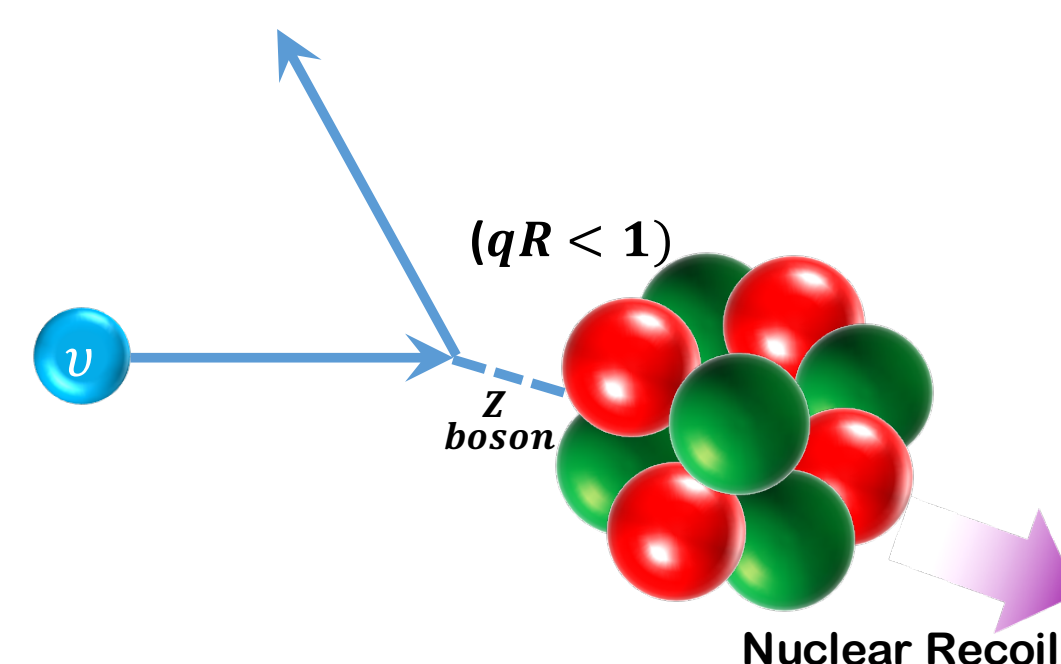
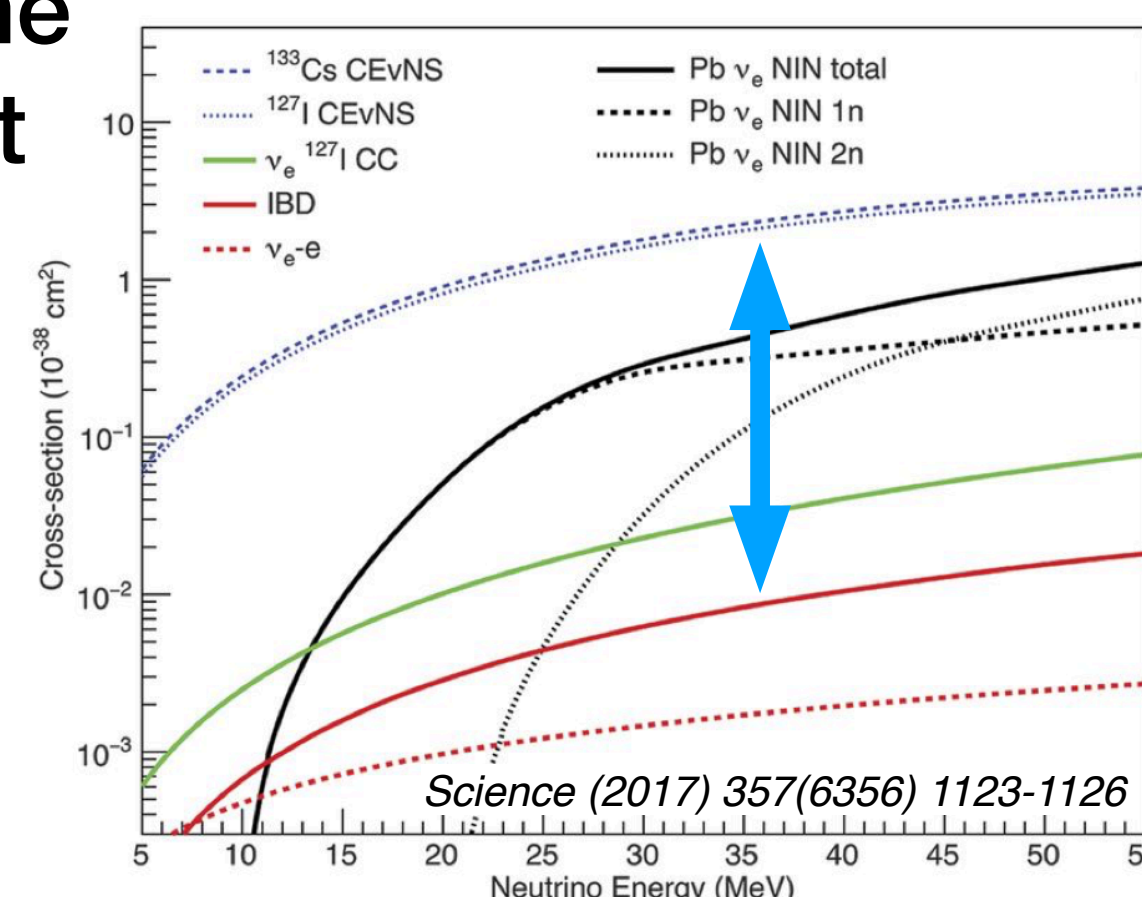


Coherent Elastic Neutrino Nucleus Scattering (CEvNS)

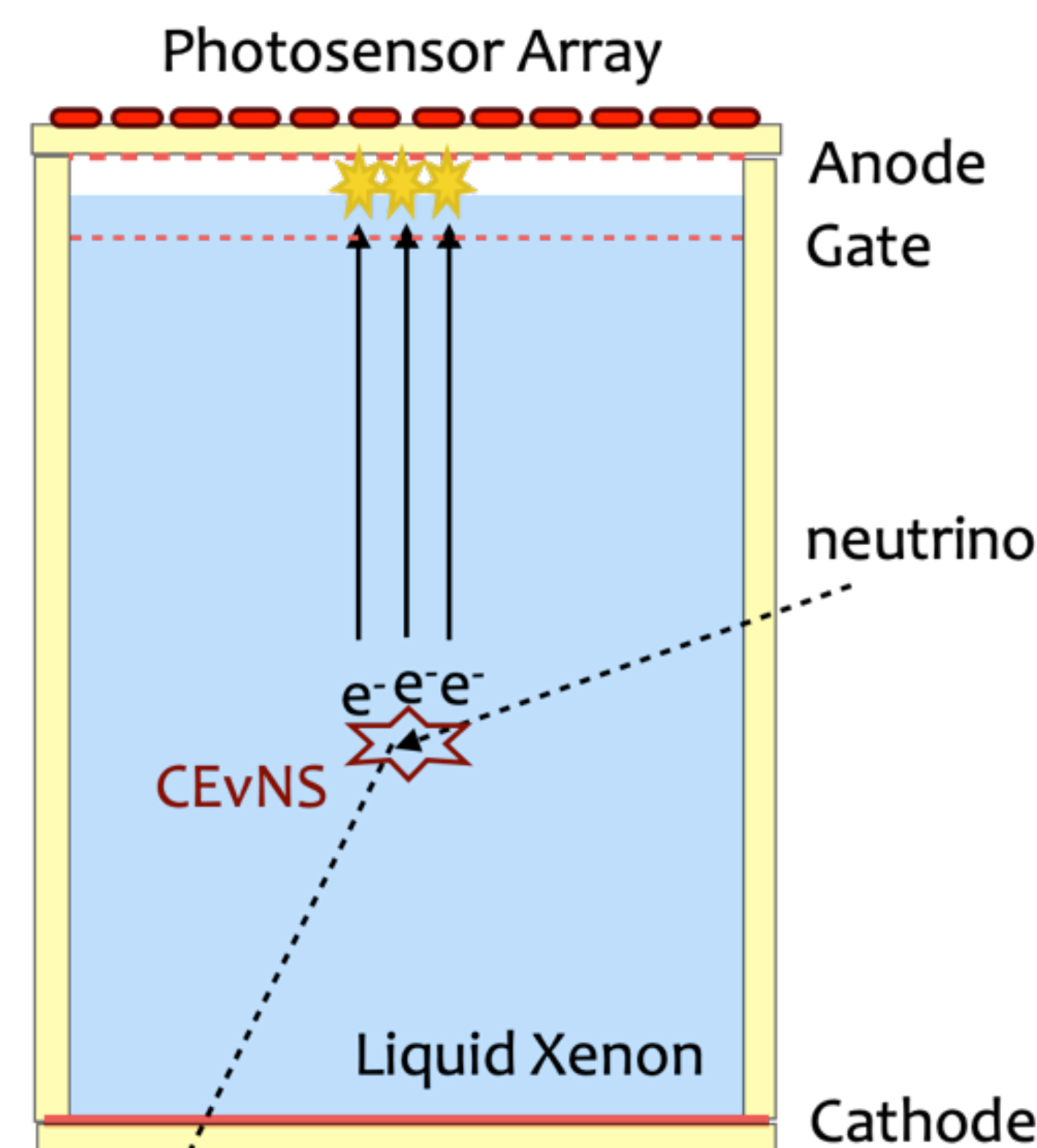
- ♦ Predicted by D. Freedman in 1974.
- ♦ The neutrino sees the nucleus as a whole rather than individual nucleons.
- ♦ Insensitive to neutrino flavor, and threshold-less.



- ♦ Cross section is proportional to N^2 , ~1000 higher with respect to inverse beta decay.
- ♦ BUT, recoil energy is low due to the small momentum transfer at coherent condition. It's hard to detect!
- ♦ First observation by the COHERENT experiment in 2017. More precise measurement is of interest for new physics and applications.



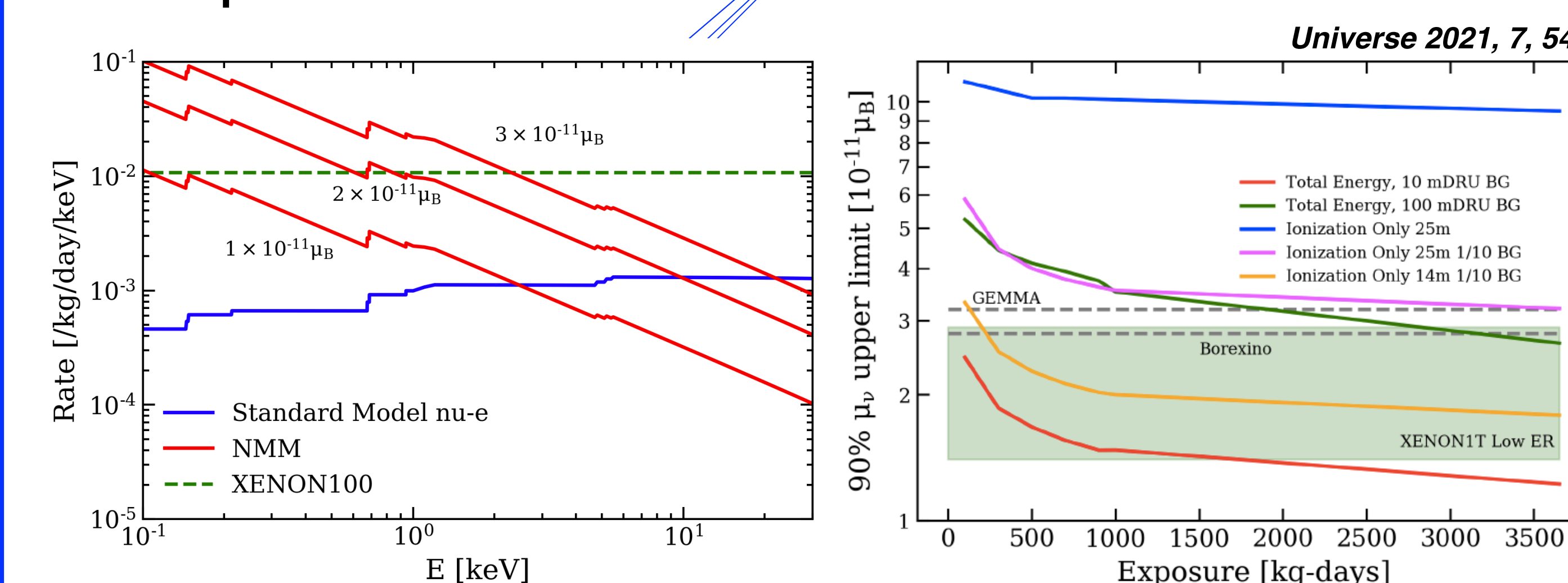
Single-Electron Sensitive Liquid Xenon Detector



- ♦ Particle interaction in liquid xenon (LXe) produce:
 - ♦ prompt scintillation (S1)
 - ♦ delayed ionization (S2)
- ♦ “ionization-only” detection technique is “single-electron (SE)” sensitive, and can reach nuclear recoils down to 300eV.
- ♦ A liquid xenon detector operated in SE counting mode can detect hundreds of neutrinos/100kg/day.

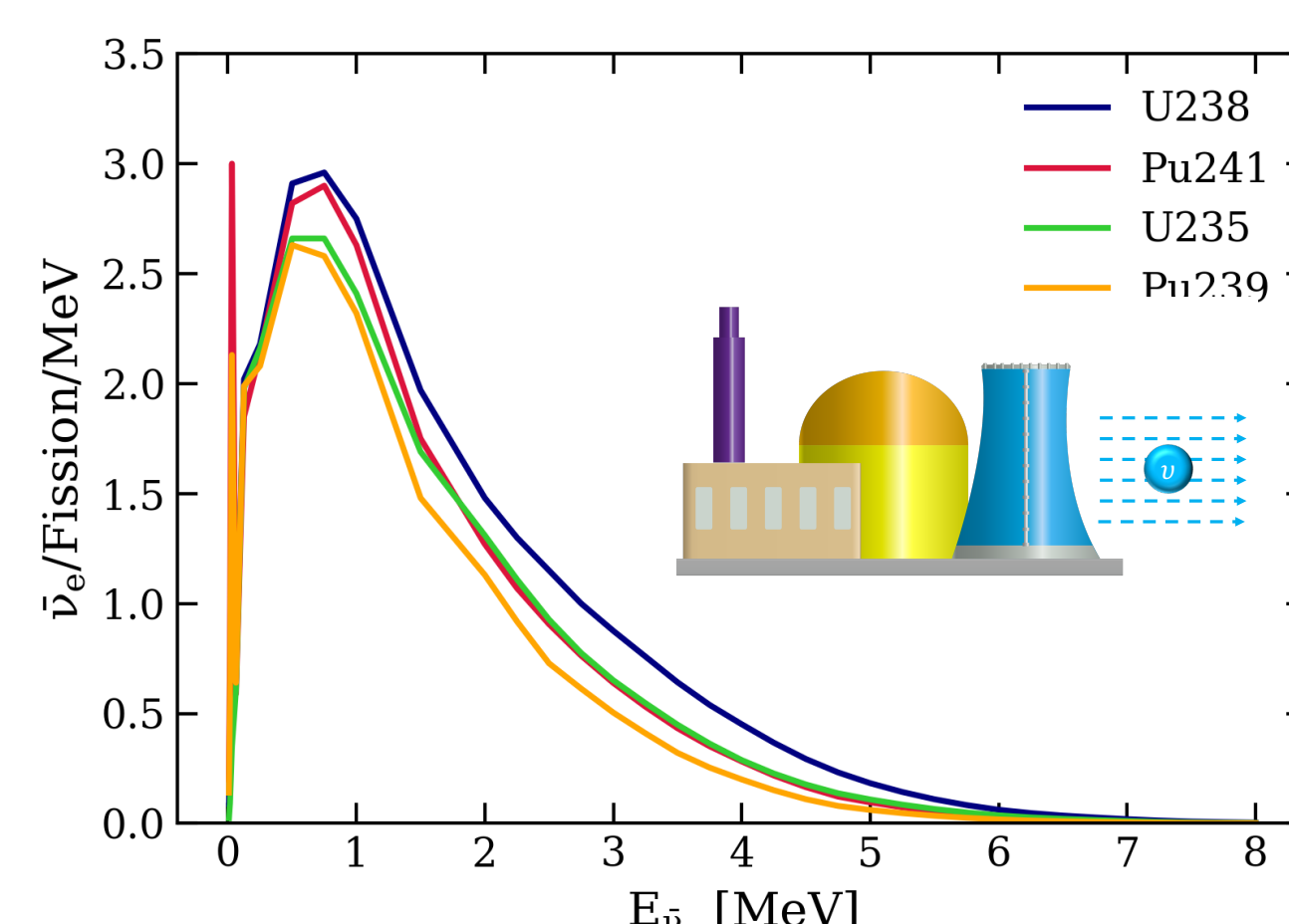
New Physics Search with Reactor Neutrinos

- ♦ Benefits from its low energy threshold and the capability of suppressing electronic recoil background at keV energy region, the LXe detectors can also probe new physics beyond the Standard Model, including neutrino magnetic moment (NMM), neutrino electric millicharge, neutrino non-standard interactions and sterile neutrinos etc.
- ♦ Using NMM as an example, A 90% upper limit of $10^{-11} \mu_B$ can be achieved with about 3500 kg-day of exposure near the reactor.

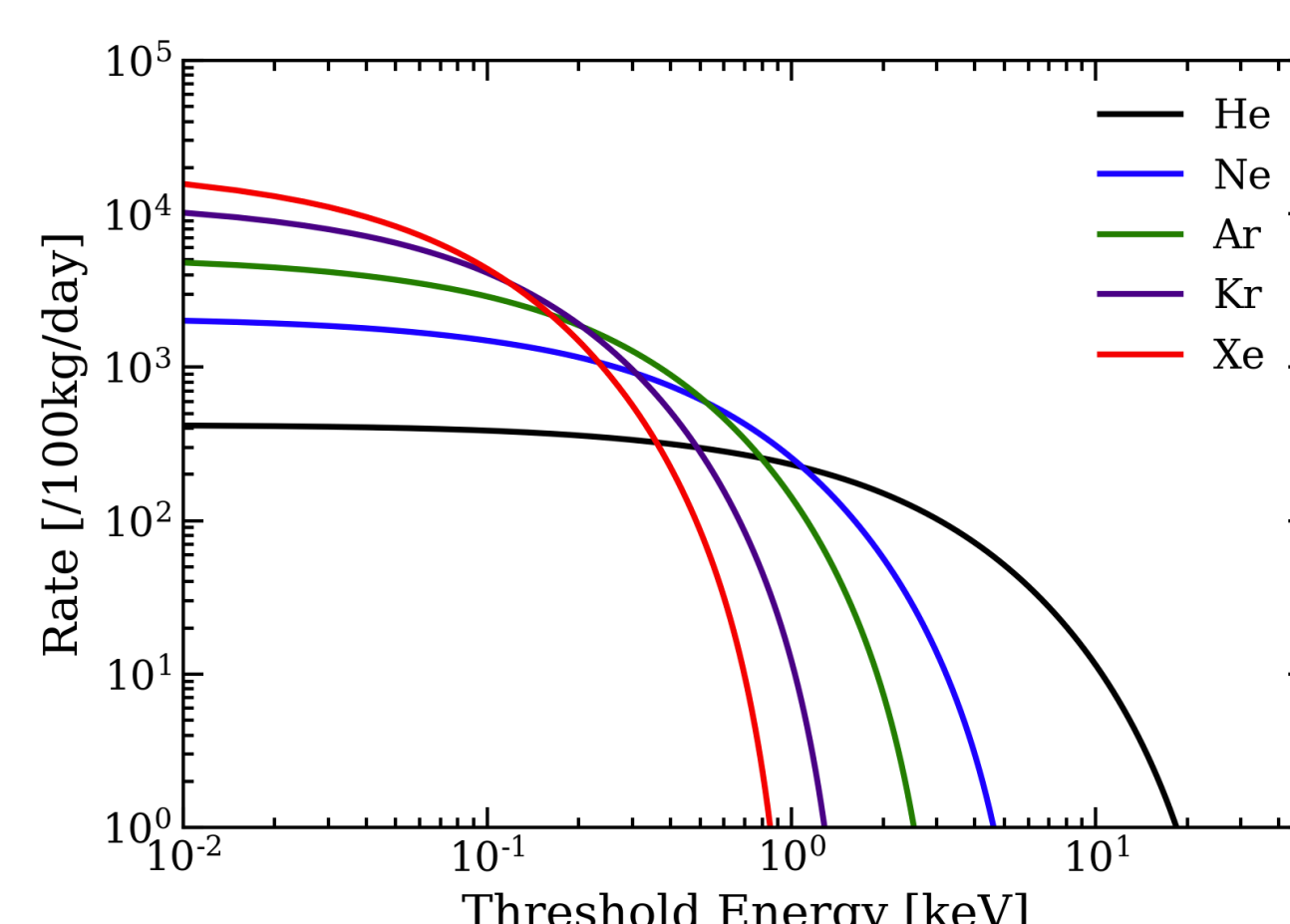


Antineutrinos from Reactor

- ♦ Nuclear reactor is an intense neutrino source, which can emit $\sim 10^{20} \nu/s$ for a typical 1GW thermal power.
- ♦ It is an ideal source to study CEvNS in fully coherent regime.
- ♦ A compact detector will enable the monitoring of reactor thermal power and the proliferation of fissile products.

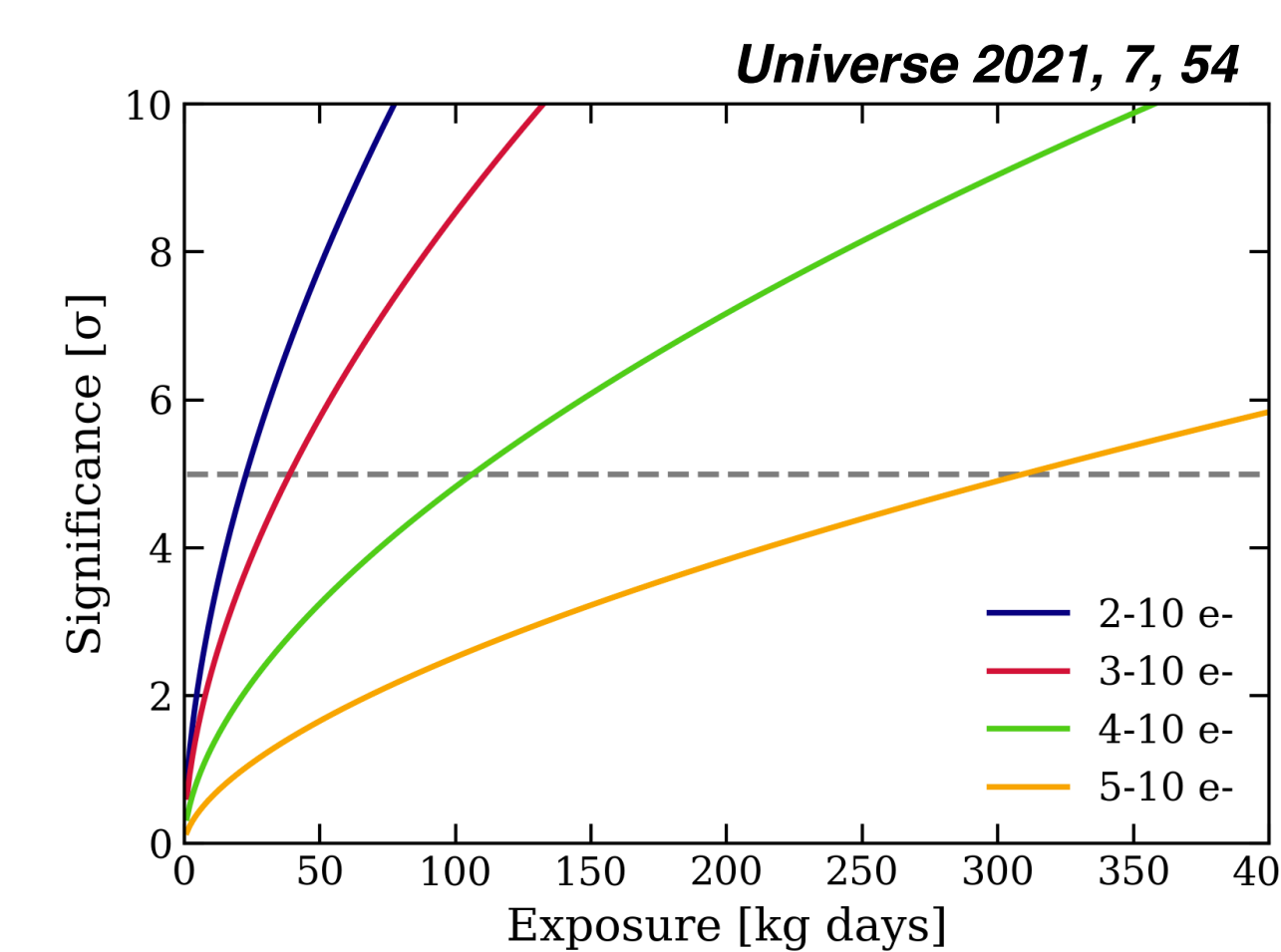
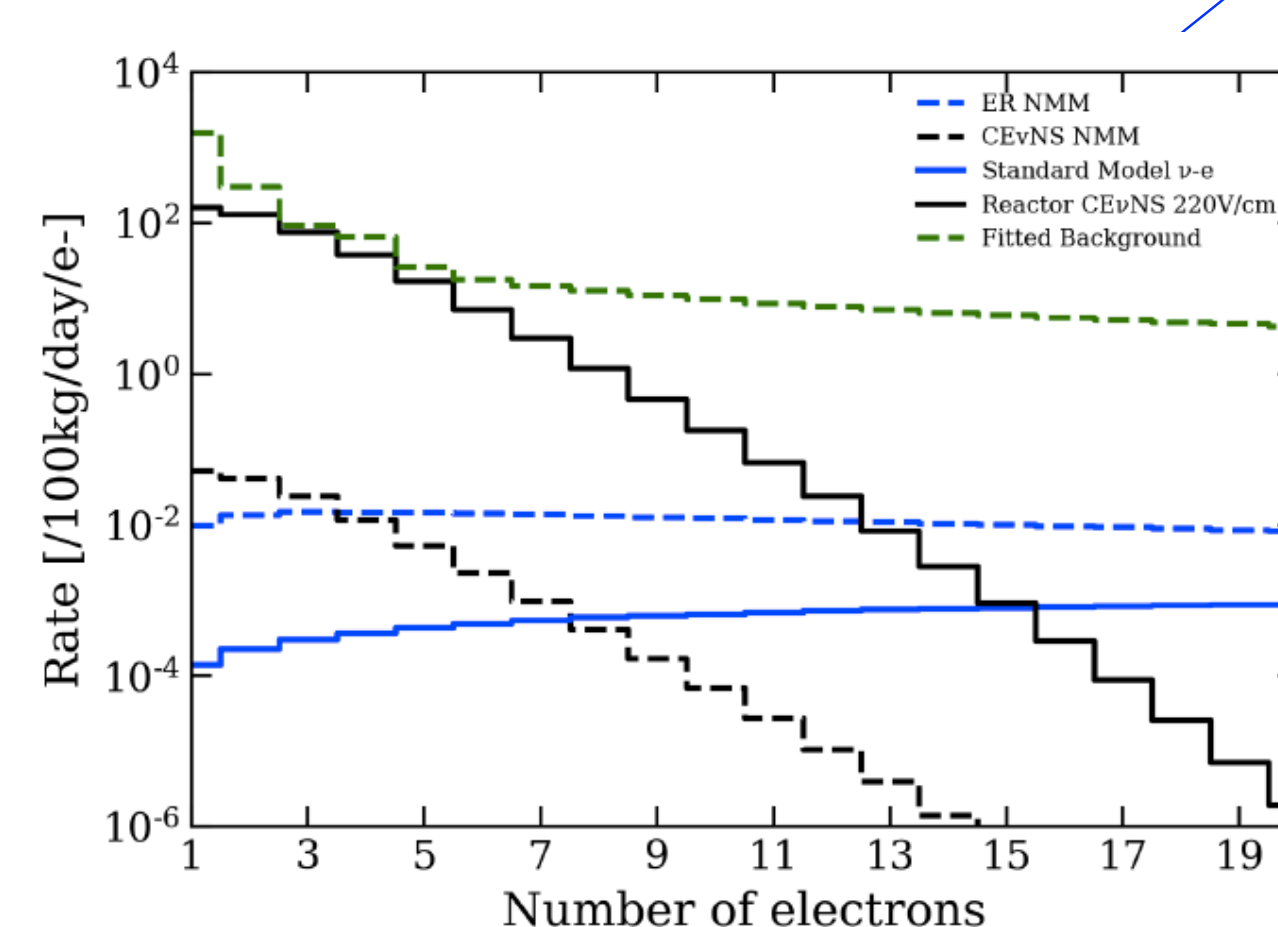


- ♦ the calculated CEvNS rates in different nuclei from a reactor antineutrinos flux of $6.3 \times 10^{12} \text{ cm}^{-2}\text{s}^{-1}$ (approximately at a distance of 25 m from the core of a 3 GW thermal power reactor).



Background Estimation & Sensitivity to CEvNS

- ♦ The CEvNS event rate in a liquid xenon detector, from a reactor antineutrino flux of $6.3 \times 10^{12} \text{ cm}^{-2}\text{s}^{-1}$, is calculated (bottom-left).
- ♦ The background is estimated based on the measured background rate from XENON10/XENON100 dark matter experiments.
- ♦ The bottom-right figure shows the expected significance: an O(10)-kg active LXe detector is expected to achieve 5σ CEvNS detection of reactor anti-neutrinos within one month of operation.



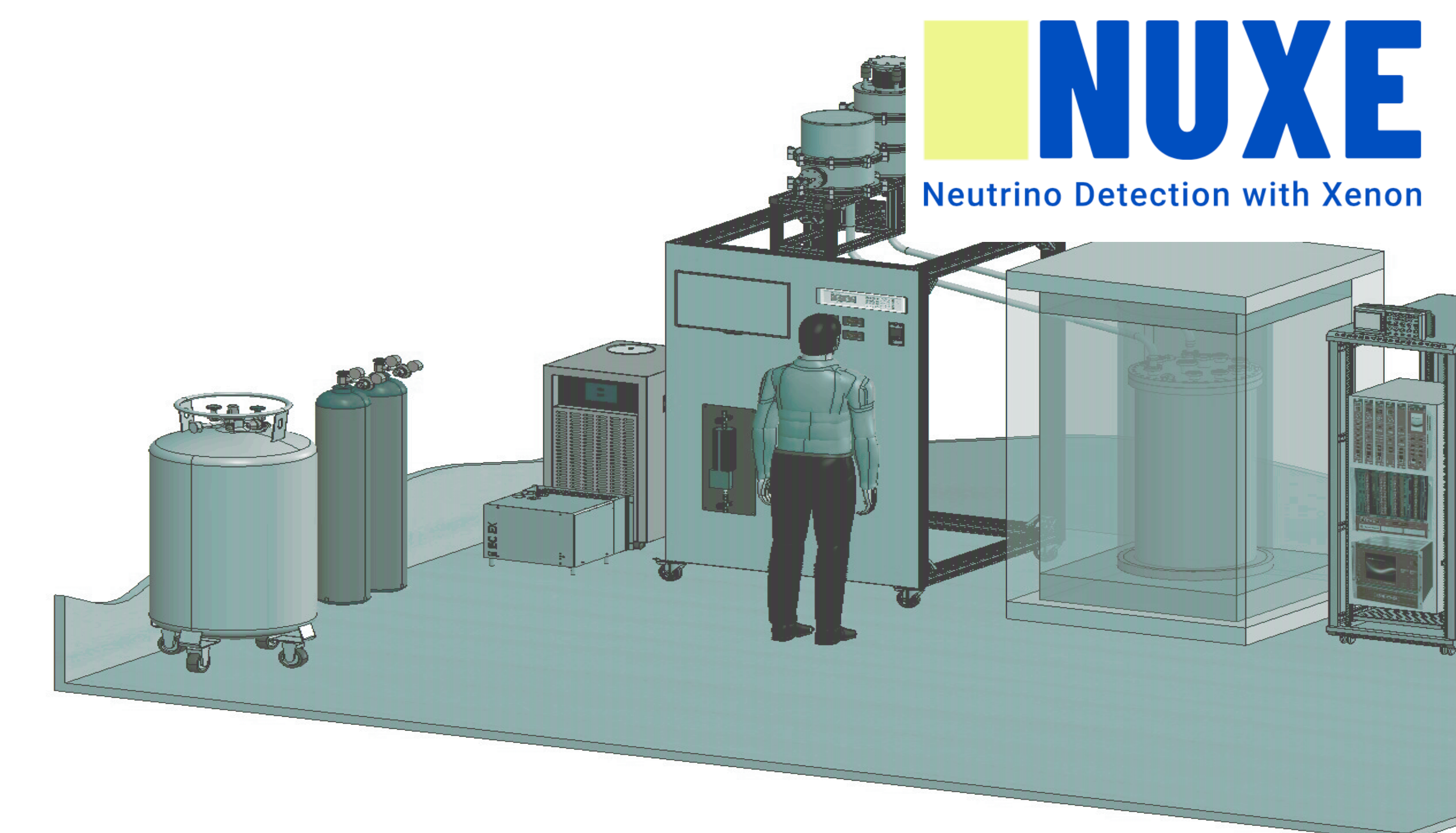
NUXE detection system for Reactor CEvNS

The NUXE detector system is currently being built at UCSD.

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This research is supported by a Young Faculty Award of the Defense Advanced Research Projects Agency. The content of the information does not necessarily reflect the position or the policy of the Government, and no official endorsement should be inferred.