COHERENT: A future ton-scale LAr detector for CEvNS
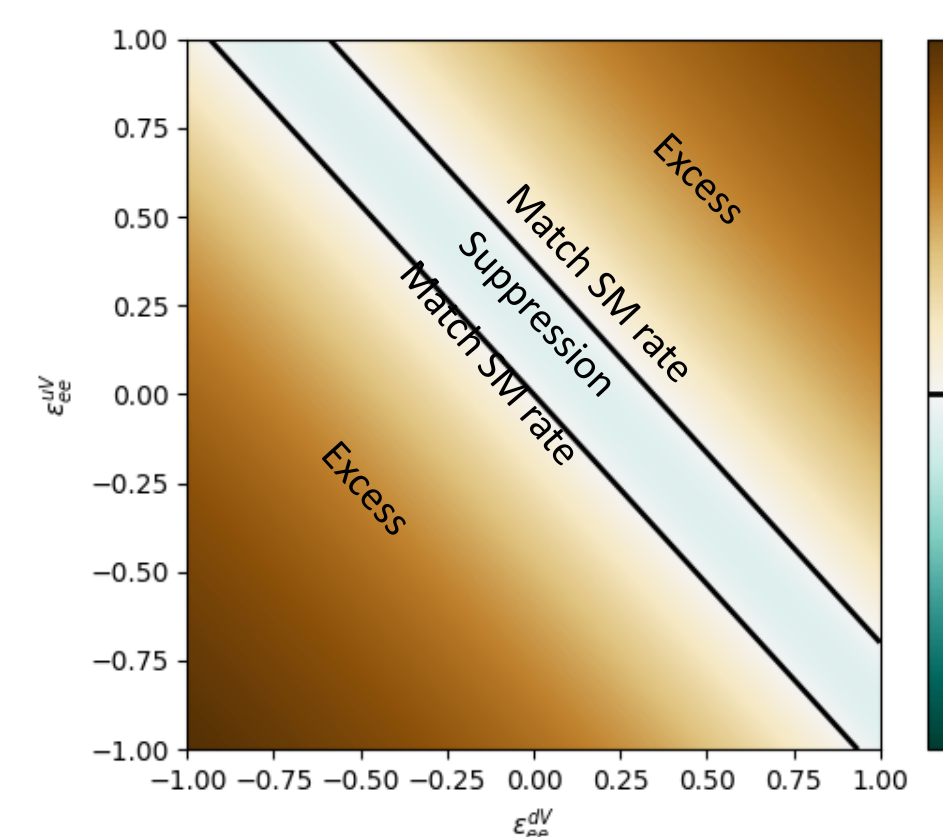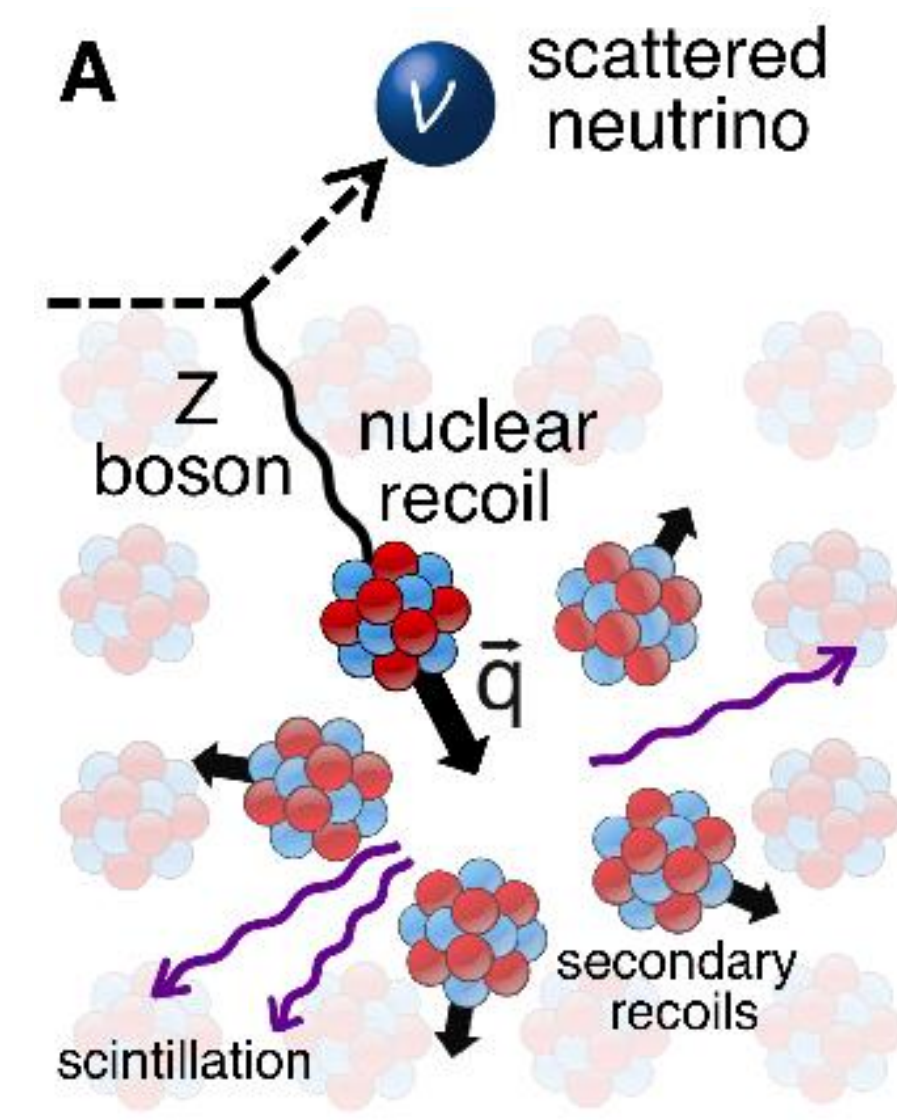
Max Hughes for the COHERENT Collaboration

Indiana University, Bloomington

Coherent Elastic Neutrino-Nucleus Scattering

- Neutrino scatters off a nucleus which recoils elastically
  - Neutrino energy up to 50 MeV
  - Cross-section is large
  - Cross-section goes as $\sim N^2 \times F^2(q^2) \times Q_W^2$
  - Recoil energy is at or below 50 keV

- Precisely described by standard model

- Important for WIMP searches

- Detectors sensitive to accelerator produced dark matter

$$Q_W^2 \to Q_{NSI}^2 = 4\left[N\left(-\frac{1}{2} + \epsilon_{ee}^{uV} + 2\epsilon_{ee}^{dV}\right) + Z\left(\frac{1}{2} - 2\sin^2\theta_W + 2\epsilon_{ee}^{uV} + \epsilon_{ee}^{dV}\right)\right]^2$$


COHERENT at the SNS

- Run using pulsed SNS source
  - Pion-decay-at-rest neutrino source
  - Run in neutron-quiet Neutrino Alley

- Part of multi-target measurement program

- Plan to go to precision measurements beyond CEvNS energy distribution
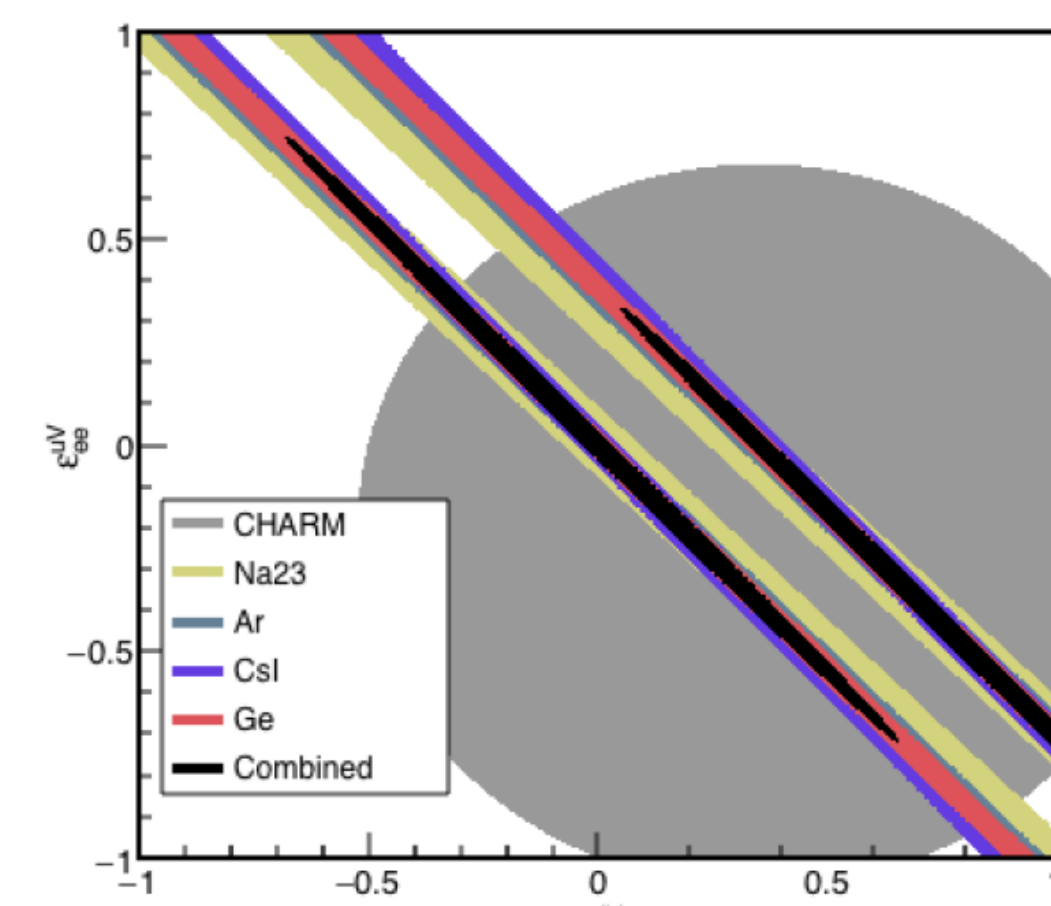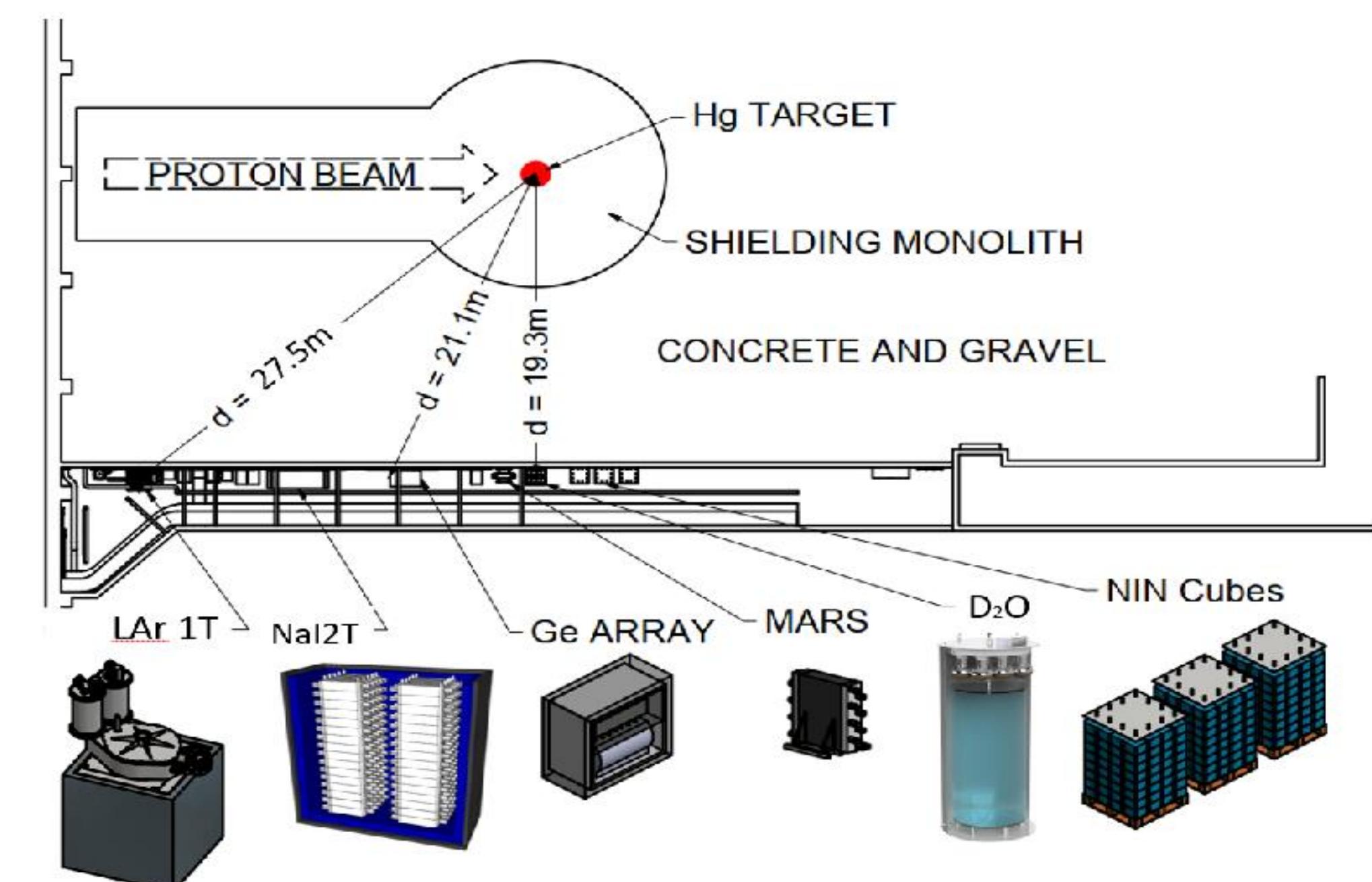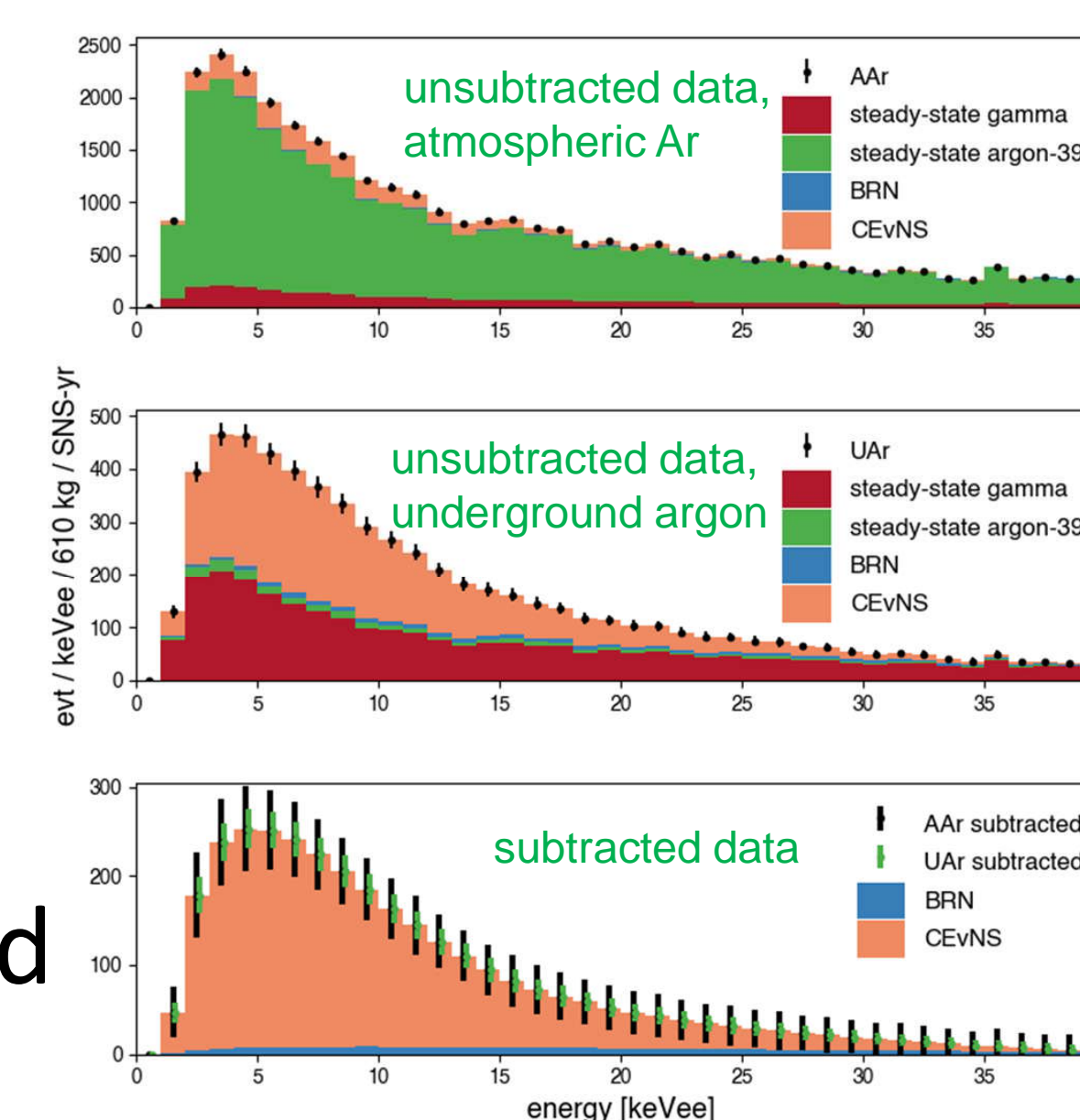

arXiv:1803.09183

COHAr-750

- Single-phase liquid argon calorimeter

- 610 kg fiducial mass

- Designed to hit 20 keVnr threshold or below

- Designed to fit in current LAr detector location
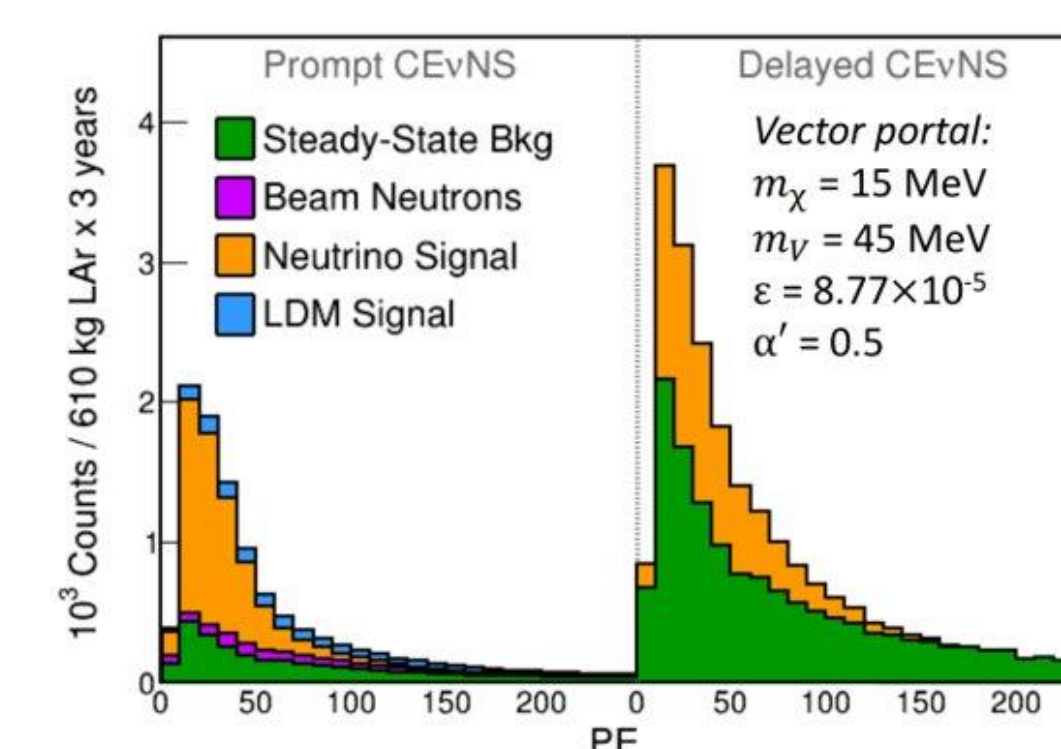
- R & D and simulations underway
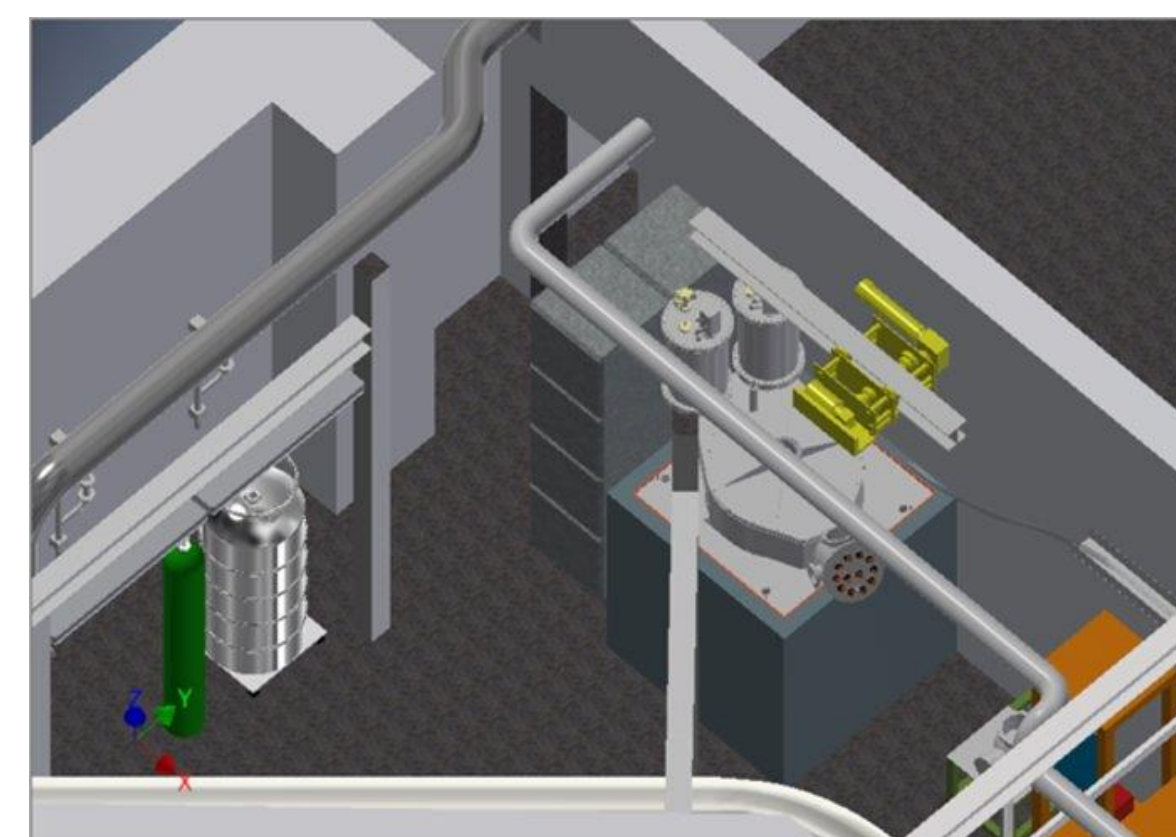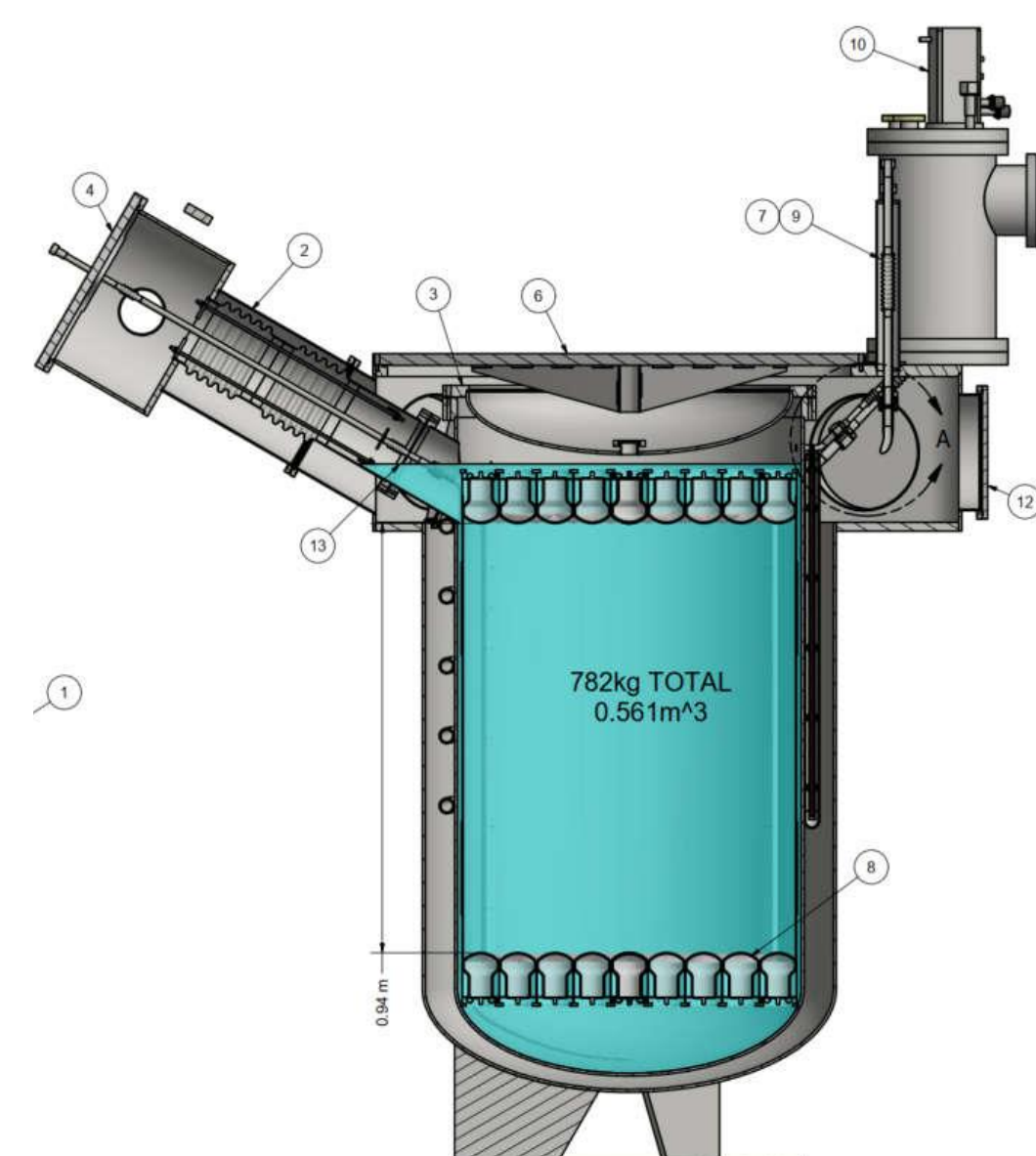
- 3000 CEvNS events/SNS year
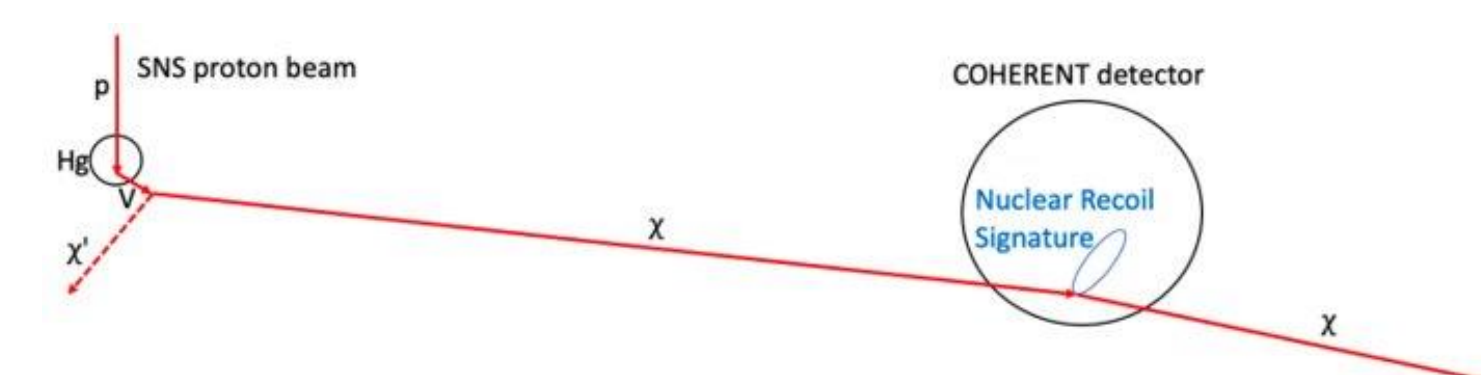- Left shows CEvNS spectrum with and without underground argon
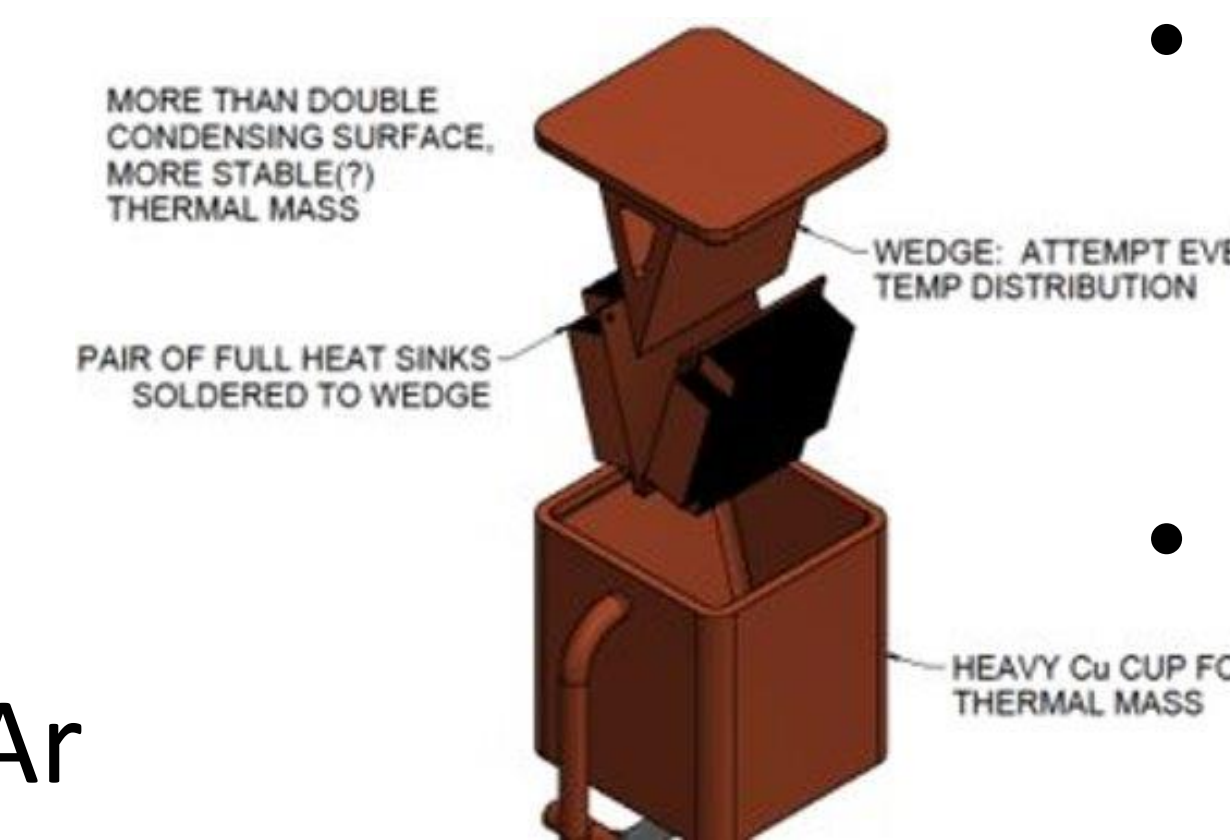

arXiv:1901.10108

COHAr-750 and Dark Matter

- Vector portal dark matter could be produced by pions in SNS
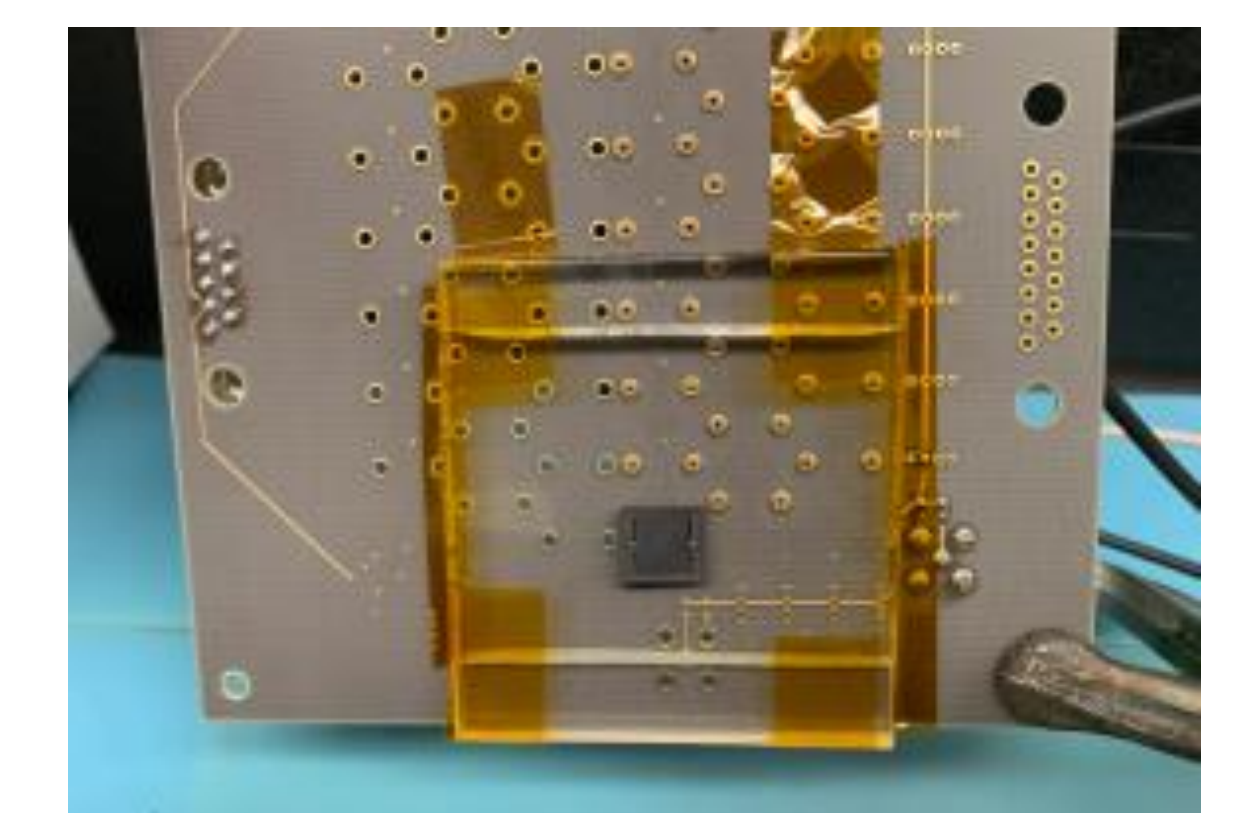
- Could detect nuclear recoils

D. Akimov et al.
Phys. Rev. D **102**, 052007

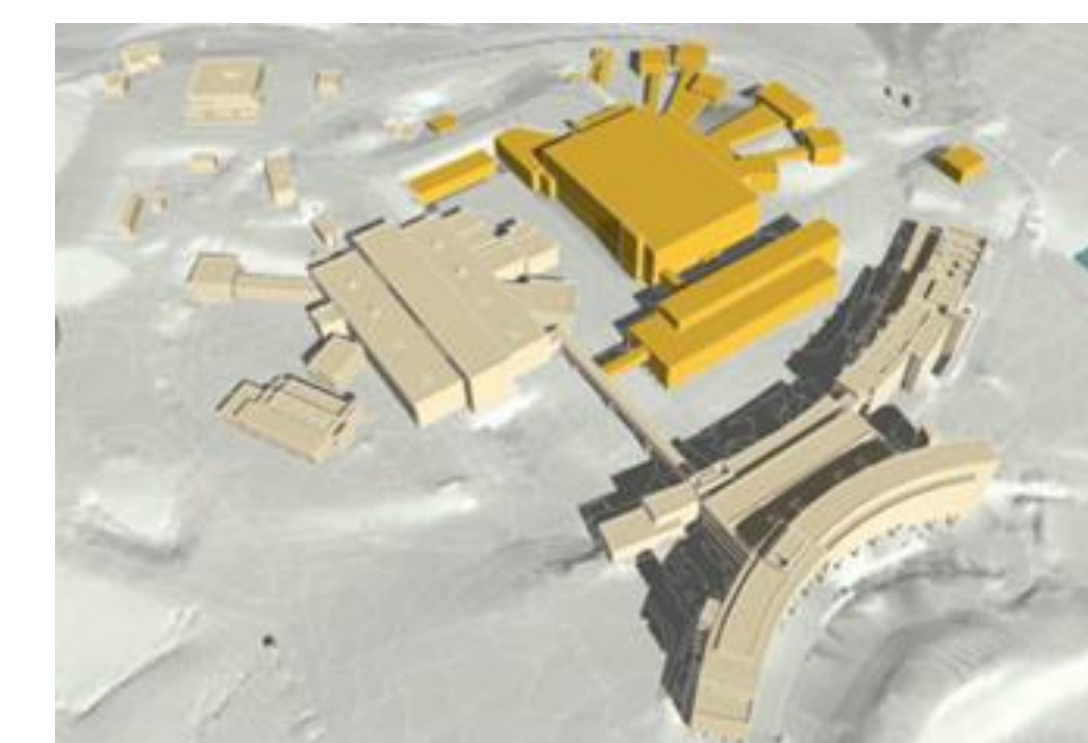## Liquefier and Light Collection Tests

- Copper liquefier cup has been machined and put together

- Testing of light collection at cryogenic temperatures is ongoing

Outlook

- After data taking is complete, CENNS-10 will be used as test stand for COHAr-750

- Can lead to 10-ton scale liquid argon detector at the second target station