

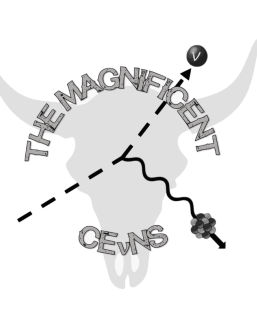
Mag7s 2024 Experimental Summary

Matthew Green

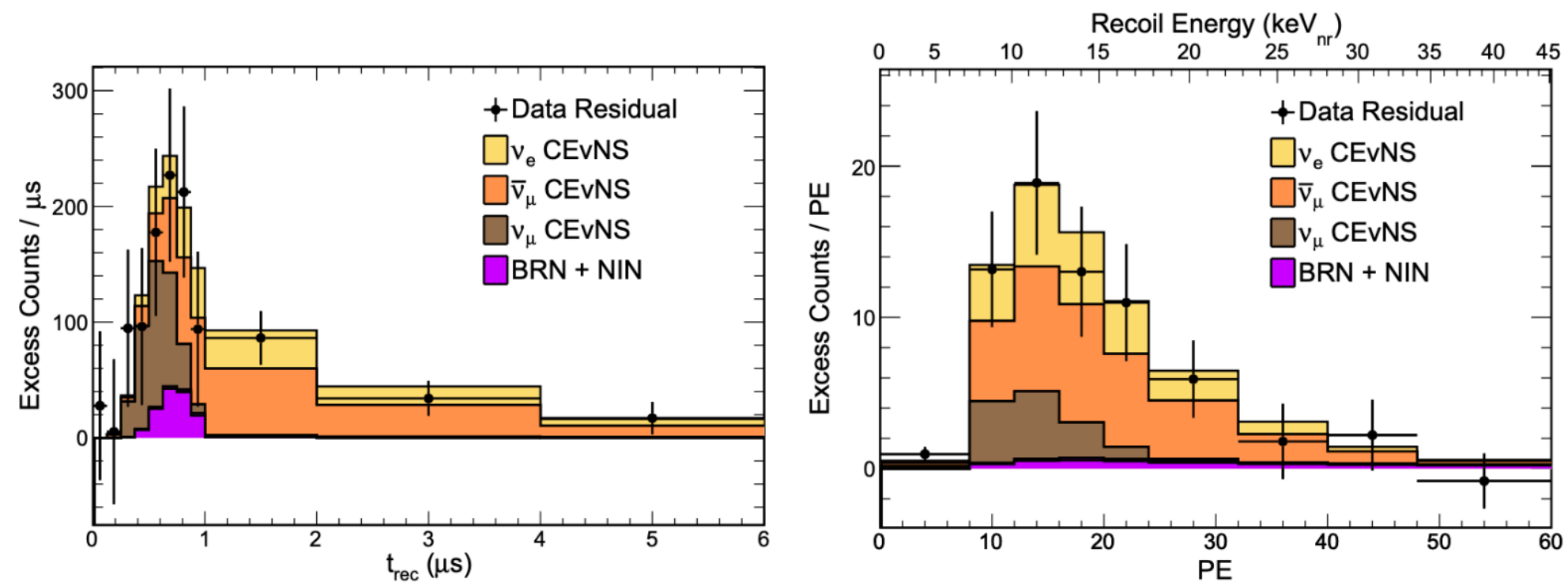
North Carolina State University &
Oak Ridge National Laboratory

***Content entirely stolen, misrepresentations are my own.**

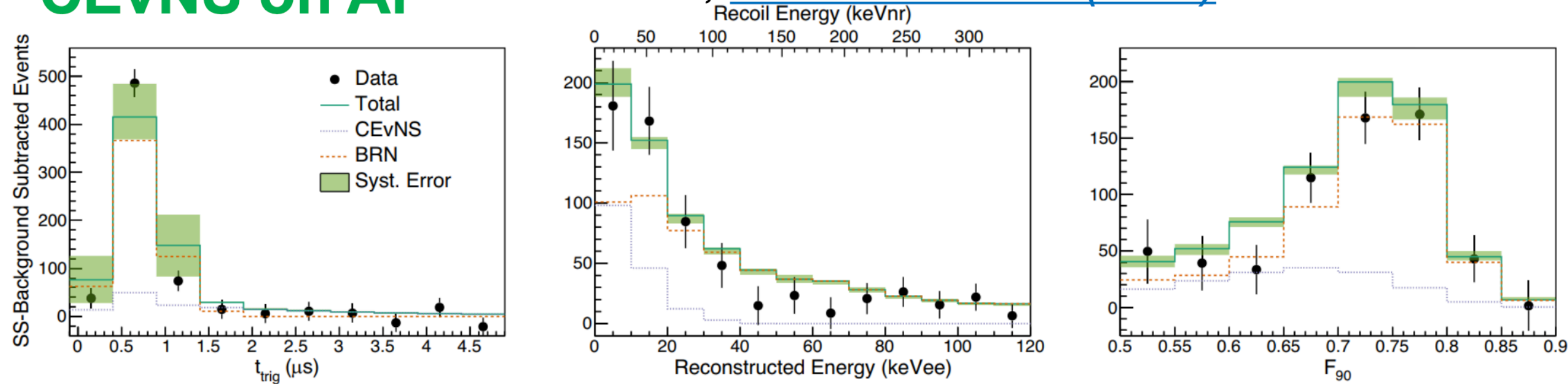
COHERENT marches ahead...



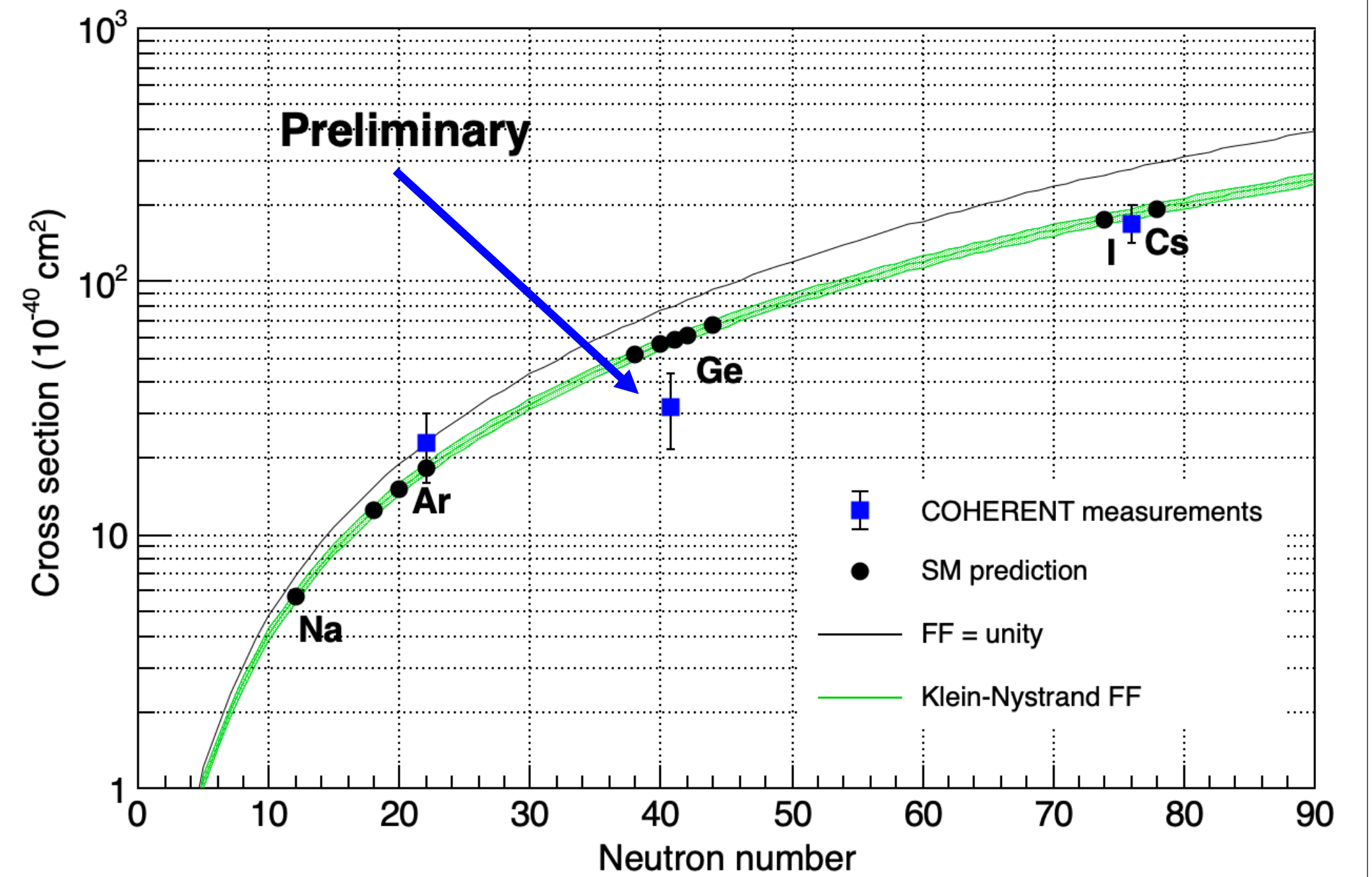
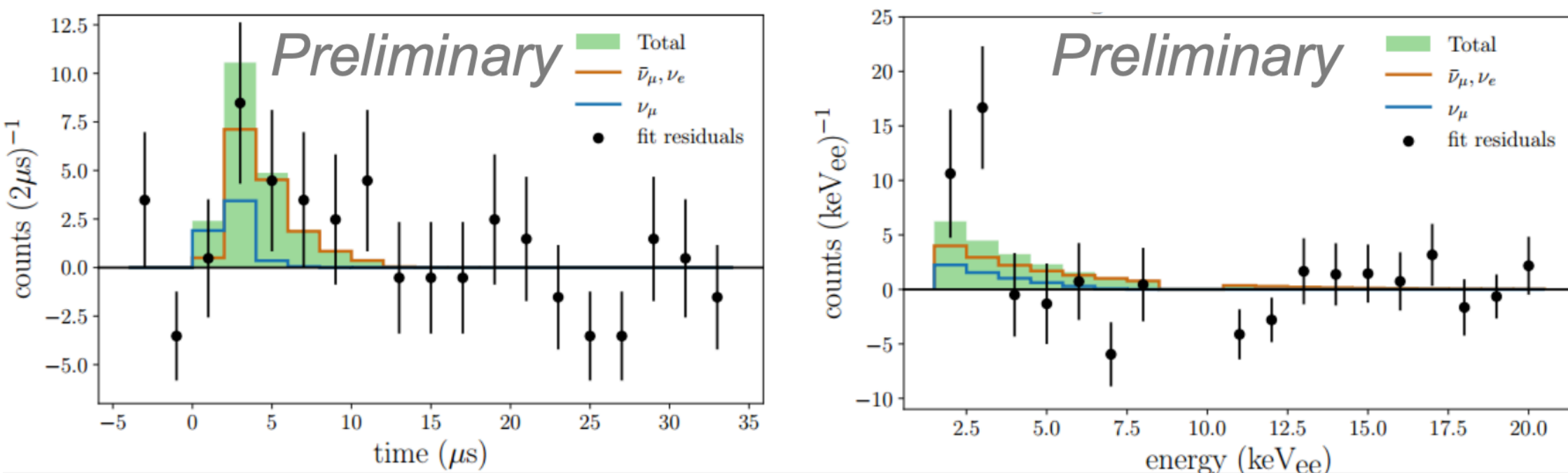
CEvNS on CsI *COHERENT, PRL 129 (2022) 081801*



CEvNS on Ar *COHERENT, PRL 126 012002 (2021)*

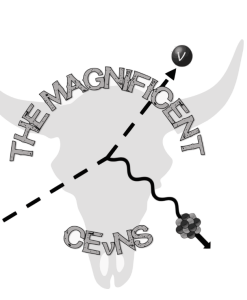


CEvNS on Ge *Paper in preparation*

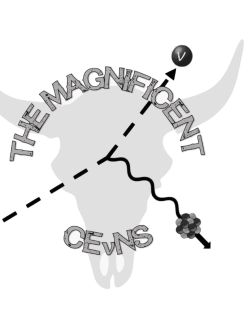


D. Parno, R. Bouabid, I. Bernardi 2

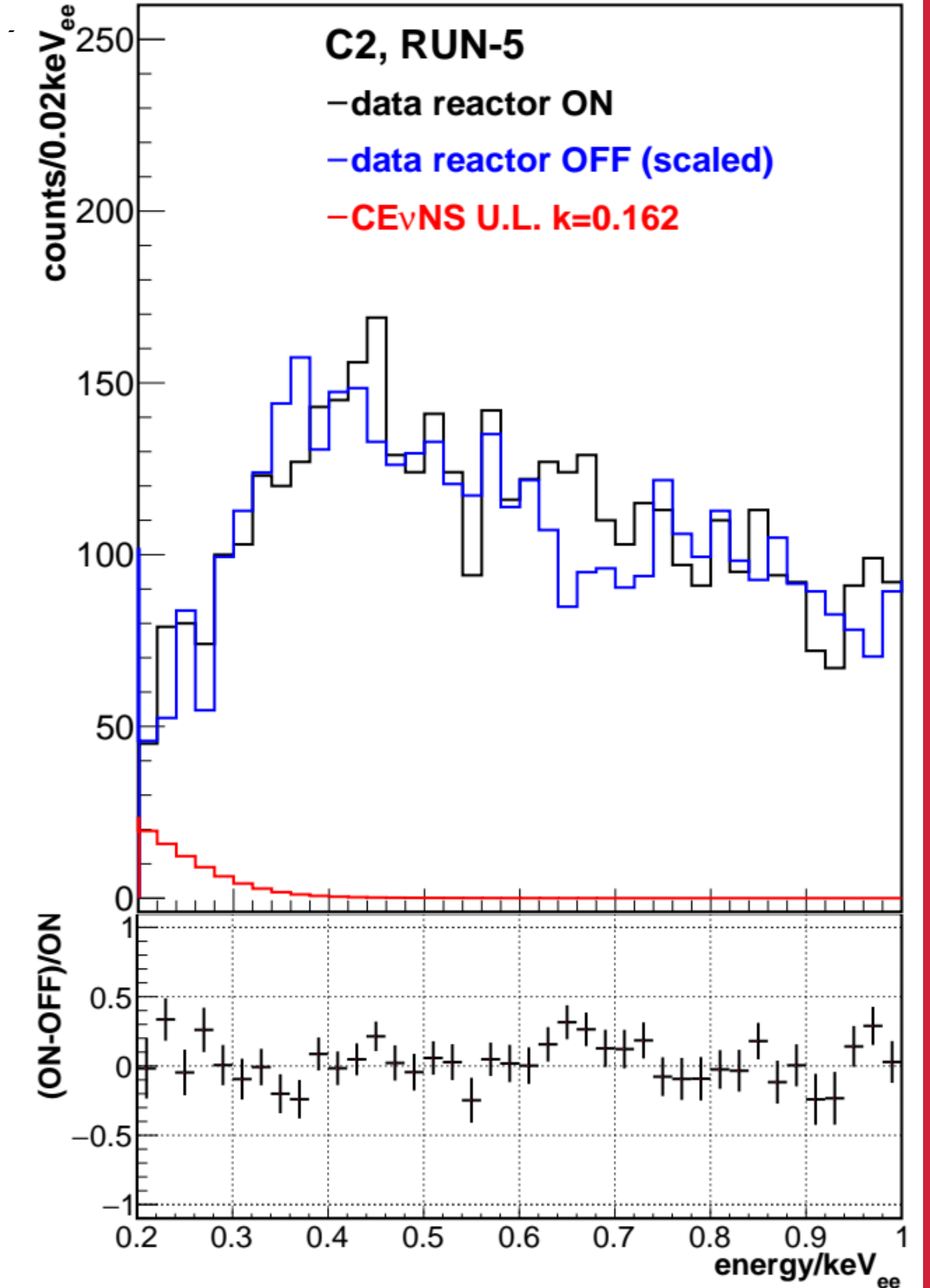
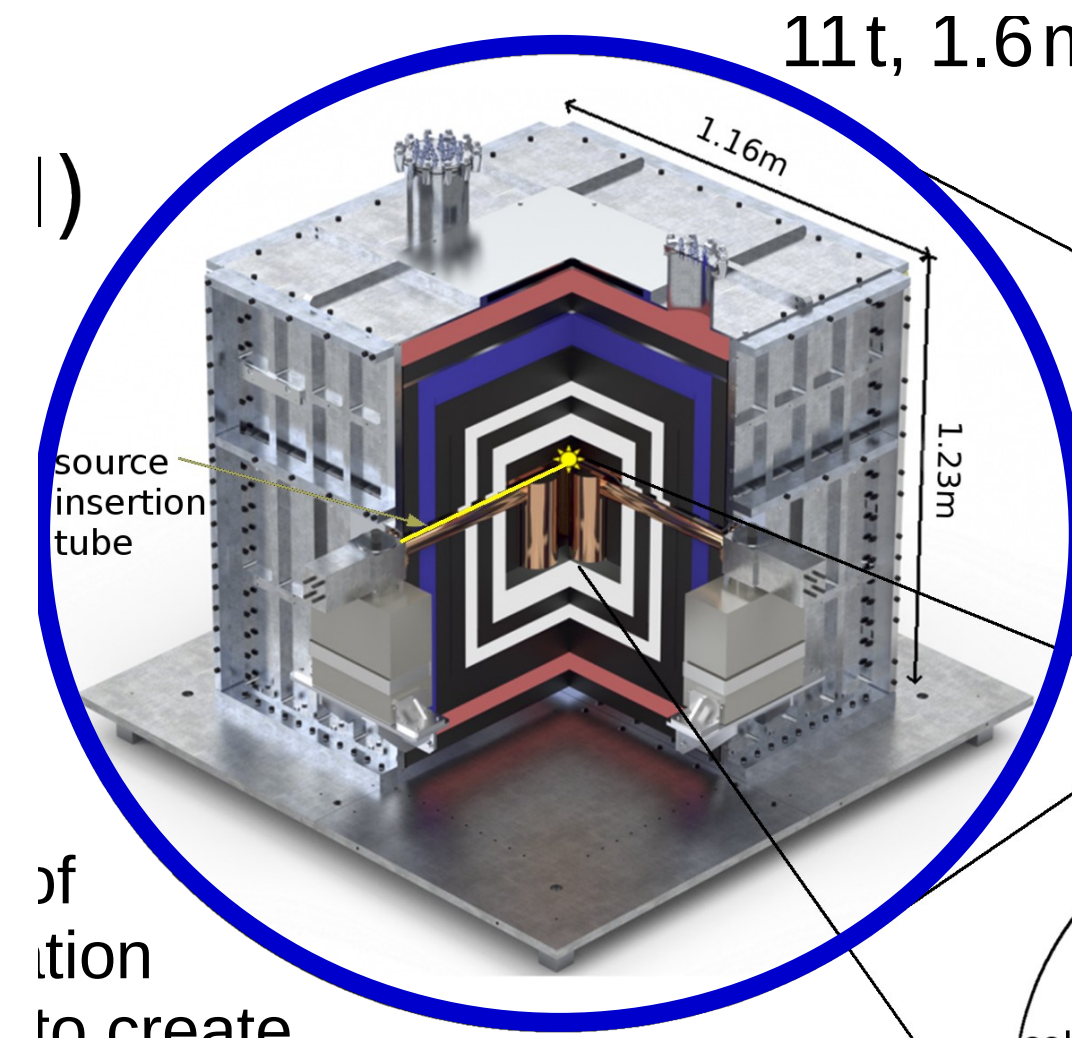
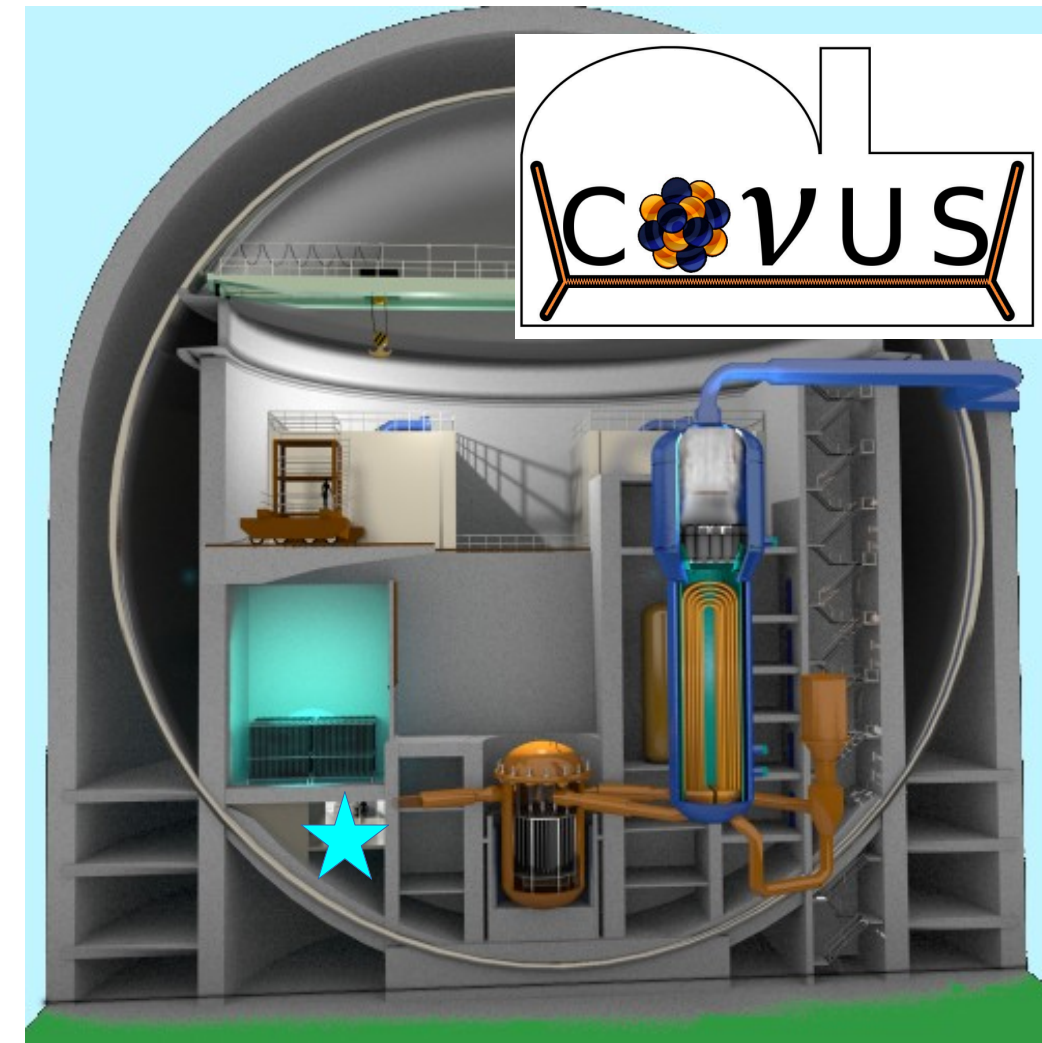
A reactor CEvNS race heats up!



CONUS



- 4 PPC Ge detectors, total 4kg
- 250eV_{ee} threshold
- Brokdorf: 3.9 GW, 17.1 m
- Shutdown of Brokdorf: “opportunity” to measure ample reactor-off data, move to new site.

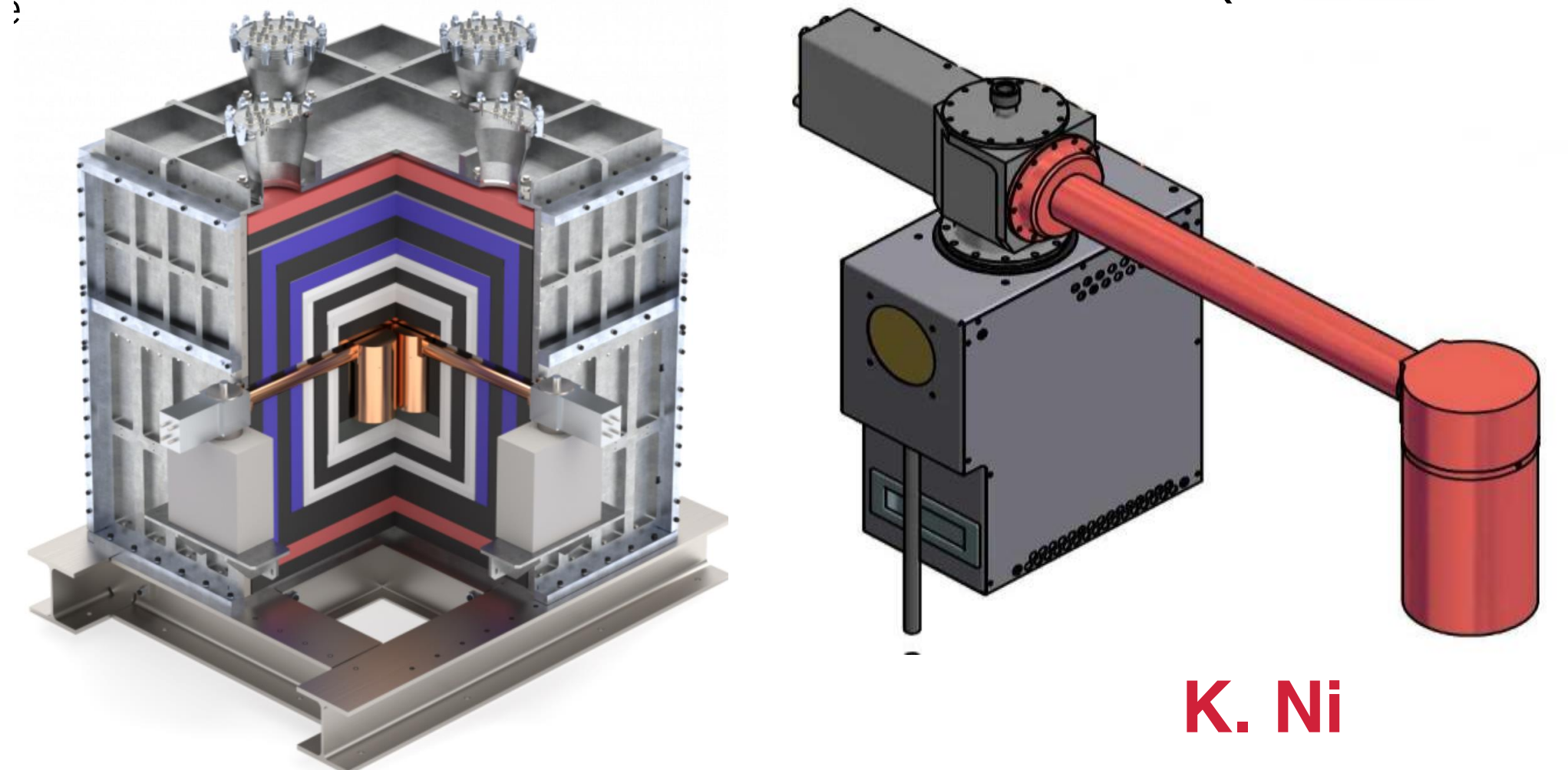


	Run-1/Run-2	Run-5
ON/kg*d	248.7	426
OFF/kg*d	58.8	272
threshold/eV _{ee}	296-348	210
Limit ($k=0.162$)	factor 17 > SM	factor 2 > SM

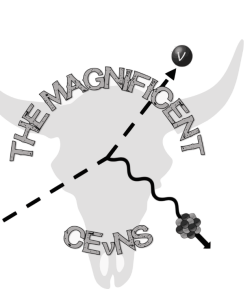
arXiv:2308.12105

J. Hackenmüller

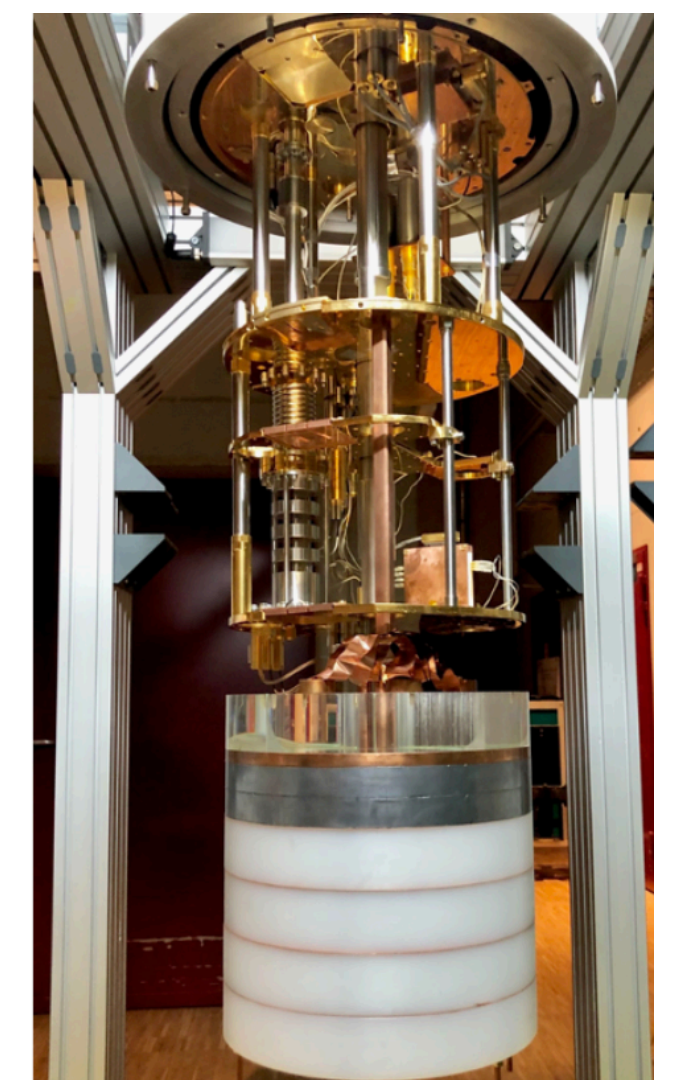
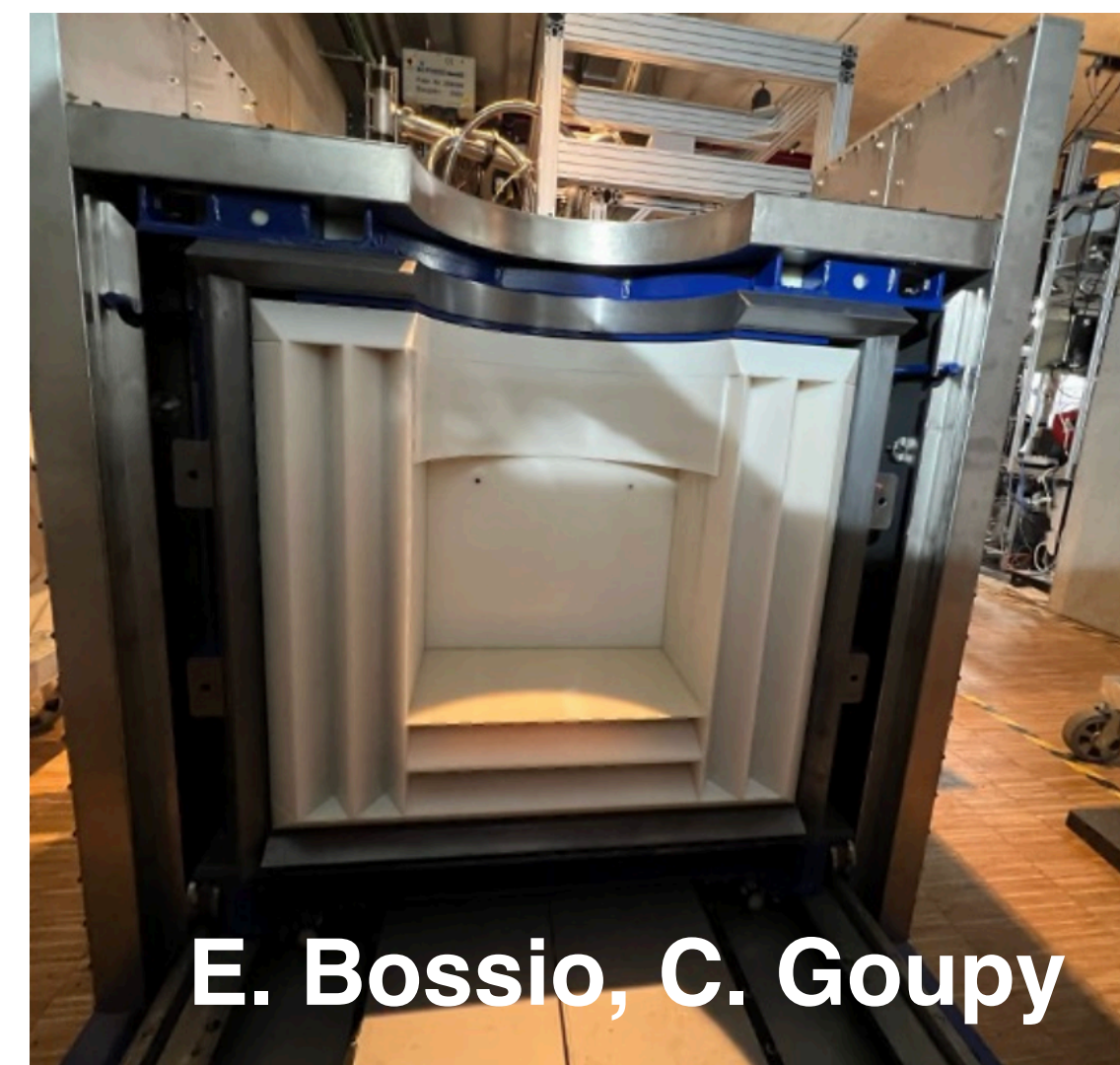
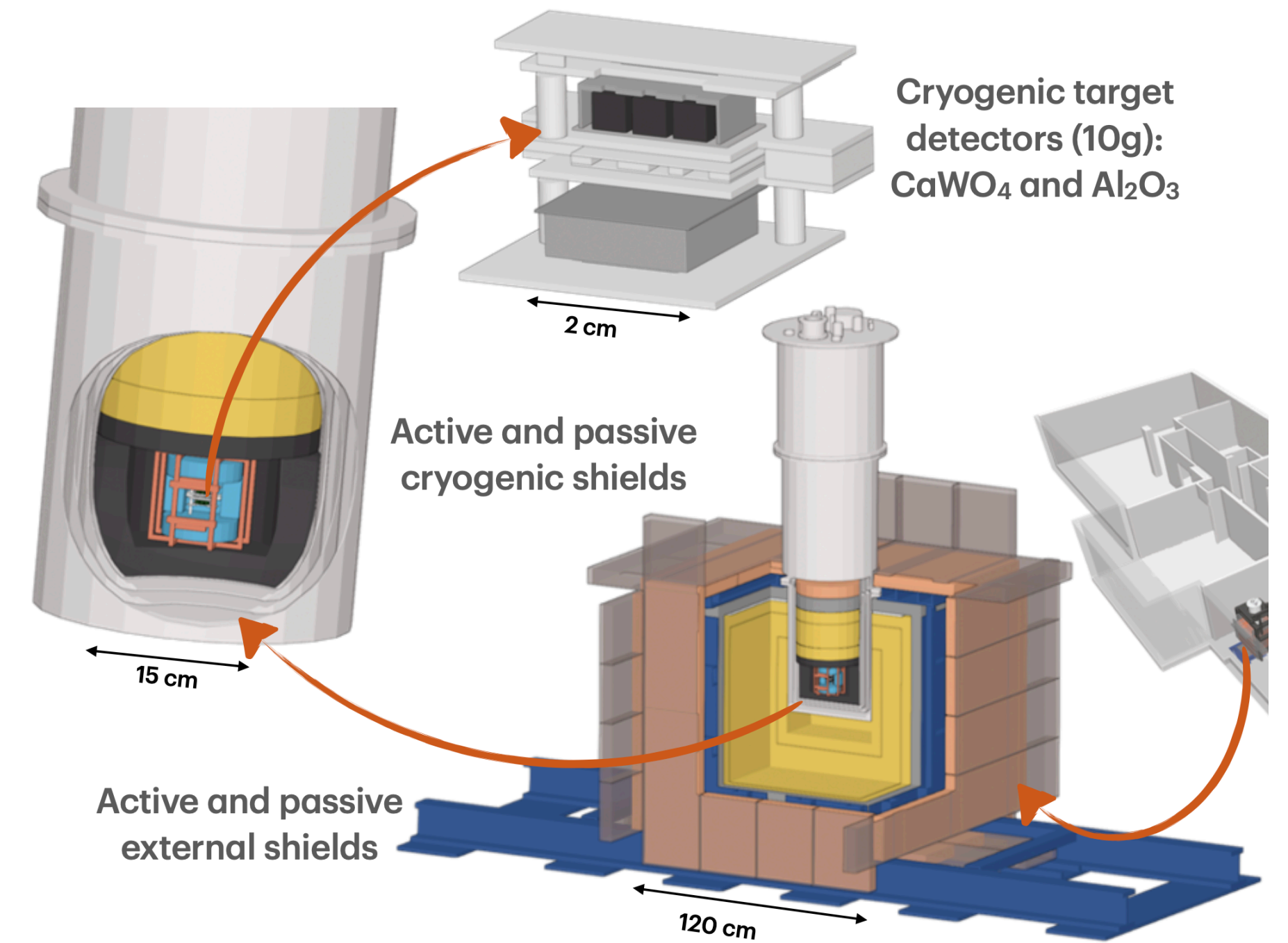
- Leibstat (KLL) Switzerland
- 3.6 GW, 20.7 m
- Upgrades:
 - ASIC readout
 - Water cooling
 - Waveform sampling
 - 150 eV_{ee} threshold
- First Rx-off data: May 2024
- Expected rate: 580 / (det yr)
- Goal > 1400 / (det yr)
- Larger detectors, lower thresholds



NUCLEUS

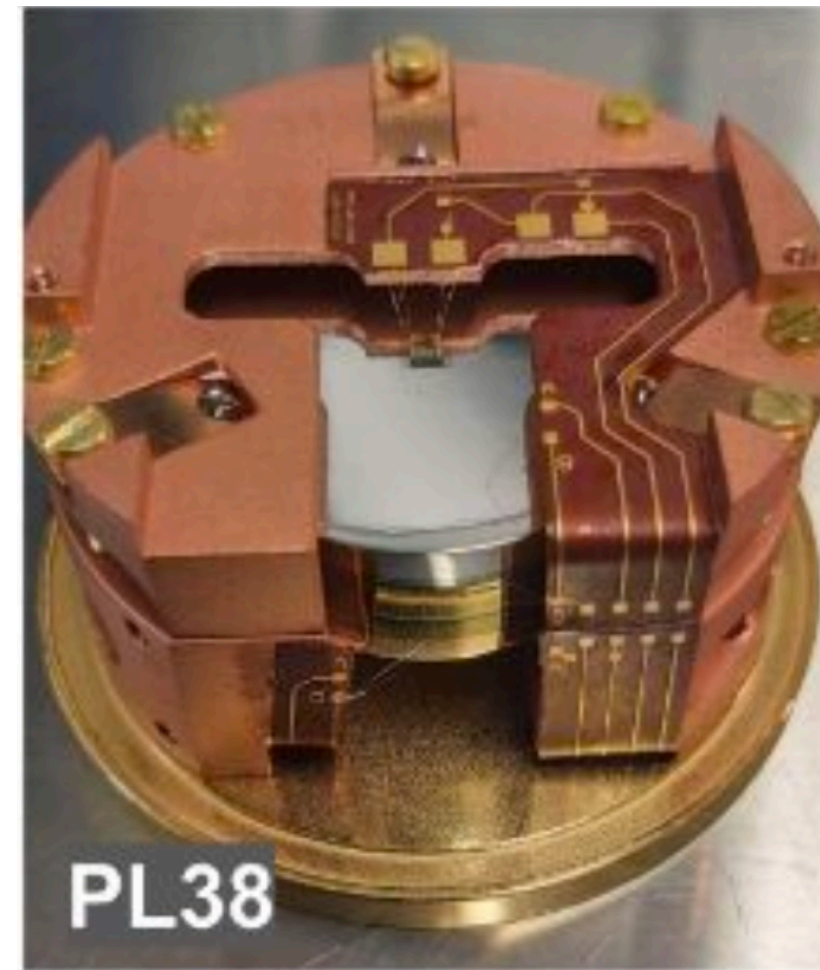


- Chooz Very Near Site
- Backgrounds extensively simulated, see upcoming arXiv
- Multi-target: Al_2O_3 for background, CaWO_4 for CEvNS
- Double TES readout + Inner Veto + PSD
- ~ 30 counts/kg/day in 10 eV - 1 keV from CEvNS in CaWO_4
- Background model highly developed, predict S/B ~ 1 .
- 5σ in 150 days



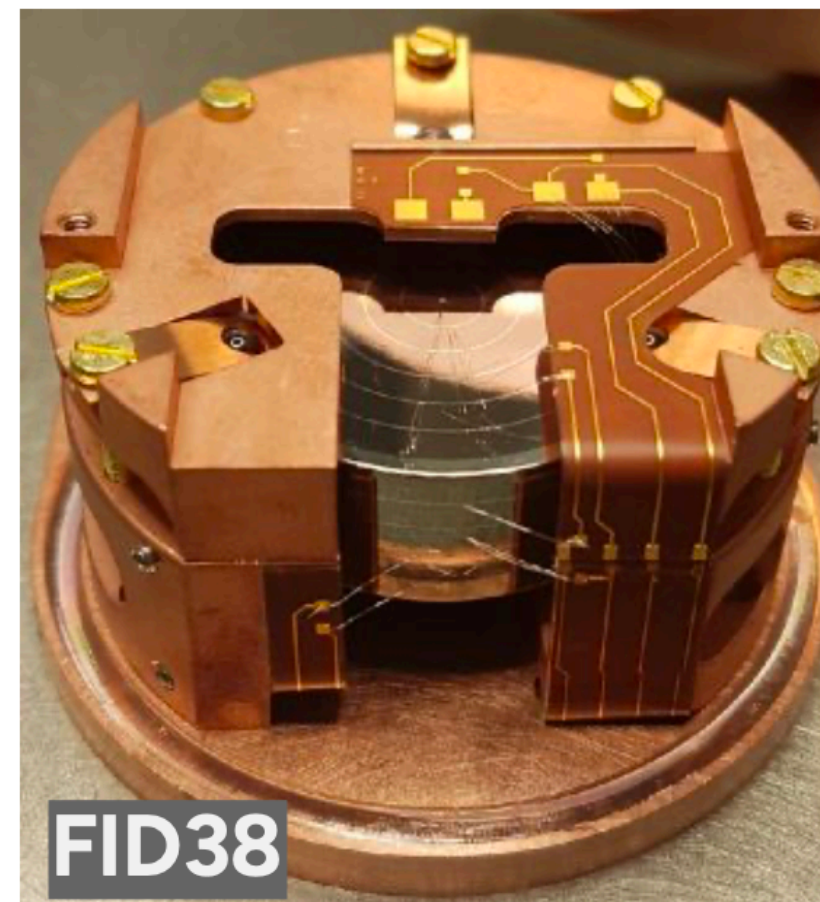
- 38g Ge bolometers
- 11 evts / (day kg) CEvNS
- 2 possible configurations:
 - Large fiducial mass
 - Surface event rejection
- Commissioning at ILL:
 - Taking data with full shielding & 1 MiniCryoCube
 - Finalizing outer and cryogenic muon vetos, DAQ
- 680g planned deployment: Spring 2025, nominal exposure by 2026

RICOCHET



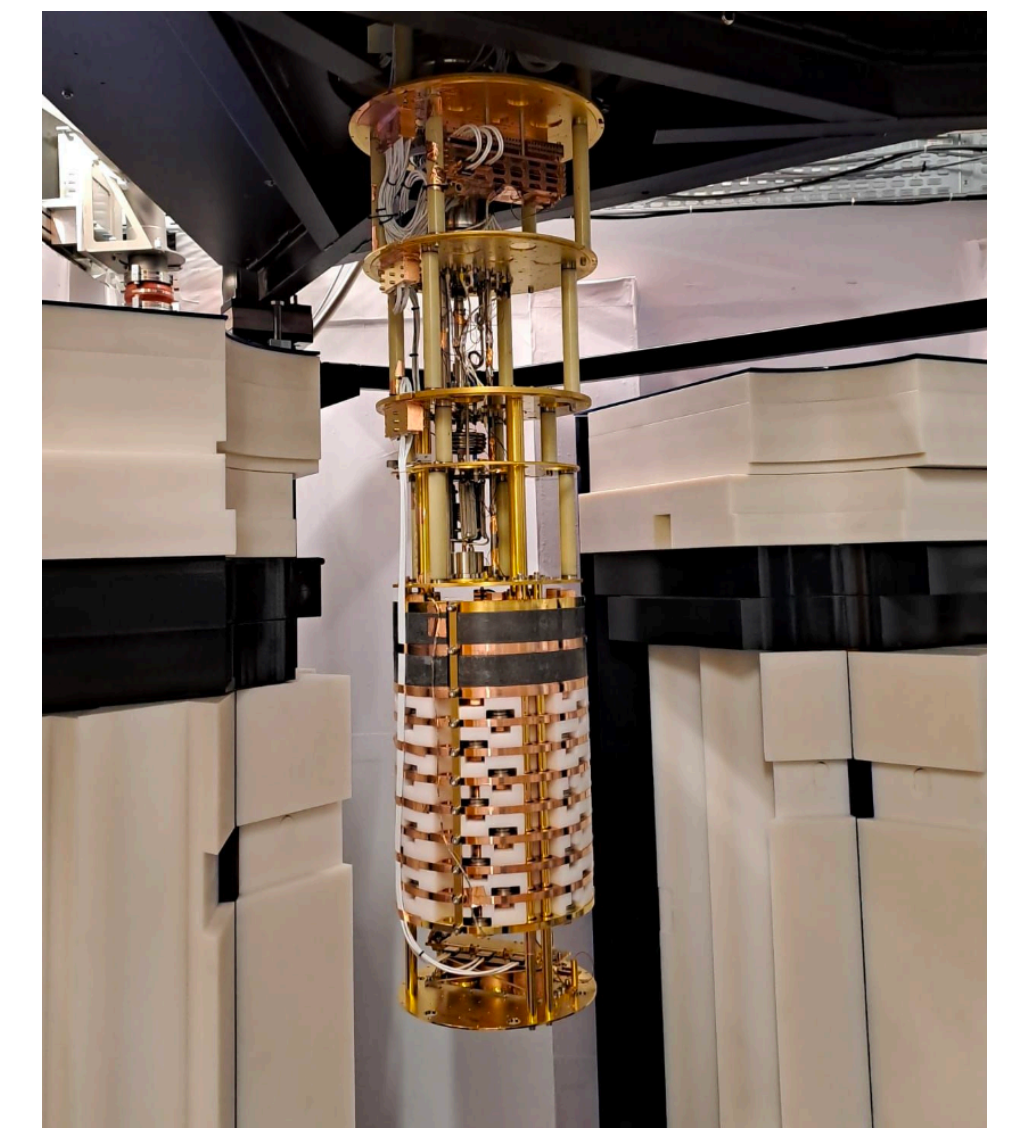
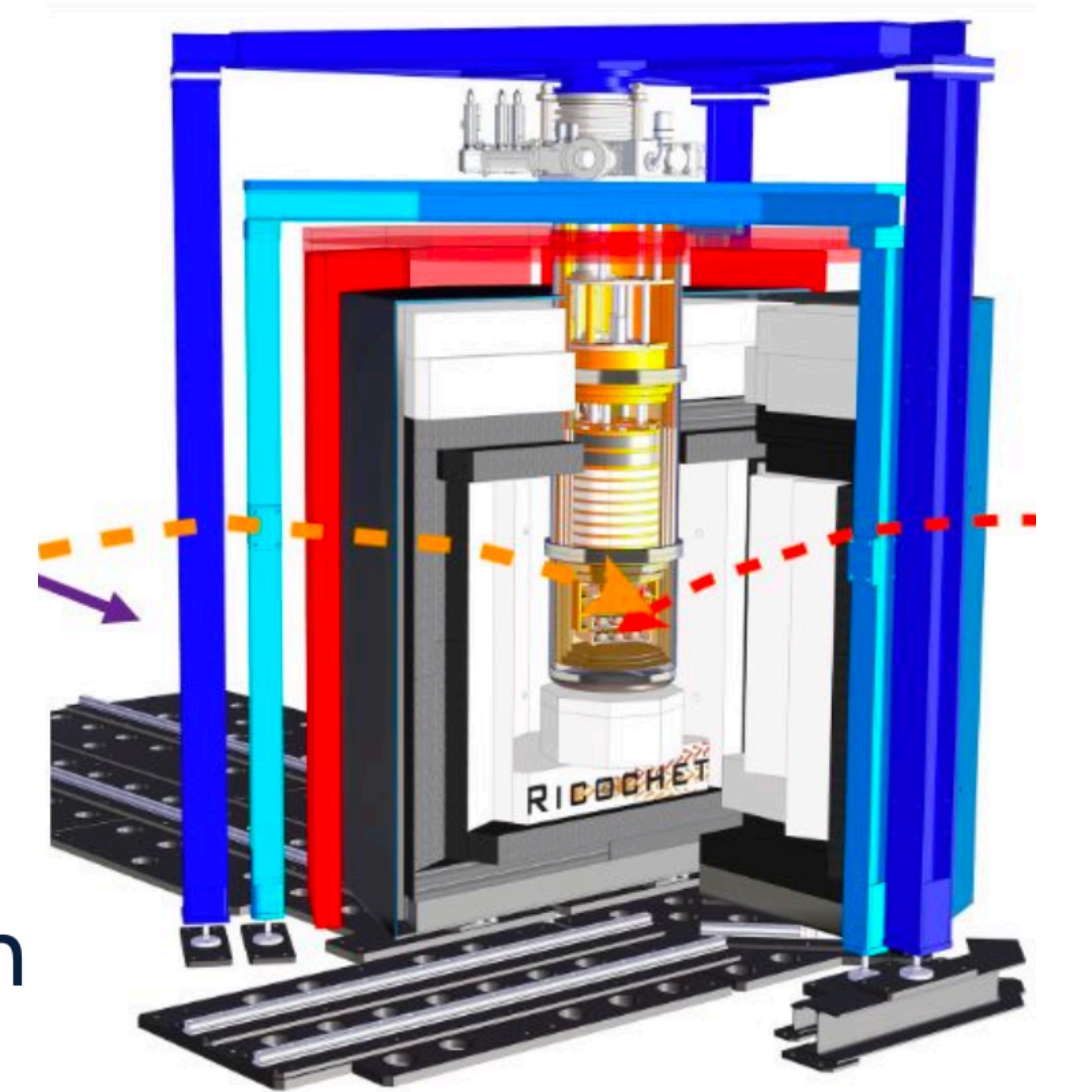
Planar :
Fiducial volume
= 98.6%

No surface
events rejection



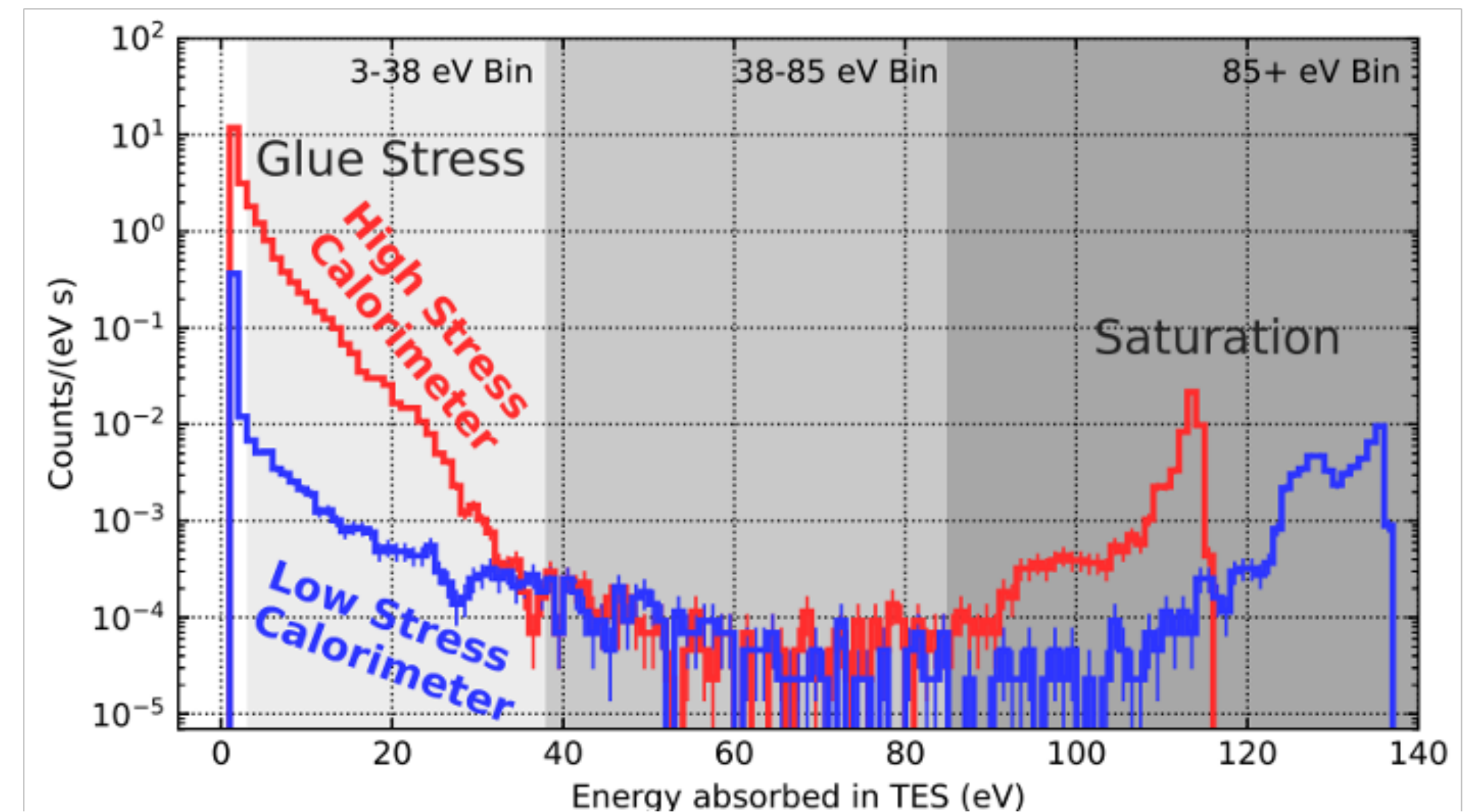
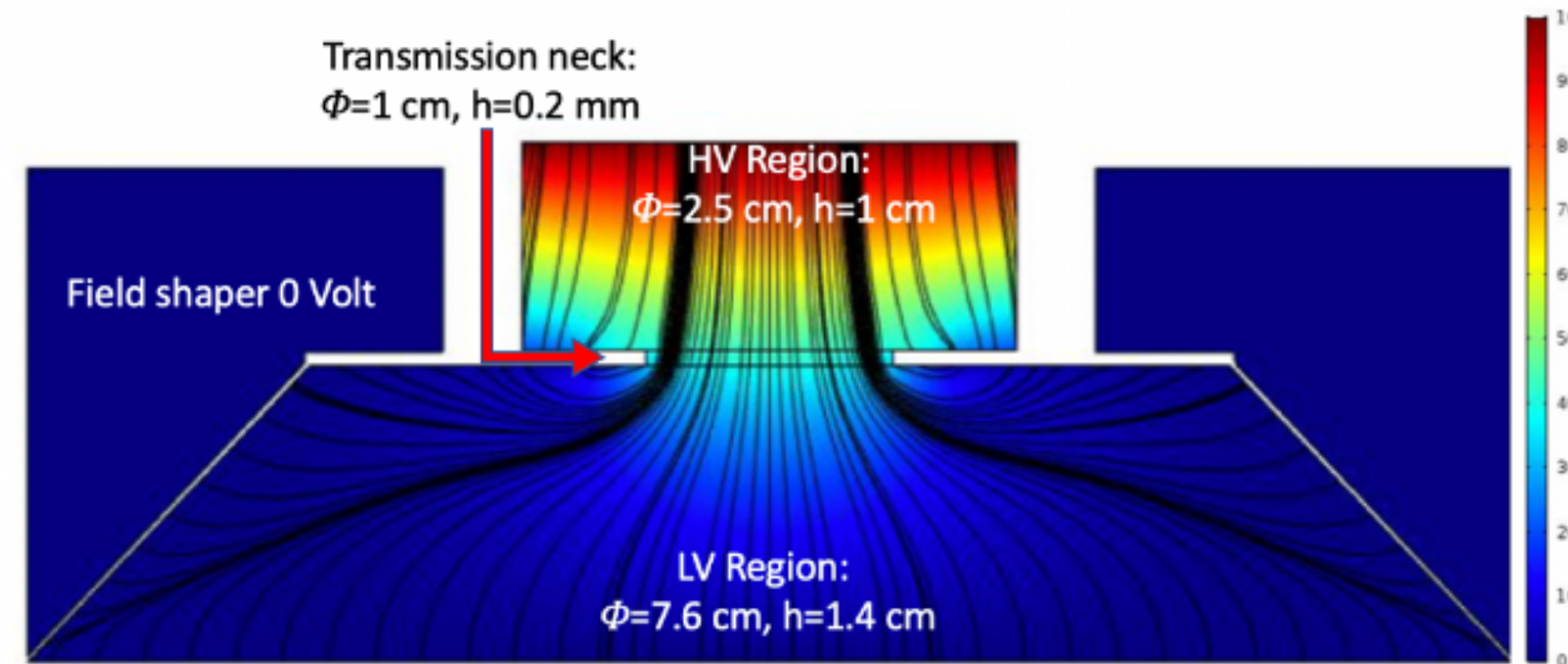
FID :
Fiducial volume
= 62%

Surface events
rejection

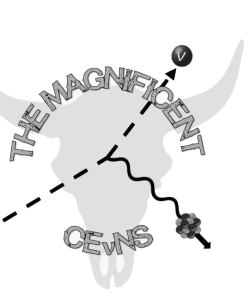


N. Martini

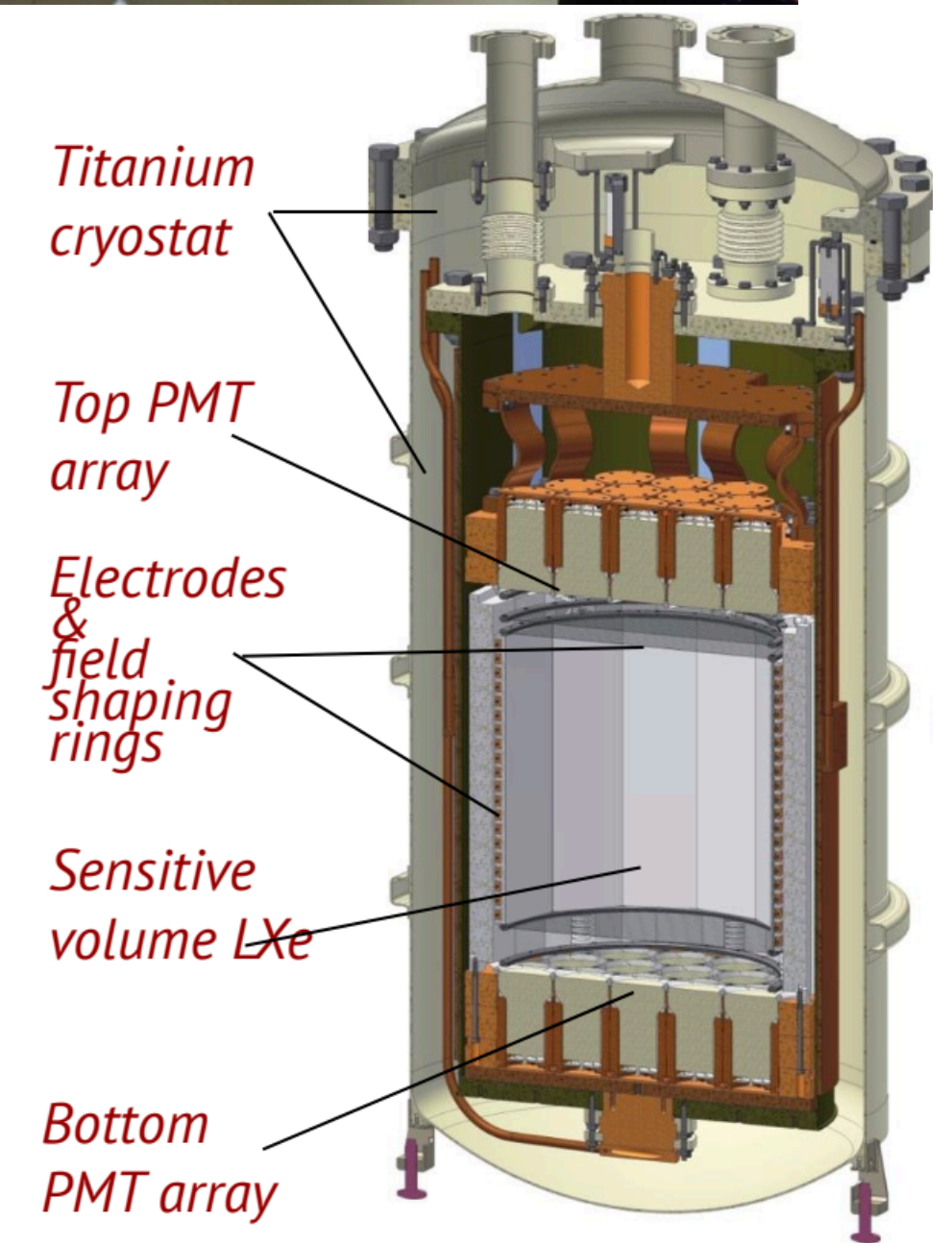
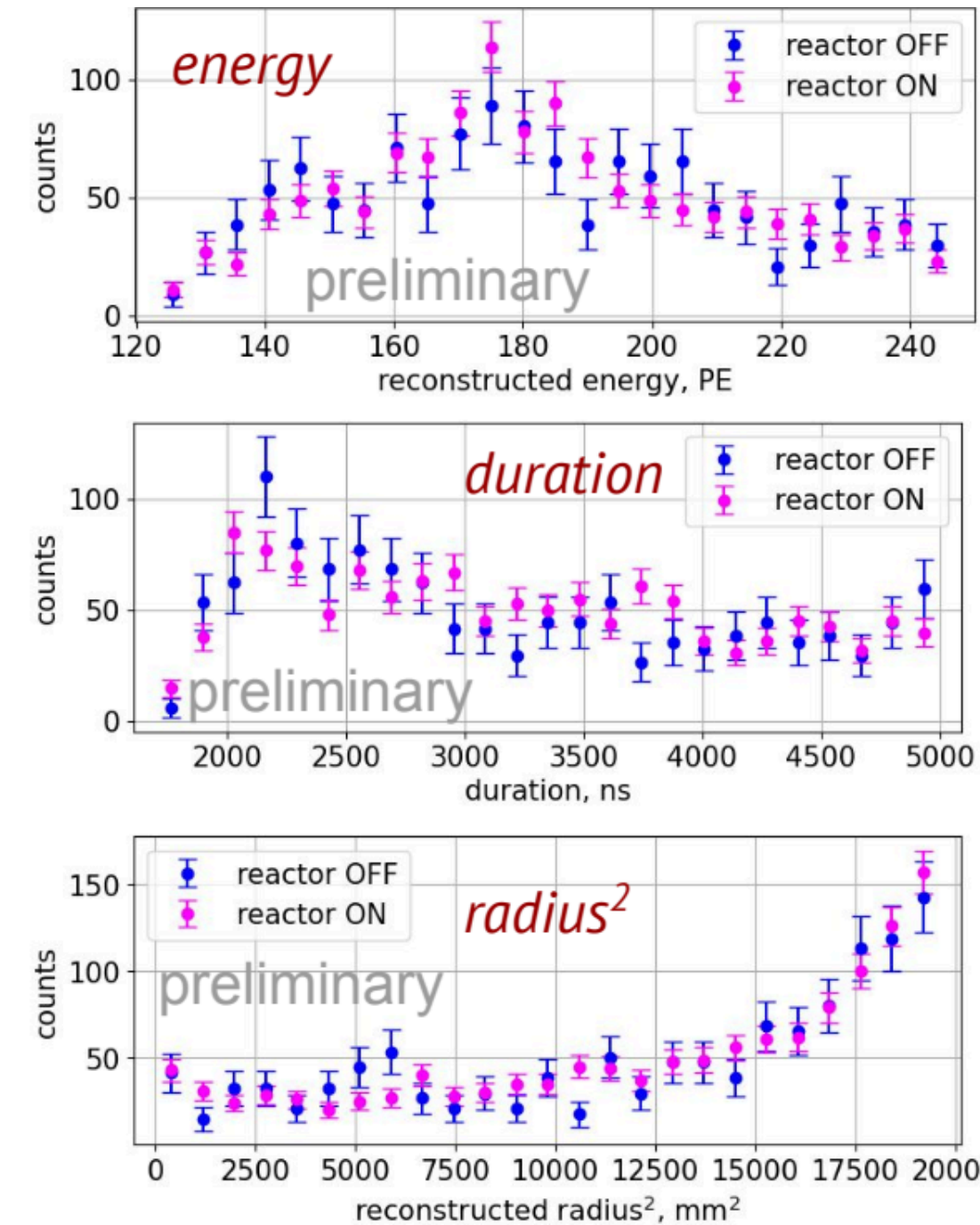
- SuperCDMS iZips
- 100eV_{ee} threshold
- Low-energy background from stress relaxation.
- New hybrid detectors offer ER/NR discrimination.
- In conversations with HFIR for possible deployment



RED-100

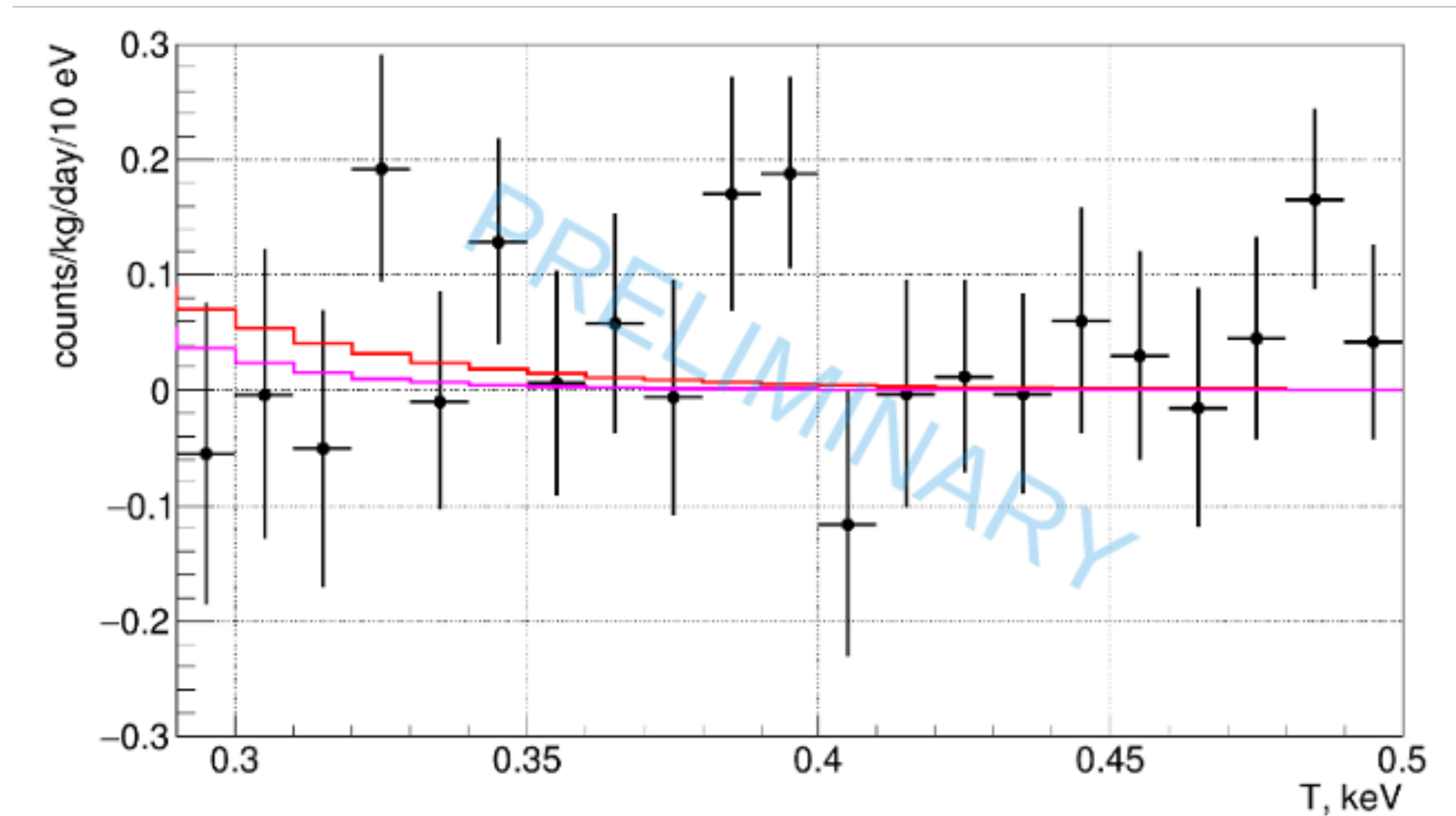


- 200 kg LXe (100 kg LAr)
- At Kalinin NPP (3 GW, 19 m, 65 m.w.e)
- Stable operation demonstrated
- 4.5 S.E. threshold
- Unexpected point like background in ROI
- Data analysis nearly finished
- Upgrading to LAr

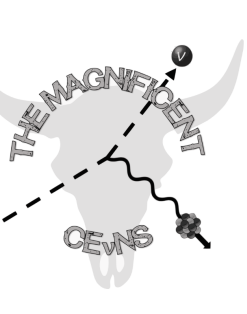


O. Razuvaeva

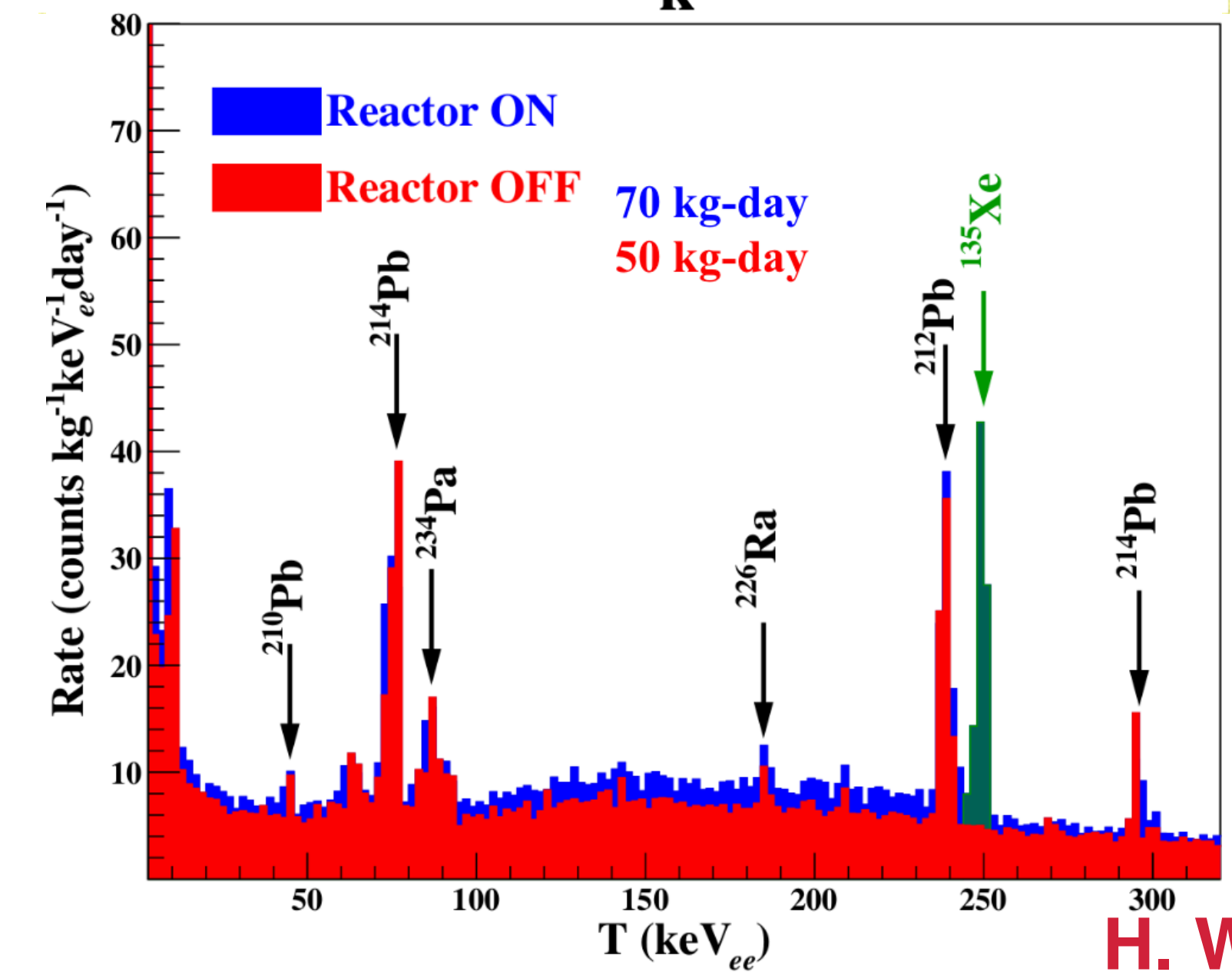
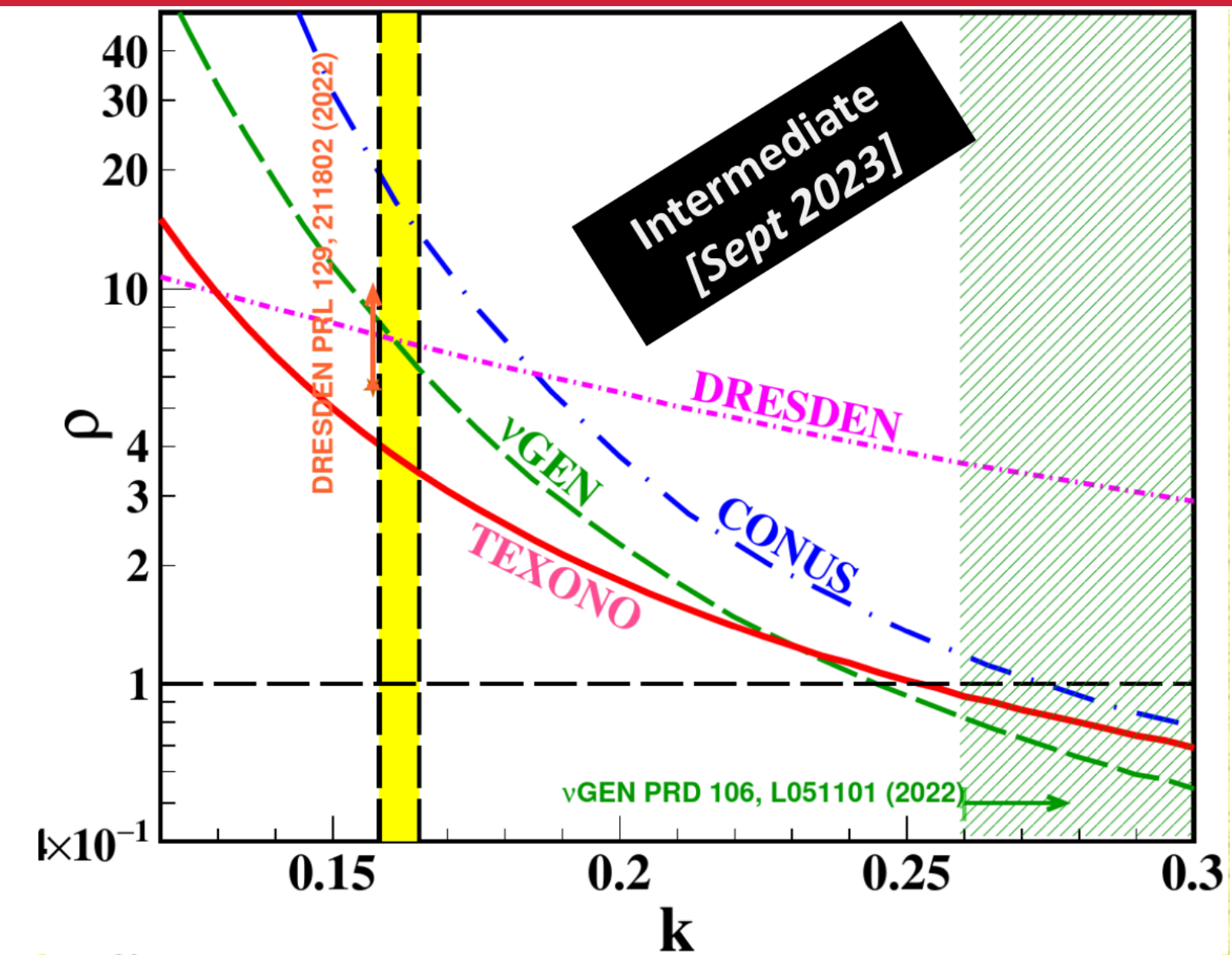
- HPGe PPC - 1.4kg
- 102 eV_{ee} pulser resolution
- Kalinin Nuclear Power Plant: 3.1GW_{th}, 11m
- Results from 11/2022-5/2023:
 - CONUS QF (k=0.162): <5x SM
 - Dresden QF (FeF, mod. Linhard k=0.157): <2x SM
- Planning Compton veto and cryocooler modification for noise reduction



TEXONO

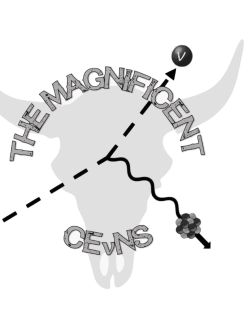


- @ KSNL (2.9 GW, 28m) since ~2003
- Updated to electro cooled PPCS with 200 eV threshold (Results presented at TAUP 2023)
- Working on updated analysis
- See evidence of Xe-135 from Rx operation—can subtract it
- New site (under CDEX): Sandmen Rx (3.4 GW, 11m!)

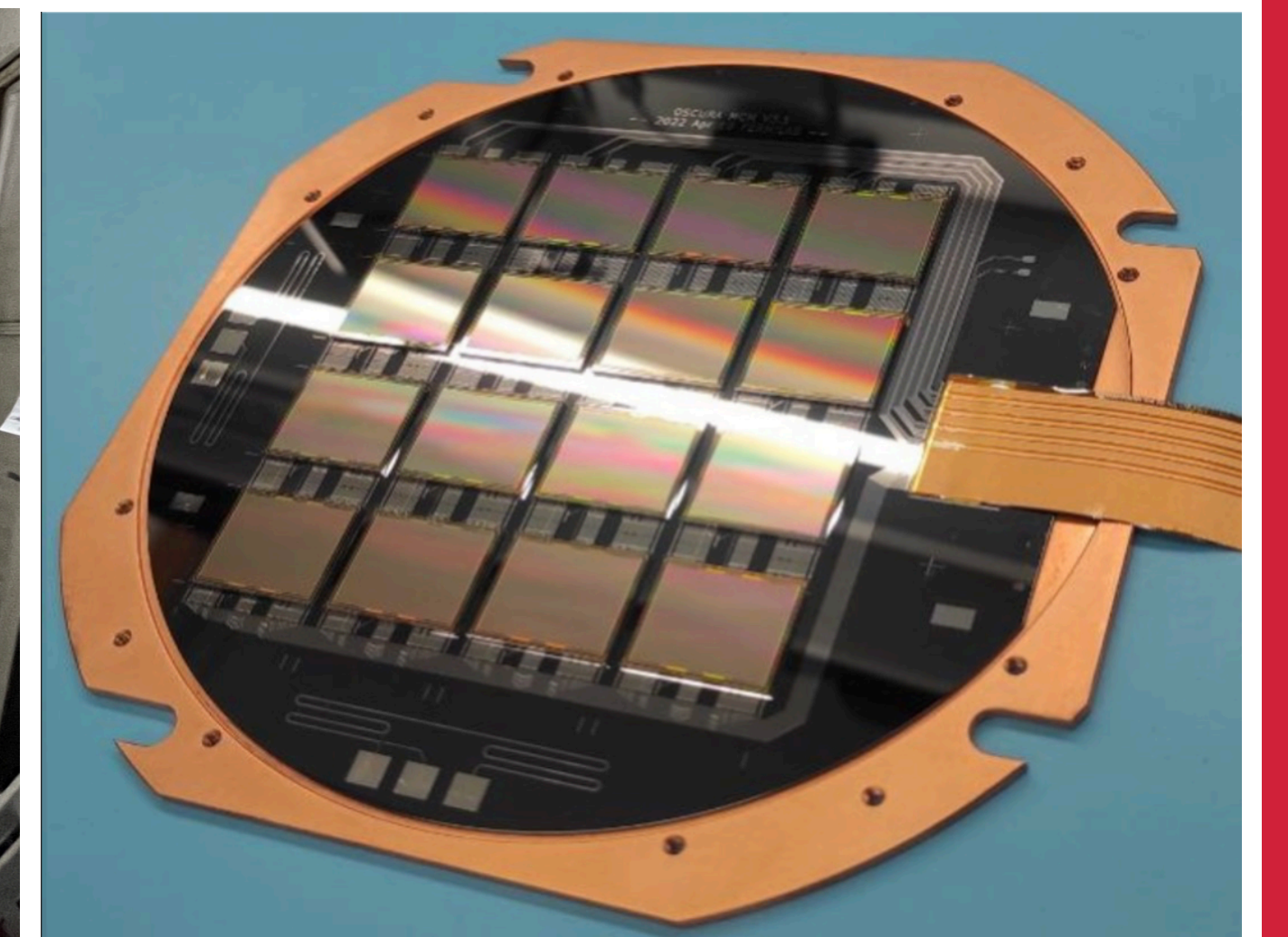
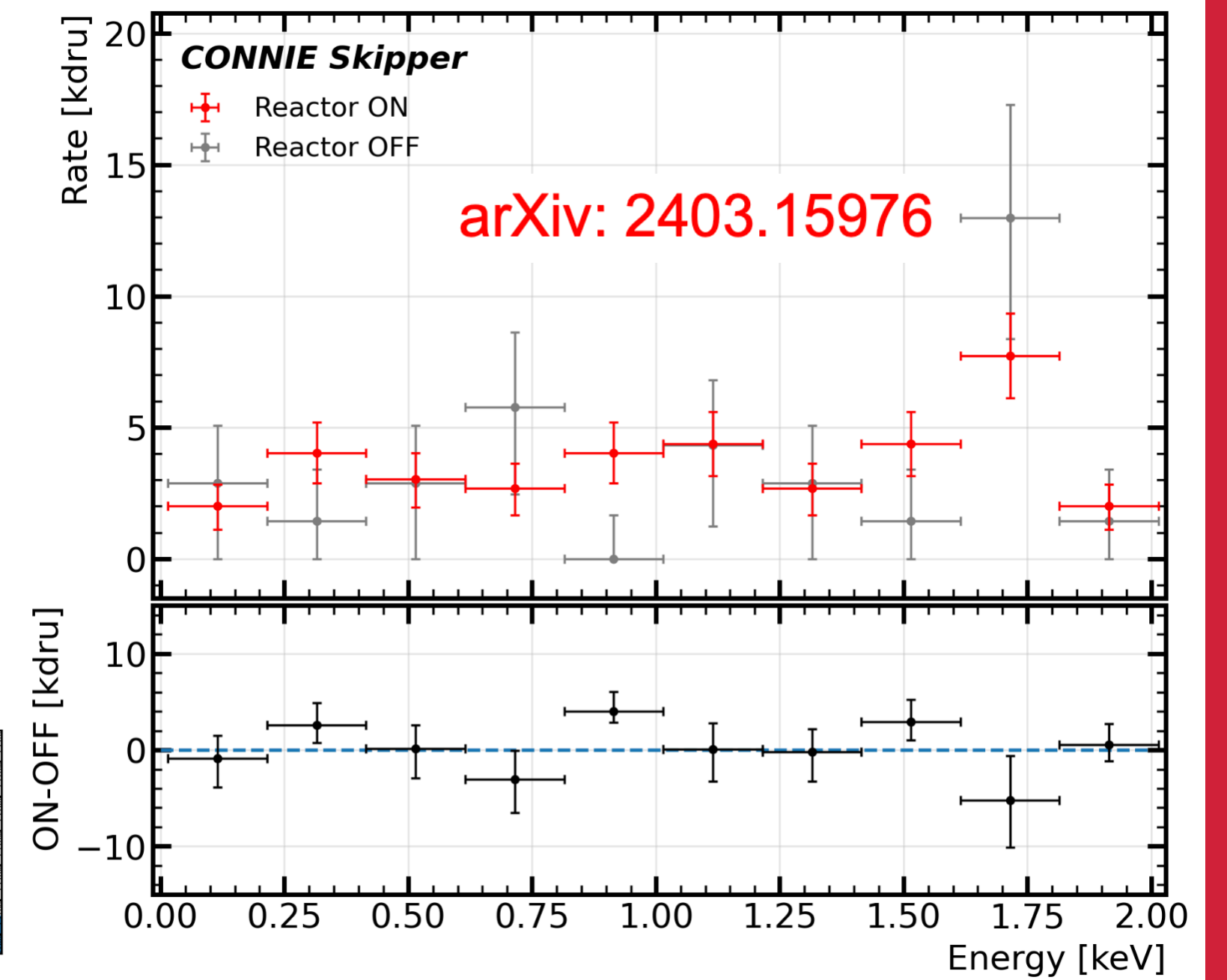
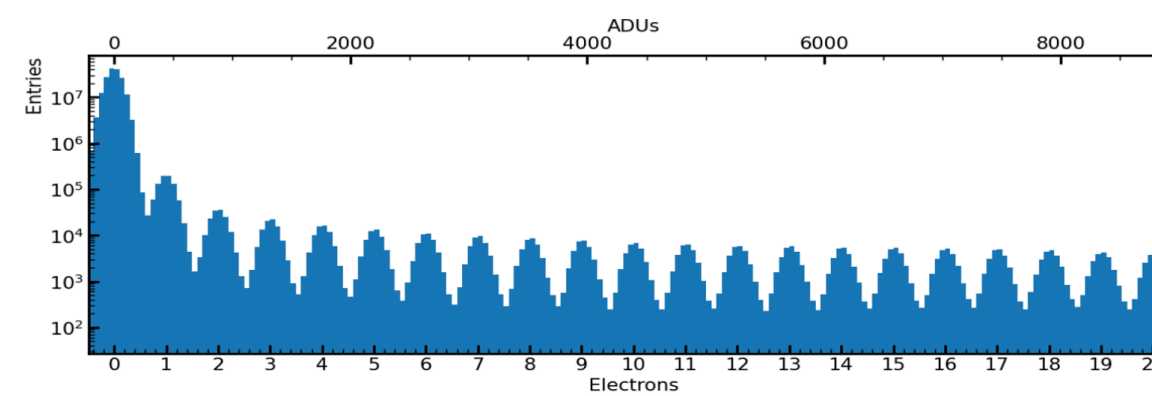


H. WONG

CONNIE

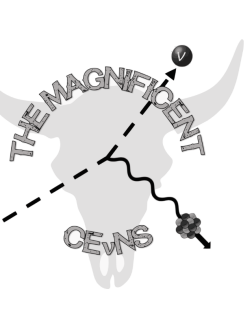


- Skipper CCD Array
- $15eV_{ee}$ threshold, single e^- resolution
- Angra 2 reactor: 3.95 GW_{th} , 30m
- CEvNS search:
 - 14.9 g-days Rx on
 - 3.5 g-days Rx off
 - Limit: 76x SM
 - Limits on millicharged particles
 - New Multi-Chip-Module installed (8g, 32x increase) May 2024

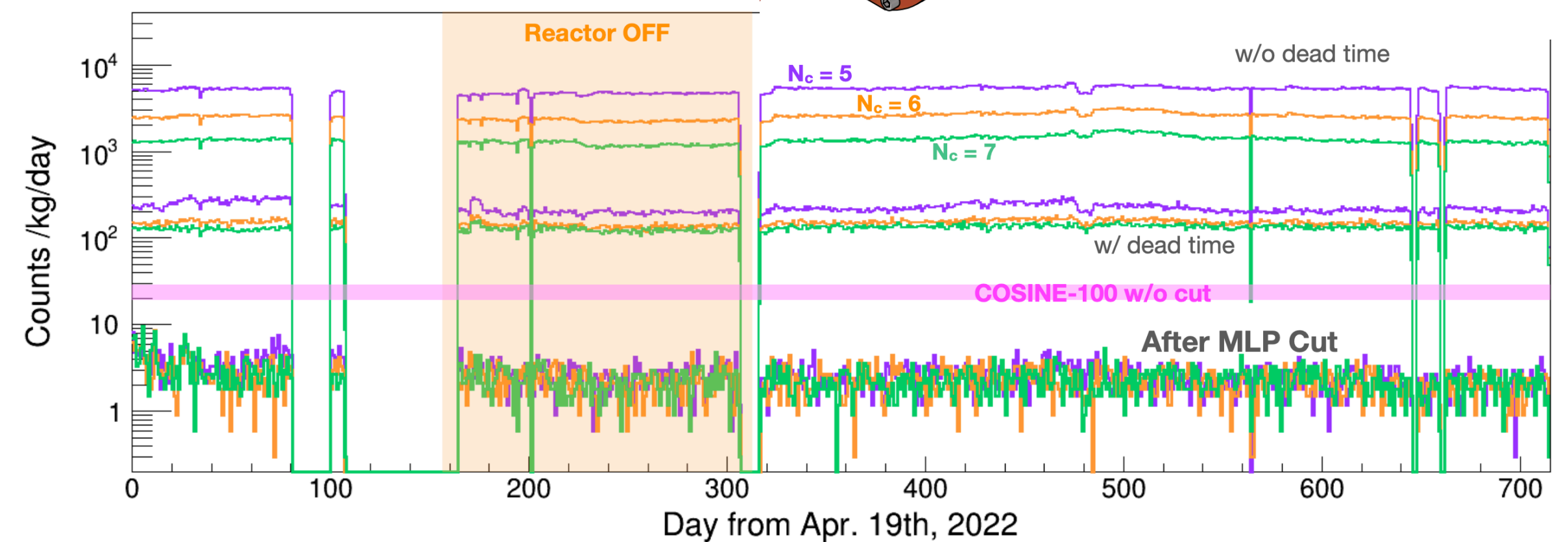
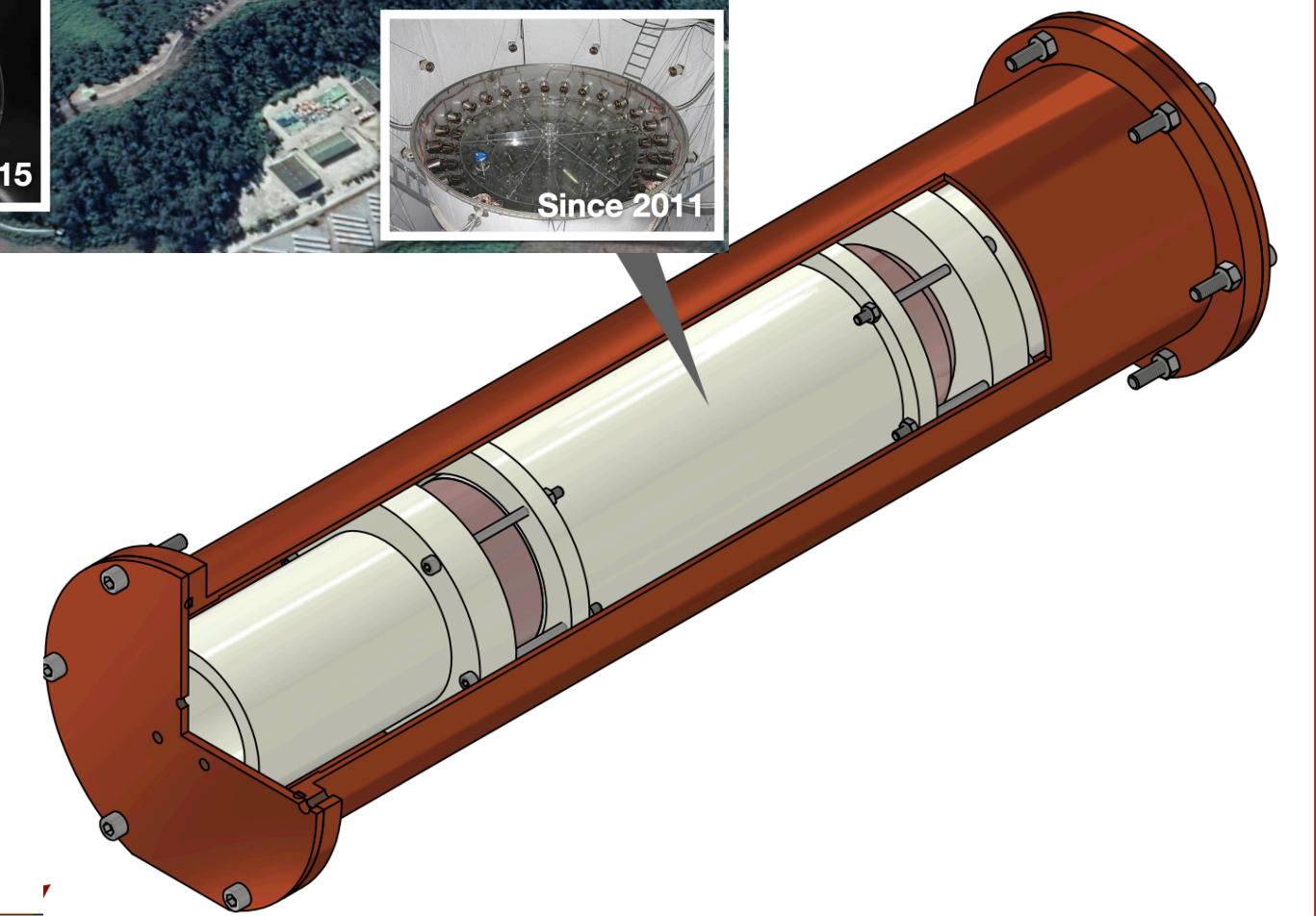
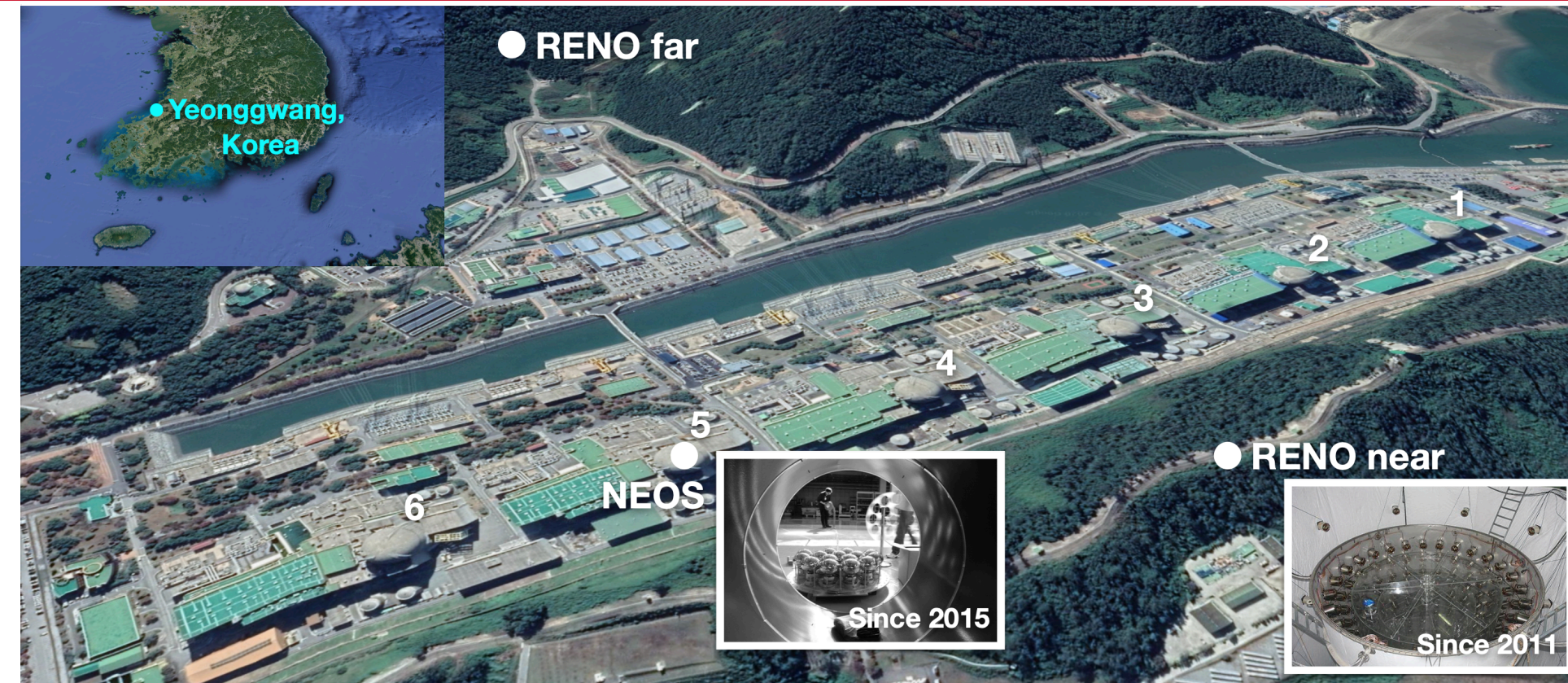


I. Nasteva

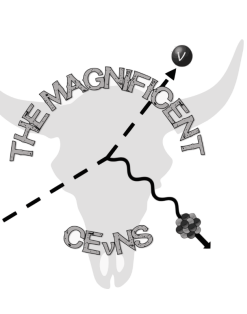
NEON



- 16.7kg NaI[Tl]
- Hanbit Nuclear Power Plant Unit 6
- 2.8GW_{th} , 23.7m
- 523 (143) days of reactor-ON (OFF) data
- Developing ML analysis to reduce noise events
- Searches for dark sector particles



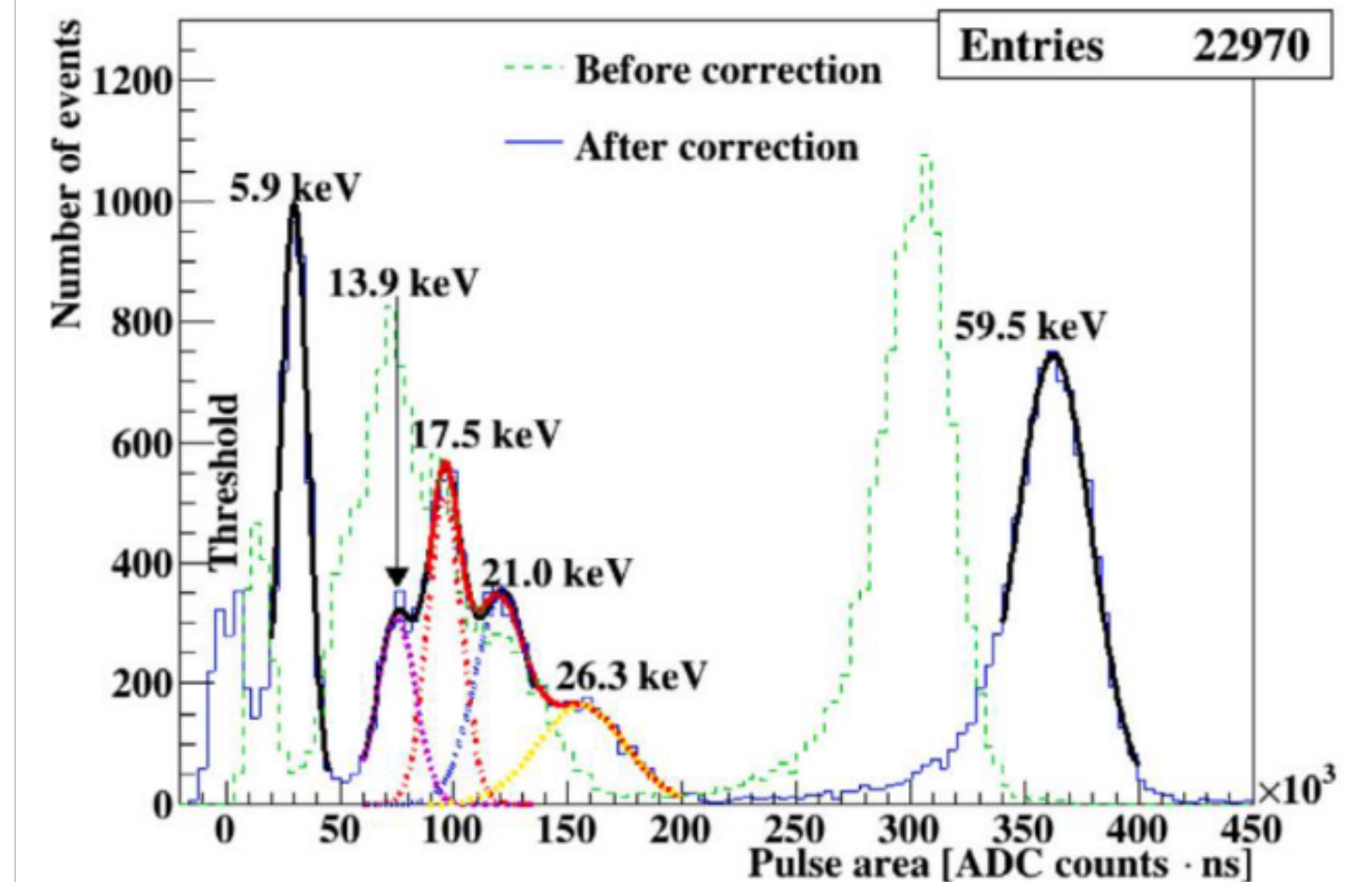
New Technologies: CryoCsI



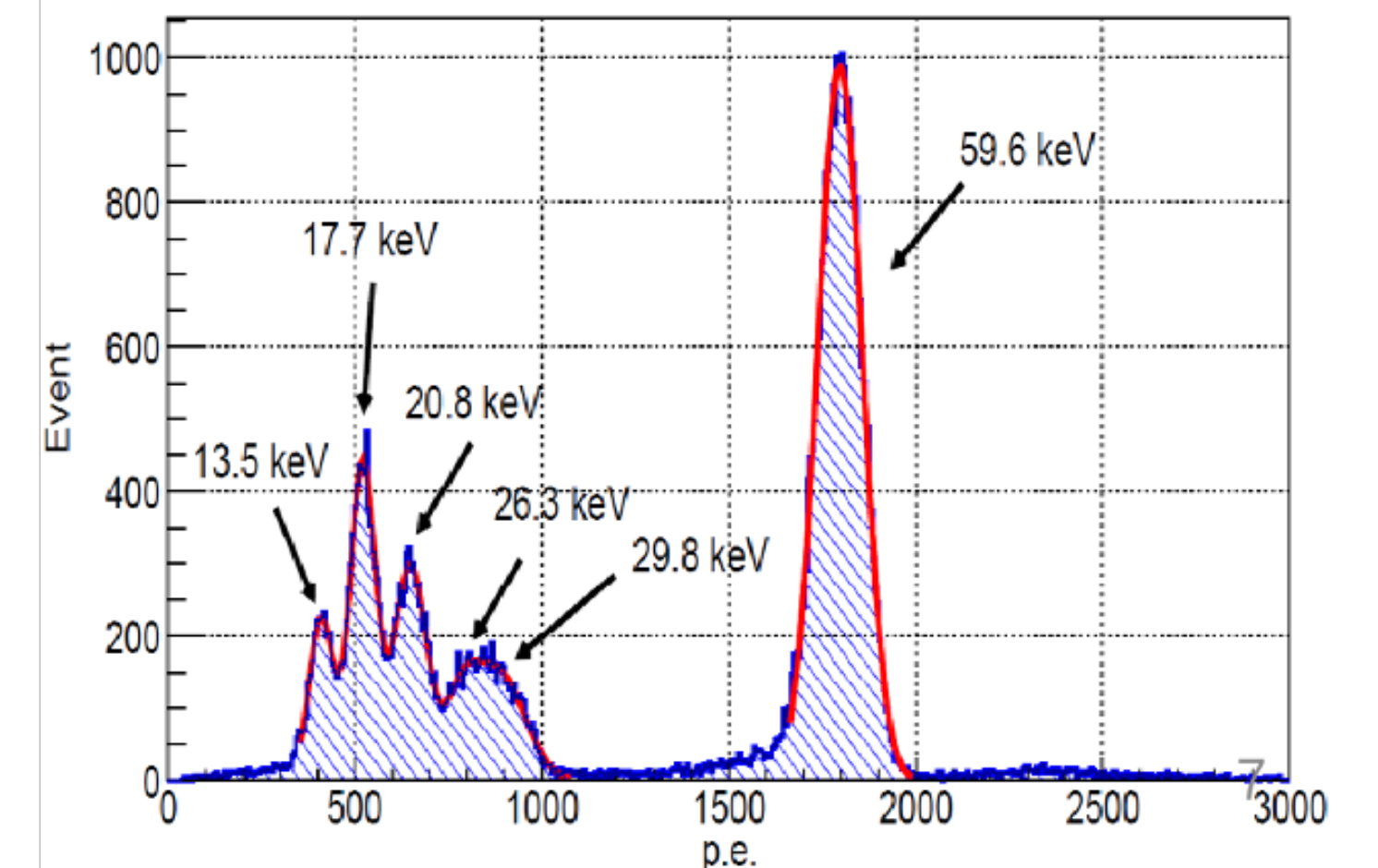
- Compared to CsI[Na]:
 - Much higher light yield
 - Much shorter decay time (less afterglow)
 - Higher quenching factor
- Excellent linearity
- Light yield peaks around 20 K
 - TPB increases light yield
 - Polishing increases light yield
- R&D ongoing at UCAS, IHEP, USD and TUNL
- Multiple upcoming deployments

C. Su

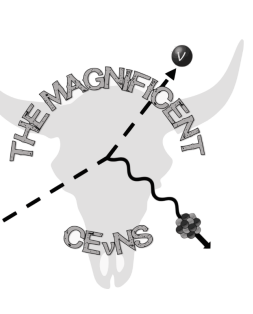
USD: arXiv:2303.05437
 $LY = 40.0 \pm 2.4 PE/keVee$ $FWHM@60keV = 8.8\%$



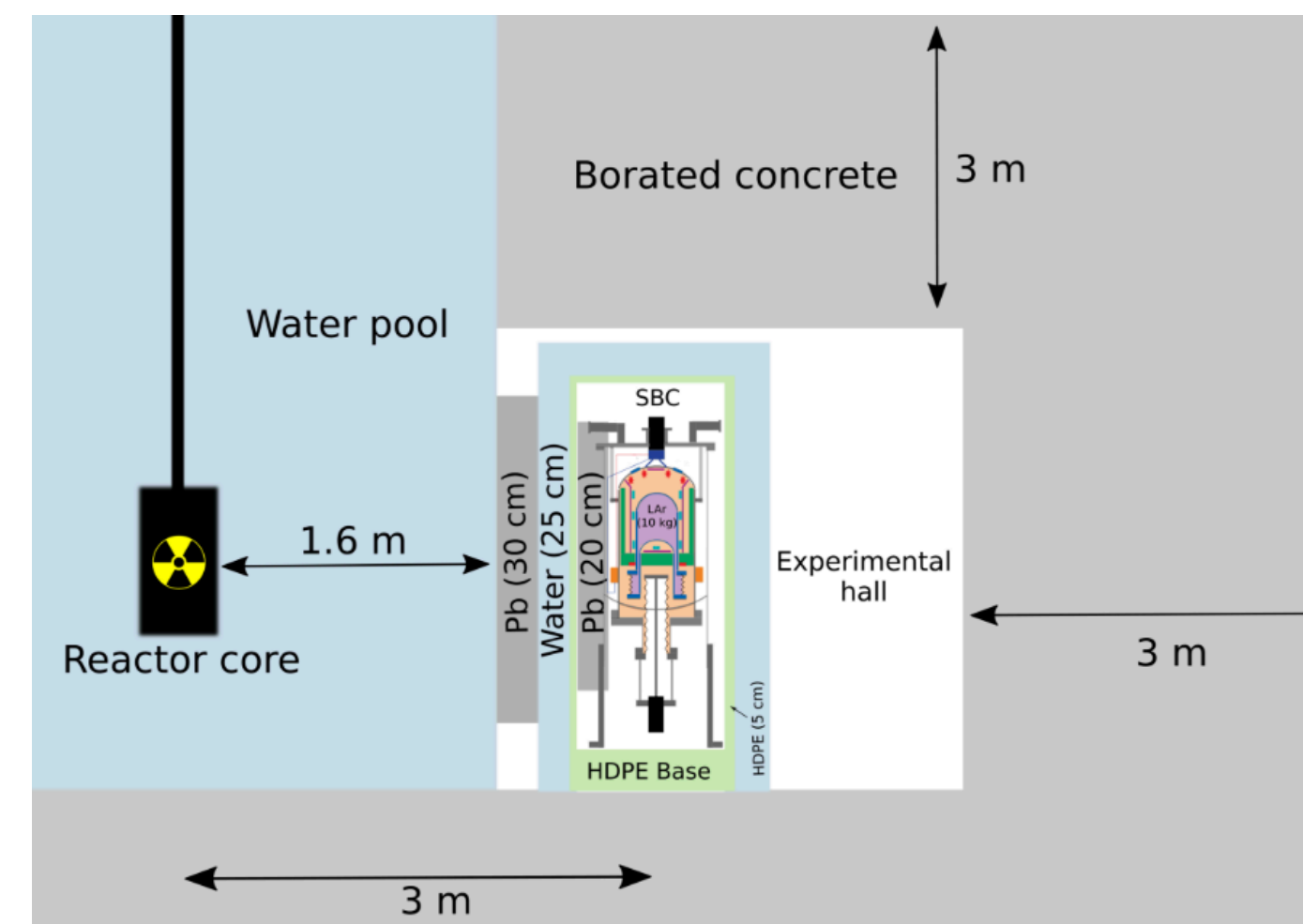
IHEP: arXiv: 2212.11515
 $LY = 30.1 \pm 8.1 PE/keVee$ $FWHM@60keV = 7.8\%$



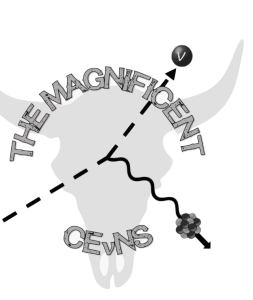
New Technologies - Scintillating Bubbles



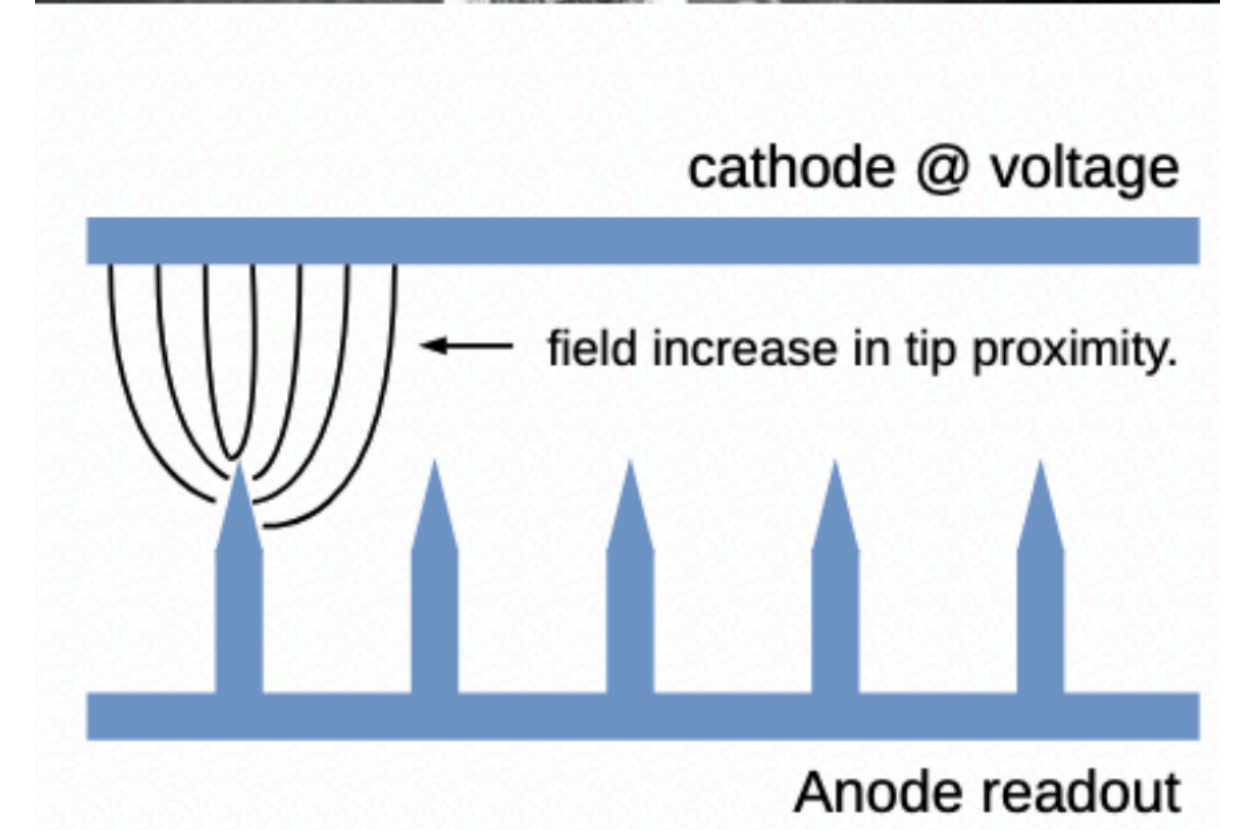
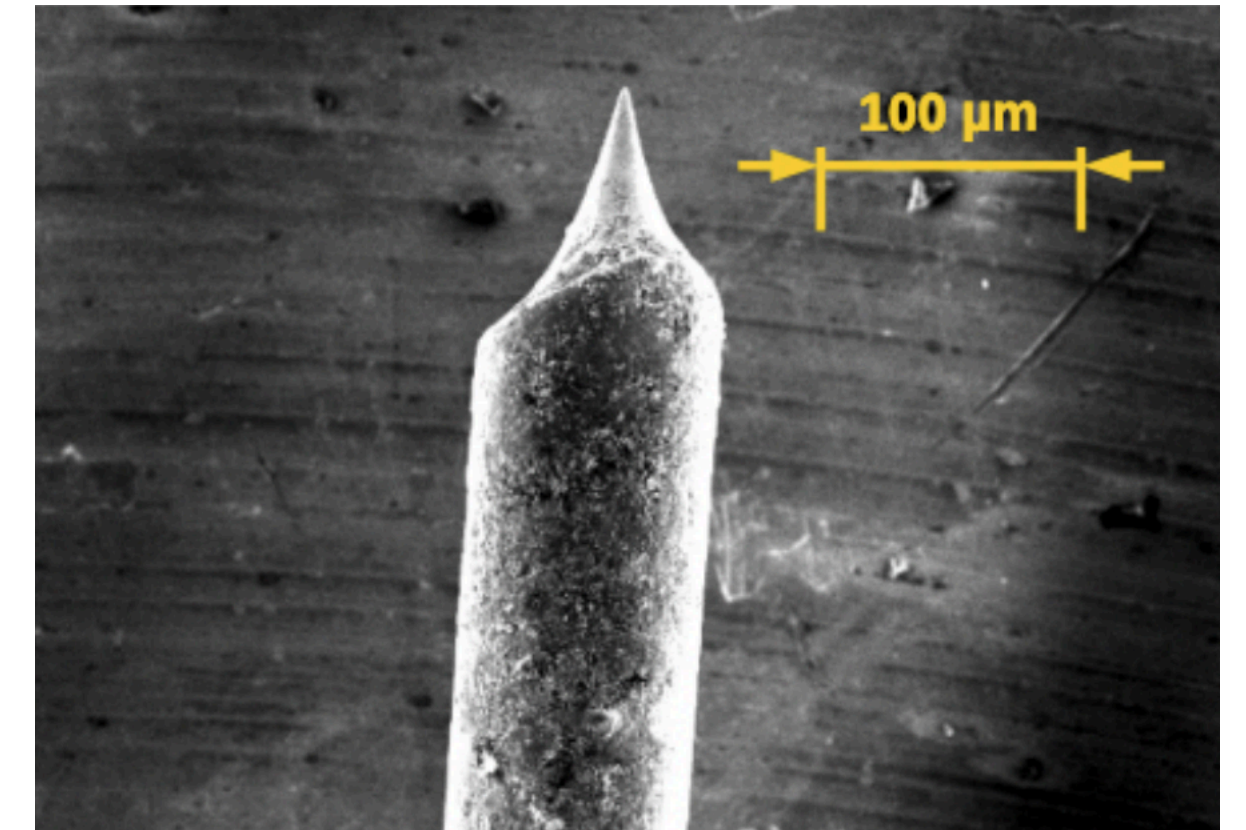
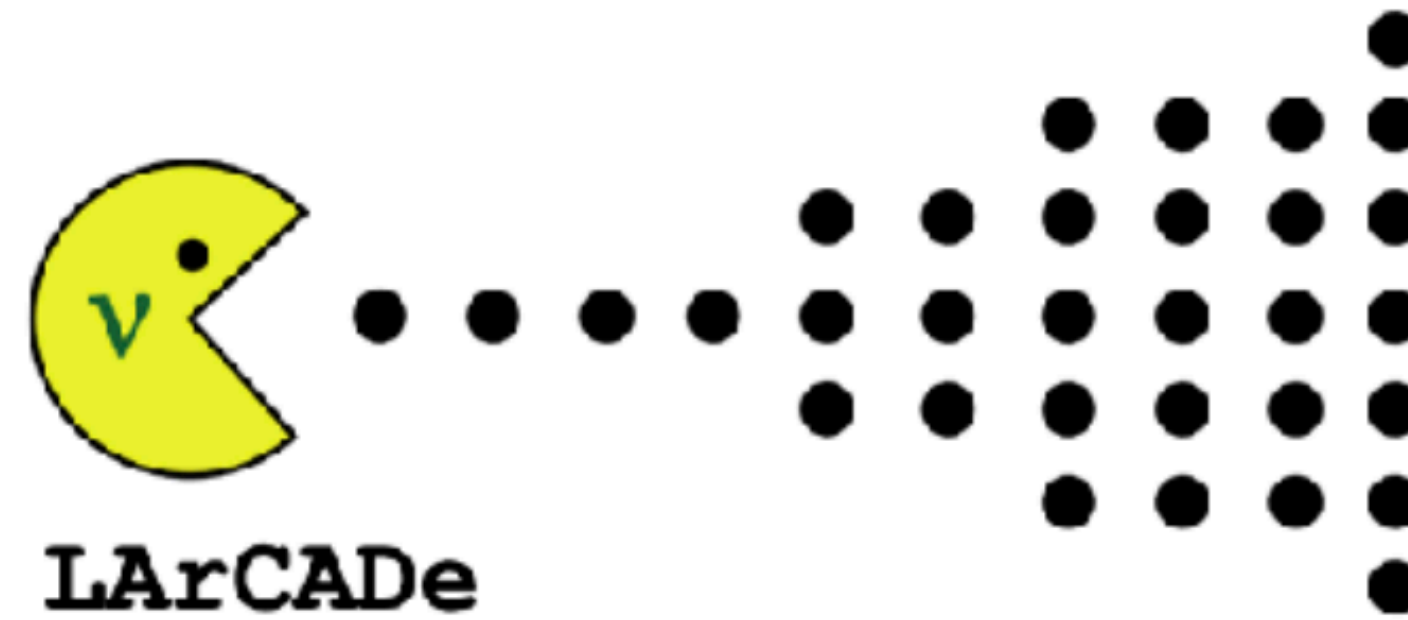
- 10 kg LAr Bubble Chamber
- 100 eV recoil detection (3 calibration techniques)
- Electron insensitive
- Build at FNAL, install at SNOLAB, Upgrade and install at Rx: ININ or Laguna Verde (1MW, 3m)
- Background Characterization at ININ ongoing



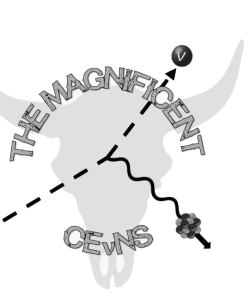
Imaging in Ar



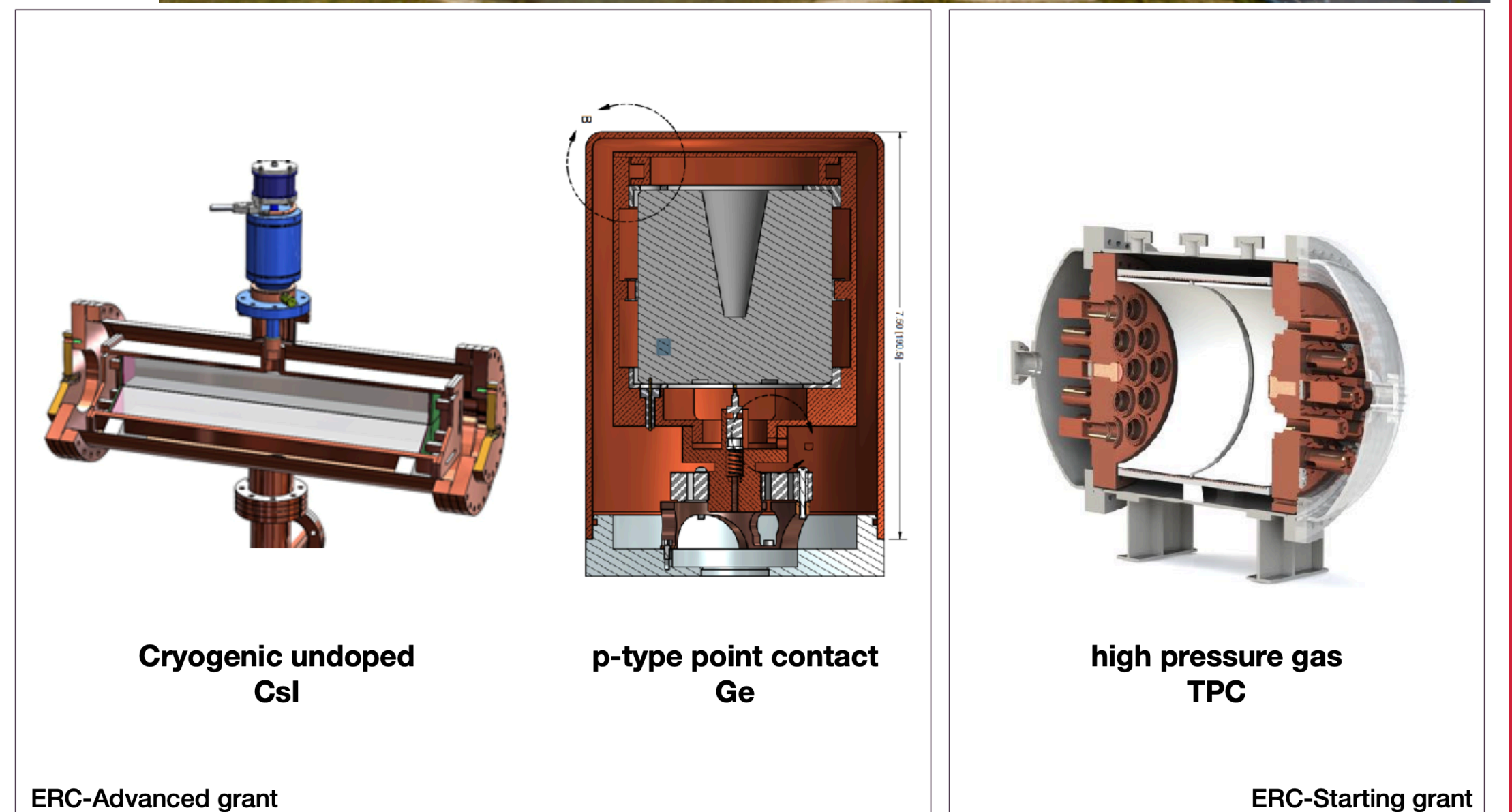
- Imaging in TPCs established at high energies
- R&D to develop amplification in LAr and tracking in GAr using nanofab electrodes



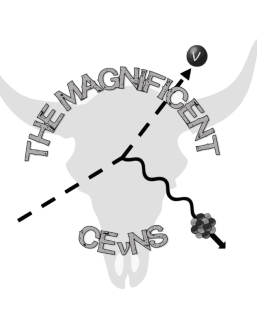
New Sources: NuESS



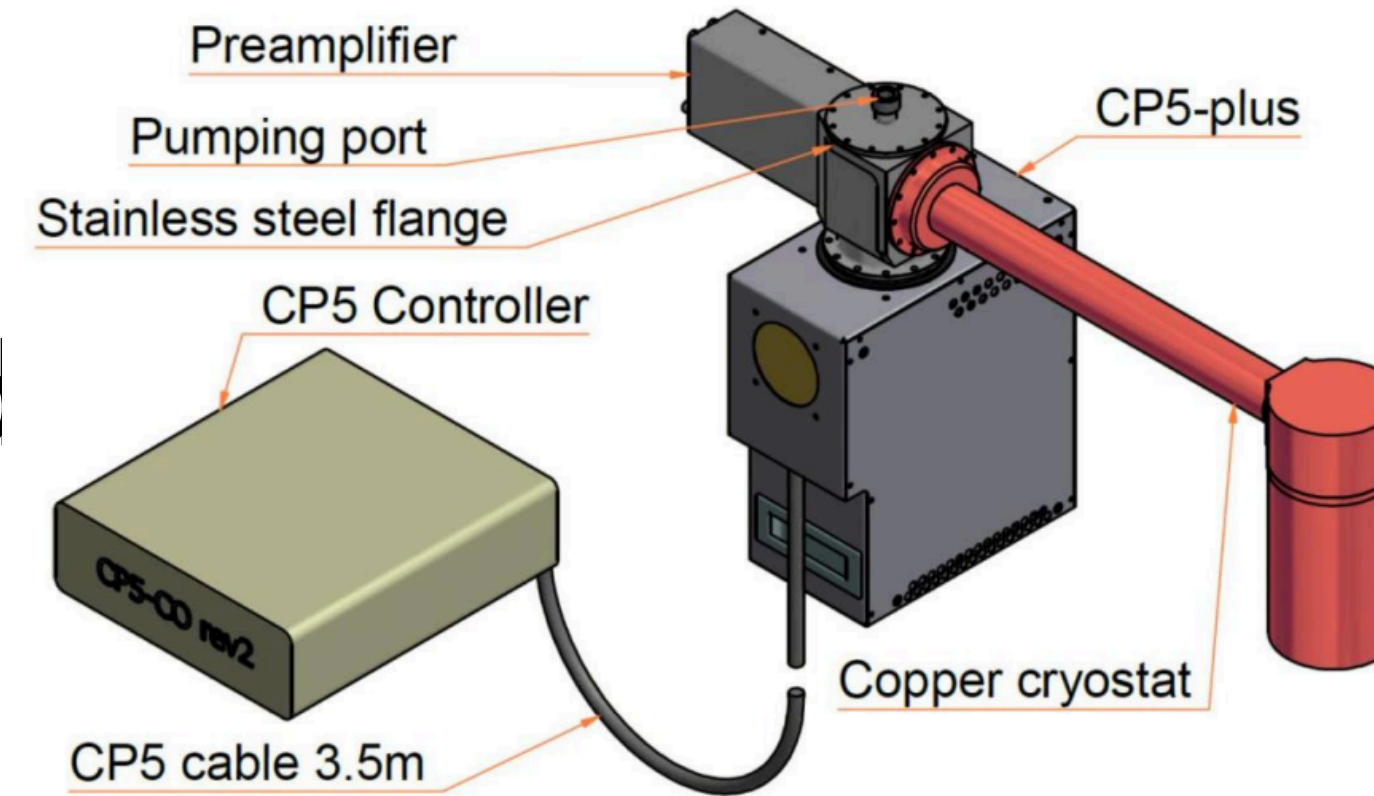
- ESS coming online with 5MW beam power, 4% duty cycle
- World's most powerful π -DAR source
- Site identified for CEvNS experiments at ESS
- Suite of detector technologies under development
- First operation at ESS in 2027



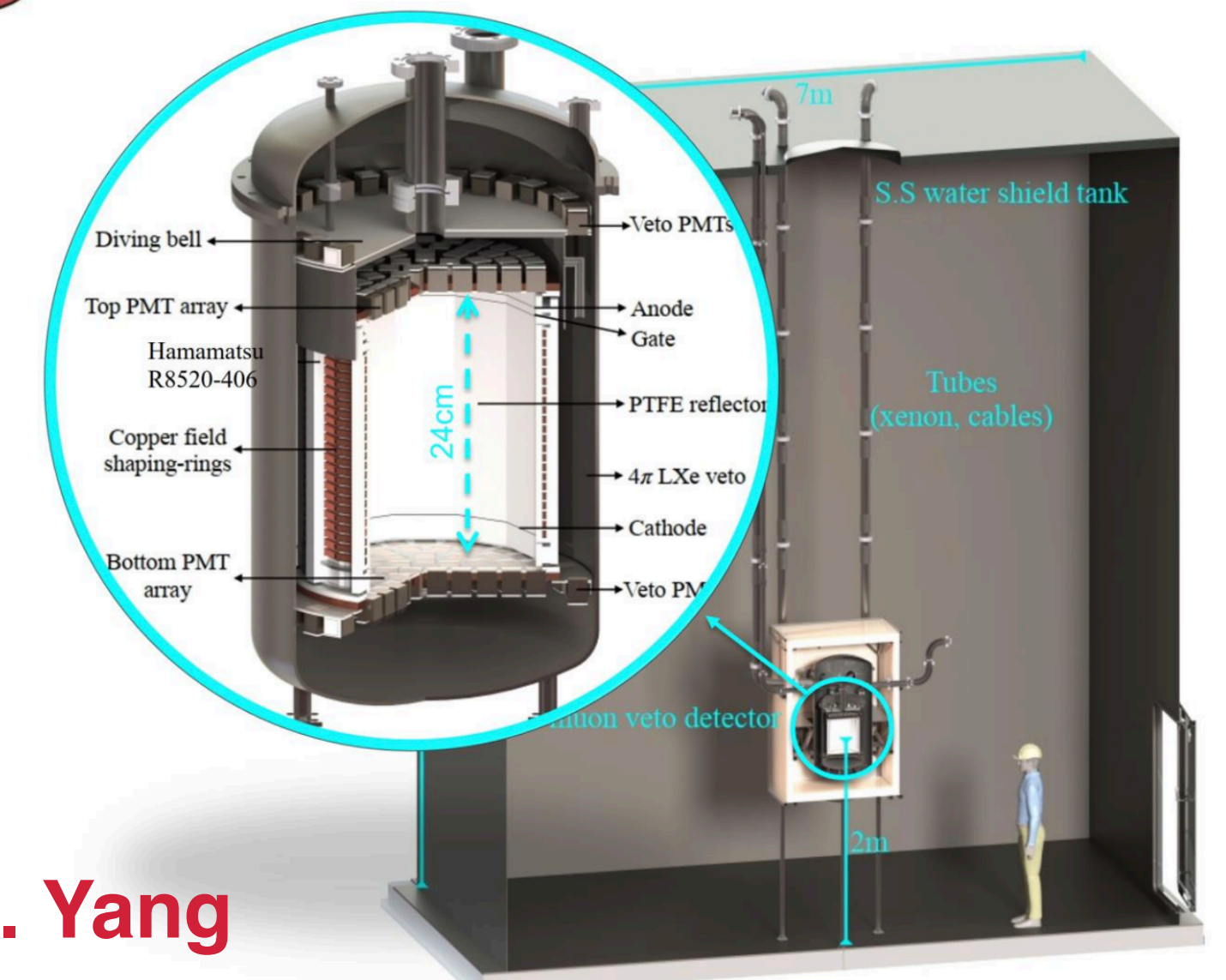
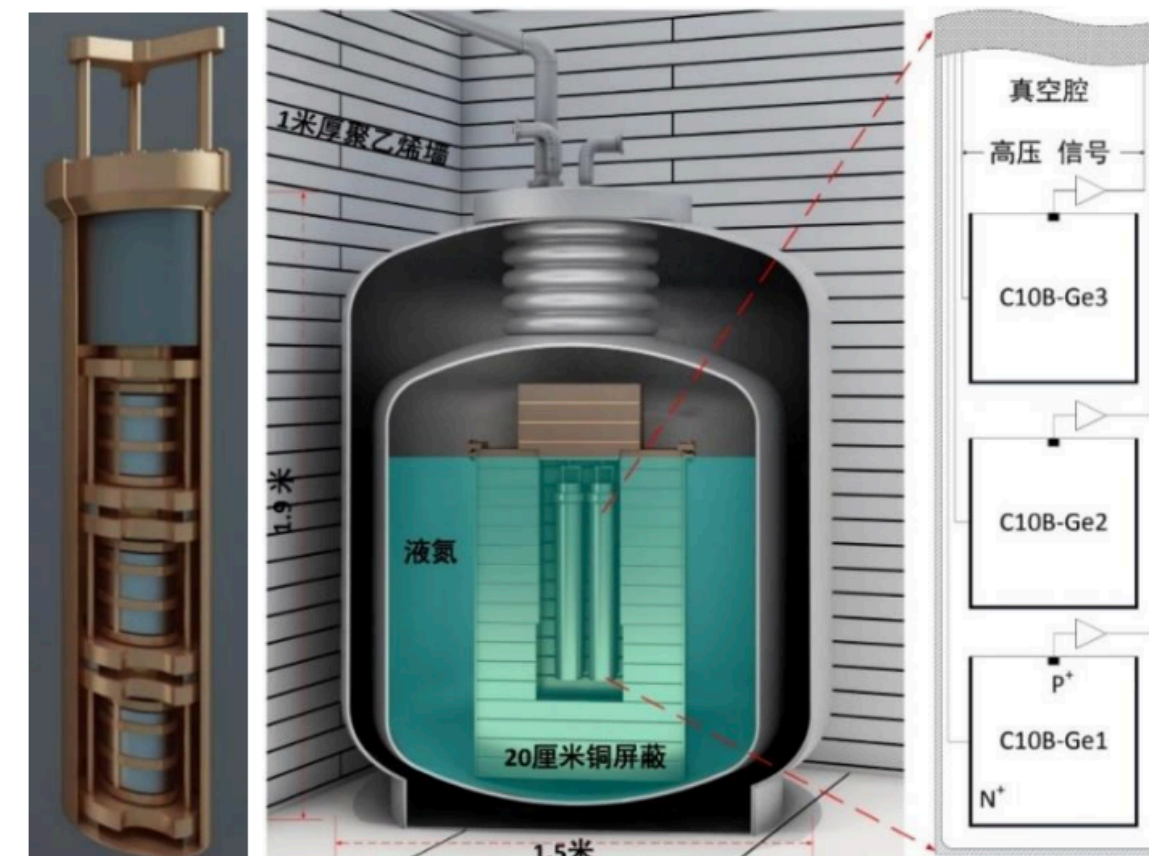
Sanmen Reactor Neutrino Laboratory



- SNPP: 3.4 GW_{th}
- Baselines: 7m, 11m, 22m
- RECODE: PPC HPGe
 - ~160eV_{ee} threshold
 - 1kg / 10kg scales, based on CDEX1, CDEX10
 - First physics: 2025
- RELICS: LXe
 - 32kg fiducial mass
 - 2-phase LXe

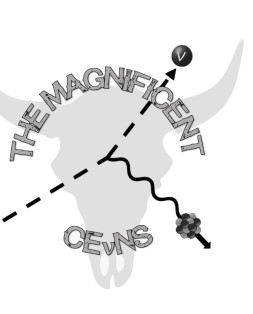


RELICS
 REactor neutrino LIquid xenon
 Coherent elastic SCattering

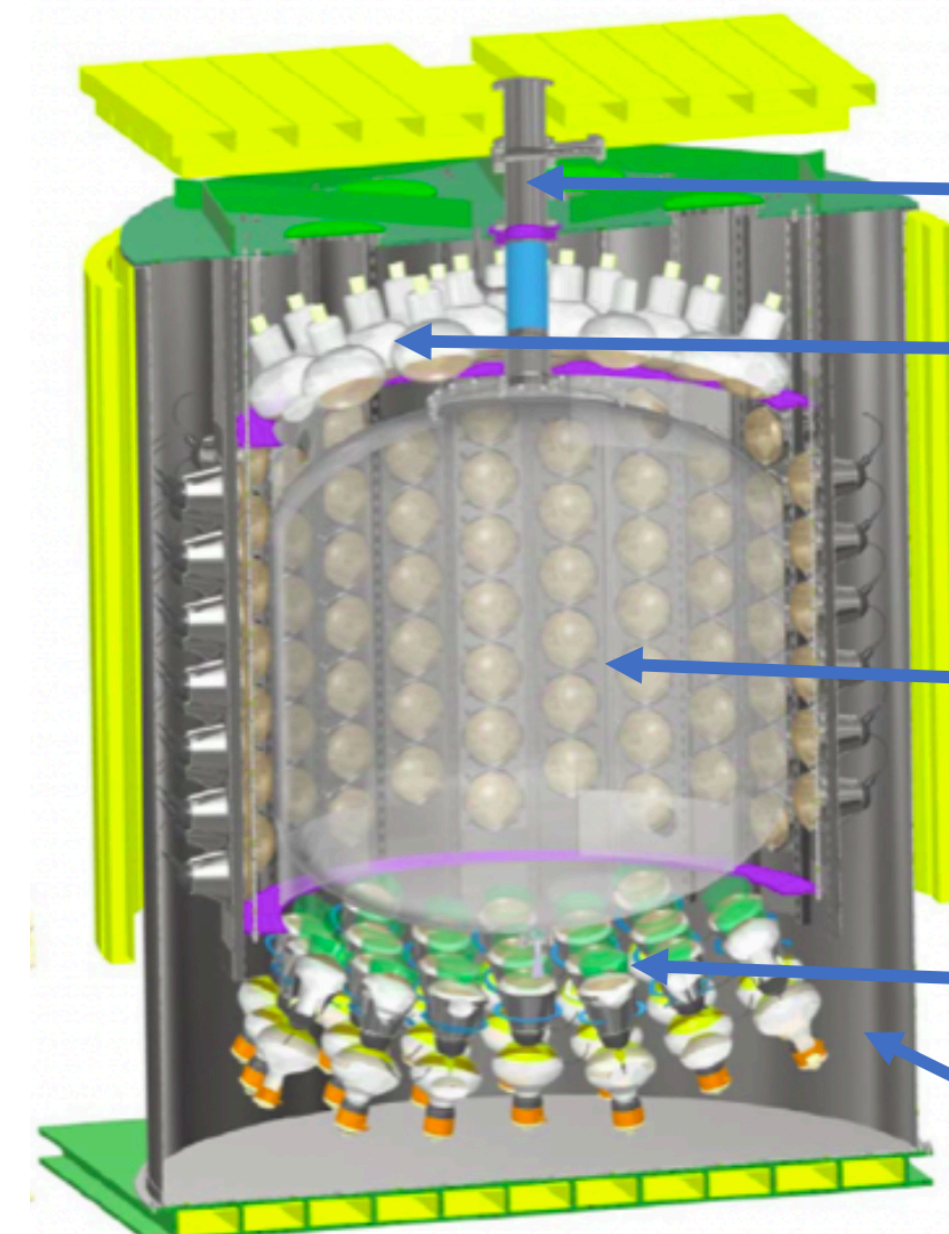
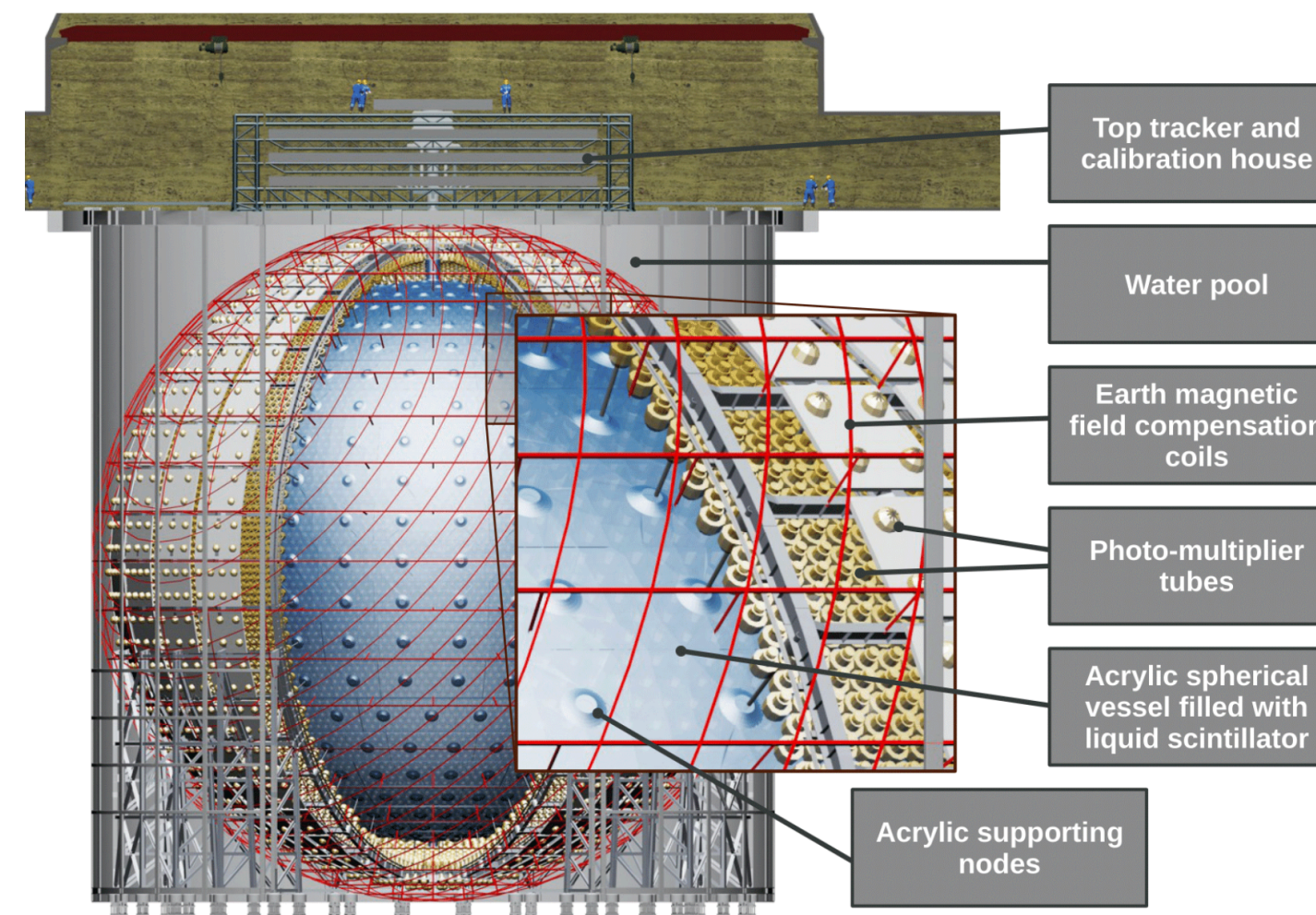


L. Yang

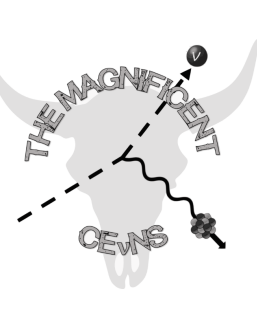
CEvNS via ^{12}C recoils in LS Detectors



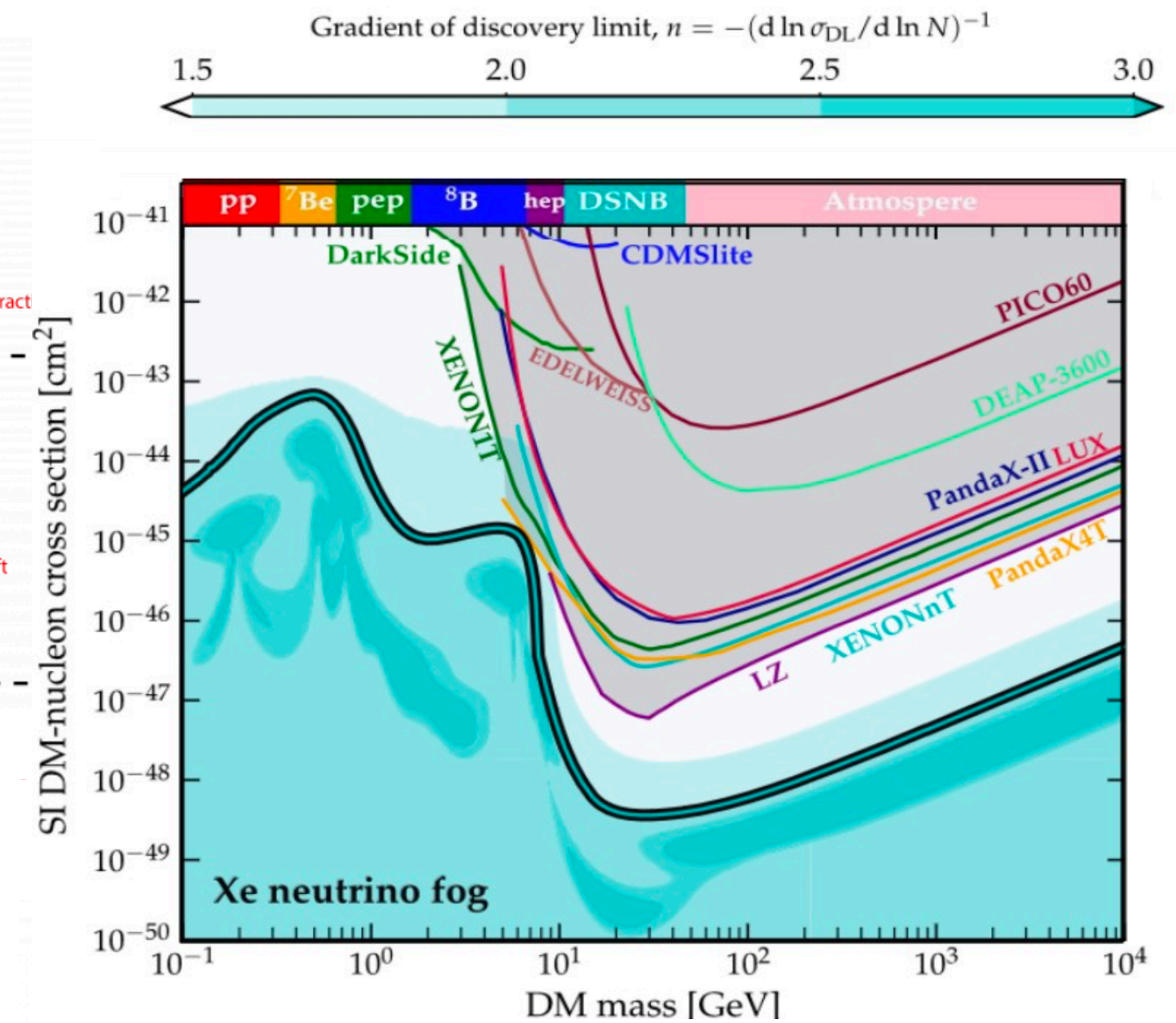
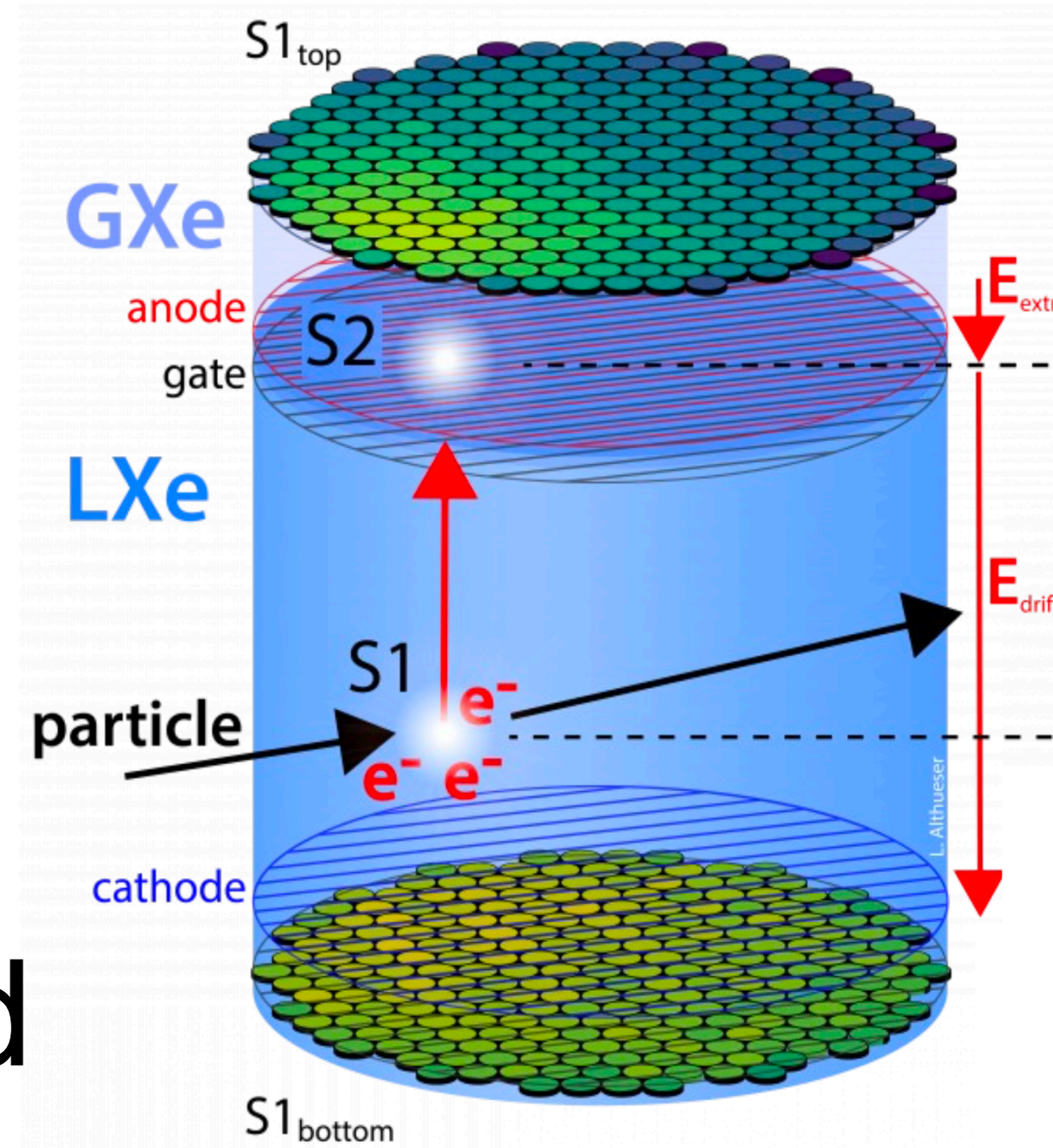
- JUNO approaching completion
- Multi-messenger mission enhanced by neutrino-nucleus scattering channels
- Threshold and resolution of JUNO-TAO suitable for beam measurements
- EOS hybrid Cherenkov/Scintillation detector planning a beam run
- Beamline under development for ^{12}C quenching factors.



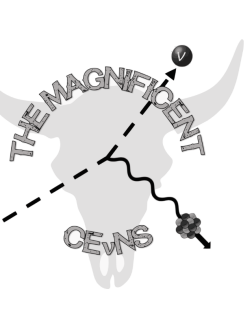
CEvNS in XENONnT



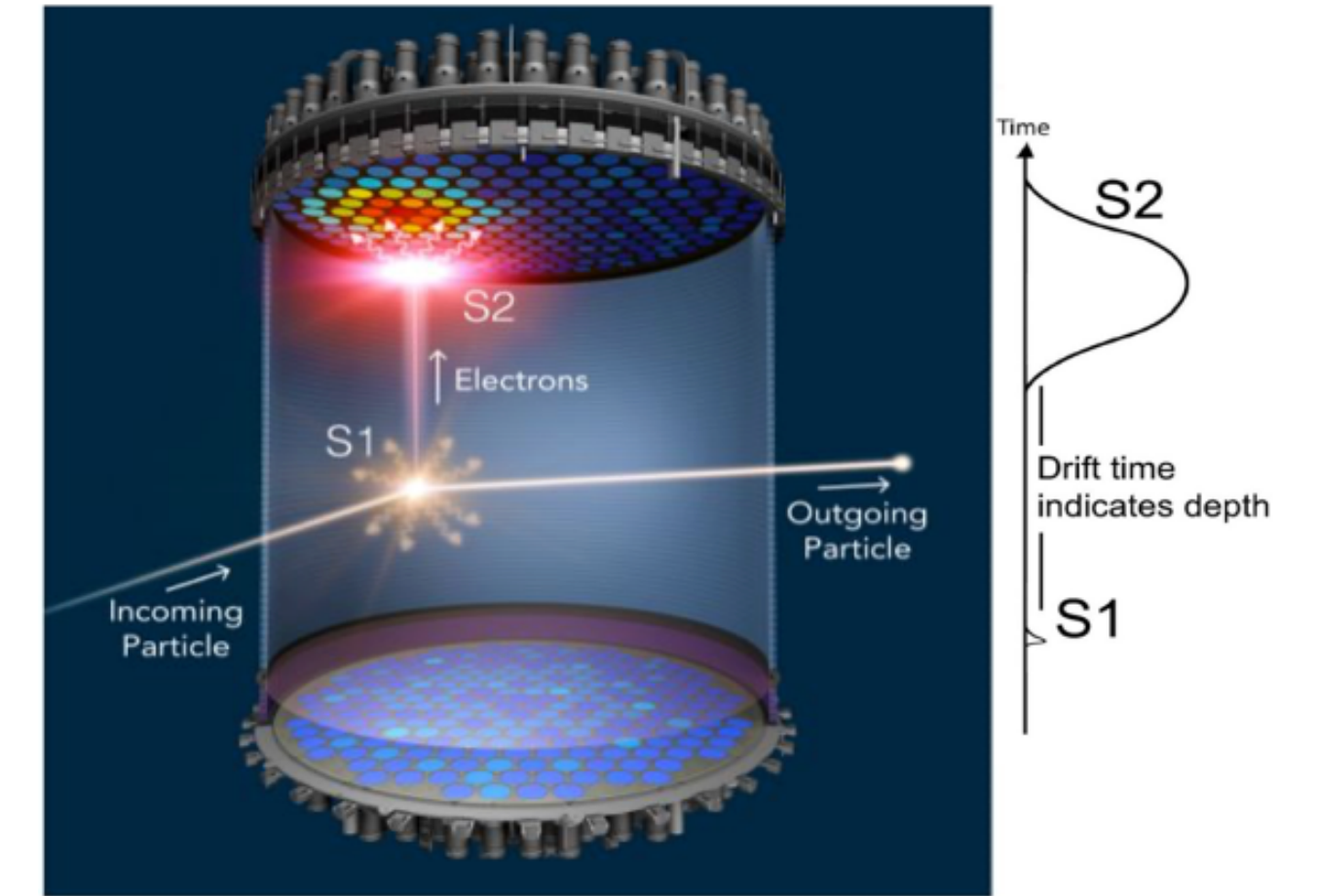
- Dual phase 8.5tn LXe
- CEvNS detection of ^8B solar neutrinos:
 - Accidental coincidence background reduced
 - NR threshold reduced
 - Performing low-threshold analysis



SN Detection in LZ

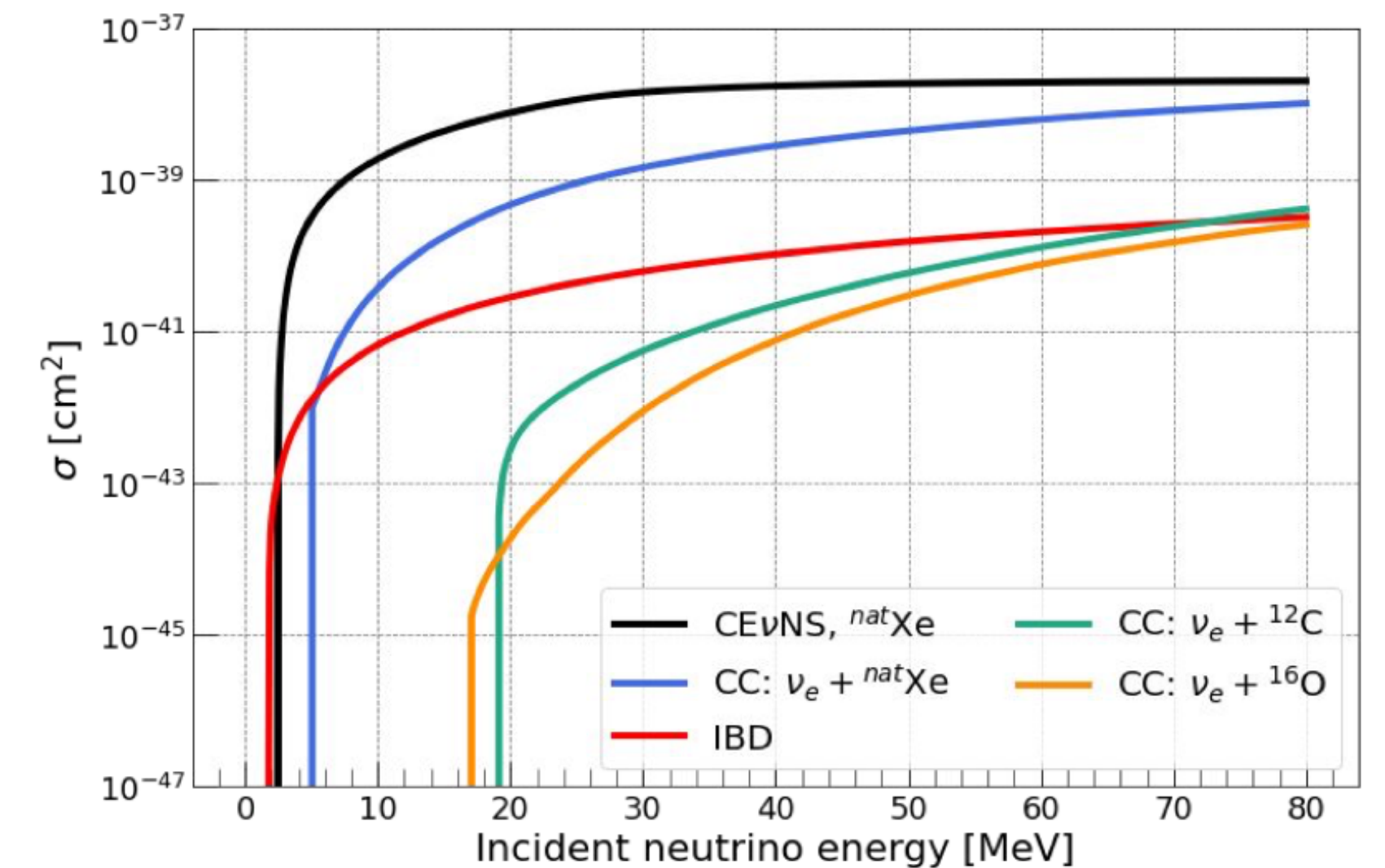


- LZ is on and in discovery mode
- ν ESPER simulates LZ response for neutrino interactions
- CE ν NS is dominant channel for LZ to see a supernova

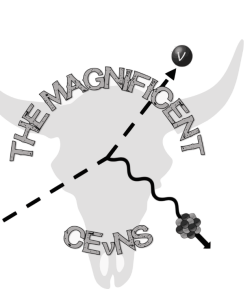


27 M_{\odot} 1D CCSN progenitor located 10 kpc from Earth

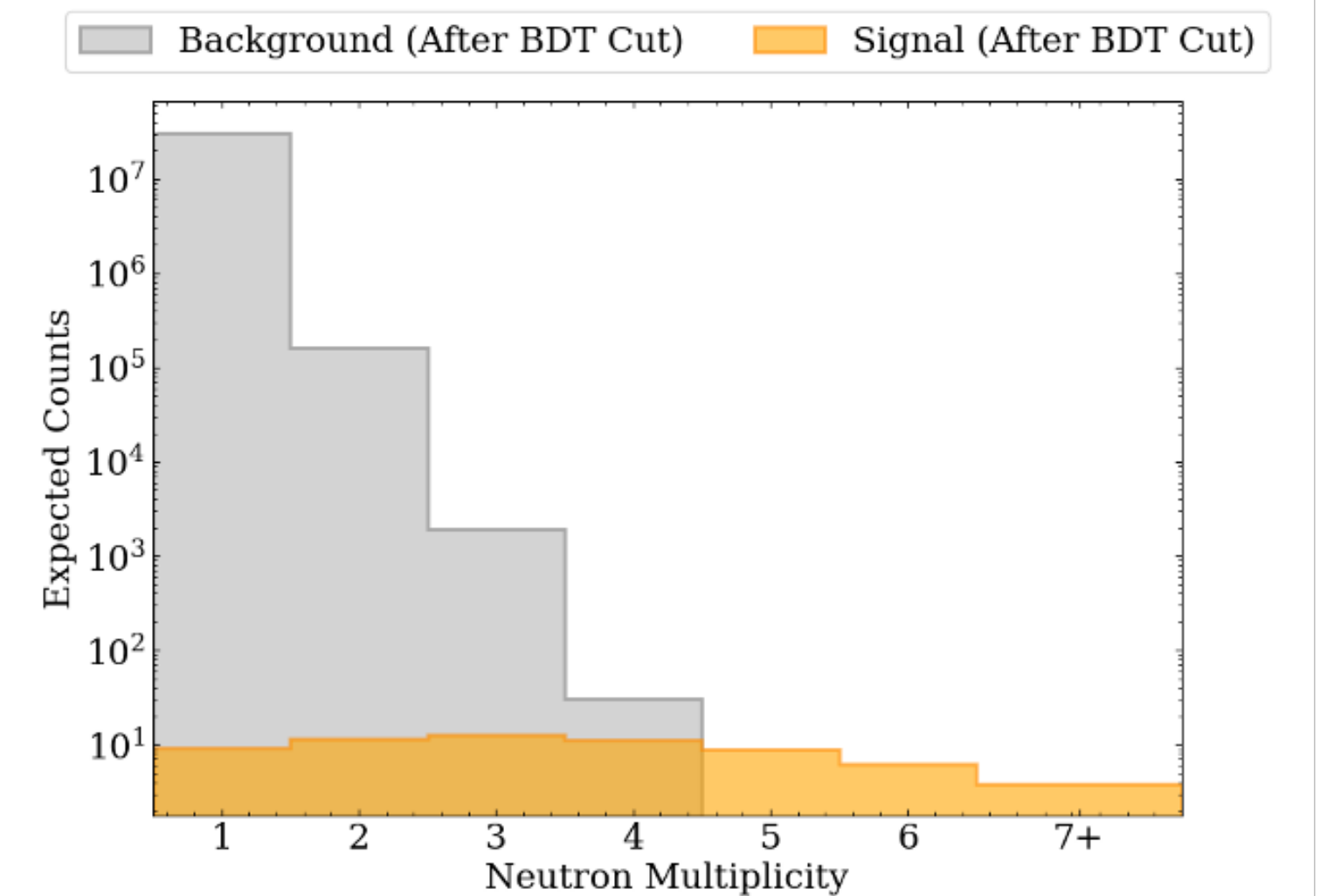
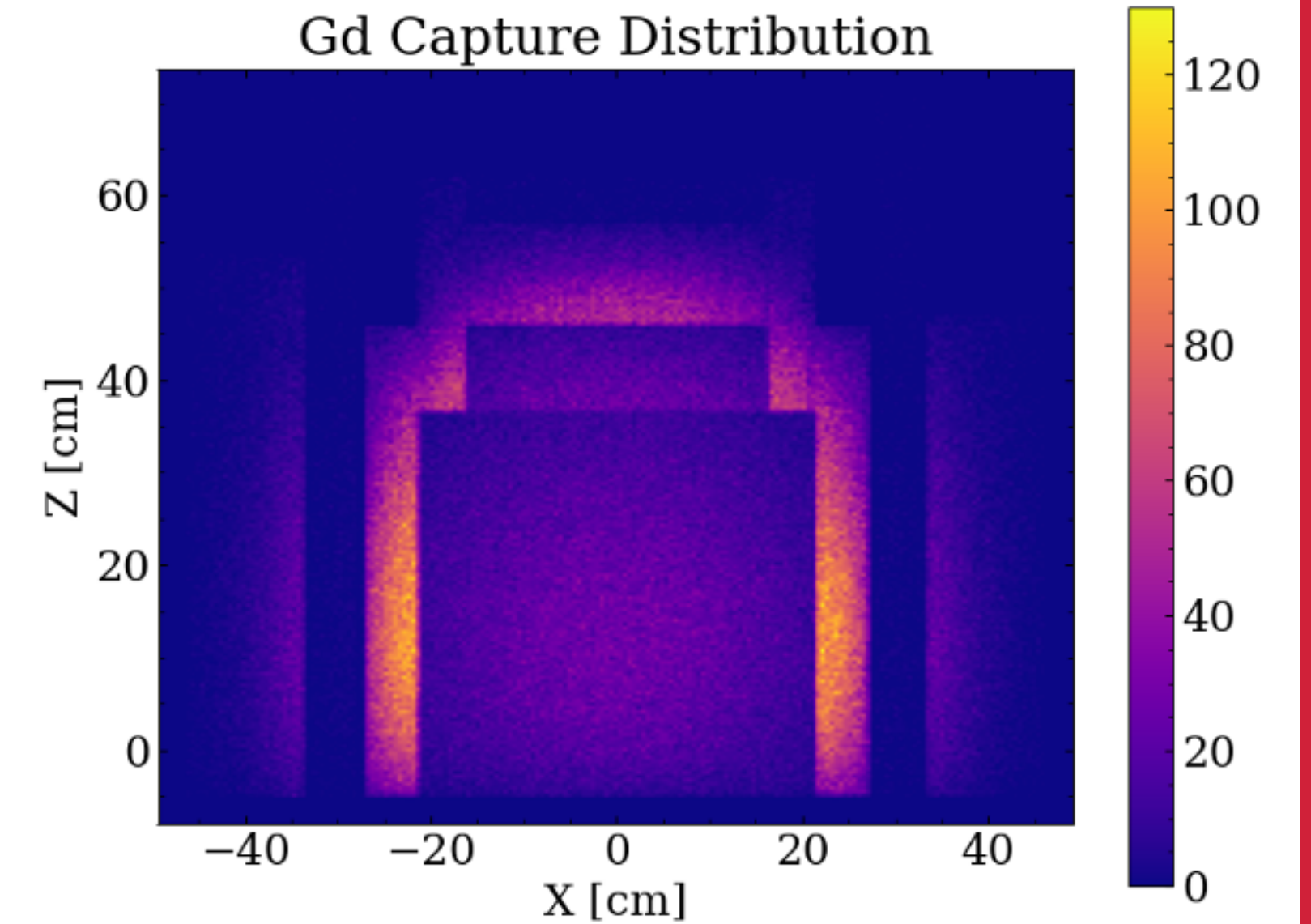
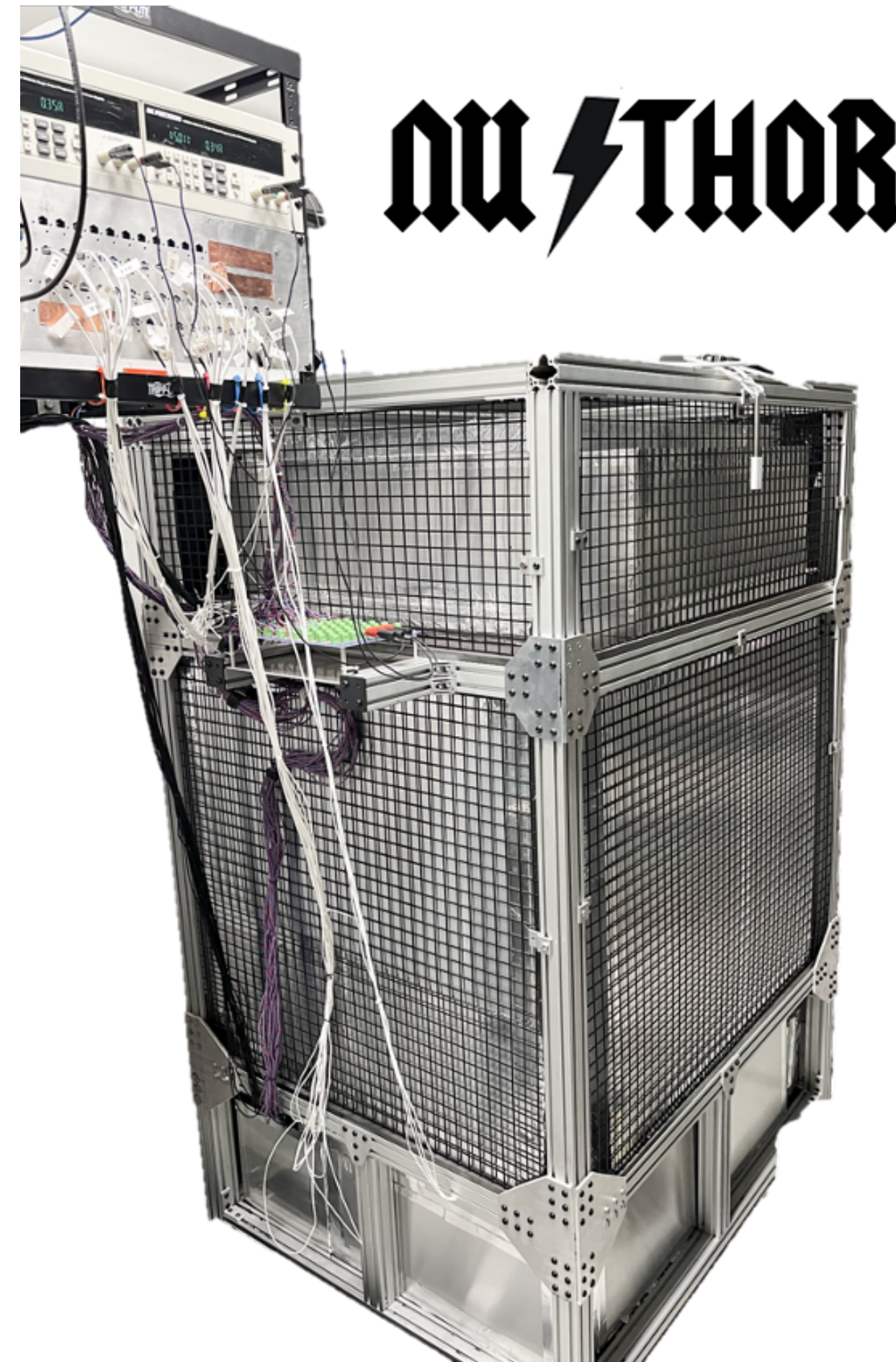
Target	CE ν NS	ν_e CC	anti- ν_e CC	ν -e $^-$ elastic
LZ TPC	84 ± 1	1.2 ± 0.1	0.02 ± 0.01	0.05 ± 0.02



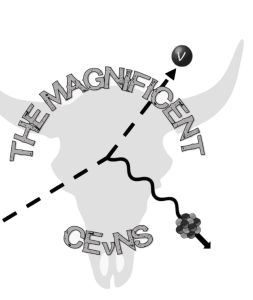
CEvNS-Adjacent: NuThor



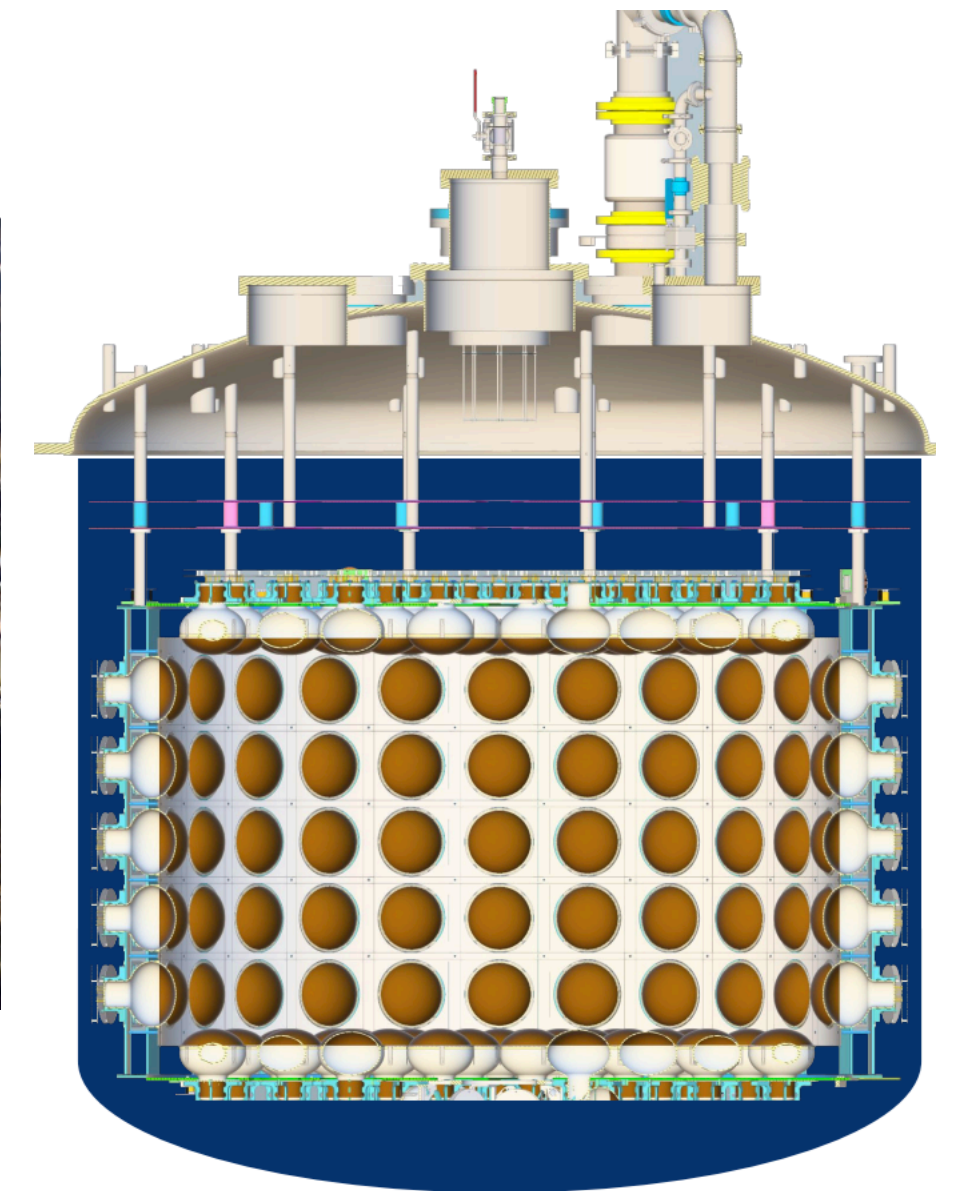
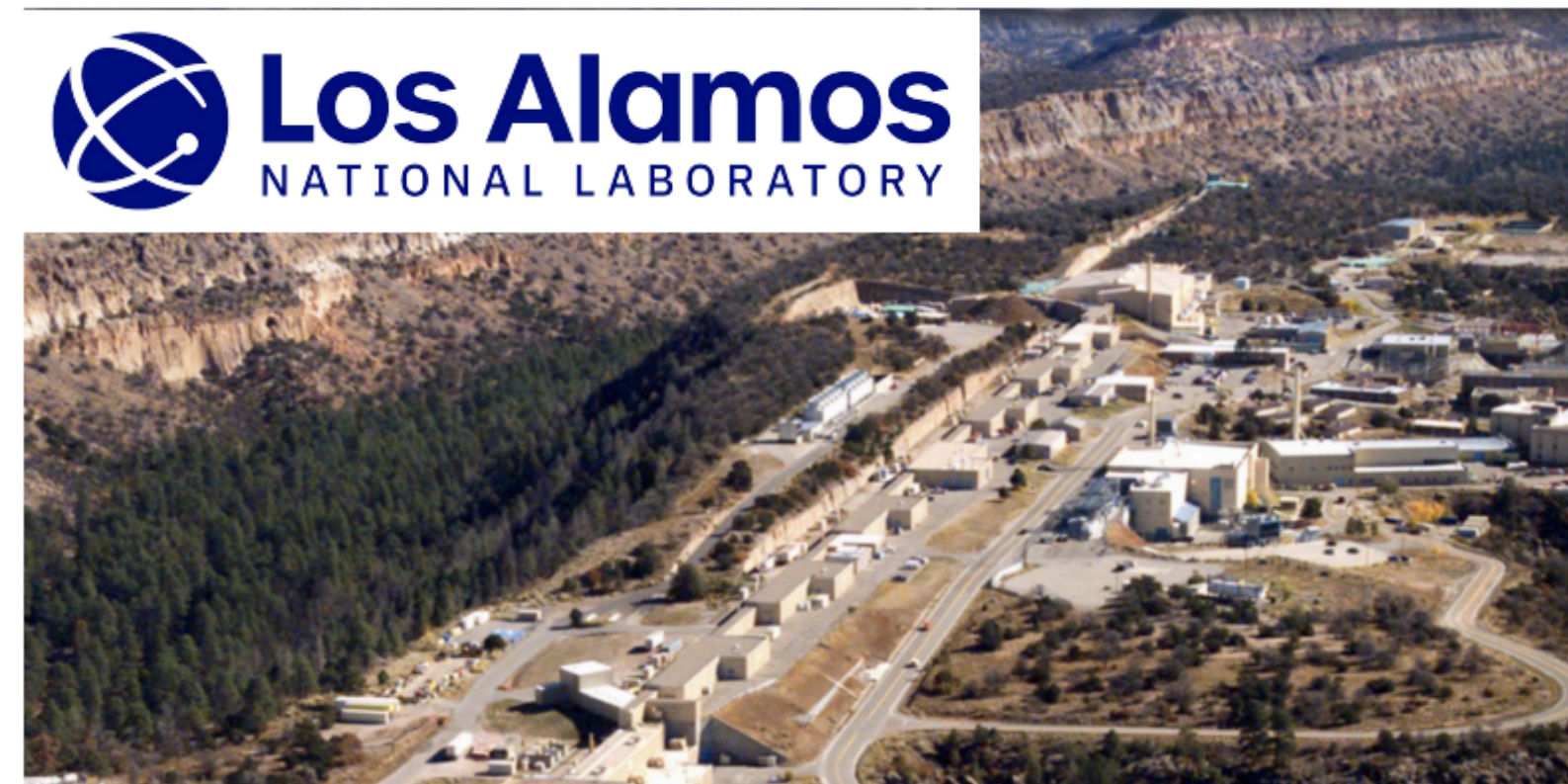
- Neutrino-induced fission of Th
- 3000 SNS-hrs of data collected
- Higher power data this summer
- Neutrino-induced Fission & Neutron Emission analyses ongoing and reaching maturity



CEvNS Adjacent: Dark Sector with CCM

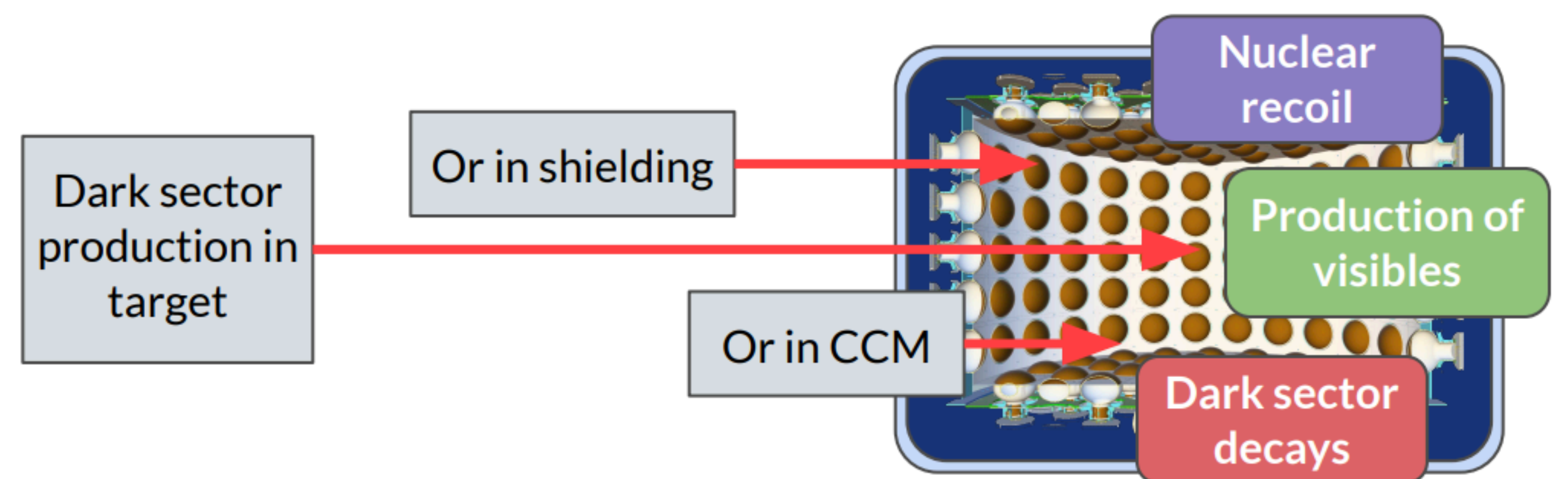


- Lujan @LANL
- 800 MeV p, 20Hz, 290ns spill
- 3-year physics run: 2022-2025
- 10tn LAr
- Hybrid scintillation / cherenkov allows NR/ER PID
- 100 keV threshold; MeV-scale BSM searches

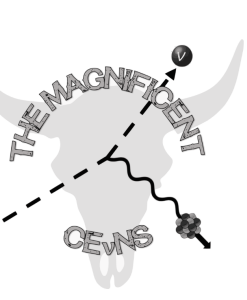


Broad program of dark sector searches at the MeV-scale

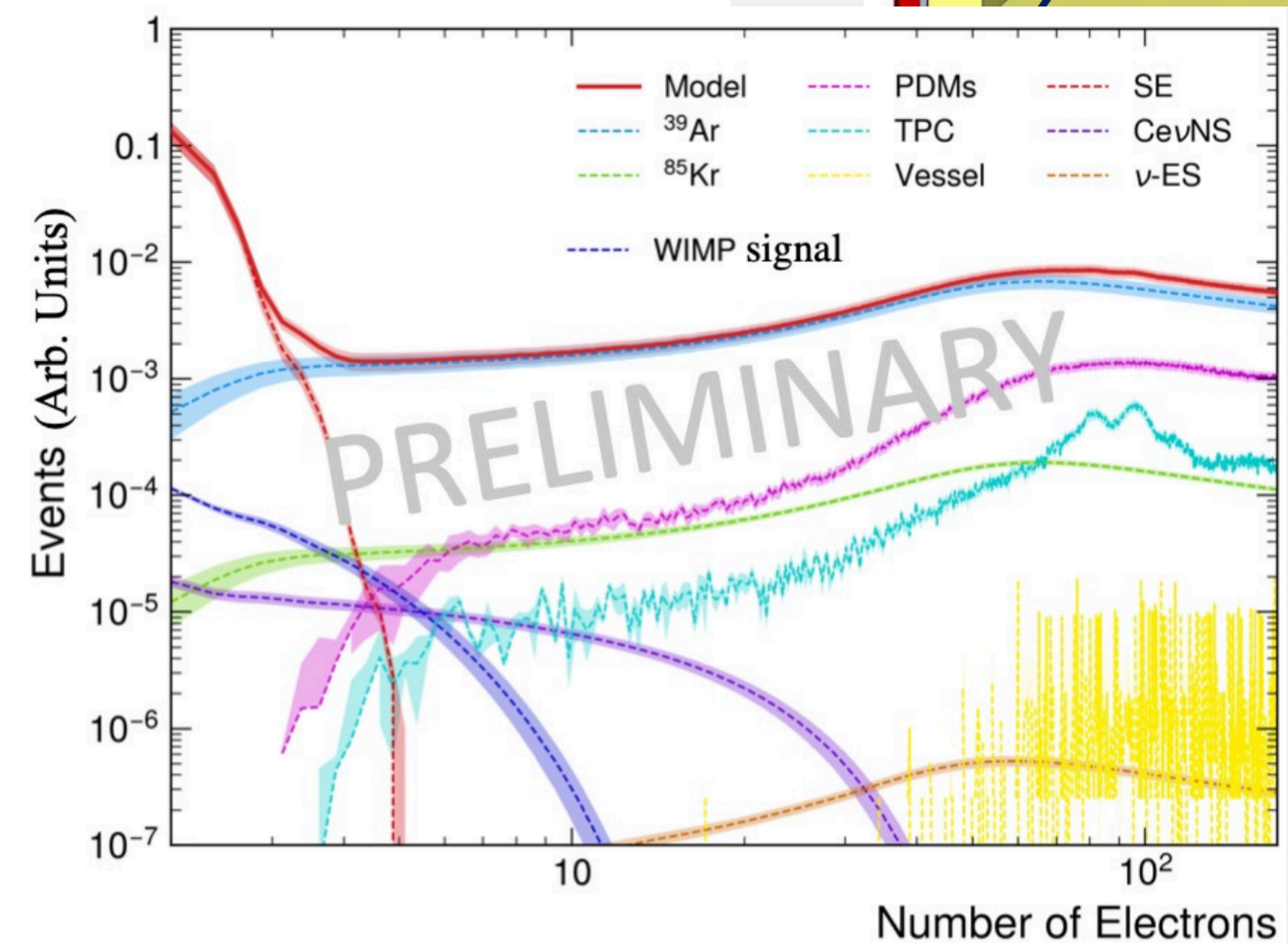
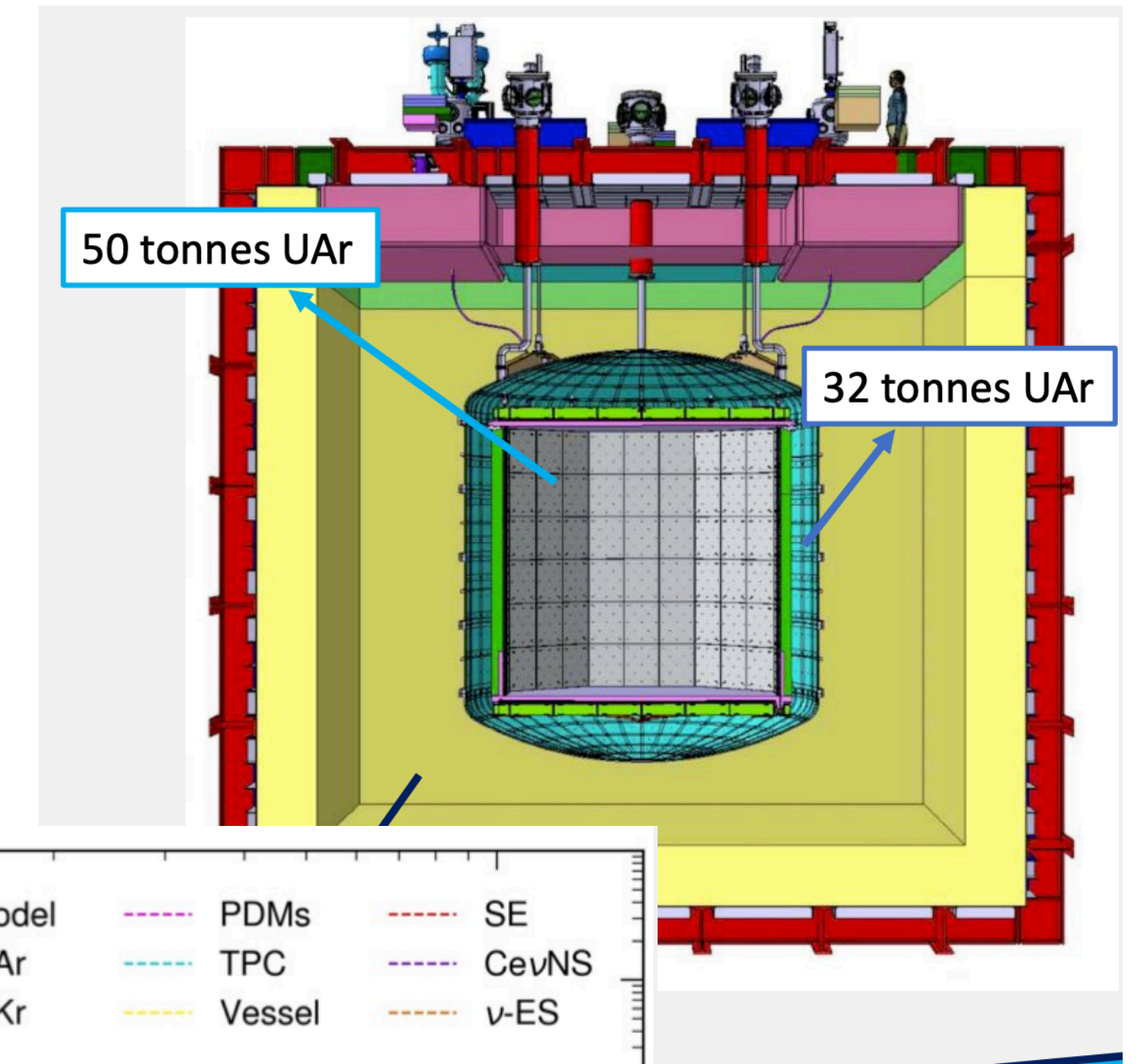
- [Search for Axion-Like-Particles and MeV-scale QCD axion](#)
- [Search for leptophobic MeV-scale dark matter](#)
- [Search for light-dark-matter](#)
- [Testing meson portal explanations for the MiniBooNE anomaly](#)
- Search for the X17 ATOMKI particle
- Search for Heavy Neutral Leptons
- Search for dark photons
- ...



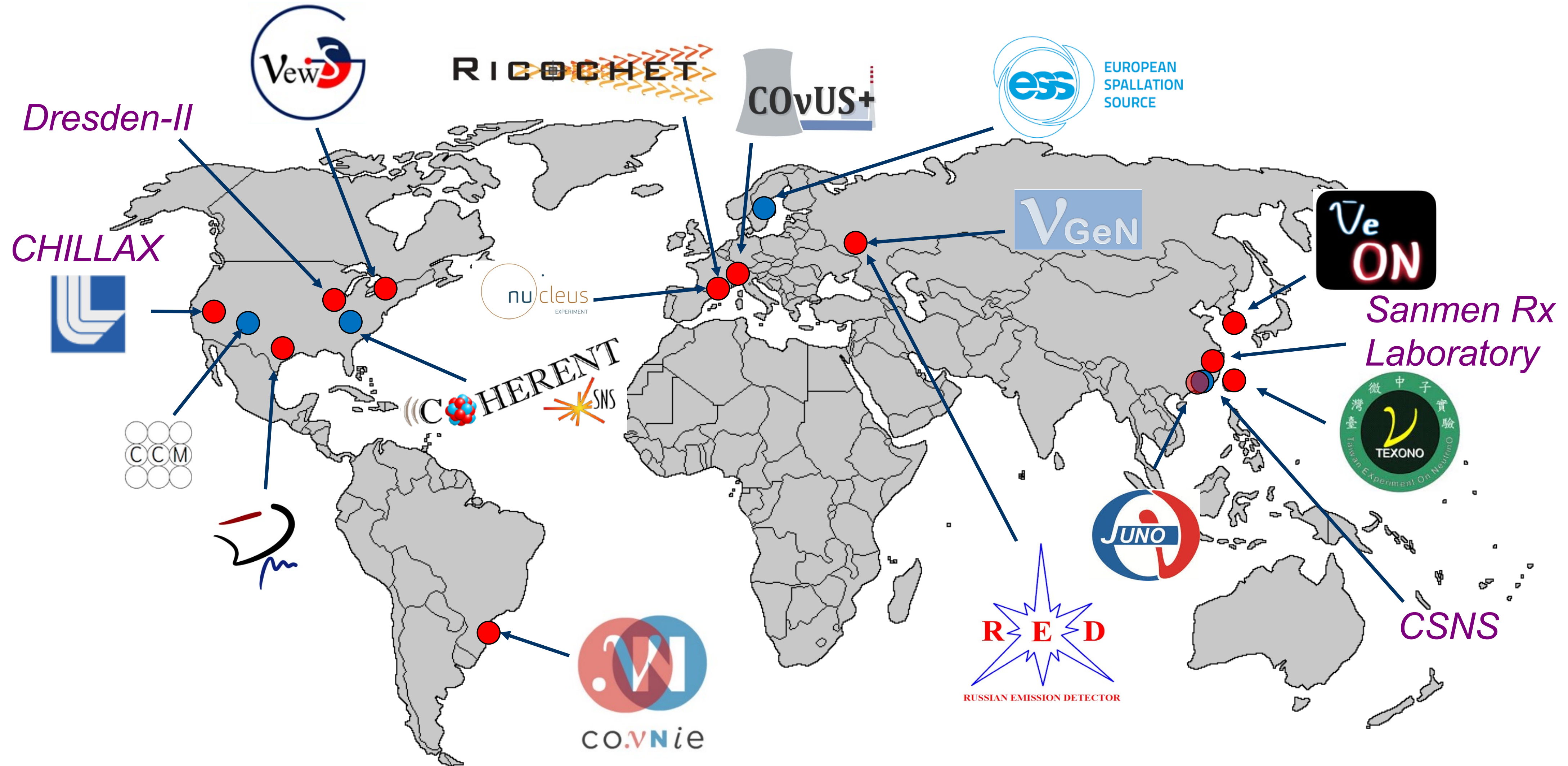
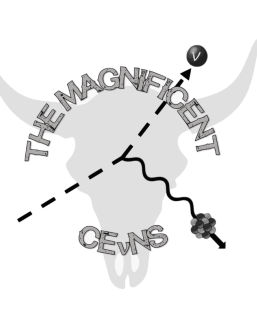
Low-mass DM in DarkSide20k



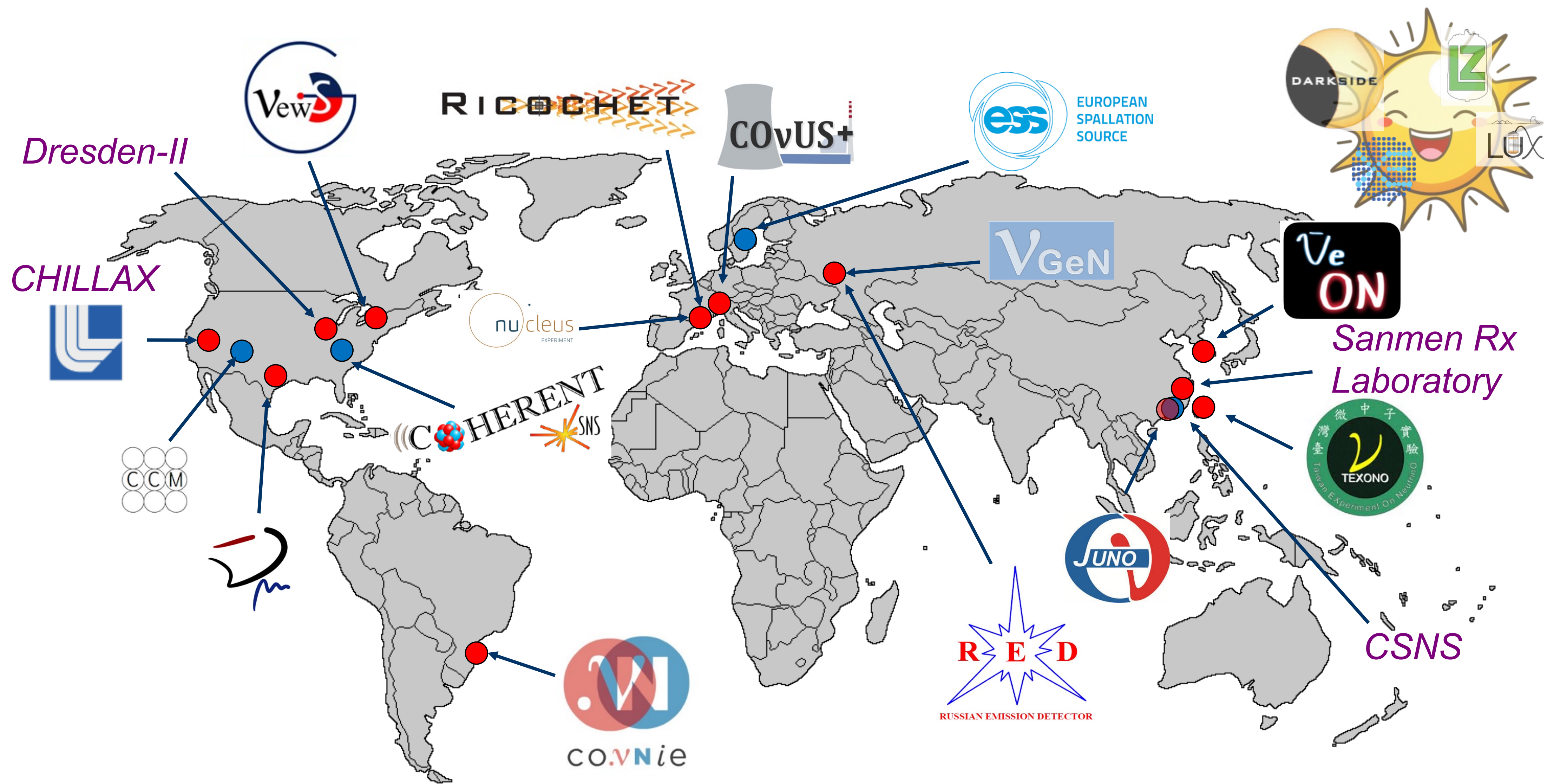
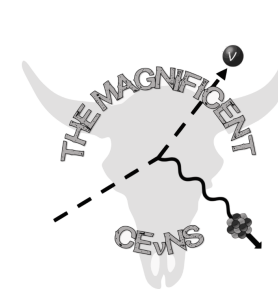
- Builds on success of DS50 in light WIMP searches
- 50tn UGAr, 20tn fiducial
- CEvNS rate for ^8B estimated.
- UG Ar extraction in CO, USA (Urania), distillation in Sardinia (Aria).
- Backgrounds measured in DS50, estimated for DS20k; WIMP sensitivity to be released soon.



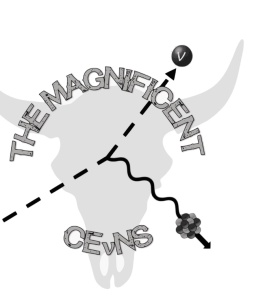
The Wide World of CEvNS



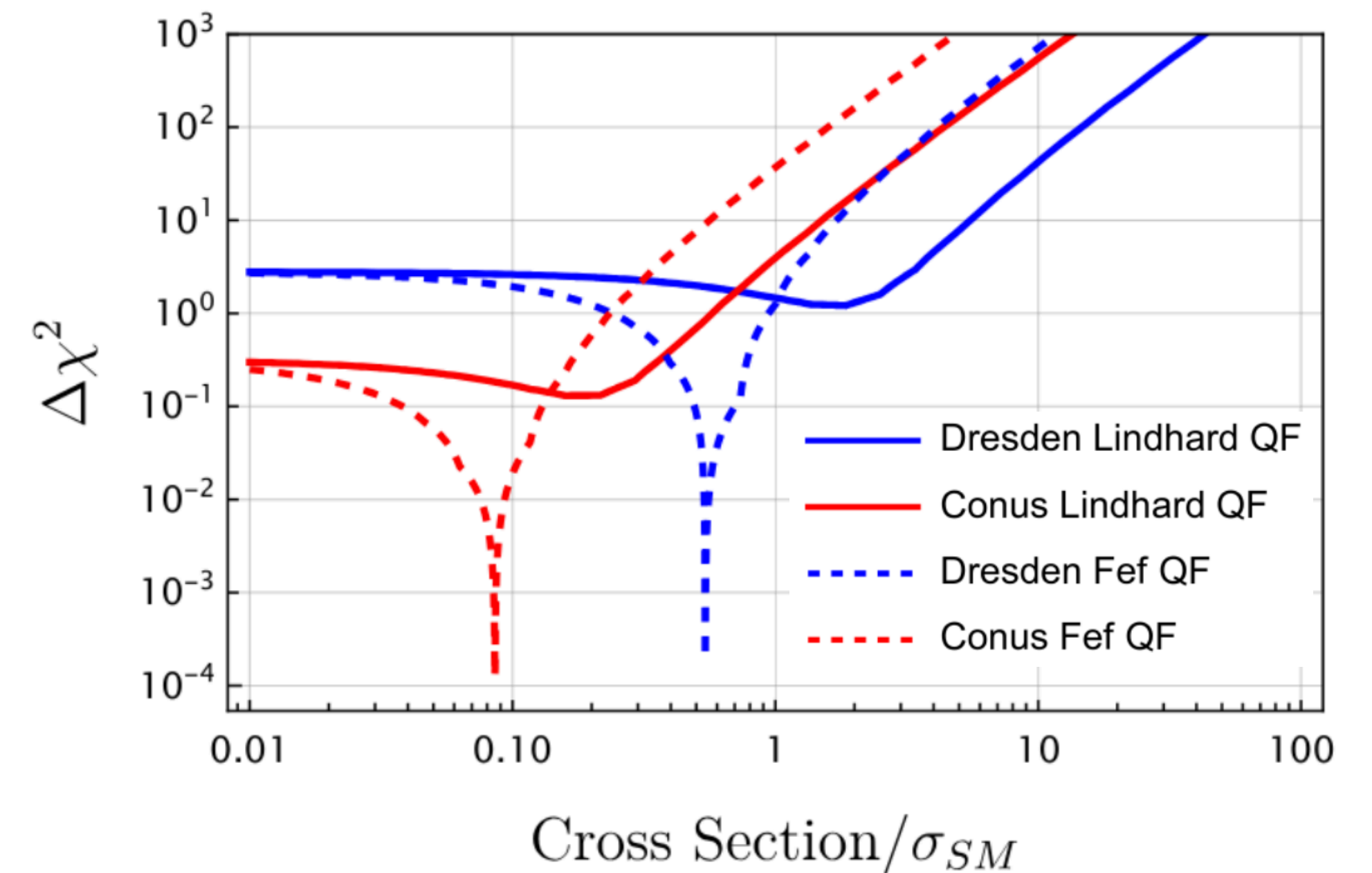
The Wide World of CEvNS



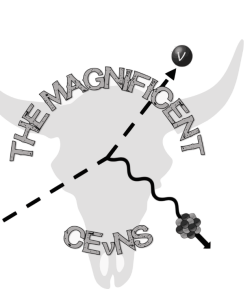
Yesterday's discussion session



- We all agree that data releases are “good,” we should do them.
- Implementation would benefit from consultation with theory colleagues regarding most useful formatting.
- Theory colleagues rely on our input regarding quenching factors
- This workshop is in perhaps the best position to consider and discuss measurements.
- **Action Item:** At each subsequent Mag7s generate a report on the state of quenching factor measurements; post to <http://magnificentcevns.org/>



Thank you from the IAC!



Would like to express gratitude on behalf of the IAC and the Mag7s community to our gracious hosts!

Thank you local organizers for sharing your beautiful city with us, and organizing a fantastic conference!

Special thanks to Valentina De Romero for making Mag7s2024 a tremendous success!

