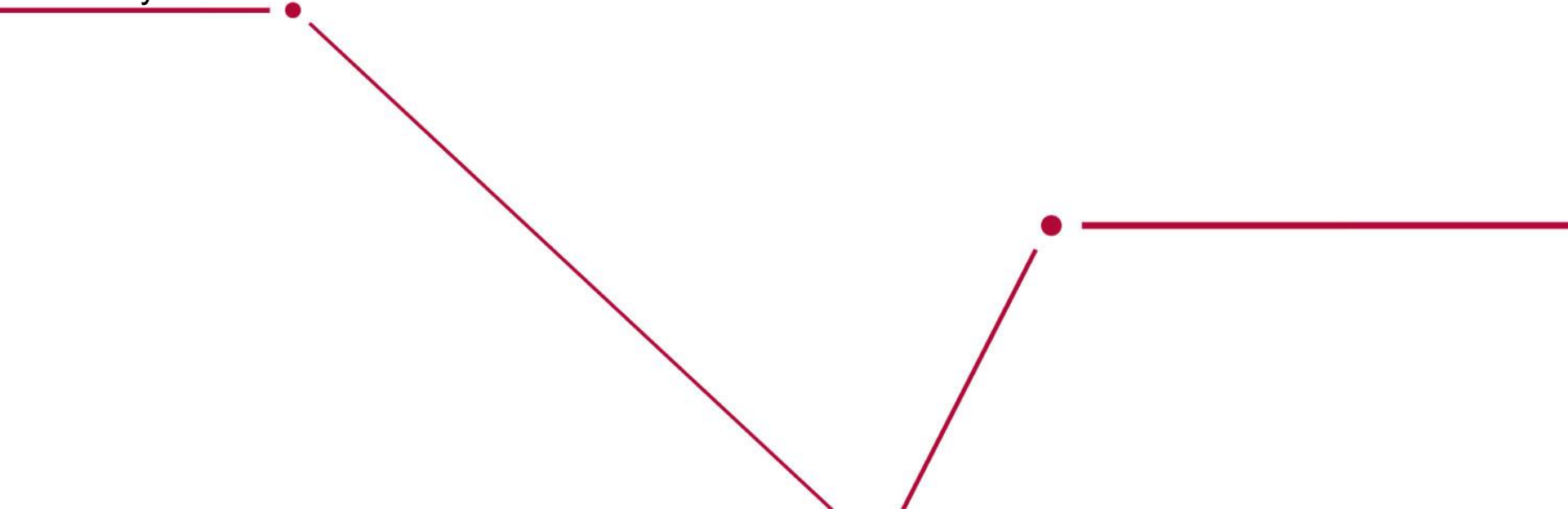


SuperCDMS: Commissioning Status

SNOLAB User Meeting 2026

Prof Miriam Diamond, University of Toronto

May 26-27 2026



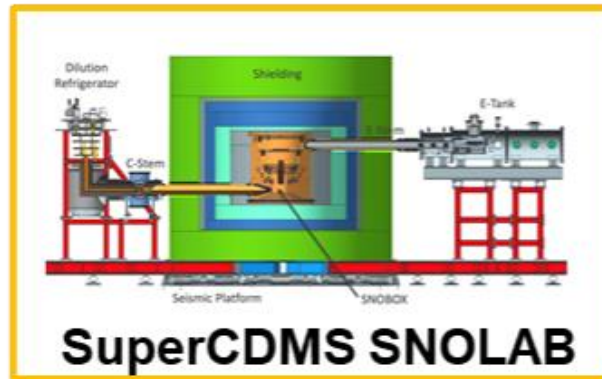
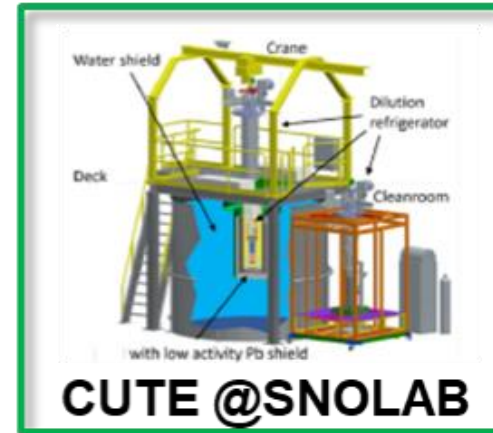
SuperCDMS Collaboration



Multiple test facilities and R&D programs provide science maximizing SuperCDMS SNOLAB reach

Lower Backgrounds, Larger Exposures

Surface R&D Facilities



Operational

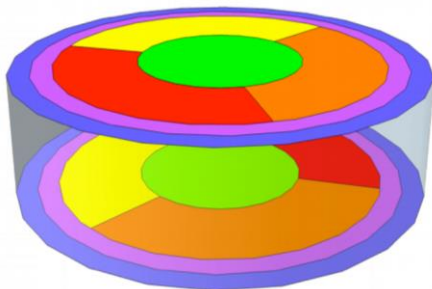


Commissioning

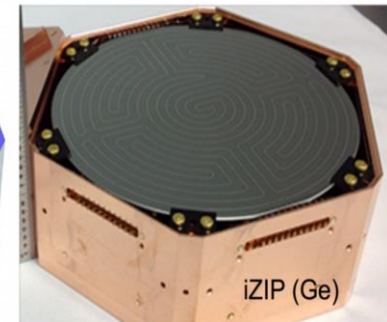
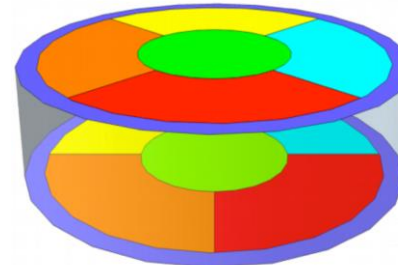
Complementary targets and technologies maximize coverage for low-mass WIMPs and electron-recoil DM

Payload: 24 detectors (4 towers)
Some iZIP (Interleaved Z-sensitive Ionization & Phonon),
some HV (High Voltage, phonon-only)

HV detector

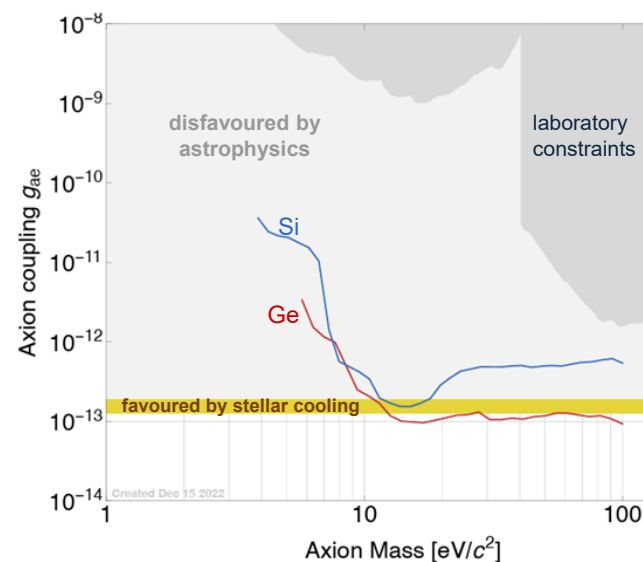
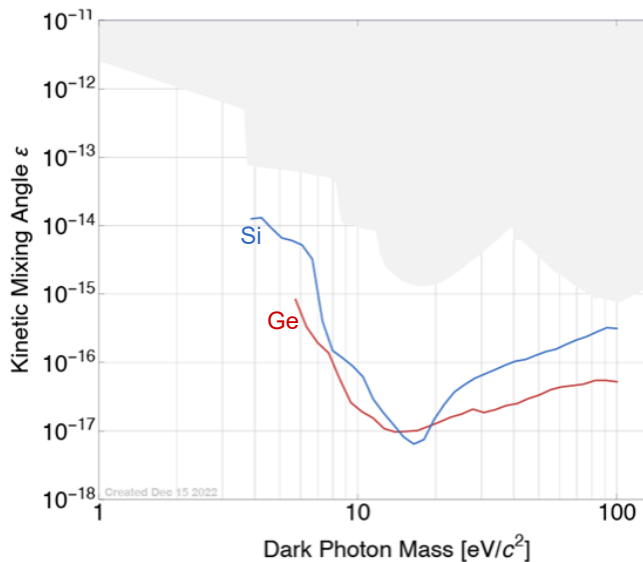
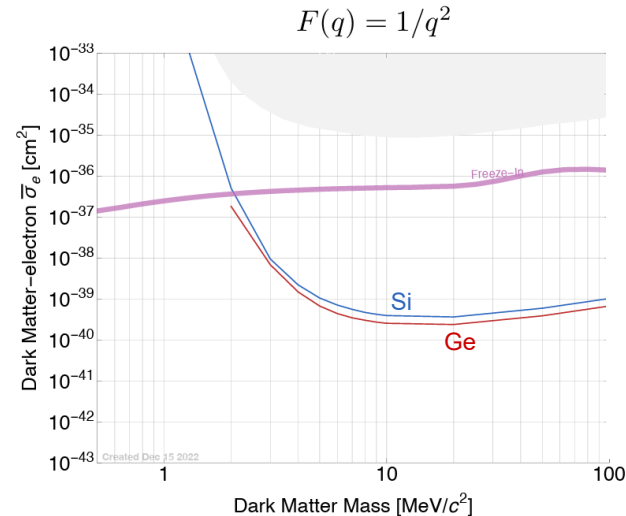
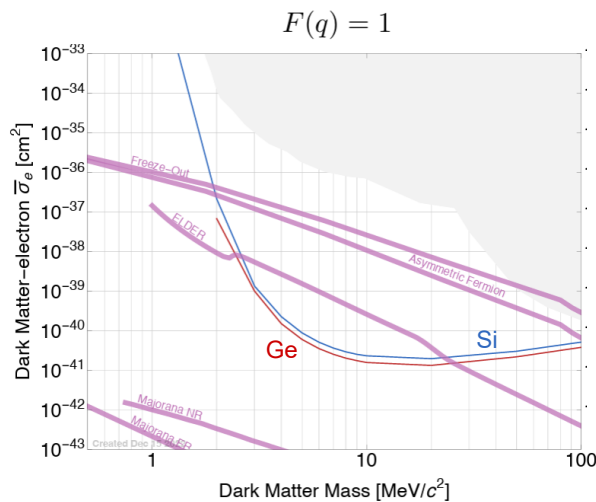
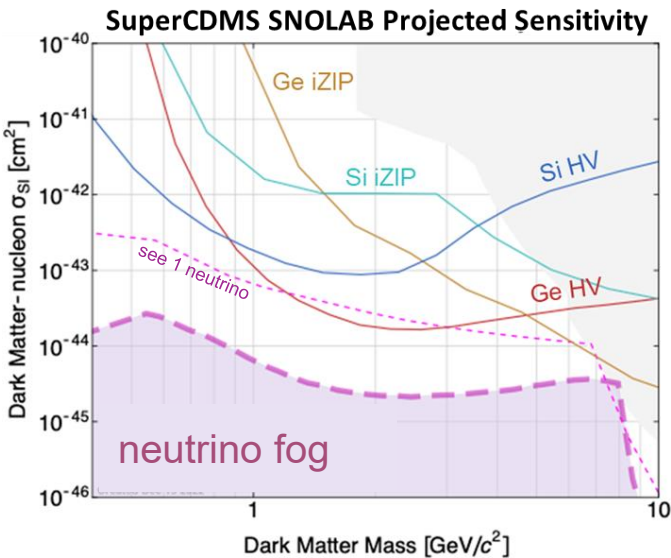


iZIP detector

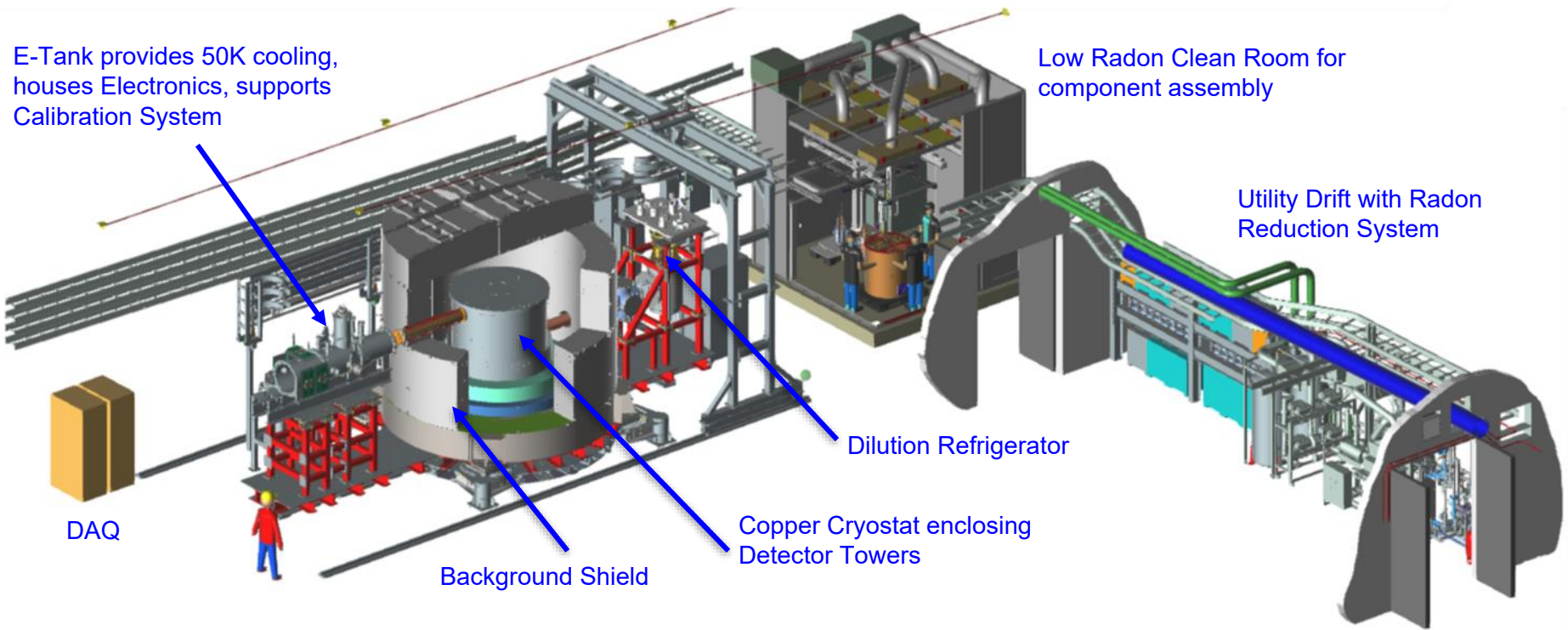


	Germanium	Silicon
HV	Low energy thresholds	
	Larger exposure No ^{32}Si radioactive background	Sensitive to lowest DM masses
iZIP	Nuclear Recoil Discrimination Sensitive to ^8B ν -scatter	
	Probe Ge backgrounds	Probe Si backgrounds

Complementary targets and technologies maximize coverage for low-mass WIMPs and electron-recoil DM



SuperCDMS SNOLAB experiment layout in Ladder Lab

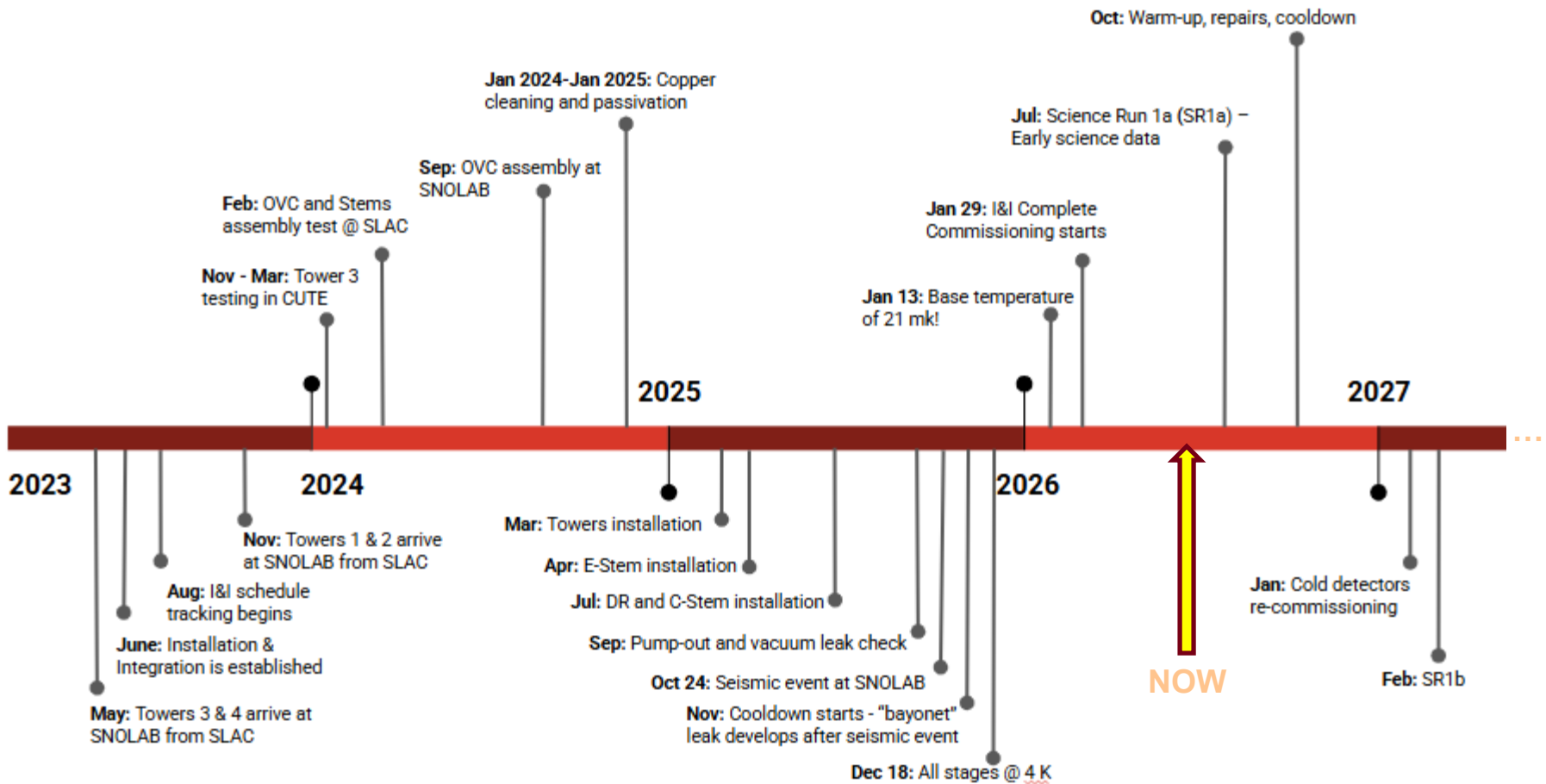


SuperCDMS SNOLAB commissioning underway, first Science Run coming later this year!



- Commissioning milestones completed
- Path to Science Run (SR) 1a
- Path from SR 1a to 1b
- Updated sensitivity projections & long-range publications plan
- Other SuperCDMS activities
 - Improved event reconstruction with Machine Learning
 - HVeV program
 - Data analysis from CUTE HV Tower Testing
 - NEXUS program

SuperCDMS SNOLAB commissioning underway, first Science Run coming later this year!



Installation & Integration milestones completed

- Summer 2025: detector towers installed in “SNOBOX”



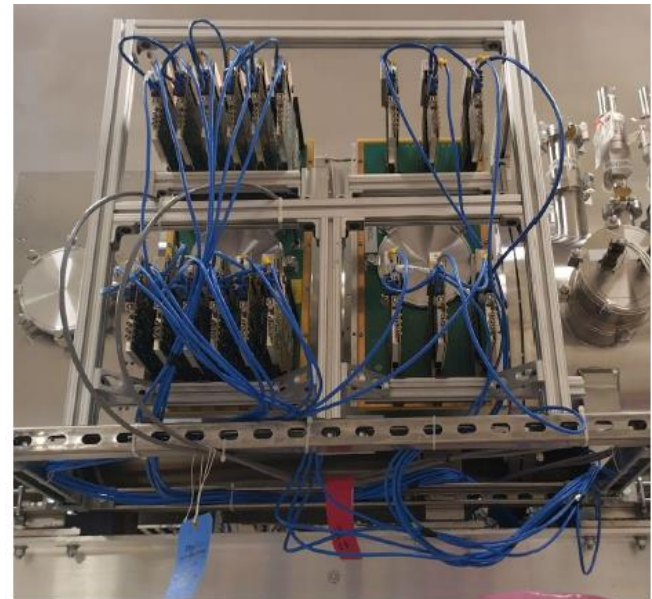
- Cryostat C-stem & E-stems installed and aligned: **Completed Jul 17, 2025**
- Dilution fridge ready for installation with cryostat: **Completed Aug 19, 2025**
- GW3 review completed: **Completed Sep 11, 2025**

Installation & Integration milestones completed

- 50K cooler installation: **Completed Sep 12, 2025**
- E-Tank installation: **Completed Sep 16, 2025**
- Long readout cables installation in Cryostat / E-Tank: **Completed Sep 17, 2025**
- Readout cables connected: **Completed Oct 9, 2025**
- Readout electronics ready for commissioning: **Completed Oct 17, 2025**



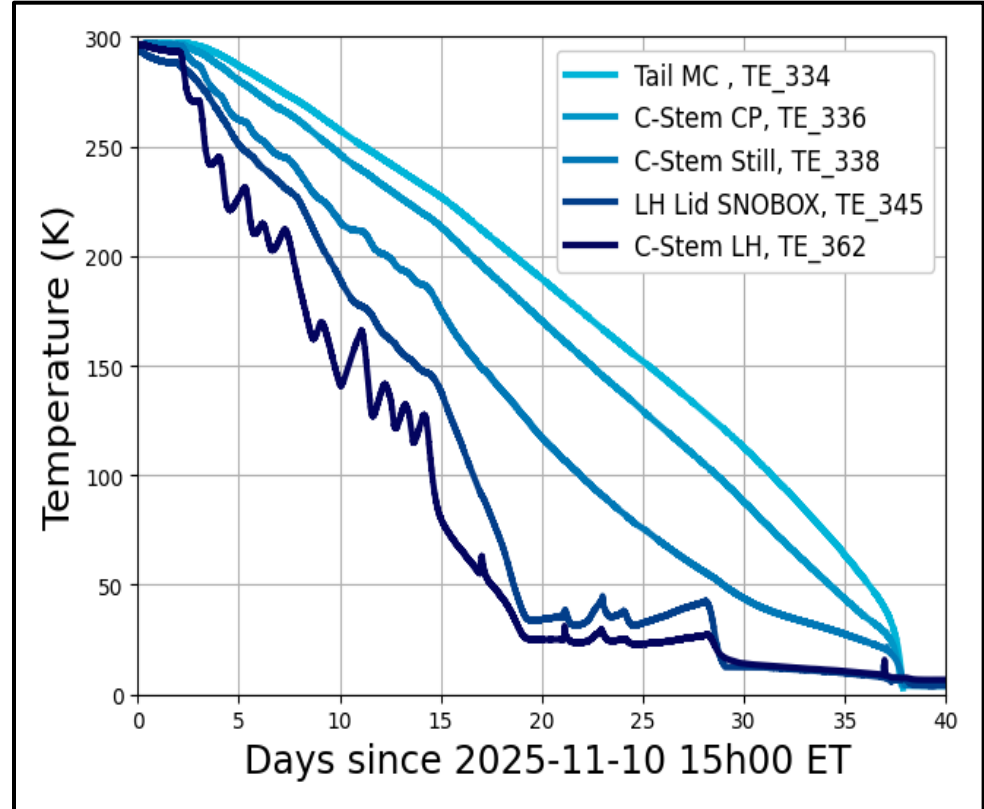
(shown in May JOG report)



Installation & Integration milestones completed: timeline of first full cooldown

- 11/10: Cooldown started
- 12/14: Reached < 70K
- 12/18: Reached < 4K
- 1/9: Condensing LHe
- 1/13: Base temp first reached

Thermometry on towers, read out through DAQ, enables remote cooldown monitoring



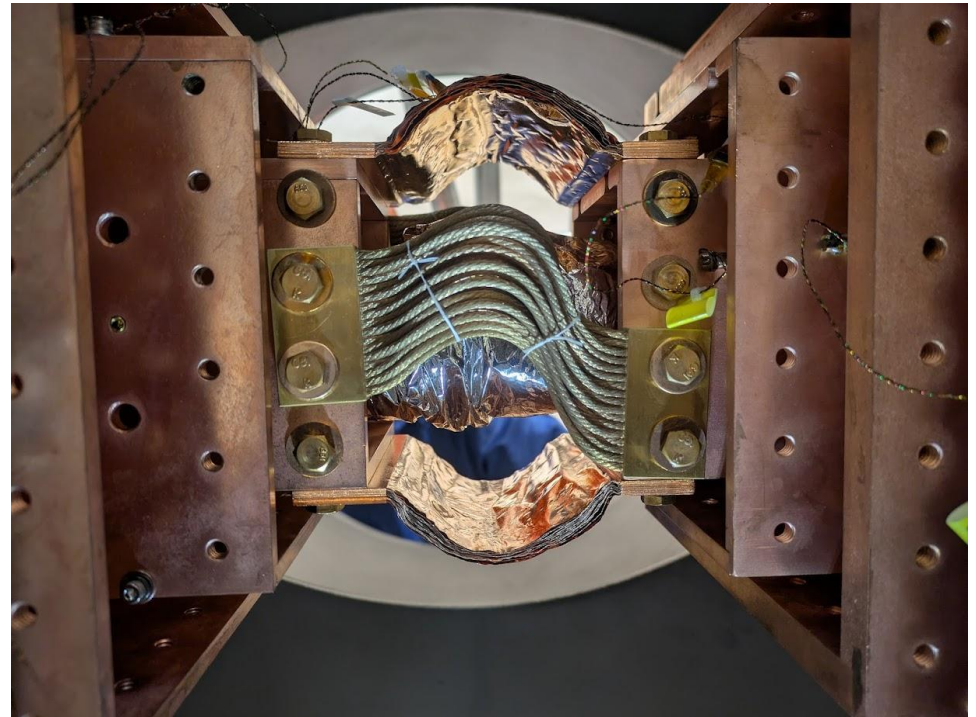
- During first cooldown, calibration system installed & tested: **Completed**
Dec 11, 2025

Installation & Integration photos

Dilution fridge with cryogenic tails, just prior to its installation

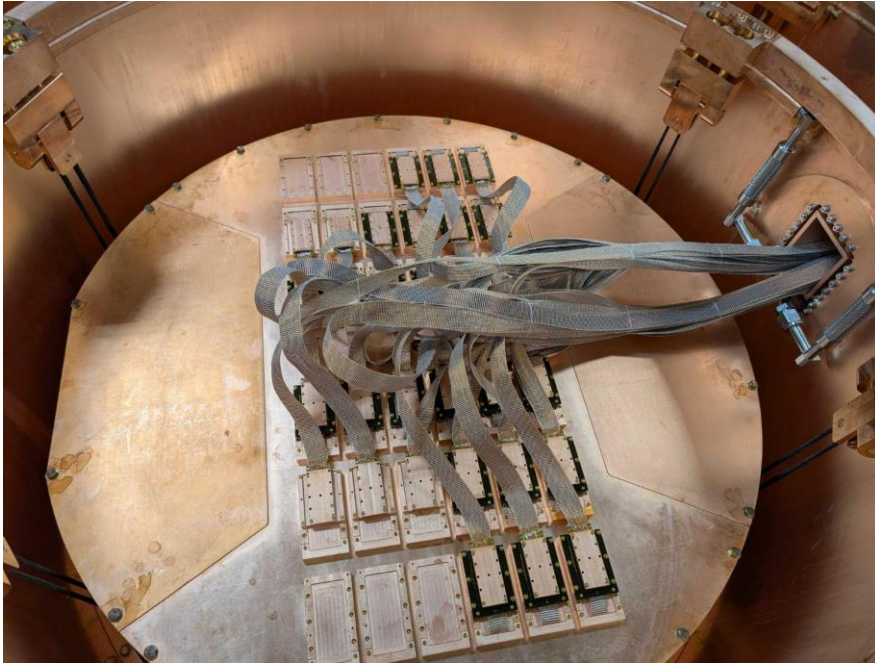


Straps providing thermal connection from dilution fridge to cryostat (Cold Plate thermal stage shown)

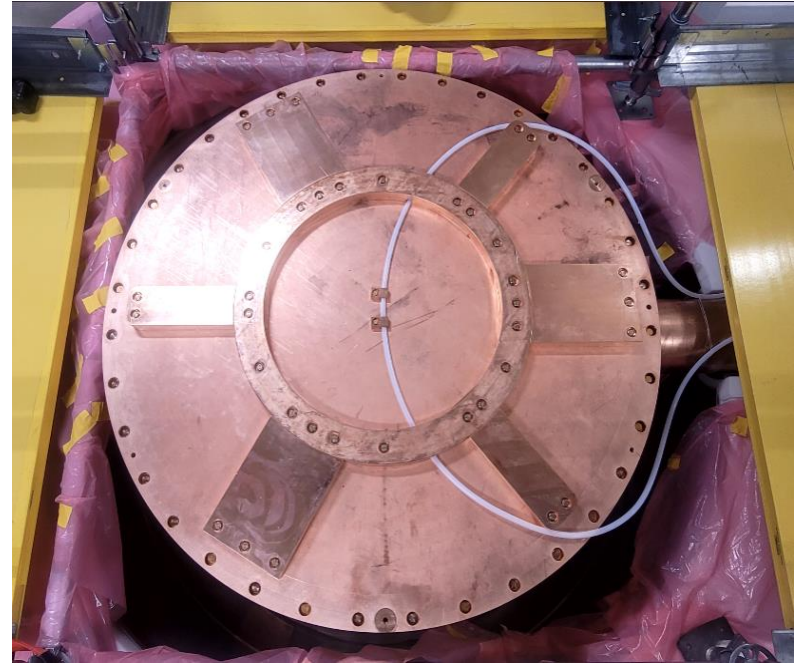


Installation & Integration photos

Cables from detectors to E-Tank vacuum feedthroughs

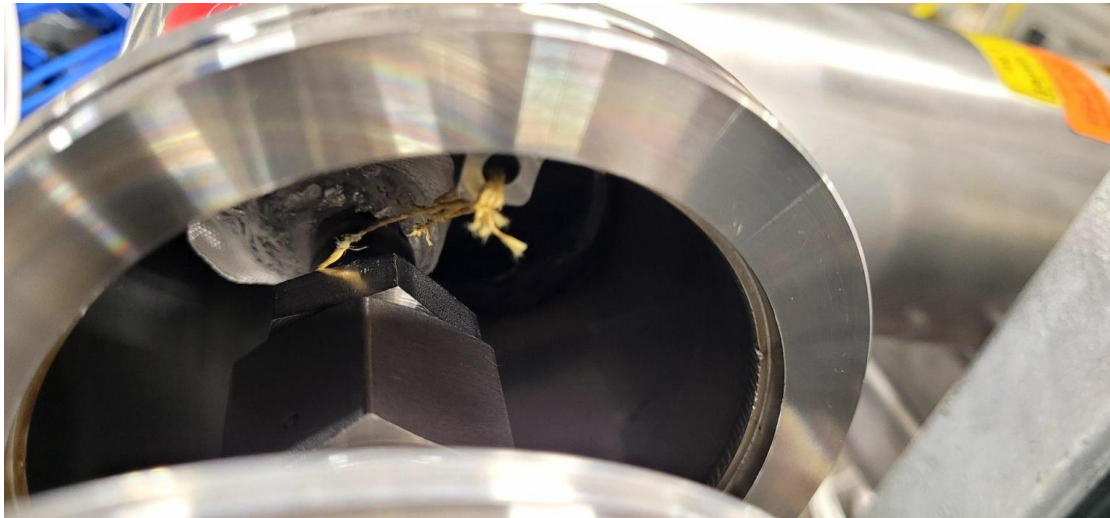


Closed cryostat, with nylon guide tube for deploying Ba calibration source



Installation & Integration photos

“Bayonet”, connecting 50K cooler to E-Tank, has He leak



Temporary setup out-pumps the leak, until bayonet can be replaced



Installation & Integration photos

Installing top section of μ -metal shield to protect detectors from Earth's magnetic field

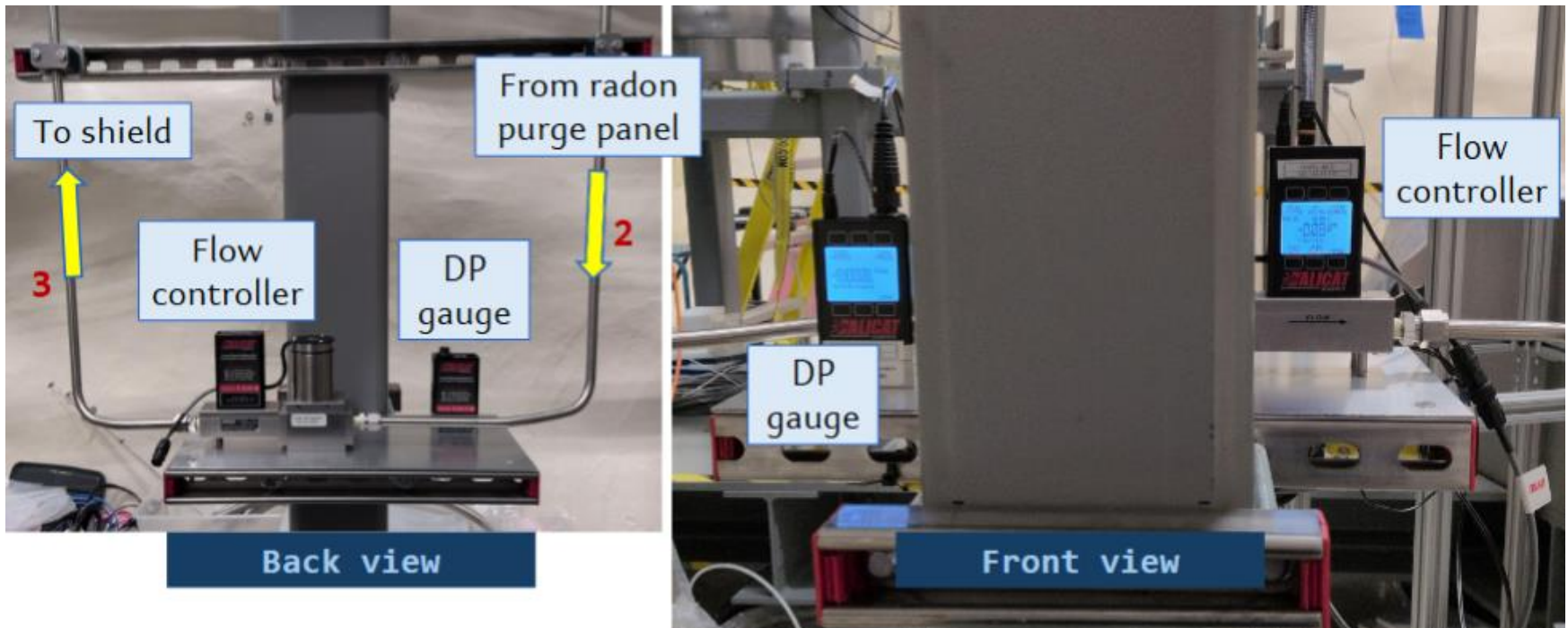


Installing heaters to offset radiative cooling



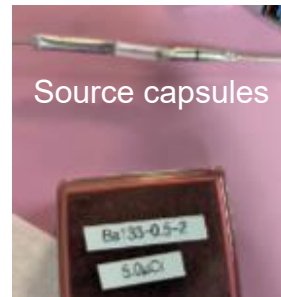
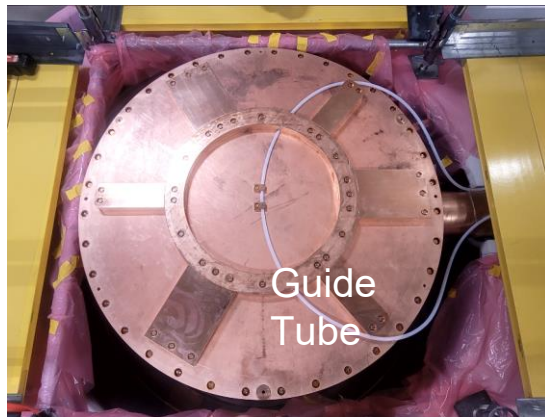
Installation & Integration photos

Radon purge subsystem: differential pressure gauge + flow controller

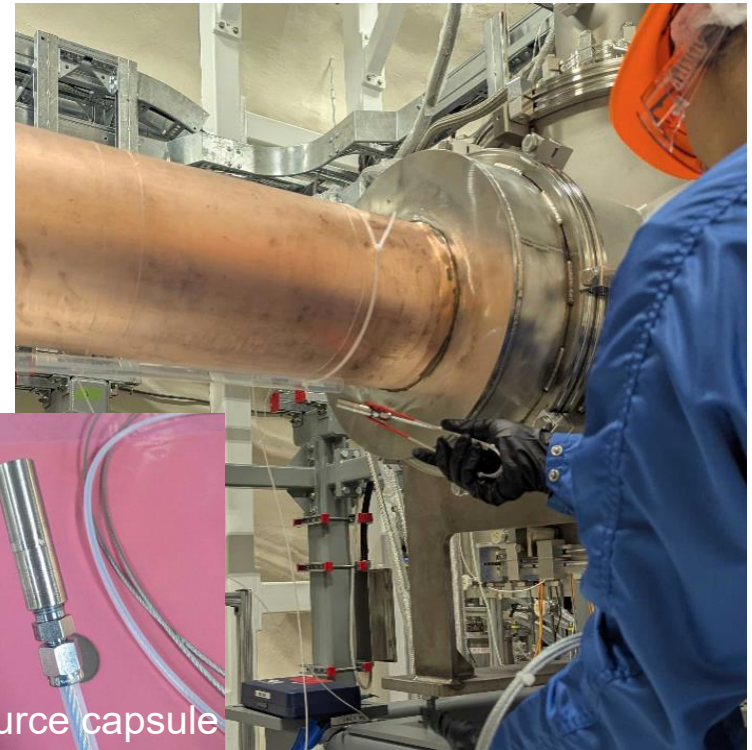


Installation & Integration photos

System for γ calibration deployment: Ba sources on steel cable (driven by motor), which goes along E-stem and across top & bottom of cryostat



Neutron calibration system: encapsulated Cf sources attached to flexible “wands” inserted into shield manually, with guide tubes running along C-stem and E-stem



Reaching base temperature: media blitz!

News release: <https://www6.slac.stanford.edu/news/2026-03-17-supercdms-cools-down-near-absolute-zero-setting-stage-one-worlds-most-sensitive>



SNOLAB officially becomes one of the coolest places on Earth

March 17, 2026 — Astrophysics News

Deep underground in Sudbury's SNOLAB, a major new experiment has just reached a critical milestone. The very centre of a series of large, nested copper vessels that make up the heart of the newest and one of the most sensitive detectors in the world has now reached a temperature a hundred times colder than outer space.



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Chilly SNOLAB experiment reaches near absolute zero

The experiment is part of Super Cryogenic Dark Matter Search, a project aimed at finding the sub-atomic particle believed to comprise up to 85 per cent of the mass of the univers

Sudbury.com Staff
Mar 19, 2026 8:00 PM



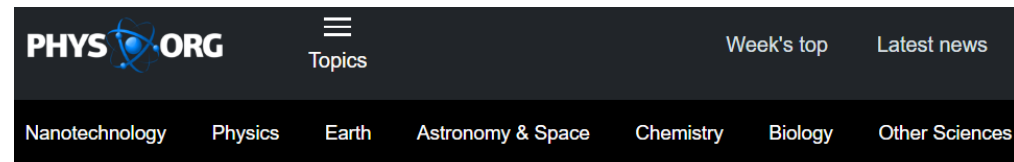

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SuperCDM Experiment Reaches Critical Temperature, Bringing it One Step Closer to Detecting Dark Matter

By Matthew Williams - April 07, 2026 10:07 PM UTC | Physics



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MARCH 18, 2026

Dark matter experiment reaches ultracold milestone

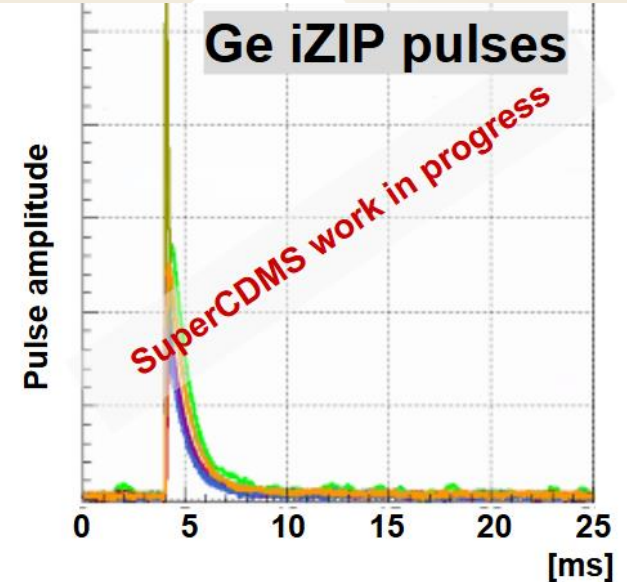
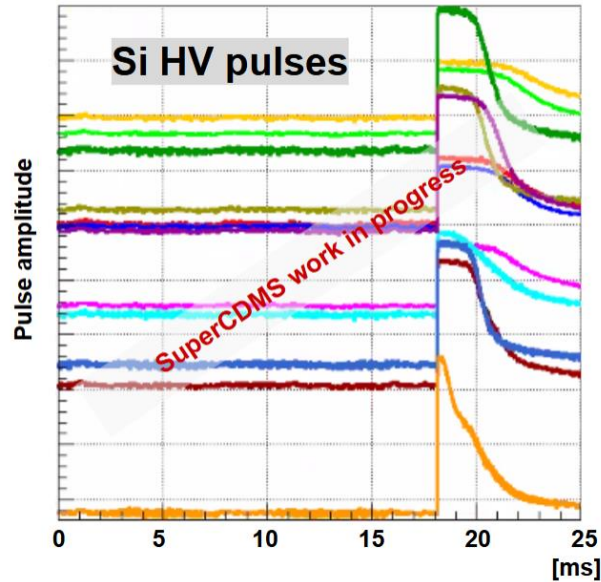
by Amanda Morris, Northwestern University

edited by Lisa Lock, reviewed by Andrew Zinin

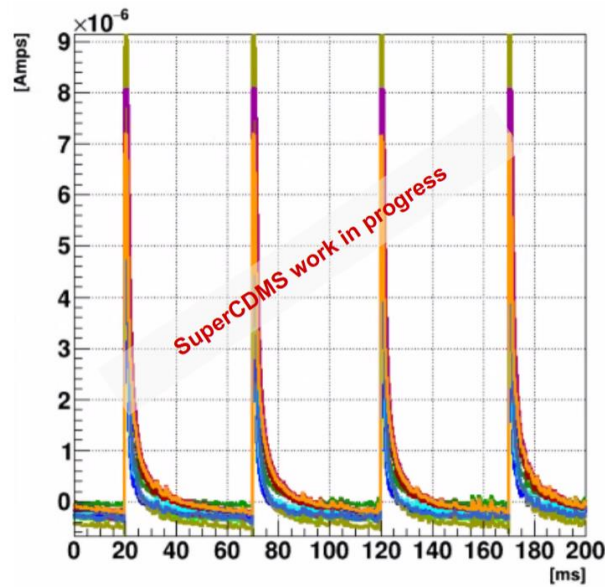
Editors' notes

First pulses in Jan: “Installation & Integration” completed, Commissioning started

On all phonon channels of a detector, ambient background events:



LED events in a Ge HV detector:

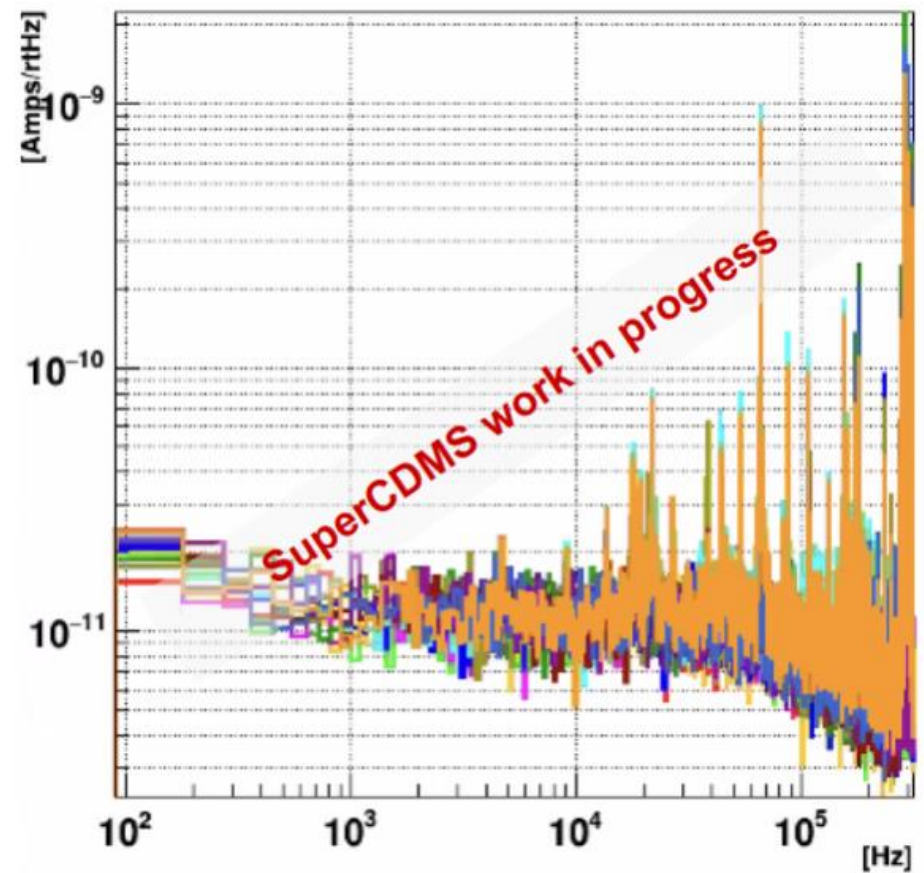
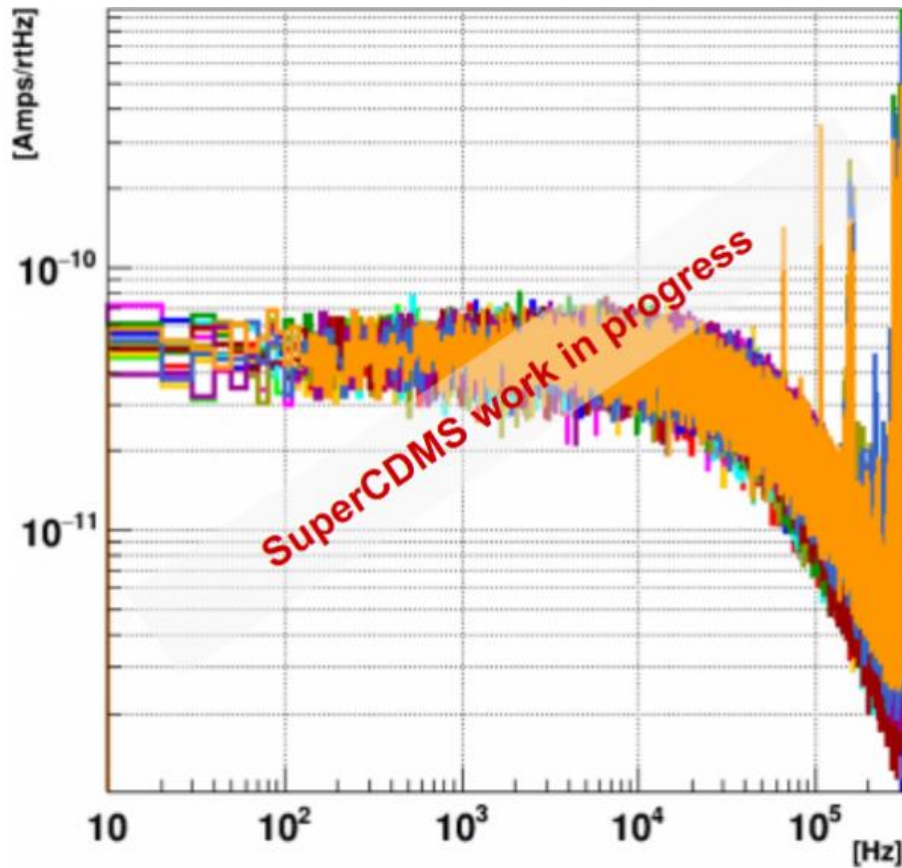


First pulses in Jan: “Installation & Integration” completed, Commissioning started

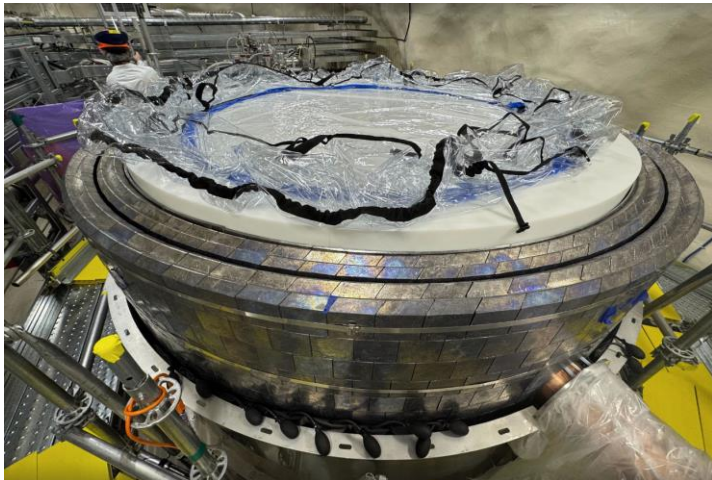
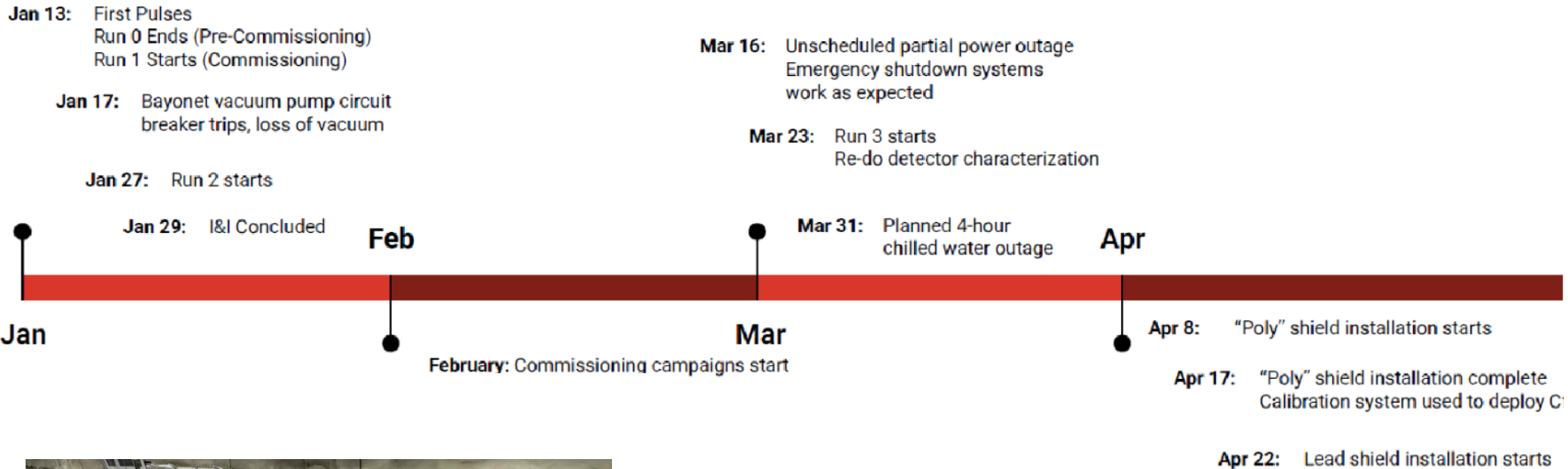
Noise Power Spectral Density, Ge iZIP detector:

All channels superconducting

All channels normal



Since first pulses, Commissioning has made great progress



Just finished (in May): Upper section & lid of lead/poly shielding wall

“Science Run 1a”: planned for mid-Jul through Sep, taking advantage of PMP quiet time

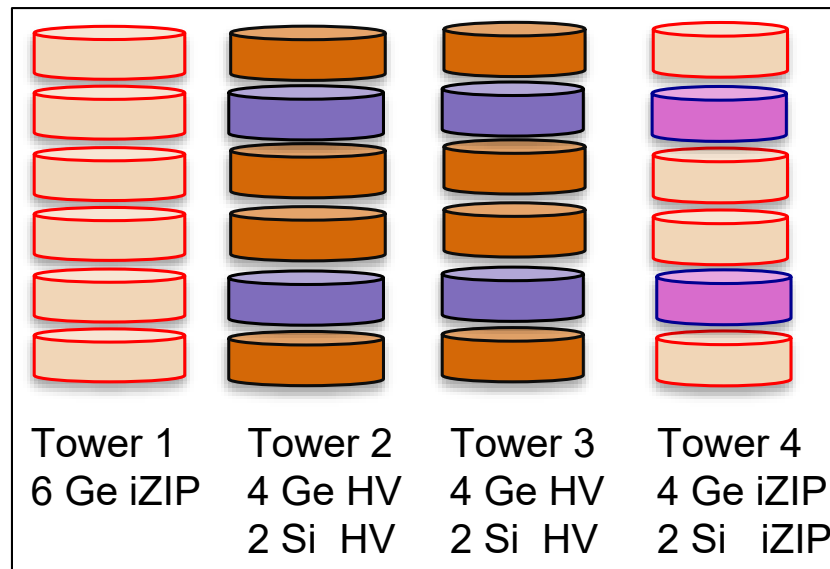
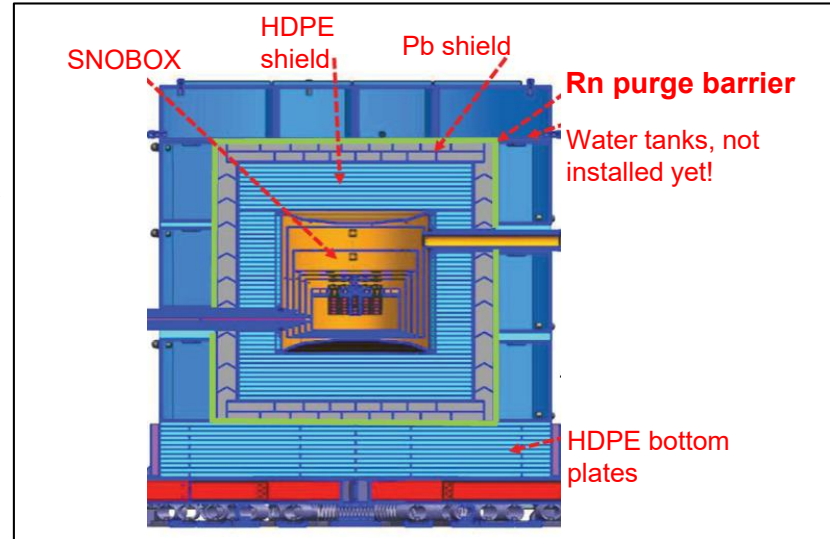
Remaining tasks before Science Run 1a:

- Completion of radon barrier (upper section) & purge system
- Data-taking with Ba source deployed, for calibration based on γ lines
- Troubleshooting high-voltage issues
- Investigating possible vibration-induced & blackbody radiation-induced heating
- Deciding which detectors to use in the Run
- Optimization: noise-hunting, trigger setup, neutralization procedures, detector settings



During Science Run 1a:

- Data-taking, no calibration sources deployed
- Cf source deployment (shortly after PMP), data-taking to calibrate Ge detectors based on n activation

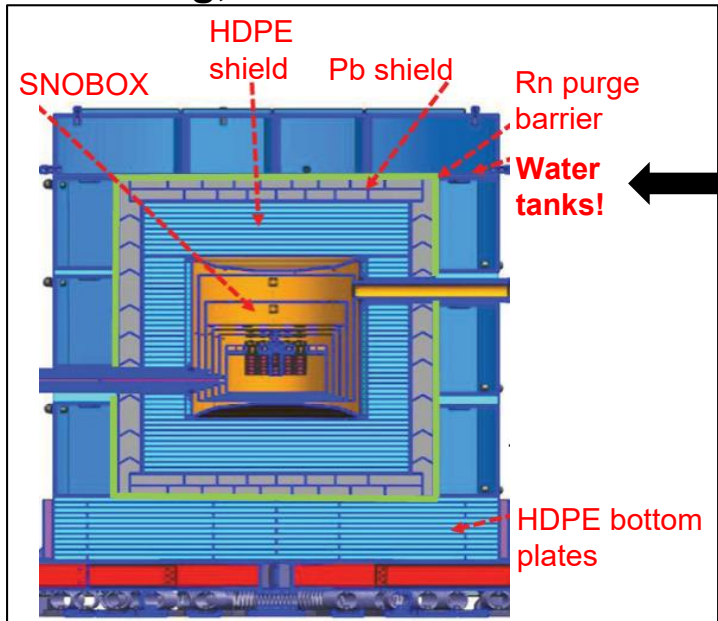


Tasks already planned for post-SR 1a, to maximize discovery potential of subsequent SRs

Full warmup after SR 1a, lasting 3-4 months

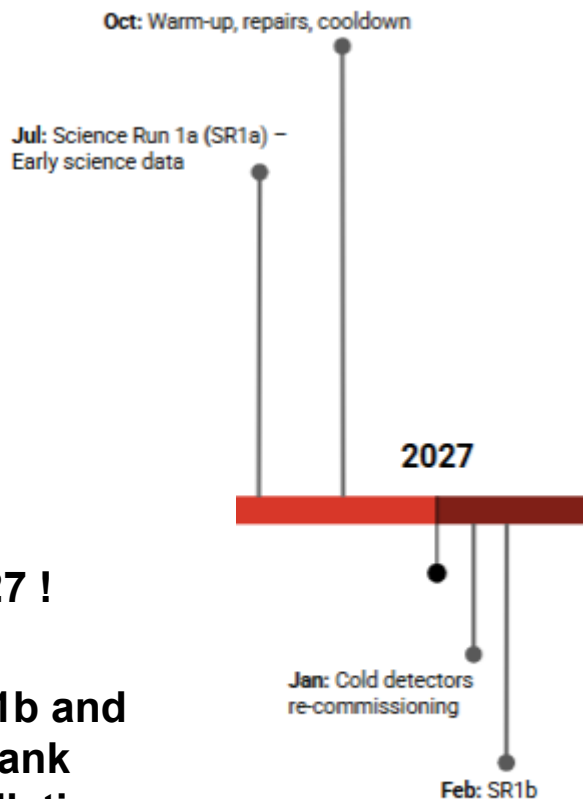
- Ice-tank chilled-water backup
- Testing additional electronics filtering schemes
- Replacing leaky 50K cooler “bayonet”
- “6-way-cross” improvements to prevent thermal touches and shield against blackbody radiation

Re-cooling, then brief detector re-characterization period

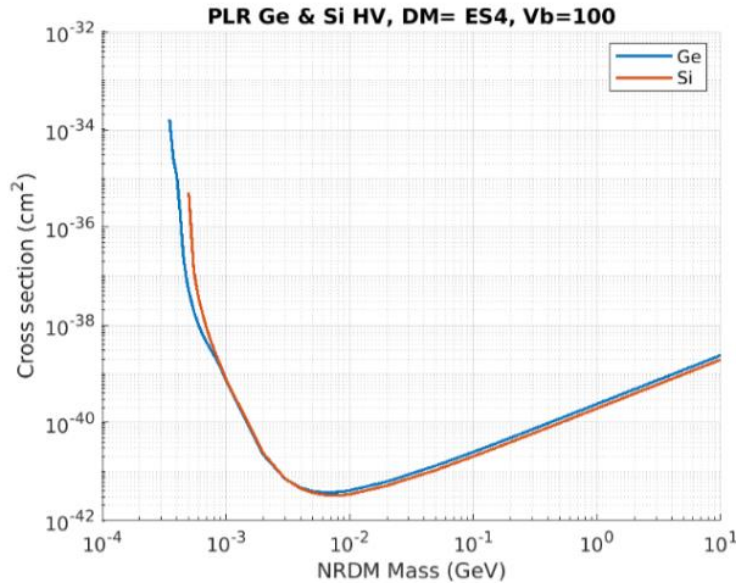


Then SR 1b early 2027 !

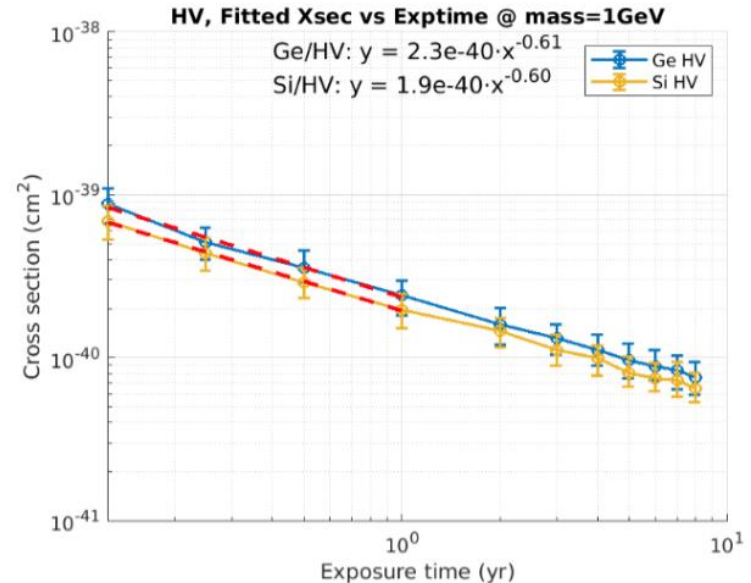
Between start of SR 1b and start of SR 2: Water tank (outer n shield) installation



Updated sensitivity projections for Nuclear Recoil DM searches



Cross section sensitivity as a function of mass for Si and Ge HV detectors for 1 year of exposure.

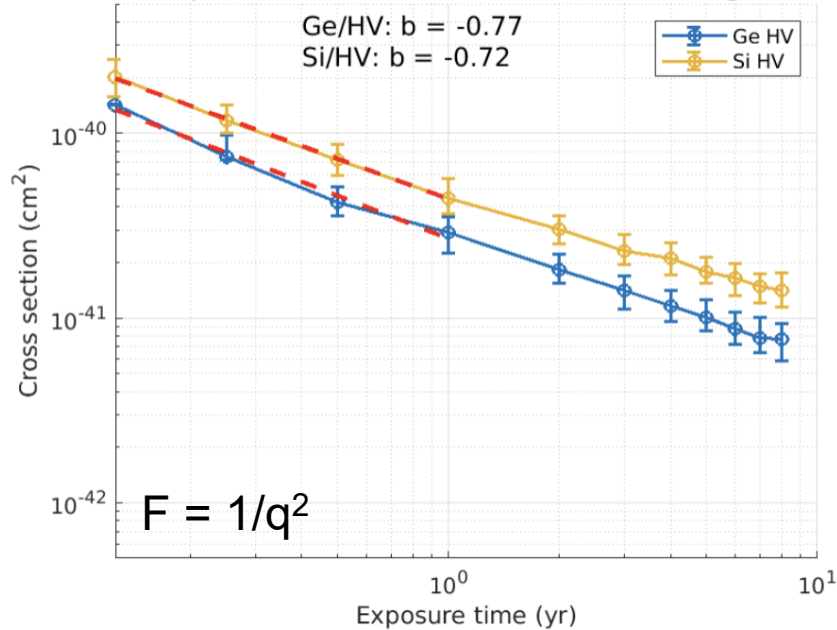


Cross section sensitivity at fixed mass, as a function of exposure

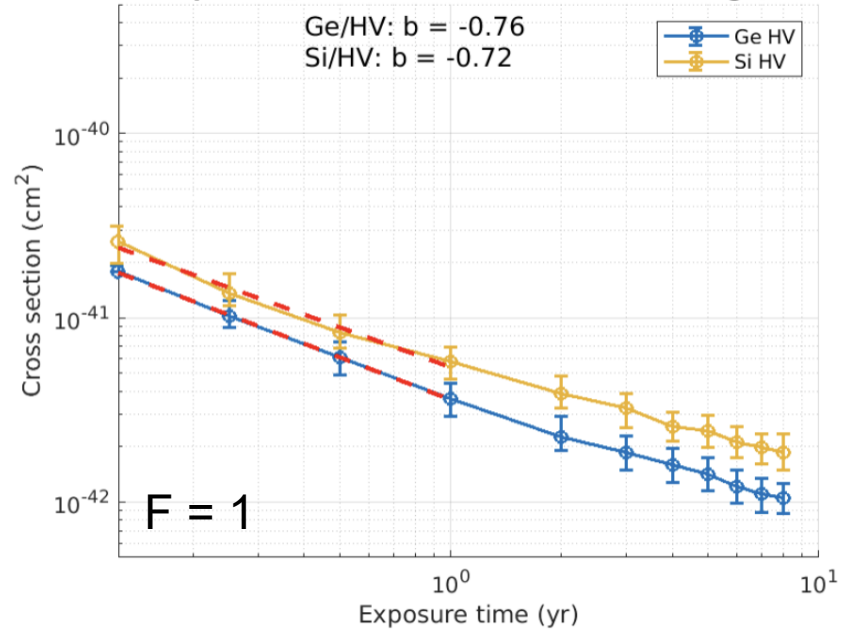
Vb = bias voltage across crystal (V)
 PLR = Profile Likelihood limit-setting, with background model

Updated sensitivity projections for Electron Recoil DM searches

Xsec vs Exptime @ mass=0.01GeV, DM=escattering6, V=100V



Xsec vs Exptime @ mass=0.01GeV, DM=escattering4, V=100V



At DM mass ~ 10 MeV (where ER reach is \sim best)

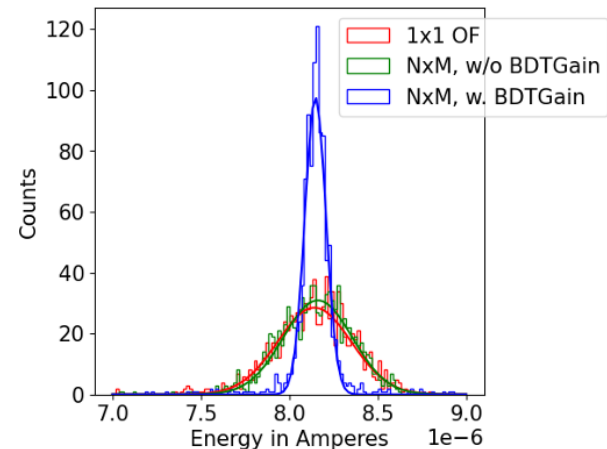
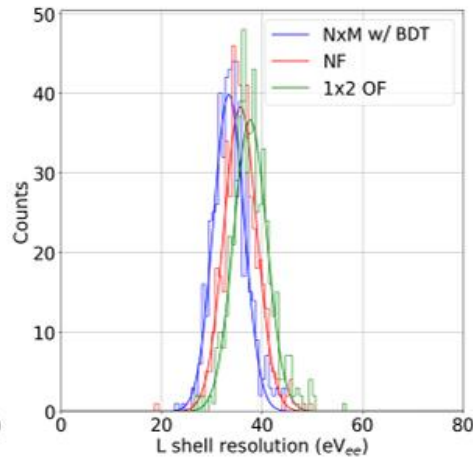
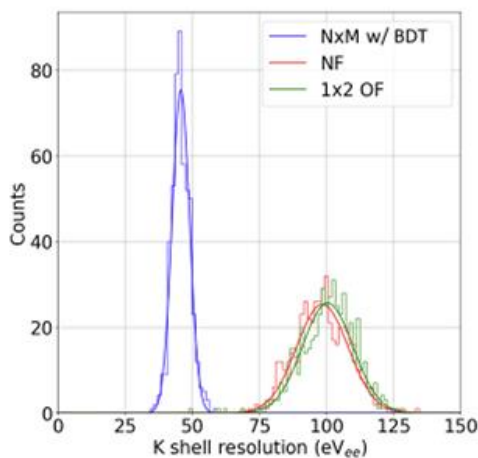
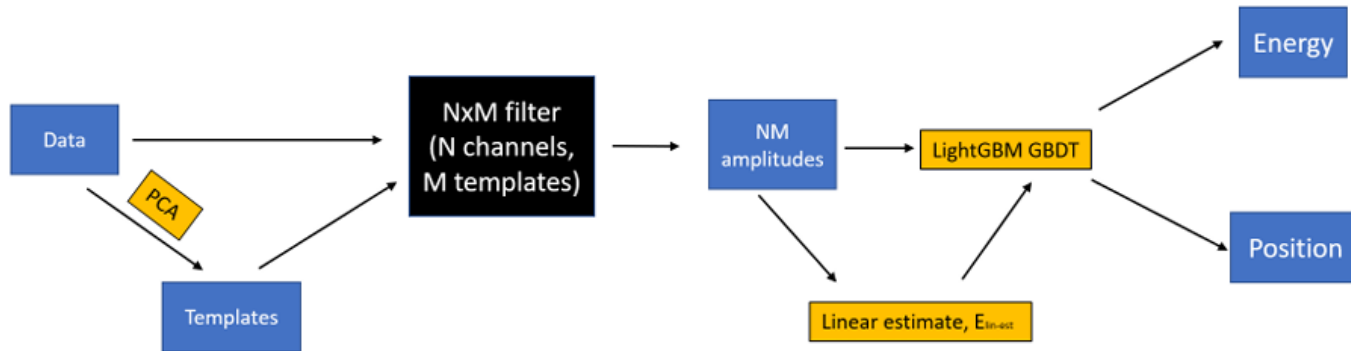
Updated long-range publications plan

SuperCDMS Publications Timeline	CY 2024	CY 2025	CY 2026	CY 2027	CY 2028	CY 2029	CY 2030	CY 2031	
<i>Last updated January 2026</i>	FY 2024	FY 2025	FY 2026	FY 2027	FY 2028	FY 2029	FY 2030	FY 2031	
SuperCDMS Program:									
Early Operations Detector Testing	█								
Integration & Commissioning at SNOLAB	█								
SuperCDMS SNOLAB Science Run 1			Run 1						
SuperCDMS SNOLAB Science Run 2					Run 2				
Dark Matter Science Results:									
IMPACT Si Calibration									
Si HVeV ERDM @NEXUS	▲								
CUTE Ge energy-calibration results			▲						
Run 1 HV detectors, NRDM initial result				▲					
Run 1 LIPs result					▲				
Run 1 HV detectors, NRDM full run						▲			
Run 1 Si iZIP result							▲		
Run 2 HV detectors, ERDM result								▲	
Run 1 + 2 solar axion result									
Annual modulation analysis								▲	
Ultimate HV detector result									

Other SuperCDMS activities: Improved event reconstruction

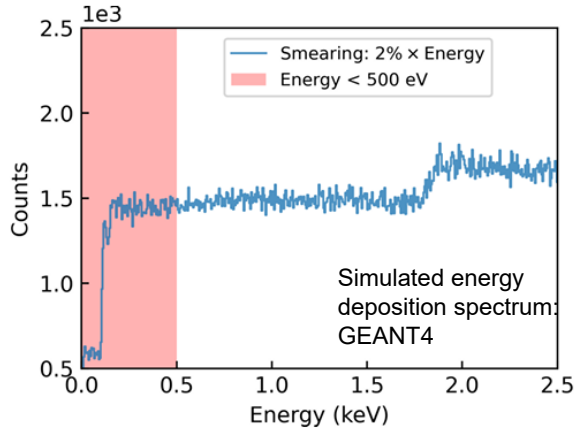
“N channels x M templates” Optimal Filter with machine-learning boost, validated on old CDMSlite data *NIM A 1087 (2026) 171437*

Goal: accounting for correlated noise between channels, and for position-dependent variations in pulse shape

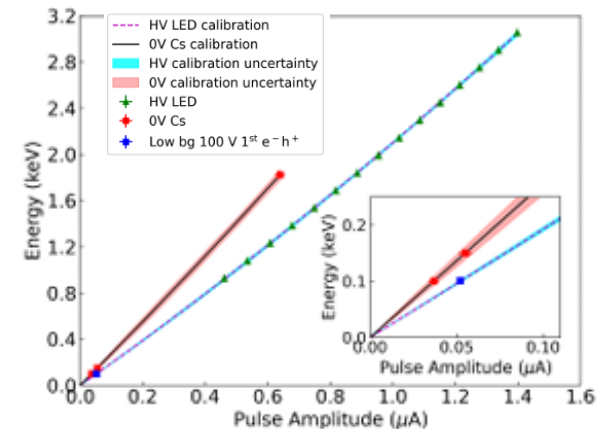
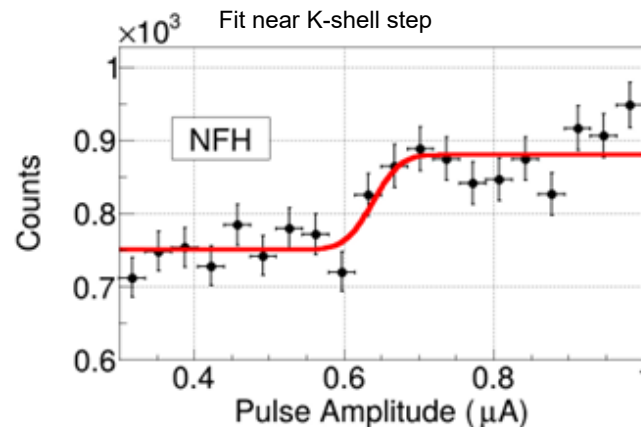
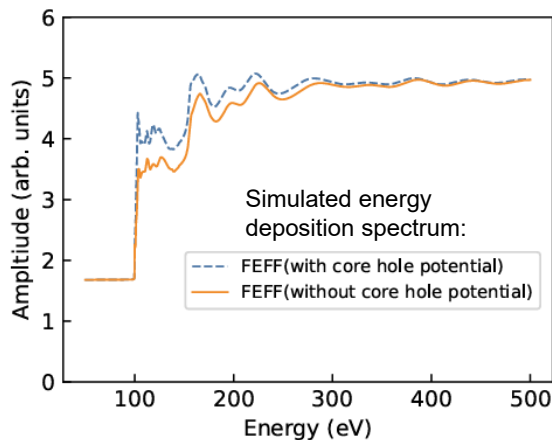
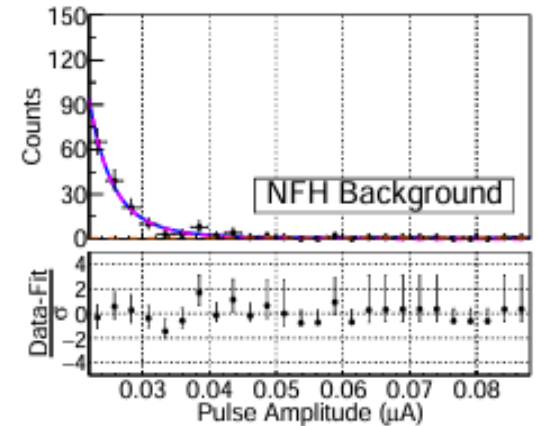
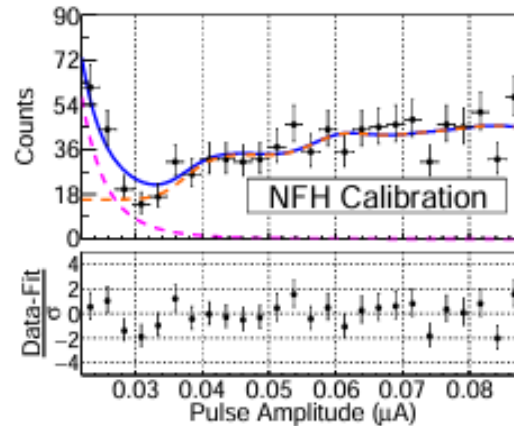


Other SuperCDMS activities: Si calibration using Compton steps in HVeV Run 4 @NEXUS

Energy signatures at $\sim 100\text{eV } E_{ee}$ (L shell steps), $\sim 2\text{keV } E_{ee}$ (K shell step) *Phys. Rev. D* **112** (2025) 092014

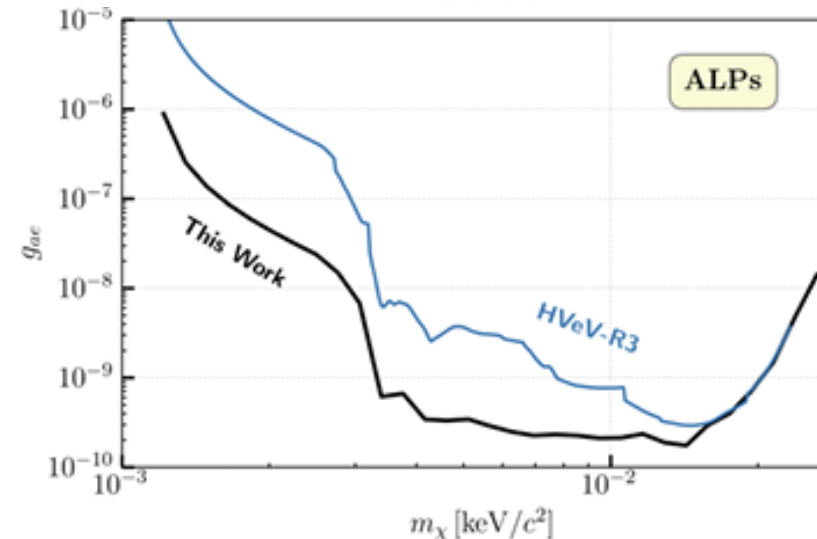
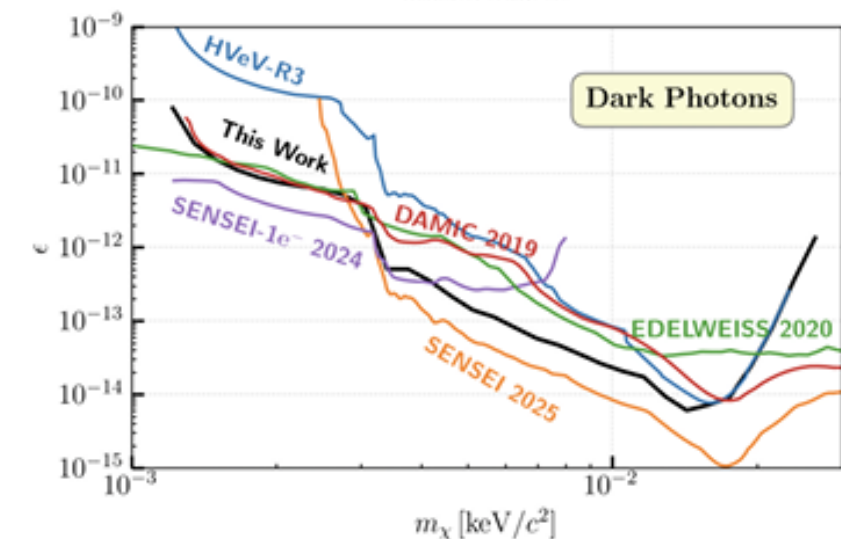
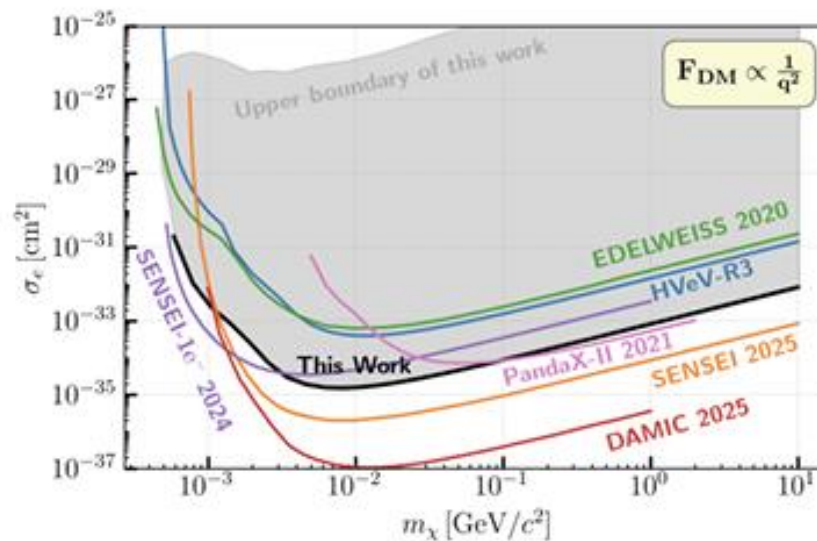
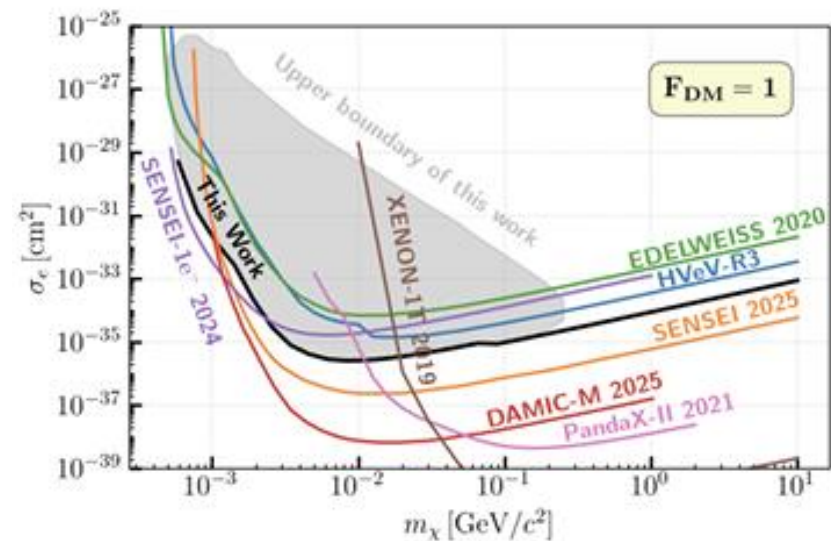


Simultaneous fit of datasets for L-steps: Compton + Low-Energy Excess



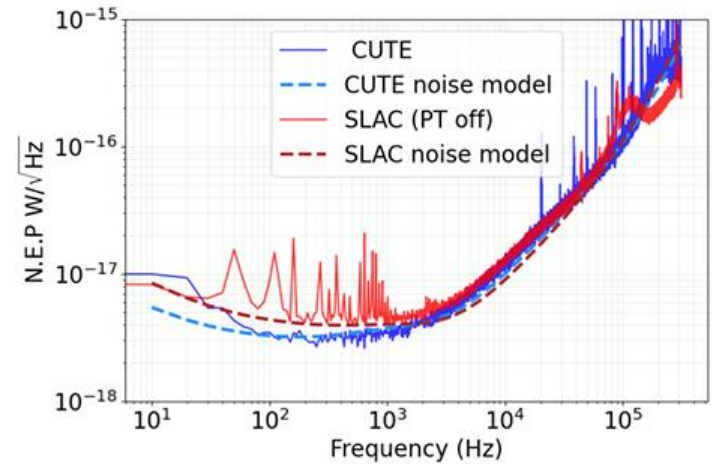
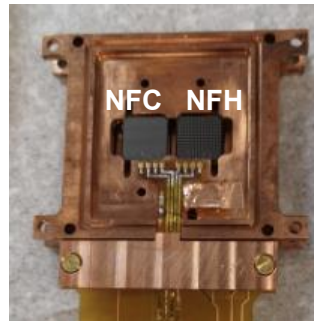
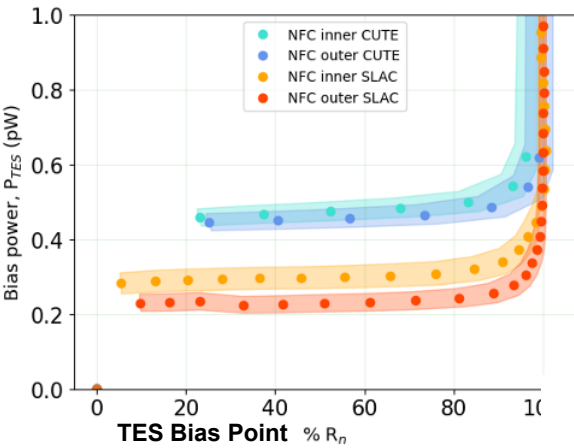
Other SuperCDMS activities: ERDM searches in HVeV Run 4 @NEXUS

Re-designed detector holder eliminated luminescence background from PCR's *Phys Rev D* **113** (2026)

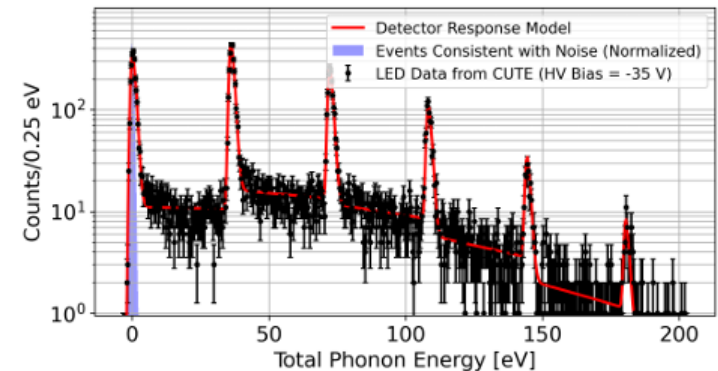
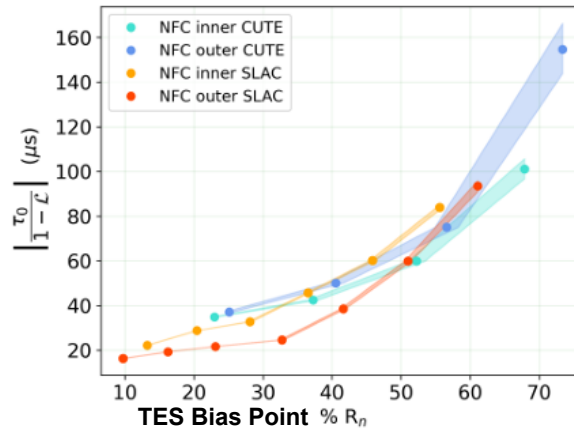


Other SuperCDMS activities: HVeV Run 5 @CUTE device characterization

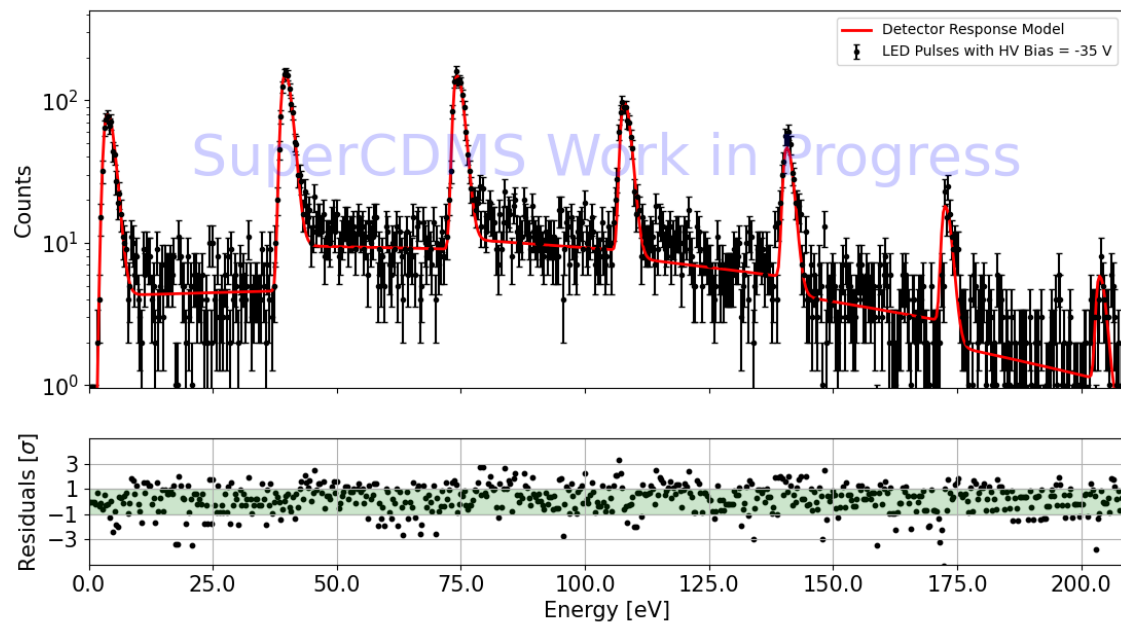
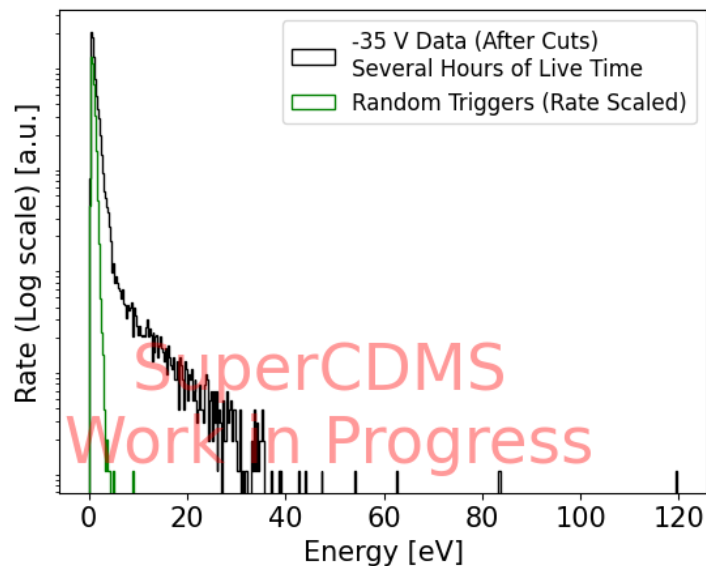
Sub-eV energy resolution, single charge sensitivity [arXiv:2601.16307](https://arxiv.org/abs/2601.16307) (Jan 2026), accepted *NIM A*
Including comparisons to previous HVeV runs in SLAC surface lab



Description	Unit	SLAC	CUTE
Resolution	meV	900^{+22}_{-3}	612 ± 4
Charge trapping probability	%	10^{+2}_{-3}	27.1 ± 0.3
Impact ionization probability	%	7^{+3}_{-2}	1.2 ± 0.4
Surface trapping probability	%	29^{+1}_{-2}	18.5 ± 0.5
Collected photon energy	eV	$2.6^{+0.1}_{-0.2}$	1.23 ± 0.03
Linear calibration factor	eV/ μ A	290^{+2}_{-4}	340.6 ± 0.3
Second-order calibration factor	eV/ μ A ²	27^{+5}_{-4}	55.2 ± 0.4
Photon energy	eV	3.40	2.0468 ± 0.0002
Lost photon energy	eV	$0.8^{+0.2}_{-0.1}$	0.81 ± 0.03

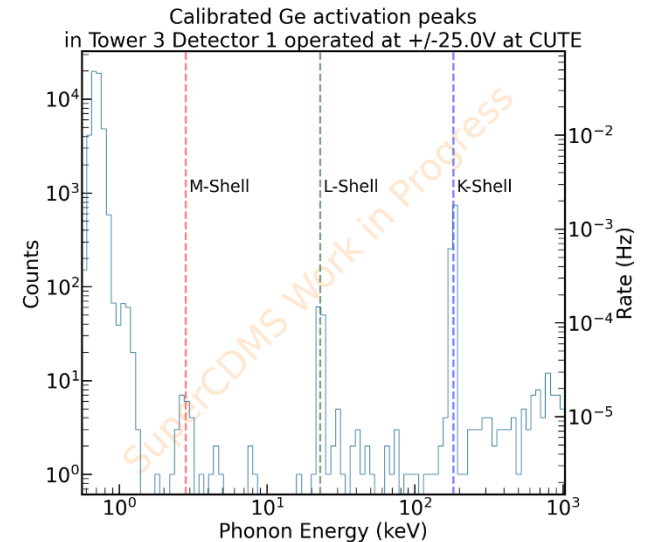
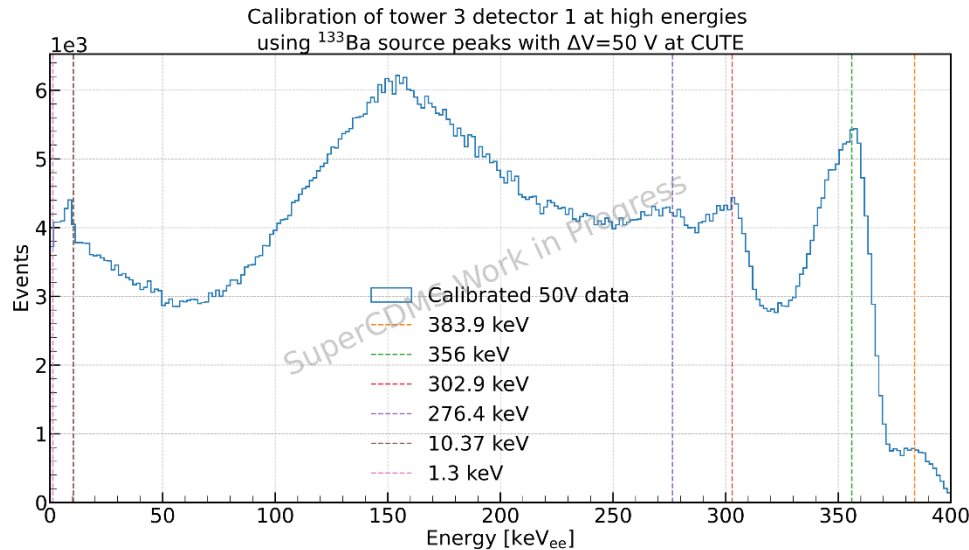
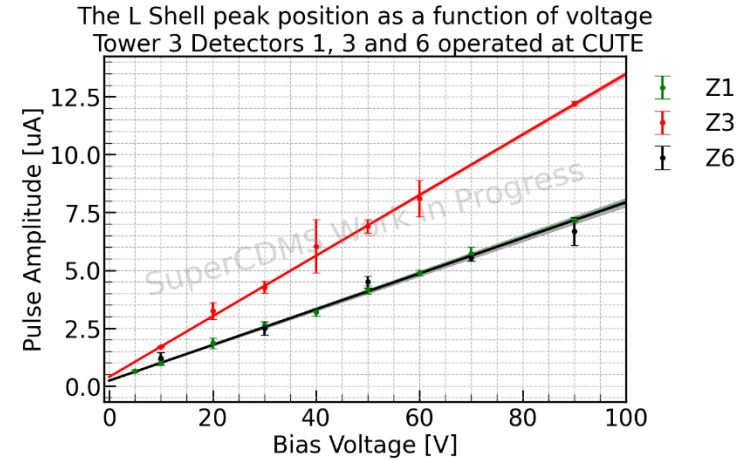
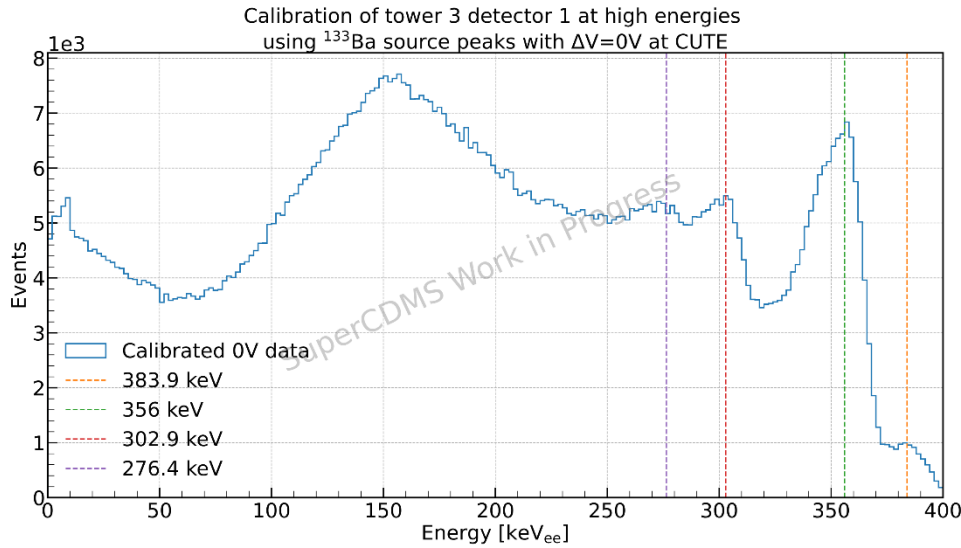


HVeV Run 5 @CUTE: ERDM search (work-in-progress)



Plus: HVeV 2mm 2-channel Prototype Run @NEXUS: data-taking just completed

Other SuperCDMS activities: Ge Calibration results in HV Tower Testing at CUTE (work-in-progress)



(Data collected Fall 2023)

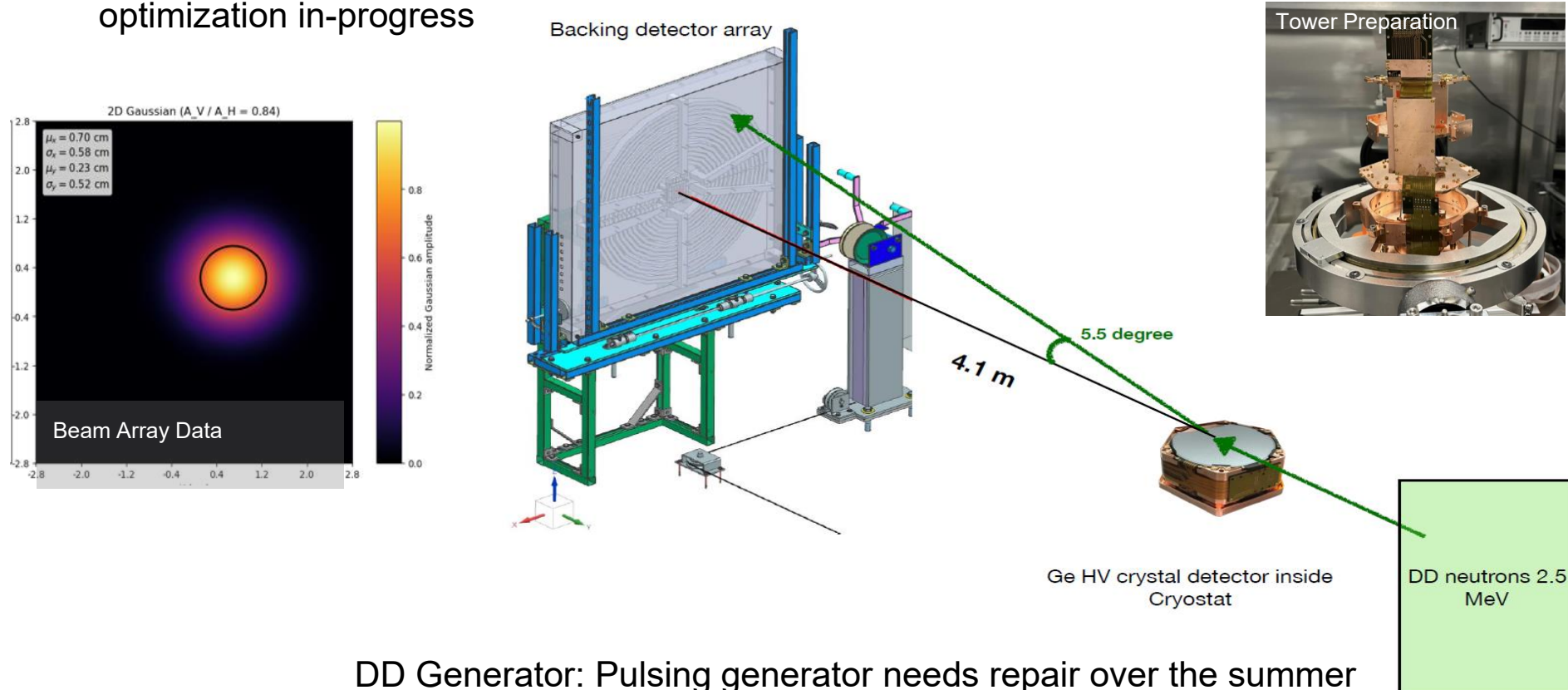
Other SuperCDMS activities: preparation for Ge HV energy calibration campaigns @NEXUS

Backing Array: 14 scintillator rings, to tag recoil angles corresponding to 14 different energies

- First data with beam taken in Fall 2025
- Integration of full array now complete, optimization in-progress

Single HV detector:

- Installed in a Tower at SNOLAB in Jan
- Just shipped to Fermilab
- Installation in NEXUS next month



Conclusion ... or just the start

Stay tuned for...

- End of Commissioning (Jul)
- Science Run 1a (July – Oct)
- Full warmup for repairs & enhancements
- Science Run 1b
- Science Run 2



Plus...

- Detector characterization & calibration from CUTE Tower Testing
- NEXUS HVeV runs & Ge HV energy calibration

