

2023/06/22

# SNOLAB Director Report

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Jodi Cooley

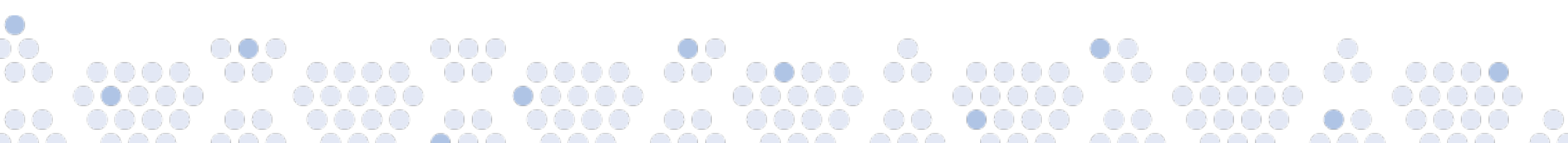
Executive Director | SNOLAB

Professor of Physics | Queen's University

Adjunct Research Professor | SMU



# SNOLAB Founding and Funding Partners



# Introducing SNOLAB



- SNOLAB hosts rare event searches and measurements. It's located 2 km underground in the active Vale Creighton nickel mine near Sudbury, Ontario, Canada.

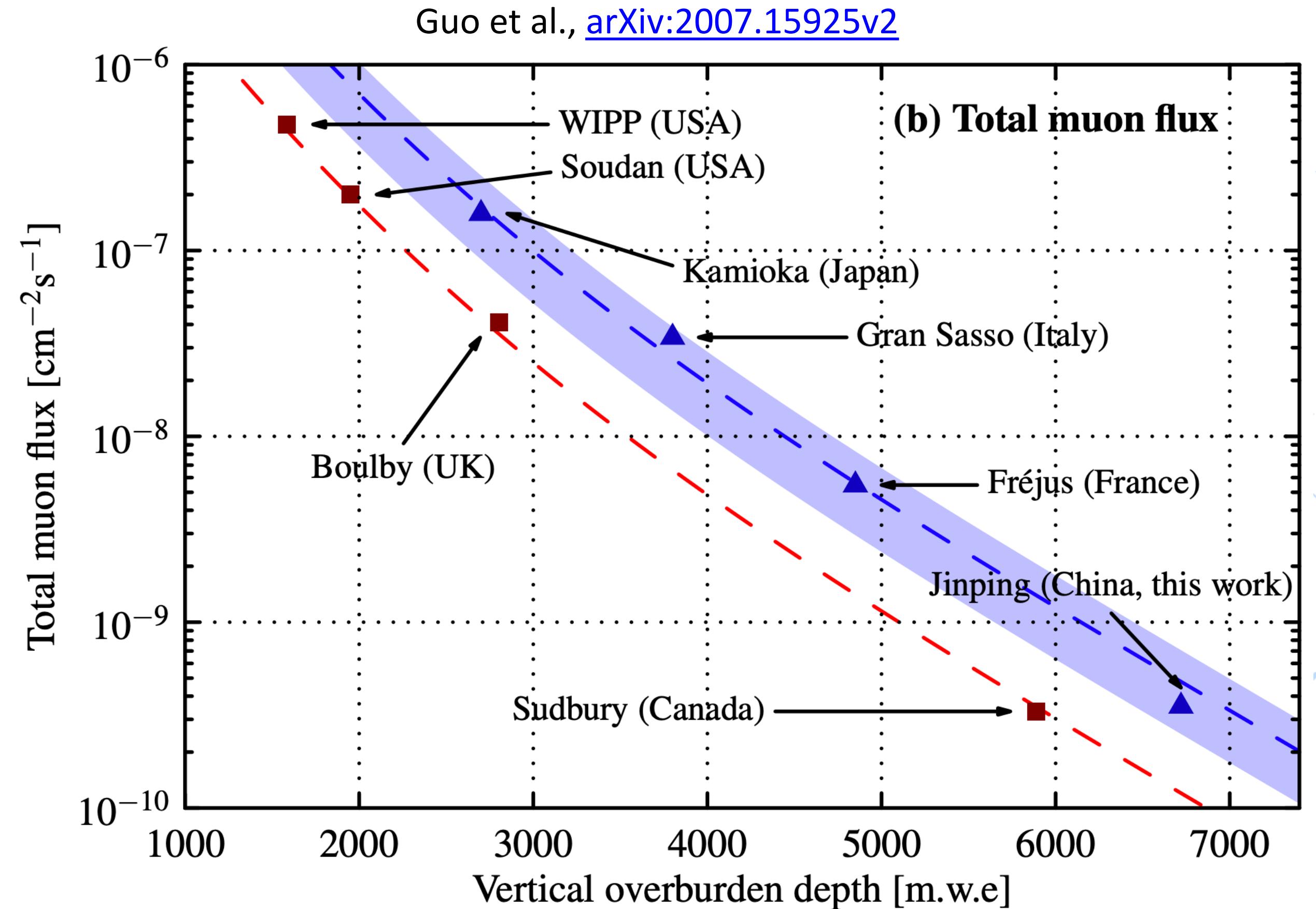


["A visit to SNOLAB" on YouTube](#)

# Introducing SNOLAB

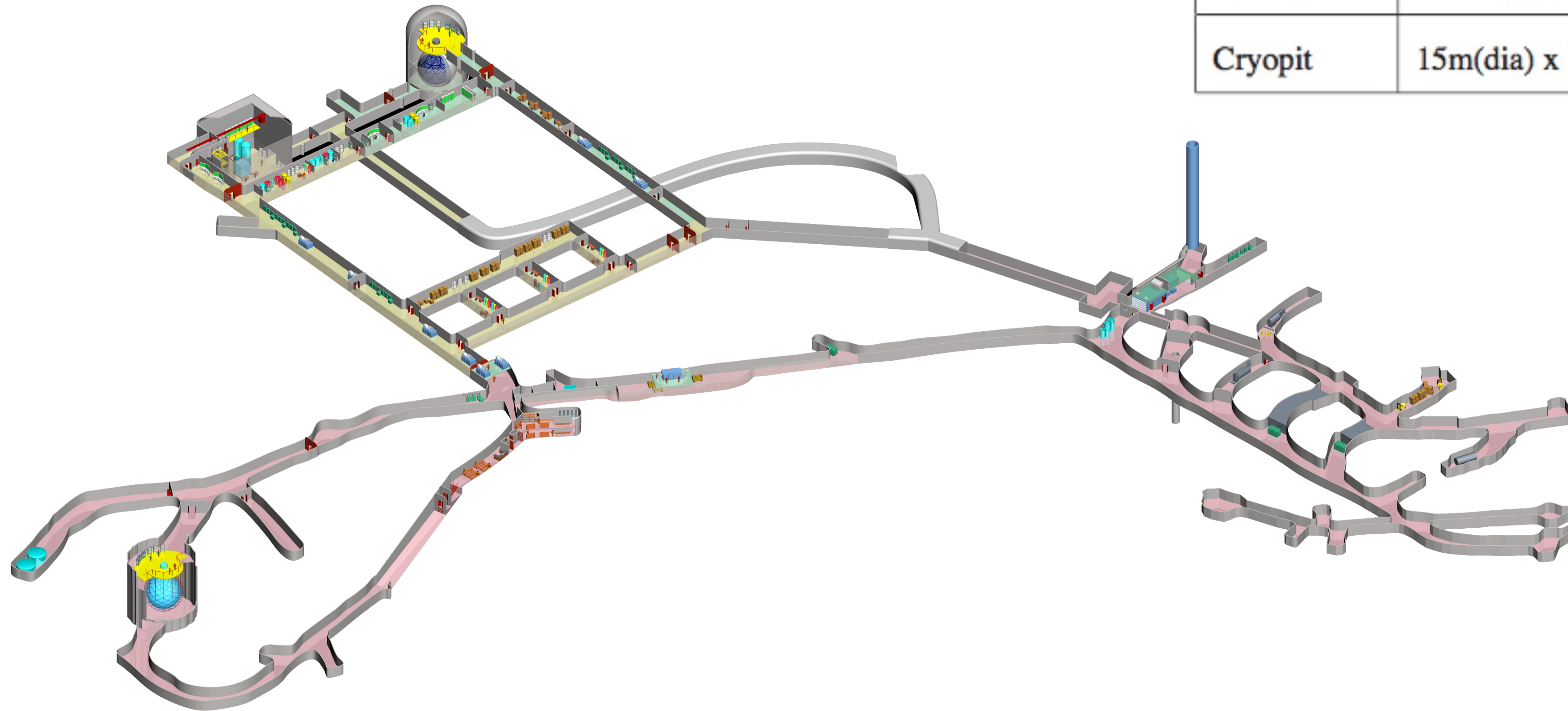


- SNOLAB hosts rare event searches and measurements. It's located 2 km underground in the active Vale Creighton nickel mine near Sudbury, Ontario, Canada.
- SNOLAB has the lowest muon fluxes available. Clean room throughout the underground.



"A visit to SNOLAB" on YouTube

# SNOLAB layout



Area	Dimensions	Area	Volume
SNO Cavern	24m (dia) x 30m(h)	250m <sup>2</sup>	9,400 m <sup>3</sup>
Ladder Labs	32m(l)x6m(w)x5.5m(h)	190m <sup>2</sup>	960 m <sup>3</sup>
	23m(l)x7.5m(w)x7.6m(h)	170m <sup>2</sup>	1,100 m <sup>3</sup>
Cube Hall	18.3m(l)x15m(w) x 19.7m(h)	280m <sup>2</sup>	5,600 m <sup>3</sup>
Cryopit	15m(dia) x 19.7m(h)	180m <sup>2</sup>	3,900 m <sup>3</sup>

5000 m<sup>2</sup> of class 2000 cleanroom underground.  
<2000 particles >0.5  $\mu$ m in diameter per ft<sup>3</sup>

# SNOLAB Funding

- CFI MSI Funding:
  - On August 19<sup>th</sup>, 2022, we held, arguably, the deepest-cleanest press conference ever at SNOLAB.
  - Innovation, Science and Economic Development (ISED) Minister François-Philippe Champagne announced that SNOLAB would be receiving \$102,000,000 from the Canada Foundation for Innovation's Major Science Initiatives for a period of six years beginning April 1, 2023.
- Ontario Provincial Funding (MCU):
  - \$6.0M in provincial funding for FY2024 was approved in an agreement made in 2022.
  - SNOLAB has been budgeted \$14M from the provincial government for the FY2025-2026.



# Reaching New Heights, Deep Underground

2023-2029 Strategic Plan

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# Reaching New Heights, Deep Underground

2023–2029 Strategic Plan



## Our Vision

*To be the leading international laboratory in deep underground science, hosting the world's most advanced experiments that provide insight into the nature of the universe.*





1

Excellent science

## Drive breakthrough discoveries at the frontiers of underground science.

Expected outcomes:

- Cementing of Canada's leadership in deep underground science
- A stronger, more competitive Canada in scientific discovery
- More Canadian researchers positioned as global leaders



2

Cutting-edge infrastructure

## Continuously improve our research infrastructure to remain state of the art.

Expected outcomes:

- Attraction of the most advanced international experiments to Canada
- Greater global impact and enhanced reputation of Canada's underground science infrastructure



3

Skilled people

## Foster and develop diverse talent in an inclusive environment.

Expected outcomes:

- Canadian leadership in advancing EDI in research facilities
- A new generation of HQPs prepared to discover and innovate in a global economy
- Greater access to STEM skills and opportunities in Northern Ontario



# Strategic Goals

*These goals build upon our values of safety, excellence, teamwork, accountability and diversity*

# Large Cavity Status

## Cube Hall

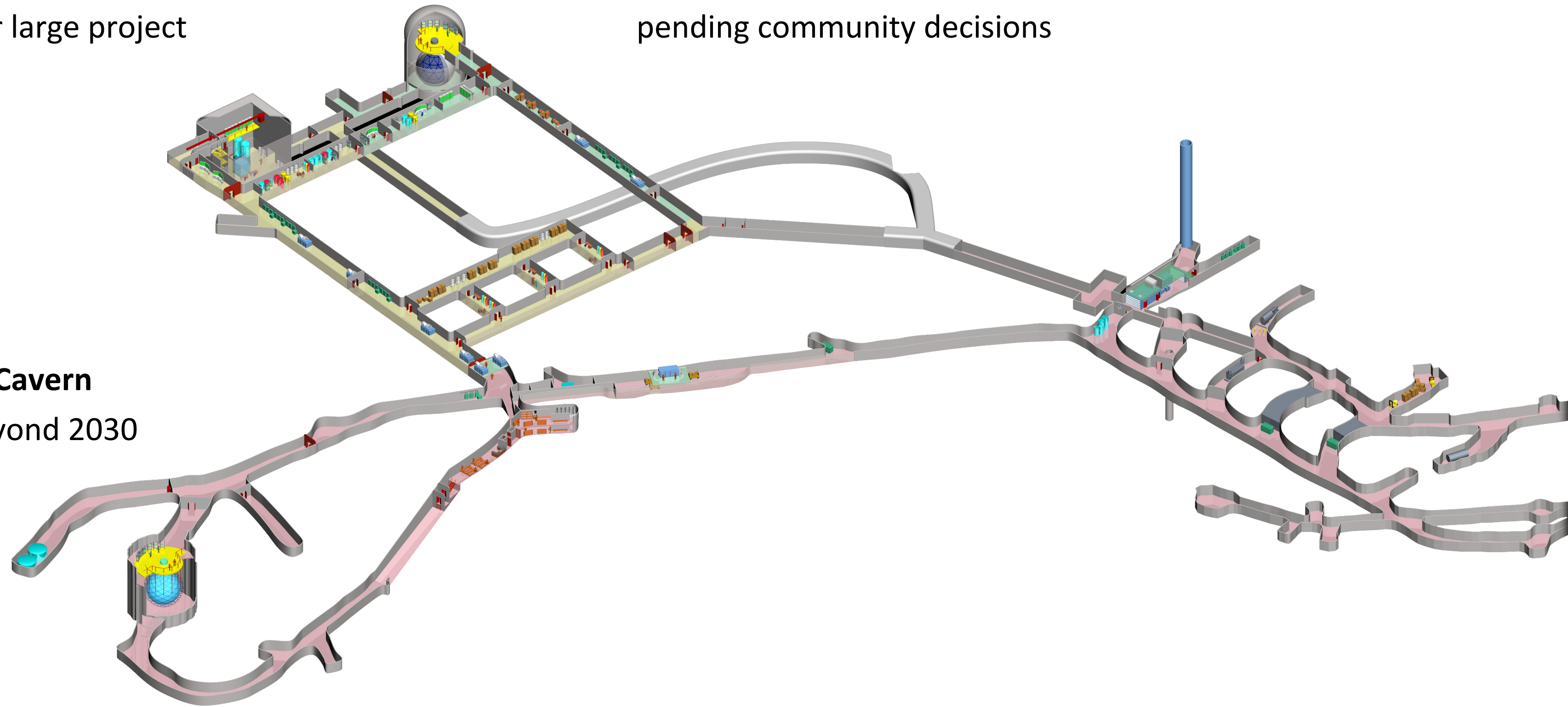
DEAP-3600, PICO500, NEWS-G  
potential for large project

## Cryopit

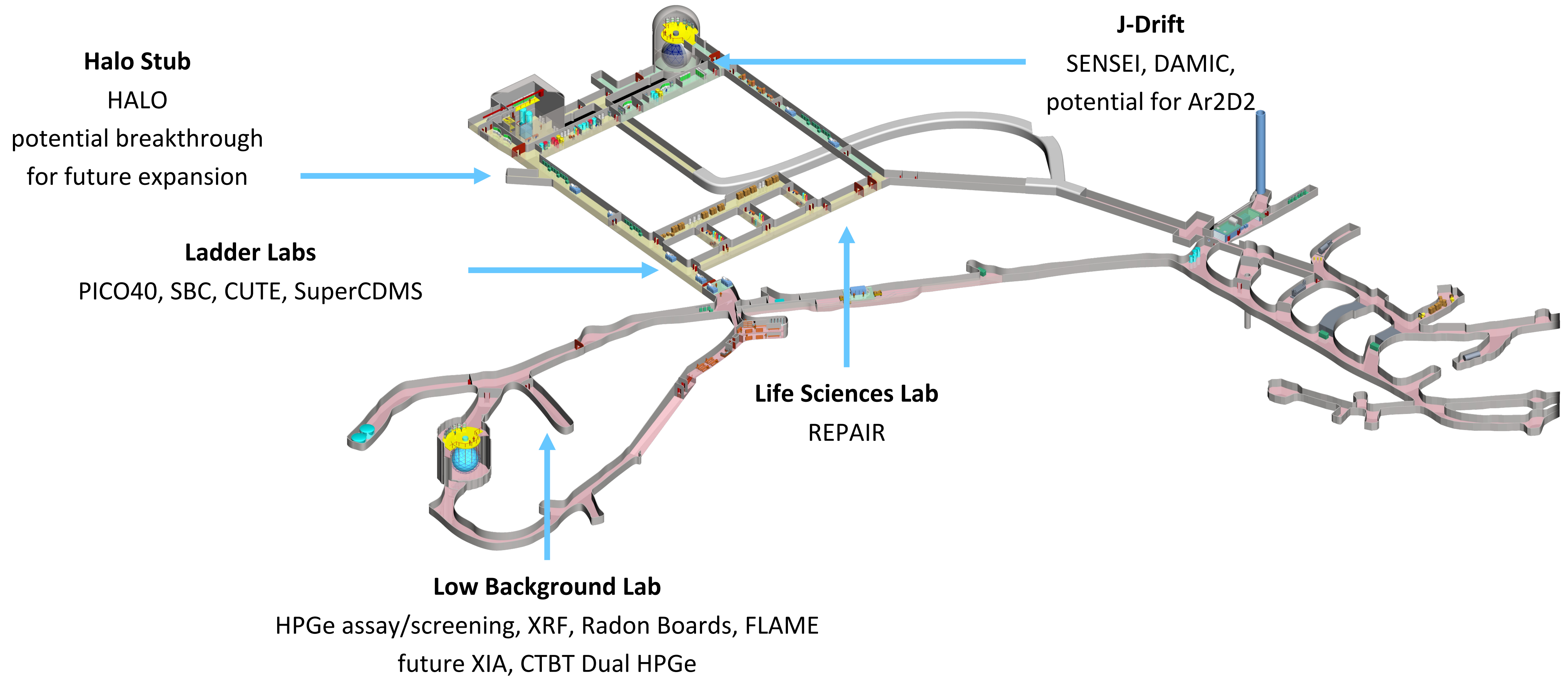
Ton-scale 0vbb beyond 2030  
pending community decisions

## SNO Cavern

SNO+ beyond 2030



# Small Cavity Status

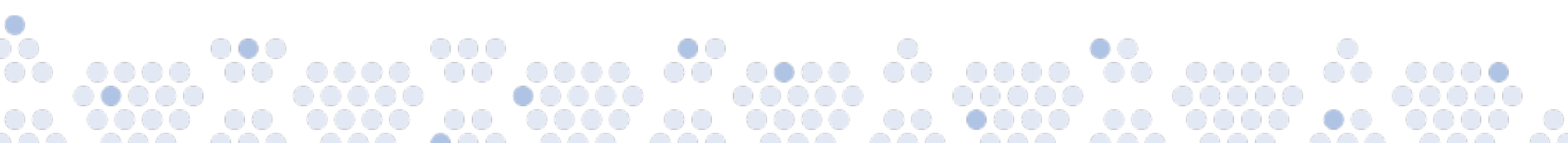


# Experiment Highlights



# SNOLAB Impact

In the last year, at least 156 pieces of scholarship resulted directly from SNOLAB collaborations or include SNOLAB science (indirect impact).



# SNO+: First observation of reactor neutrinos in water



APS Journals Physics Magazine Help/Feedback Journal, vol, page, DOI, etc. Log in

## PHYSICAL REVIEW LETTERS

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Featured in Physics Editors' Suggestion

### Evidence of Antineutrinos from Distant Reactors Using Pure Water at SNO+

A. Allega *et al.* (The SNO+ Collaboration)  
Phys. Rev. Lett. **130**, 091801 – Published 1 March 2023

Physics See synopsis: [Reactor Neutrinos Detected by Water](#)

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Article References No Citing Articles Supplemental Material PDF HTML Export Citation

#### ABSTRACT

The SNO+ Collaboration reports the first evidence of reactor antineutrinos in a Cherenkov detector. The nearest nuclear reactors are located 240 km away in Ontario, Canada. This analysis uses events with energies lower than in any previous analysis with a large water Cherenkov detector. Two analytical methods are used to distinguish reactor antineutrinos from background events in 190 days of data and yield consistent evidence for antineutrinos with a combined significance of  $3.5\sigma$ .

Issue  
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Check for updates

Congratulations to the SNO+ team for their work!

# SENSEI @ SNOLAB: New Results



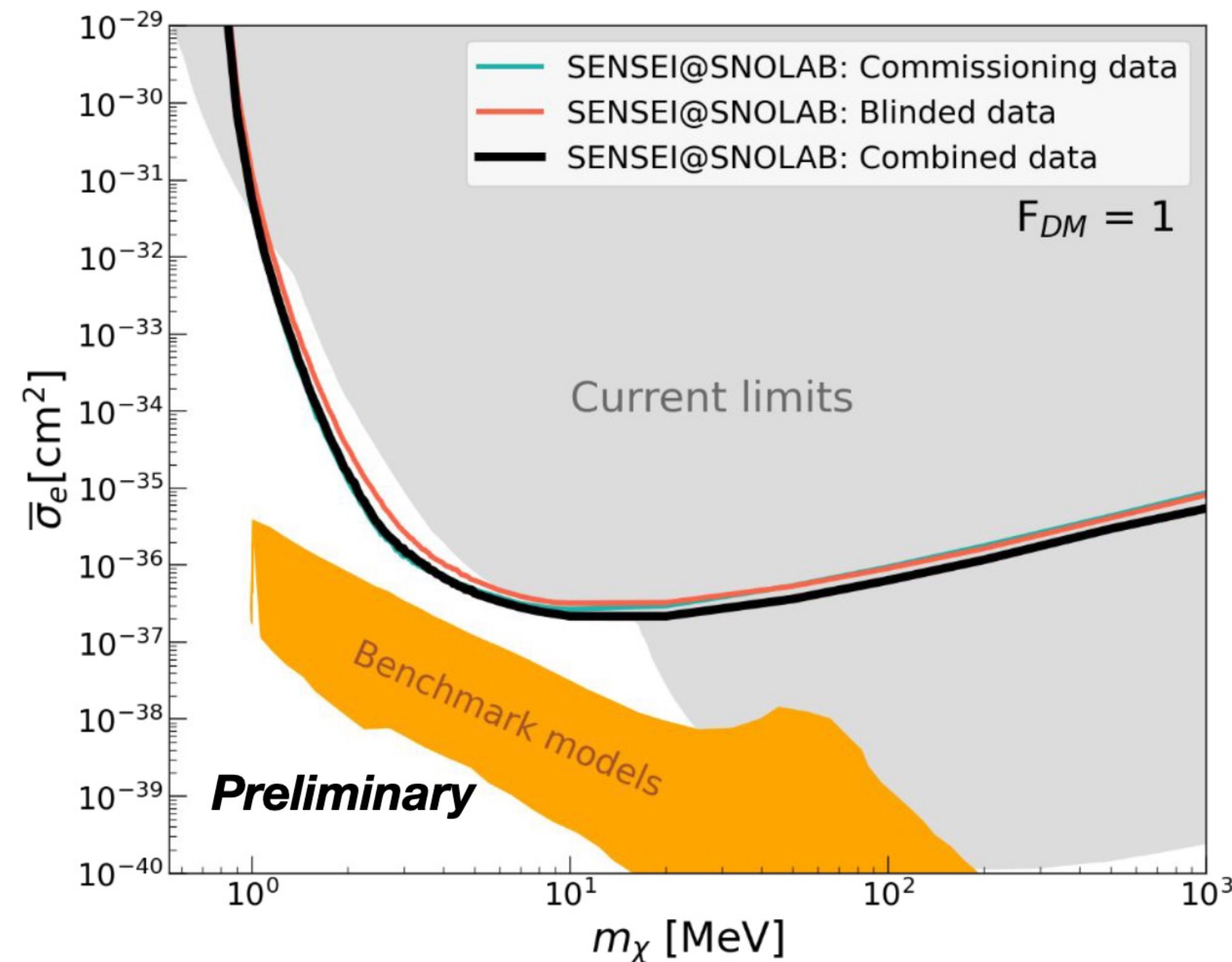
## Dark matter-electron scattering limits

**Data:** 45 unblinded commissioning images, 37 hidden images, 2-10  $e^-$  channels

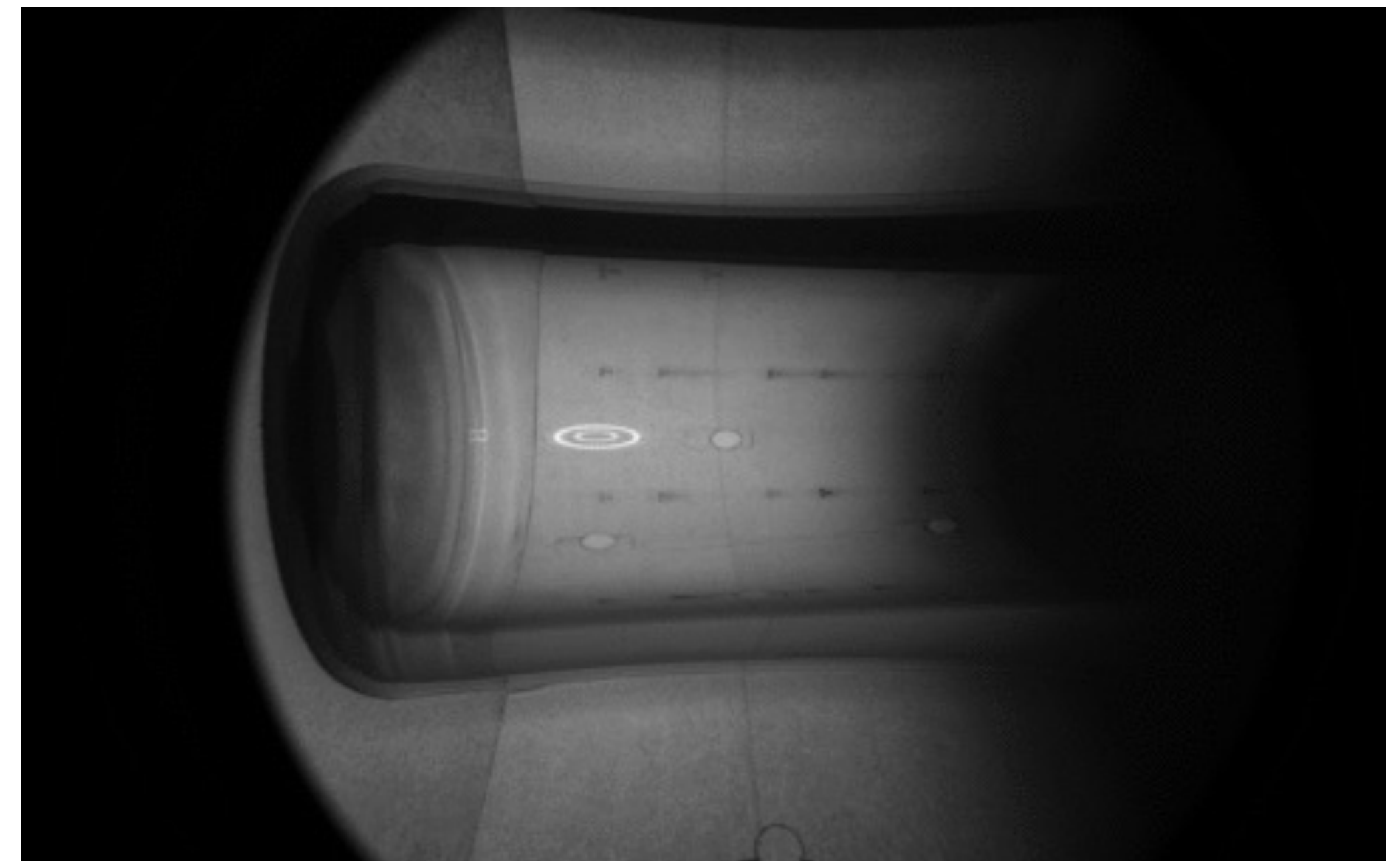
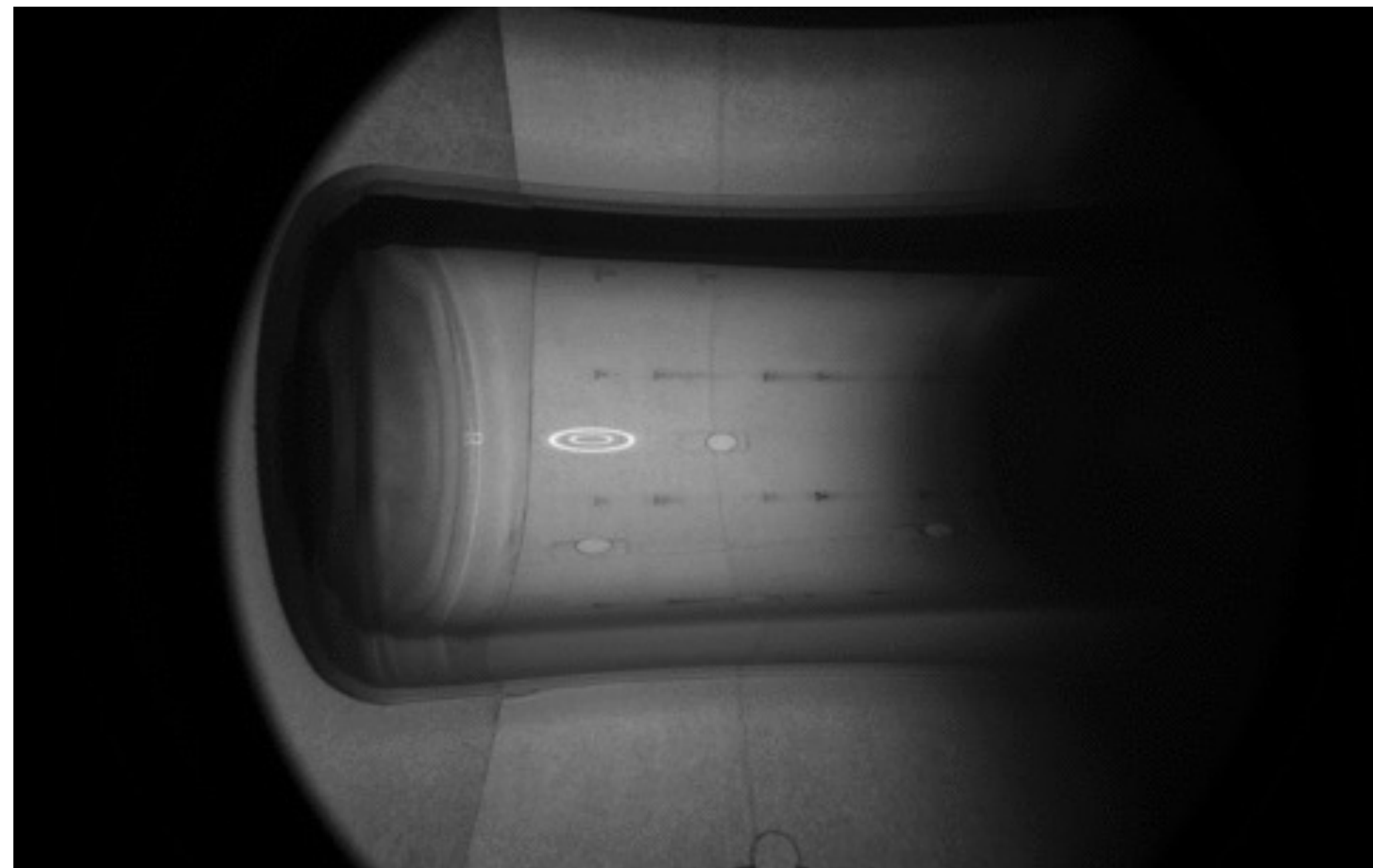
**Exposure:** combined datasets amount to  $\sim 70$  g-days per electron channel with current masks

**Three limits:** blinded dataset, commissioning dataset, and combined commissioning + blinded exposure

**Paper in preparation to present full results**

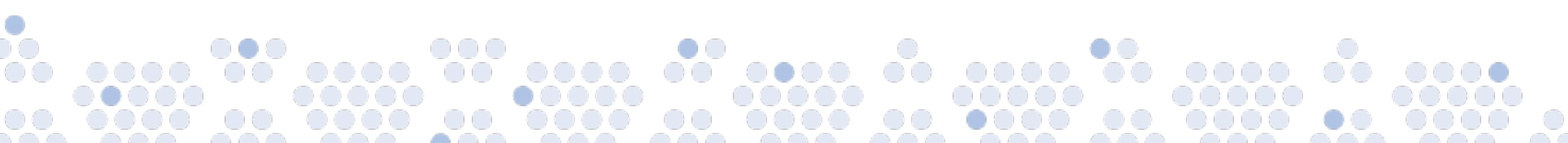


# PICO-40L Begins Operations!



*Courtesy of the PICO Collaboration.*

PICO-40L bubbles! Regular operations began in February.





# SuperCDMS Construction Underway!



SuperCDMS Fridge arrived underground on Saturday, February 4<sup>th</sup>!

*Courtesy of the SuperCDMS Collaboration.*

# SuperCDMS Construction Underway!



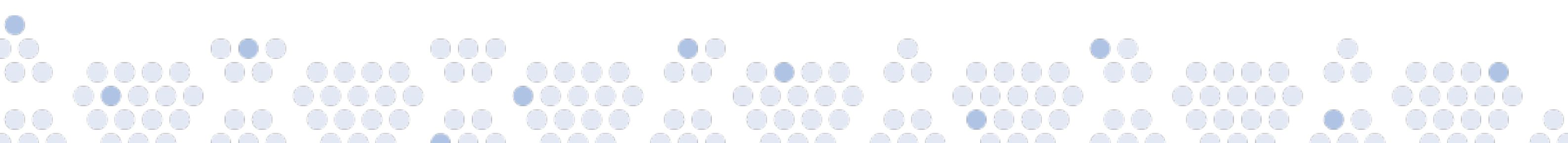
SuperCDMS Towers 3 & 4 arrived underground on Saturday, May 15th!

*Courtesy of the SuperCDMS Collaboration  
& SNOLAB.*

# 2<sup>nd</sup> International Summit on Future Tonne-Scale $0\nu\beta\beta$ Decay Experiments



Participation from Canadian, European and US scientists and funding agencies.  
Goal: To discuss and progress a campaign for a global tonne-scale  $0\nu\beta\beta$  program.



# 2<sup>nd</sup> International $0\nu\beta\beta$ Decay Summit: Readout from In-Camera Sessions



- The international stakeholders in neutrinoless double beta decay research who attended this summit (agencies representing Canada, France, Germany, Italy, UK, and USA) agree in principle the best chance for an unambiguous discovery is an international campaign with multiple isotopes and more than one large tonne-scale experiment implemented in the next decade.
- These stakeholders discussed a scenario that could accomplish the goals of the first bullet by deploying CUPID, LEGEND-1000, and nEXO with one tonne-scale experiment in Europe and one tonne-scale experiment in North America.
- These stakeholders agree on the need for a coordinated effort to efficiently and cost-effectively advance the field for the proposed double beta decay experiments, as well as the future of the field. To that purpose, these stakeholders agree that a structure for international collaboration on this research should be explored. (e.g., an international virtual observatory for neutrinoless double beta decay).
- These funding agencies intend to create a working group to explore how such an international effort could be coordinated. The stakeholders welcome additional international partnerships.

# Summary

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- It has been an exciting and busy year at SNOLAB.
- We have secured a new 6-year CFI grant and Ontario Provincial Funding which will enable continued experimental support and laboratory operations.
- We have announced a new 6-year strategic plan.
- We have a healthy diversity of experiments in terms of size and stages of their life-cycles. 10 experiments are currently operating and taking data (HALO, CUTE, DAMIC, FLAME, REPAIR, Xe-Still, SNO+, NEWS-G, SENSEI, PICO-40), 3 experiments are under construction (SuperCDMS, DEAP-3600, CTBT), 9 experiments are in a design phase (PICO500, SBC, OSCURA, nEXO, LEGEND-1000, ARGUS, SNO+ Te,) and 2 CUTE facility experiments (Qbits, HVeV).