2022/08/09
GUINEAPIG

SNOLAB Introduction

Jeter Hall
SNOLAB/Laurentian

Land Acknowledgment

SNOLAB is located on the traditional territory of the Robinson-Huron Treaty of 1850, shared by the Indigenous people of the surrounding Atikameksheng Anishnawbek First Nation as part of the larger Anishinabek Nation.

We acknowledge those who came before us and honour those who are the caretakers of the land and the waters.

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 is operated jointly by University of Alberta, Carleton University, Laurentian University, University of Montreal, and Queen’s University

SNOLAB operations are funded by the Province of Ontario, and the Canada Foundation for Innovation

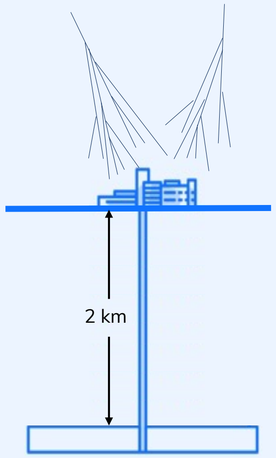
Science Strategy

The science at SNOLAB is currently focused on fundamental particle physics. Primarily looking at further **investigating the nature of matter**. Specifically:

- What is the nature of dark matter?
- What is the nature of the neutrino?

SNOLAB is interested in collaborating on any scientific research that requires deep underground facilities. For example:

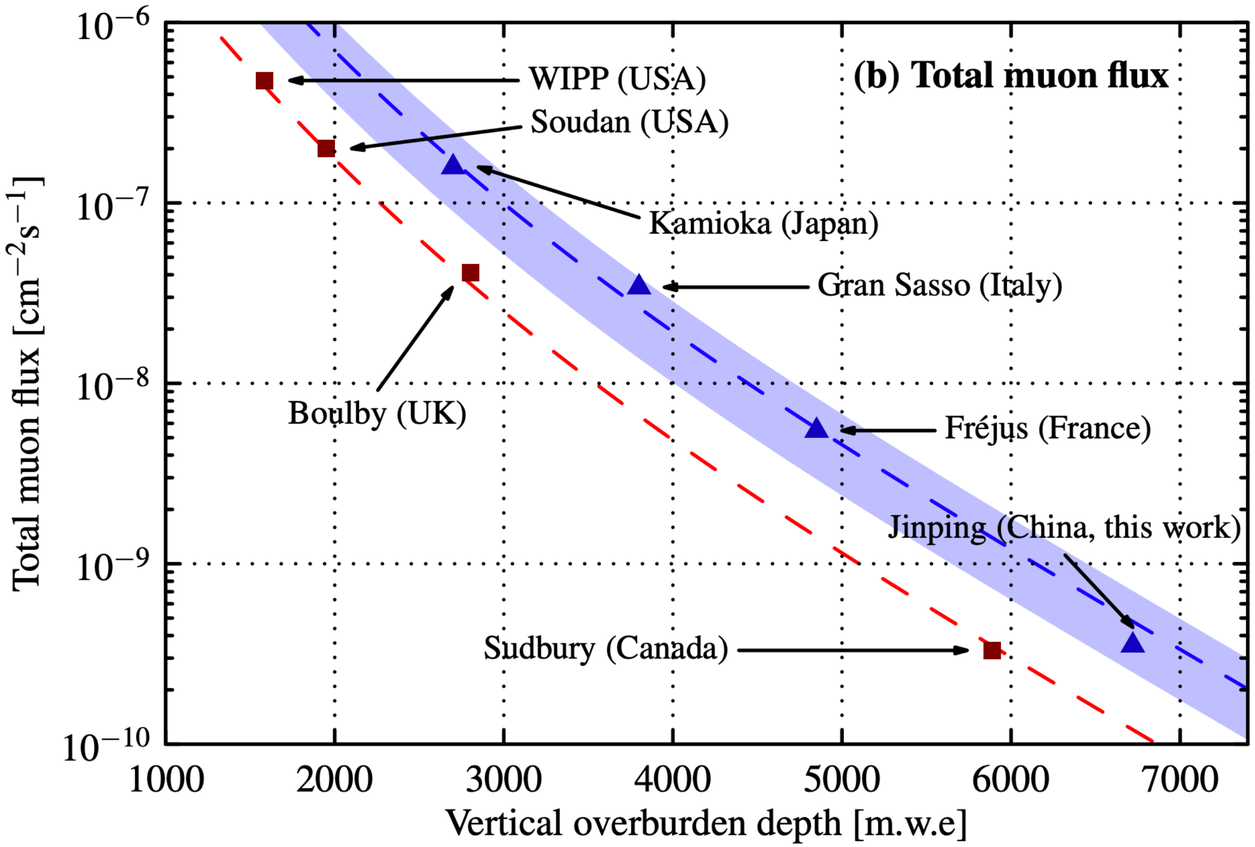
- Neutrino observatories (solar, supernovae, geo, reactor, etc.)
- Effects of radiation on biological systems
- Environmental monitoring (nuclear non-proliferation, aquifers, etc.)
- Effects of radiation on quantum technologies



SNOLAB Advantage

- 2 km Canadian shield
- SNOLAB has the lowest muon fluxes available
- Clean room throughout the underground facility
- Growing community of users

Guo et al., arXiv:2007.15925v2



Strategic goals (2023-2029)

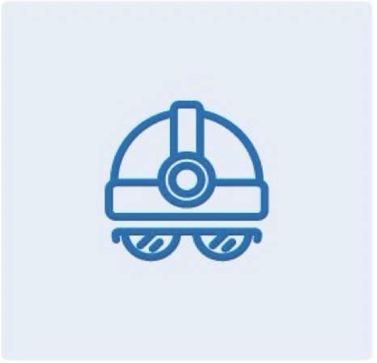
Enable and deliver world-class underground science

Continuously improve our world-class research infrastructure

Educate, inspire, and innovate

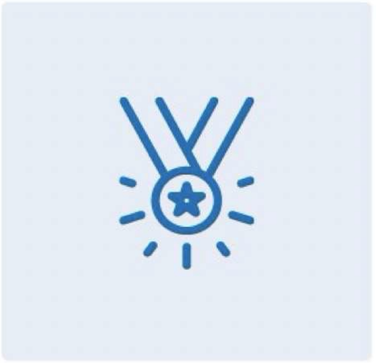
Enhance our culture of equity, diversity, and inclusion

Core values



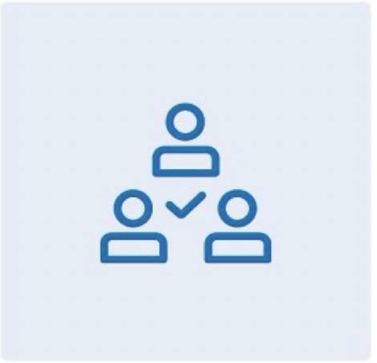
Safety

This is the foundation upon which we realize our mission: We are committed, both individually and as a team, to protecting the health and safety of our staff, users, and visitors



Excellence

We are committed to making full use of and continual improvement to our skills and knowledge. Our focus is on delivering high-quality inspiring science, through driving, supporting, and enabling excellence in research, operations, and community relations.



Teamwork

Our approach to teamwork is based on the belief that each member brings unique experience and important expertise to the workplace, allowing project challenges to be resolved and creating a work environment that supports cooperation and collaboration in all aspects of work.

Diversity

We are committed to strengthening our team by embracing different perspectives. We strive to ensure our culture and work environment are fair, respectful, and support the success of all. Creating a diverse and inclusive workplace will accelerate science, innovation, and discovery.

Accountability

We are committed to upholding an environment of trust, responsibility, and accountability to our stakeholders. Accountability to internal governance structures, external research communities, funding agencies, and public sponsors is an ongoing goal. Strong governance and effective management will guide our organizational development.

SNOLAB Organizational Diagram
SL-MCS-LED-10-001-P Rev 109 (August 2022)

Functional and line management organisational chart, job titles descriptive.

Governance

SNOLABI Committees:
Audit/Finance
Governance
Science/Technical

SNOLAB Institute Council
Chair: N. Ross

SNOLAB Institute Board
Chair: K. Strong

Advisory

SNOLAB Committees:
Experiment Advisory Committee
SNOLAB Experiment Forum

Directorate

Executive Director
J. Cooley
Interim Executive Director
C.J. Virtue
H. Hoddinott

Director of Research
J. Hall
E. Brunelle
B. Morissette (Advisor)

Director of Projects
R. Ford
L. Yasinowski

Director of Operations
A. Barr
O. Lobban

Chief Business Officer
Samantha Kuula
S. Moskal
S. Milks

Research Division

Research Group
S. Sekula

Research Scientists
A. Bialek
E. Caden
B. Cleveland
J. Farine
P.Giampa
P. Gorel
C. Jillings
C. Kraus
A. Kubik
I. Lawson
C. Licciardi
S. Manecki
S. Scorza
U. Wichoski

Post-Docs / Students
J. Baker
S. Daugherty
J. Deloye
C. Lin

Scientific Support
L. Anselmo

Laboratory Technologist
J. Dzilums
D. Fabris
S. Read
C. Tanguay

Scientific Staff
D. Chauhan
S. Hall
S.A. Hussain
S. Luoma
S. Maguire
T. Sonley

Projects Division

Engineering Office
P.Larochelle

Design Engineers
G. Berardi
N. Boyd
R. Hupping
O. Li
P. Liimatainen
I. Rajput

Designers
E. Archer
D. Barton
S. Stankiewicz

Project Management Office
M. Seguin

Project Managers
J. Adams
M. Bertels
D. Hawkins
G. Howard
M. Stoddart

Project Engineers
P. Grylls
A. Mathewson
E. Poulin
M. St-Amant

Project Coordinators
R. Castilloux
M. Hood
M. Ralph

Project Controls Specialist
R. Fournier
M. Piercey

Operations Division

Operations
D. Bailey

Engineer/Planner/ Supervisors
S. Back
T. Carrier
A. Claveau
J. Cooper
R. Deguire
J. Hawkins

System Operators
A. Campbell
S. Clark
L. Herechuk
D. Jones
C. Paquette
A. Stripay

Operators
K. Archer
A. Grylls
K. Kean
J. Montpellier

Warehouse
L. Bonany

Mechanical Maintainers
A. Moss
C. Pugliese

E.I.T.s
D. Byrnes
O. Conrad
T. Hillier
R. Schleehahn

Cleaner Maintainers
B. Carrier
M. Charbonneau
G. Danuk
J. Flowers
S. McBride
B. Mines
C. Ockenden
J. Pilon
H. Punkari
D. Sajnovic

Operations Student
A. Kumar

Integration
M. Obaid

Planners / Supervisors
R. Desjardins
K. Risto

Instrumentation
C. Beaudoin
A. Hesketh

Industrial Technologists
S. Brunelle
S. Cresswell
K. Guba
M. Knaud
A. Lane
A. Larocque
R. Maki
R. Michaud
L. Whipple
B. Zalan

Corporate Services Division

Finance
S. Moskal

Accounts Payable Specialist
E. Gareau

Finance Support Specialist
K. Linklater

Procurement Specialist
J. Young

H. R.
B. Donnelly

HR Advisors
L. Christie
S. Fuller

HR Assistants
K. Joshi
R. Patel
A. Rorison

Communications
M. Whitehouse

E.H.S.
S.Thakre

EHS Training Coordinator
N.Brown

H & S Technician
M. Jorgensen
T. Tom

Education & Outreach
B. Flynn

Ed. & Outreach Coordinator
R. Richardson

I.T.
I. Winsor

Computer Technologists
D. Lessard
K. Patel
J. Roberts

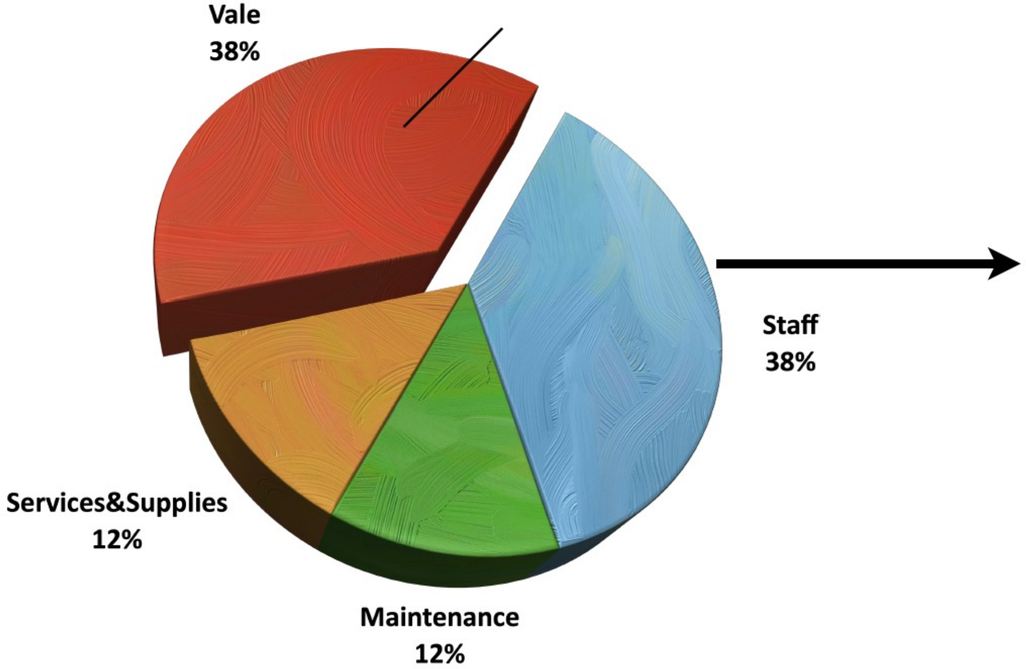
Documentation Coordinator
A. Sokoloskie

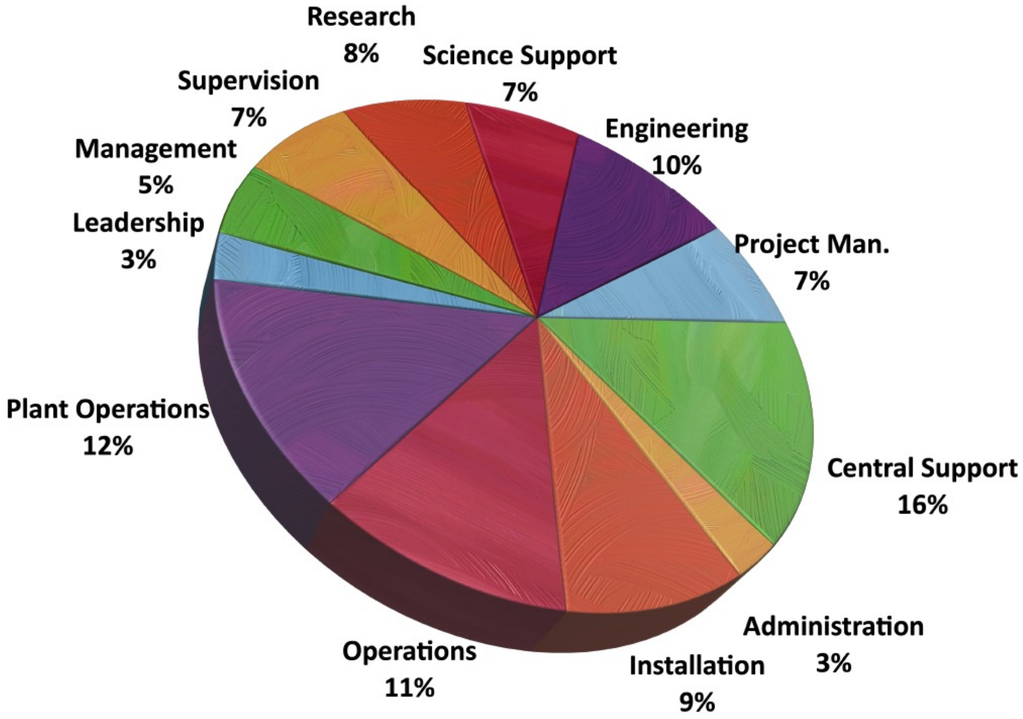
Student
A. Sadnani

SNOLAB 2023-2029

Operations funding from CFI announced last month, $102M over 6 years

Vale is in-kind shaft operations



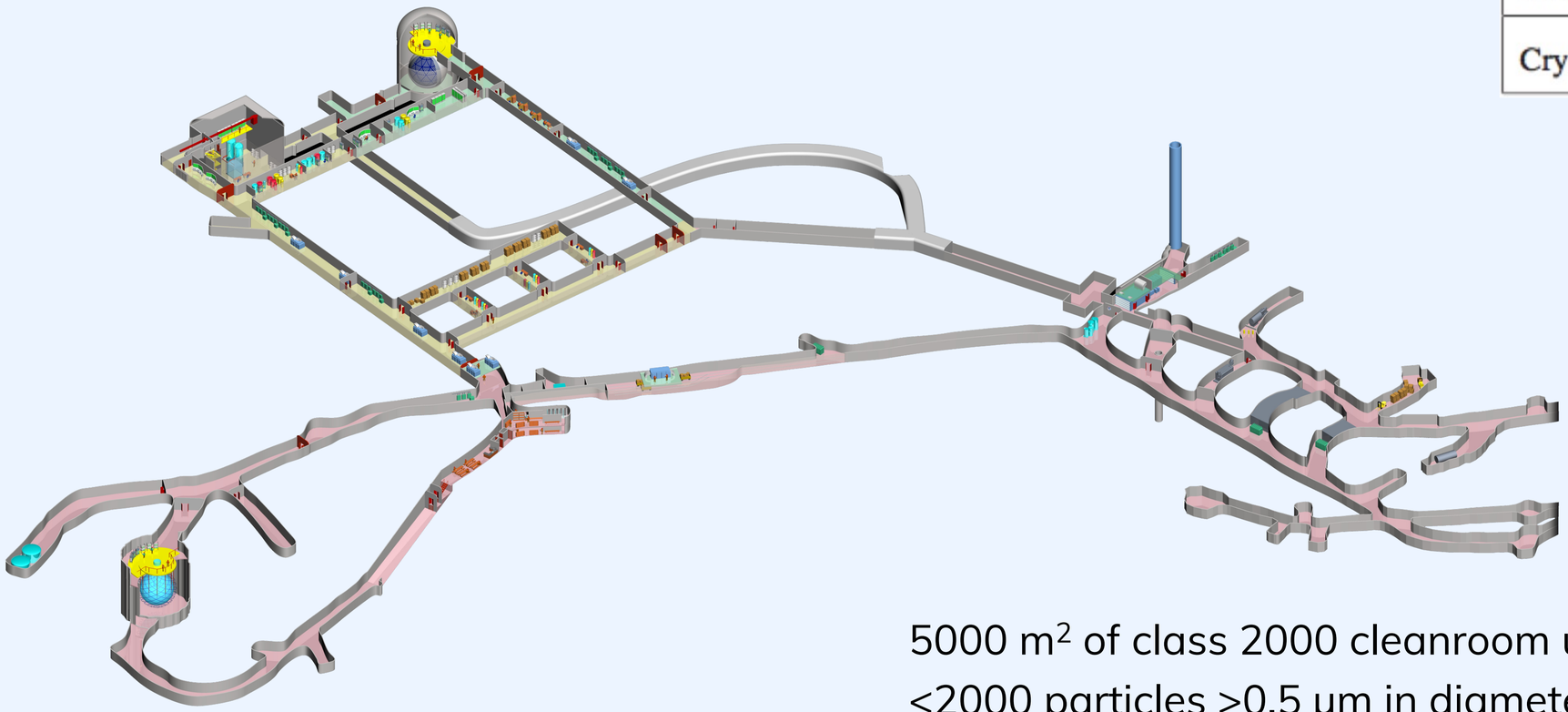


$30 MCAD/year including Vale in-kind support

2022:150 staff

SNOLAB layout

Area	Dimensions
SNO Cavern	24m (dia) x 30m(h)
Ladder Labs	32m(l)x6m(w)x5.5m(h) 23m(l)x7.5m(w)x7.6m(h)
Cube Hall	18.3m(l)x15m(w) x 19.7m(h)
Cryopit	15m(dia) x 19.7m(h)



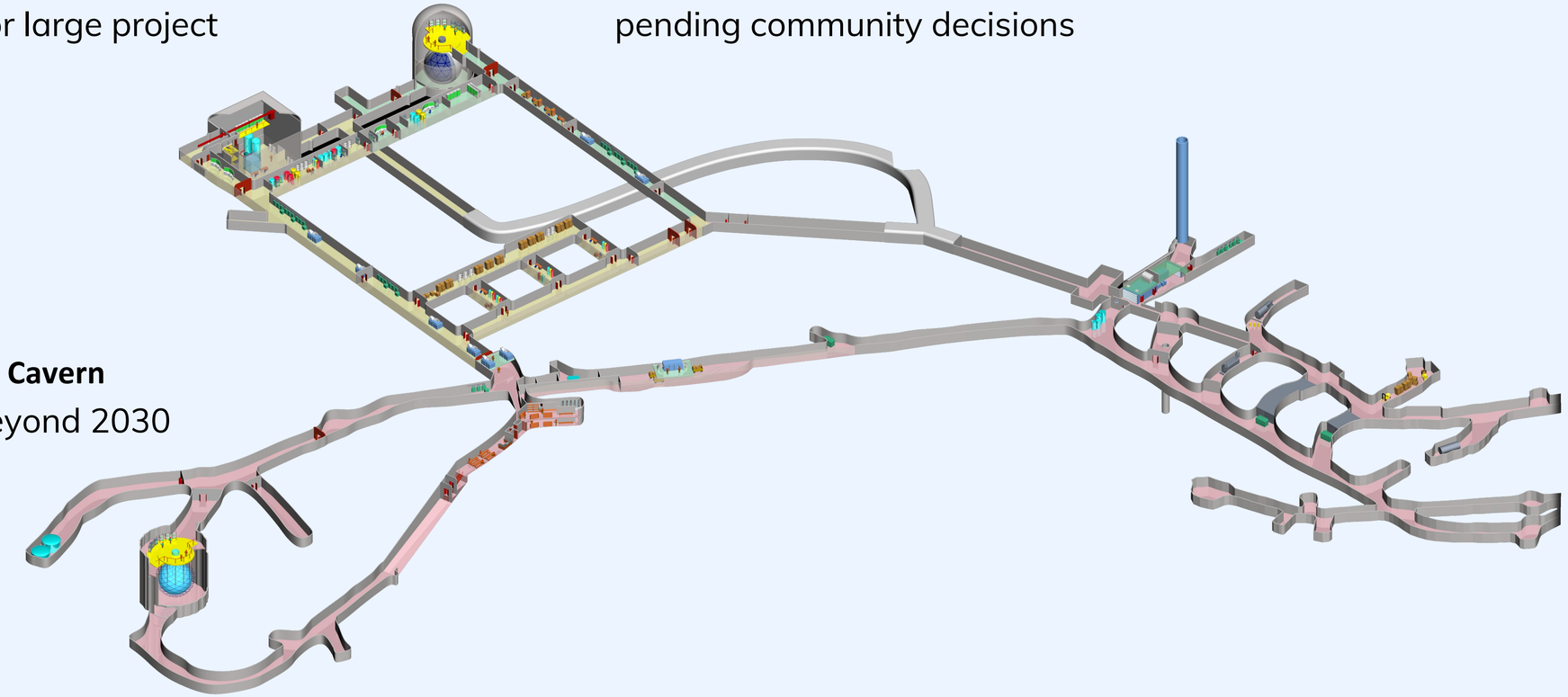
5000 m^2 of class 2000 cleanroom underground.
<2000 particles >0.5 μm in diameter per ft^3

Large Cavity Status

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

Cryopit
Ton-scale 0vbb beyond 2030
pending community decisions

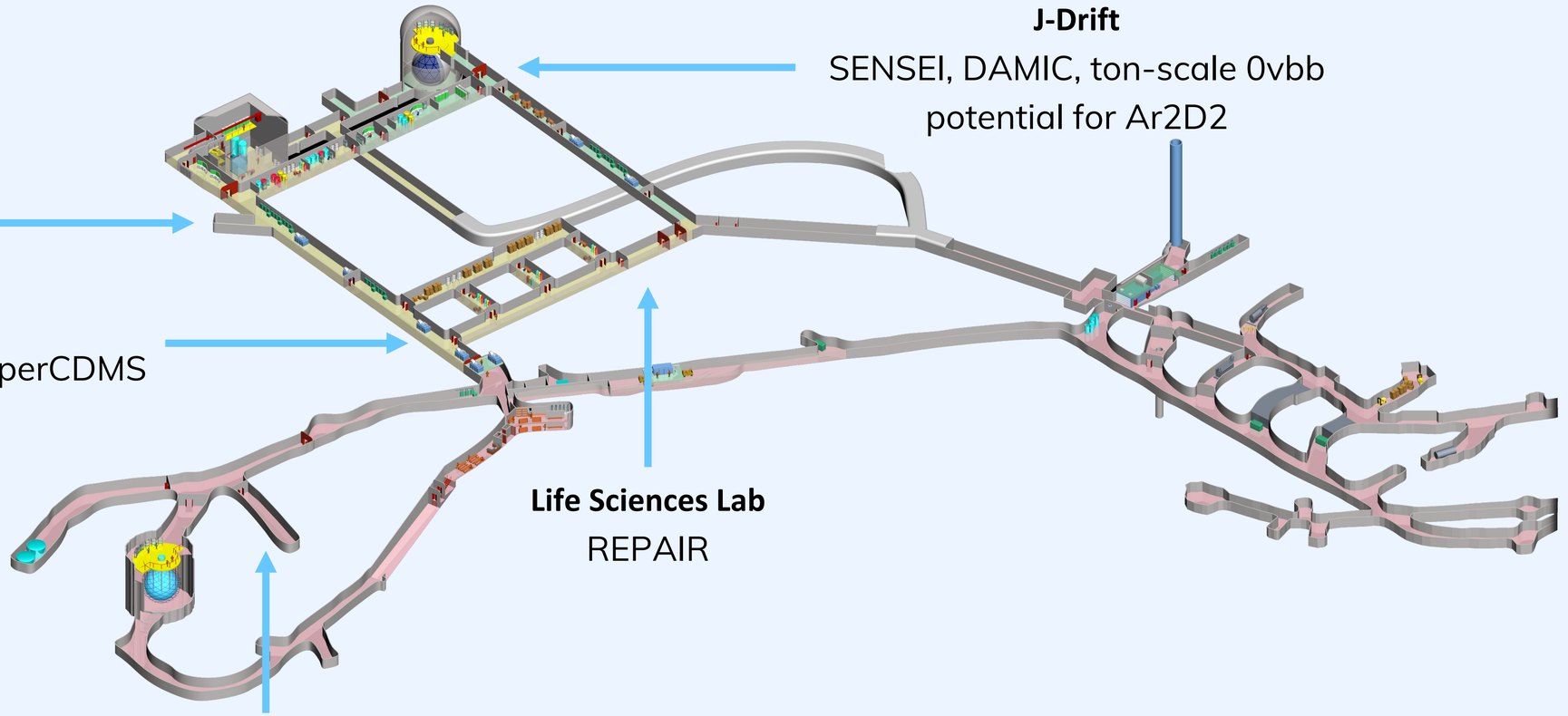
SNO Cavern
SNO+ beyond 2030



Small Cavity Status

Halo Stub
HALO
potential breakthrough
for future expansion

Ladder Labs
PICO40, SBC, CUTE, SuperCDMS

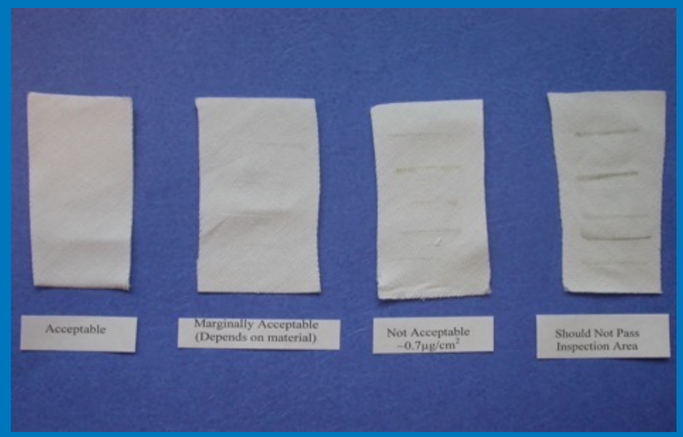


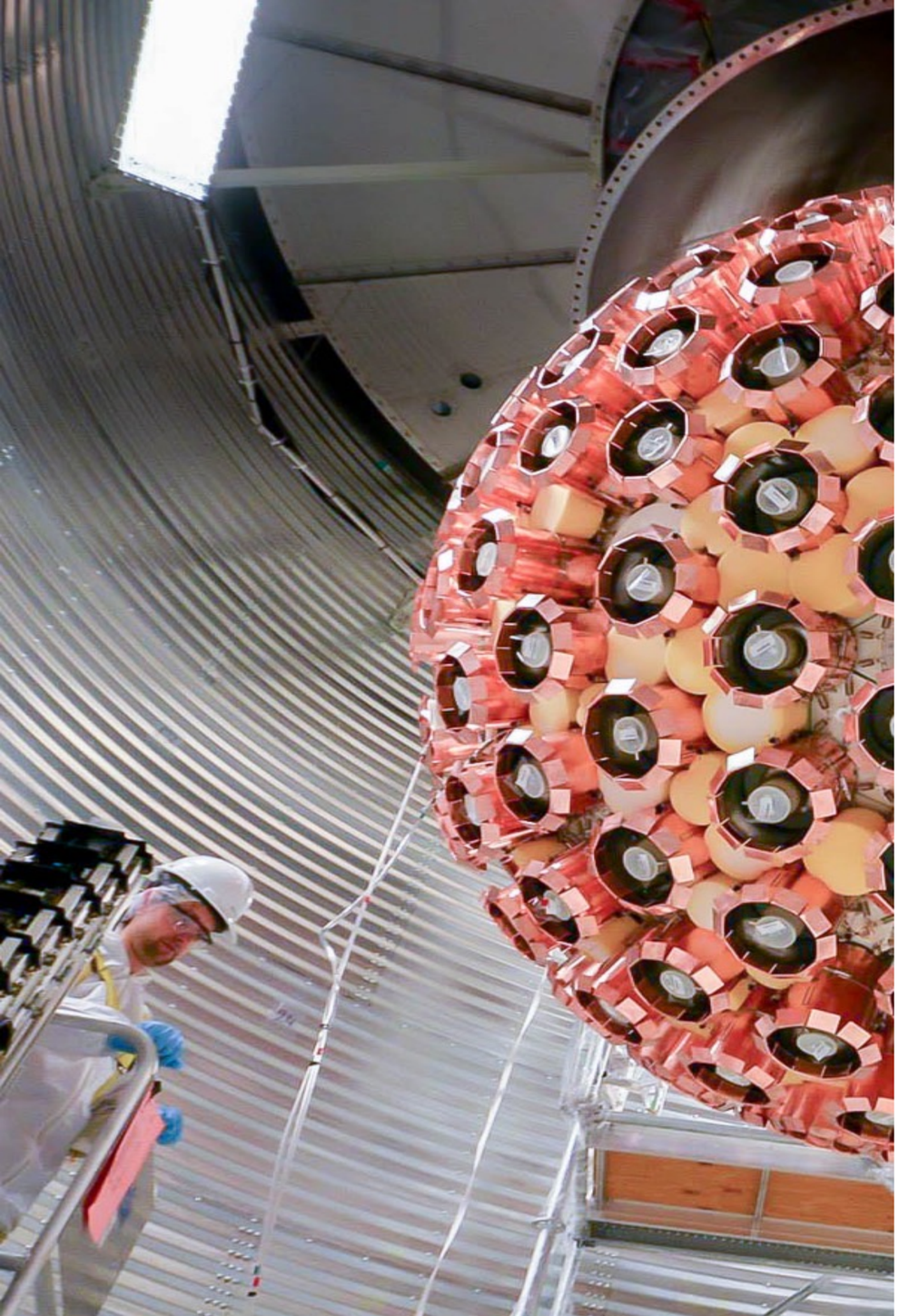
J-Drift
SENSEI, DAMIC, ton-scale 0vbb
potential for Ar2D2

Life Sciences Lab
REPAIR

Low Background Lab
HPGe assay/screening, XRF, Radon Boards, FLAME
future XIA, CTBT Dual HPGe

Cleanliness is critical to SNOLAB operations and science





SNOLAB people are experts at shielding and low background construction

The SNOLAB research community includes world leading expertise in low background materials.

Analysis, including selecting the fiducial volume and background rejection, is the easiest (most difficult) part of the experiment before (after) the data are taken.

SNOLAB people enable science

SNOLAB has a focus on User Support

- Scientific
- Engineering
- Construction
- Operations

Sudbury hosts a strong mining/industrial base that projects can draw from

- Excavation
- Fabrication
- Integration

Laurentian University was the research anchor for the user base

Capability Development

Not complete list!

- **Cryogenics** are in many experiments. The lab plans to target this area for development of expertise.
- **Radon** is a fact of life underground, and a critical background concern for most current experiments. The lab plans to target this area for development of capability and expertise.
- The **project management** office is approaching full staffing, accelerating scientific excellence.
- Community levels of HPGe screening capacity appear sufficient for current and future use. No plans for development.
- The community has asked for an increased focus on **lab environment monitoring**, so we are developing capability in monitoring seismic activity, radon levels, dust levels, temperature, pressure, etc.
- Engineering support continues to develop expertise in requested disciplines including **seismic modeling**.

New Capabilities

- Initial seismic monitoring system is now running and recording events
  - Still working on learning the system, tuning thresholds, and enabling user access
- Laboratory survey for thermal neutrons, fast neutrons, gamma rays starting later this year

Equity, Diversity, Inclusion Initatives

- EDI statement is now complete
- EDI page on the “About” on the SNOLAB website
- Page also includes a link to the EDI Action Plan, The NSERC Dimensions Charter and the TRCC Calls to Action

EDI Statement

Diversity and Discovery

At SNOLAB, we believe advancing equity, diversity, and inclusion strengthens the scientific community and the quality of our research output. We are committed to creating, supporting, and maintaining a learning, research, and work environment free from discriminatory and intimidating behaviour, and to work collaboratively with other stakeholders, when appropriate, to do the same.

SNOLAB recognizes challenges remain in achieving the full participation of equity-seeking groups (including, but not limited to, women, visible minorities, Indigenous persons, people with diverse gender identities, and people with disabilities) in STEM. SNOLAB is committed to increasing equity across our organization and within our experimental collaborations through our 2023-2029 Strategic Plan, our **2020-2023 EDI Action Plan**, and our internal committees and task forces.

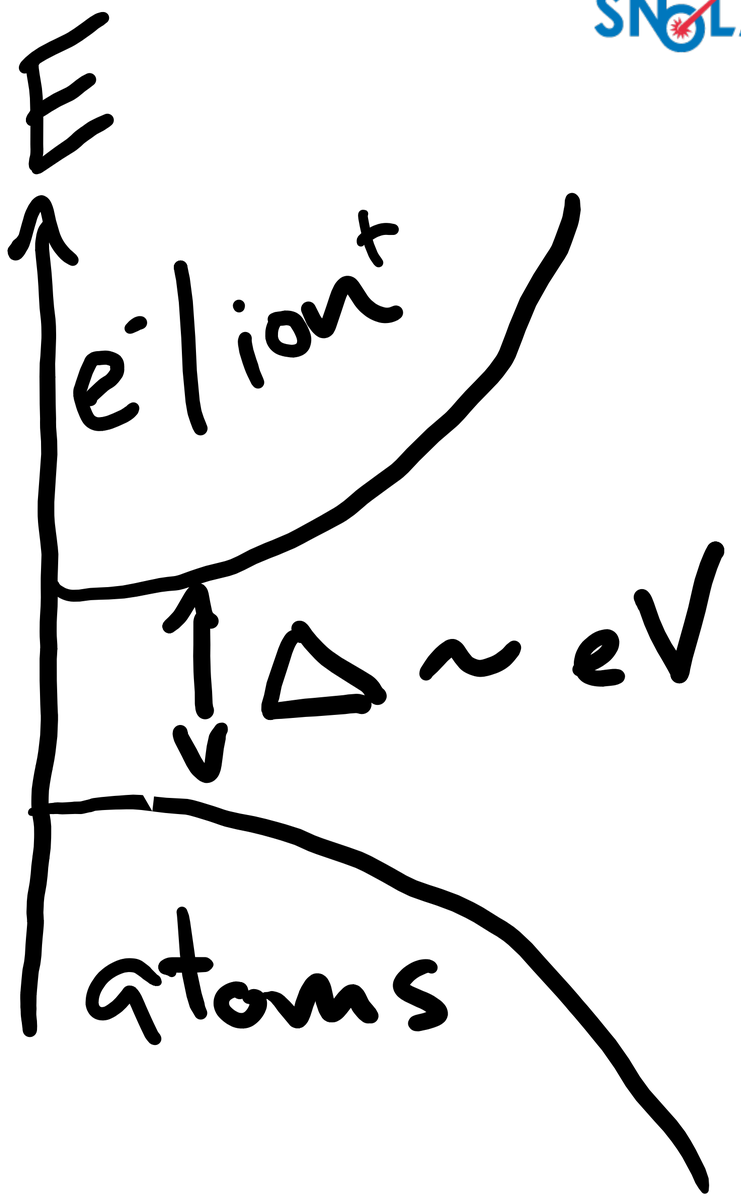
Other EDI Initiatives

- Poster campaign expected to begin in the fall to educate and empower the workforce
  - Task force currently working on posters

- Signage for gender neutral washrooms
  - Will be a variation of this design

Ionizing Radiation Detection

- Most technologies are based on the ionization gap in materials
- Nuclear and particle physics were spawned from efforts to understand non-thermal ionization processes
- Physicists have split the radiation in nature into “ionizing” and “non-ionizing” radiation at the eV scale
- Fundamental energy threshold limitation for light dark matter searches



Rare Event Radiation Detection

- Long history of underground science exploring regimes of backgrounds orders of magnitude below unshielded surface lab levels

Brodzinski, Reeves, Avignone, Miley, "The impact of natural radioactivity in solder on low background experiements" NIM A254 (1987)

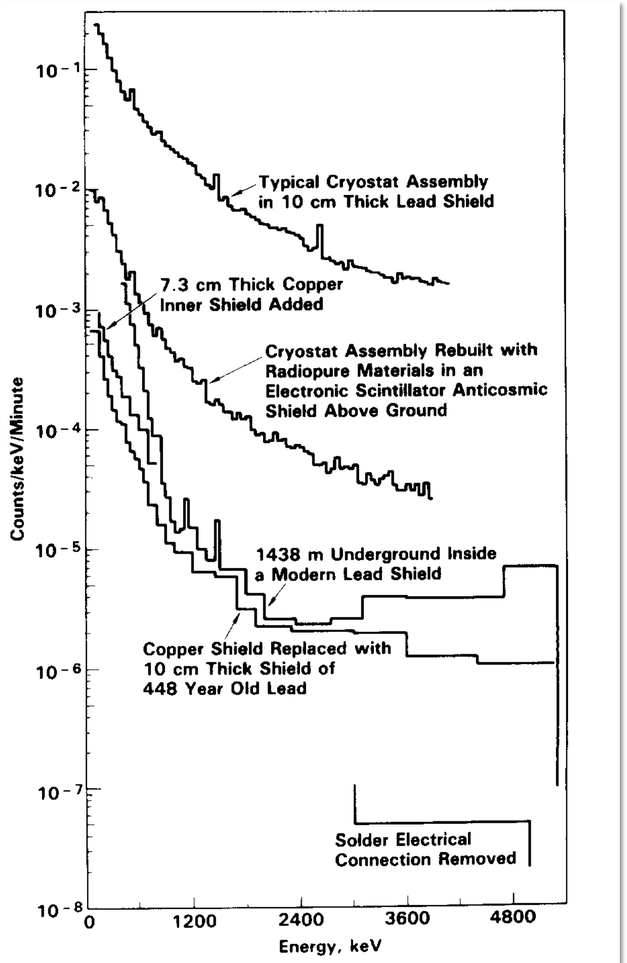


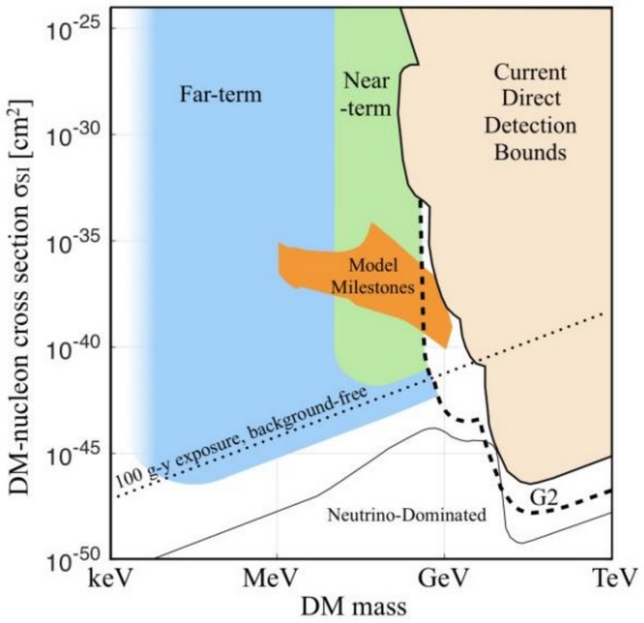
Fig. 1. Background spectra of the PNL/USC, 135 cm^3 prototype Ge spectrometer.

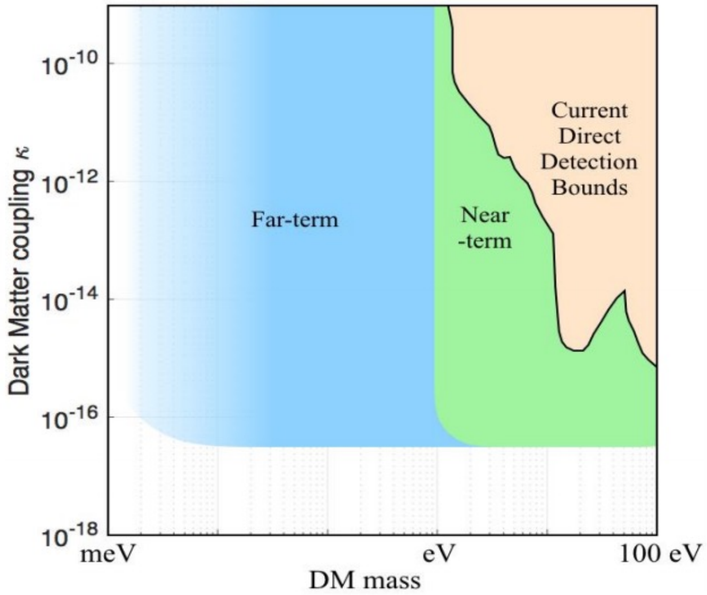
Light Dark Matter

Department of Energy, Office of Science, Office of High Energy Physics

Basic Research Needs for
Dark Matter Small Projects New Initiatives

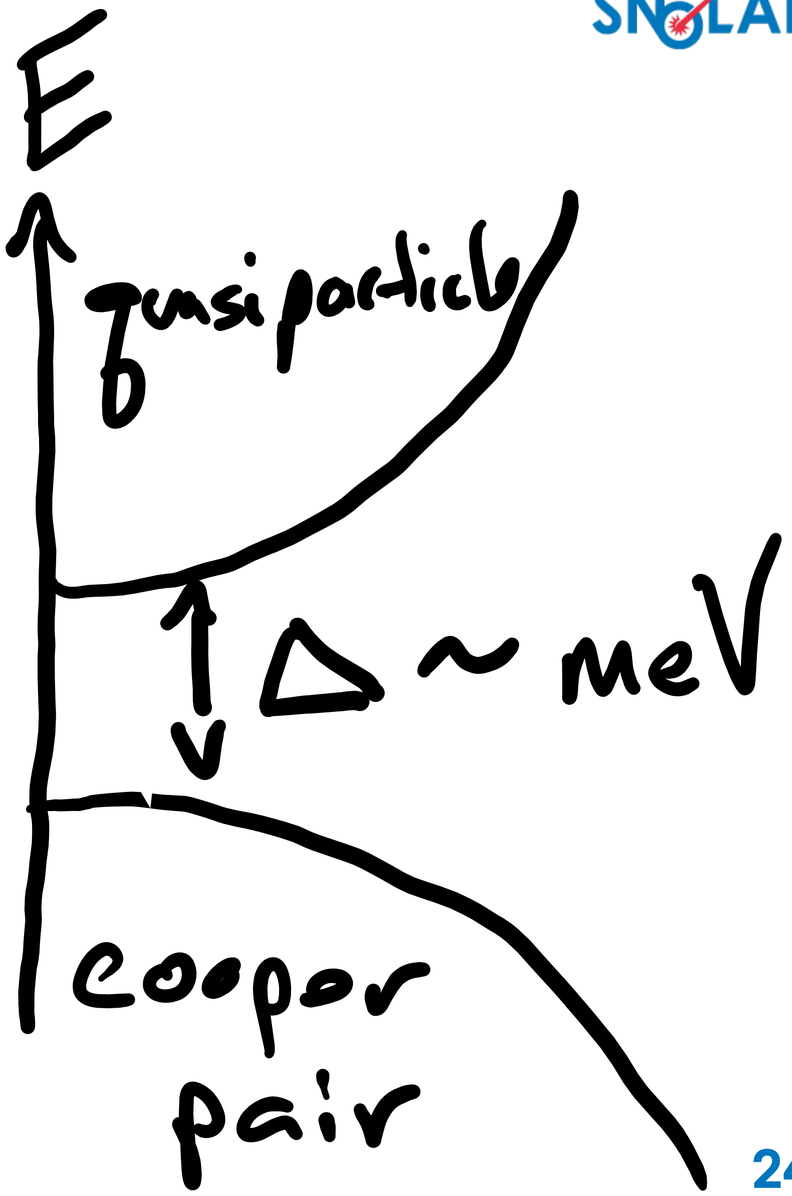
- Light Dark Matter is an opportunity for discovery if that is how nature works
- Challenging goals in both threshold and backgrounds





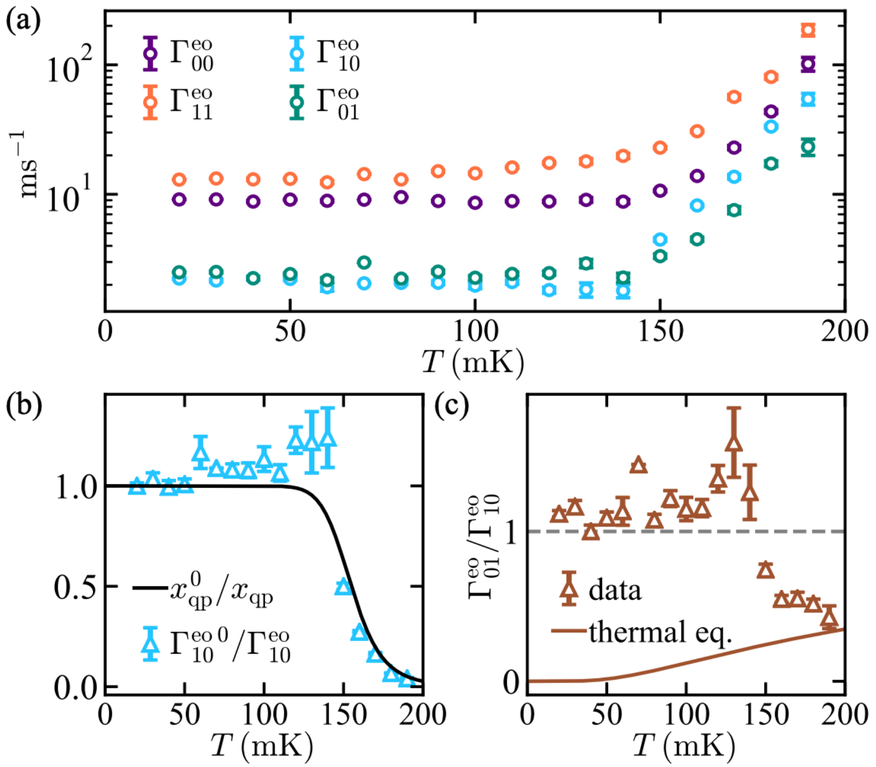
Low-Gap Radiation Detection

- E.g. Counting quasiparticles in superconducting films offers interesting advantages due to the lower energy gap
- Nqp ~ 1000 Ne, so
  - Better energy resolution ~sqrt(N) (~30X better)
  - Lower energy threshold ~N (~1000X lower)
- Allows exploration of a new radiation regime
  - Spectrometers with range [~1 meV, 1000s meV]
  - Threshold potentially below the neutrino mass scale



Quasiparticle Poisoning

Serniak et al., PRL 121 (2018) 157701, arXiv:1803.00476



- Non-thermal quasiparticles seem to be a limitation at low temperature
  - “In conclusion, … QP-induced loss can be responsible for a significant fraction of dissipation in state-of-the-art superconducting qubits. Additionally, we confirm that hot QPs with a highly-excited energy distribution are responsible for the residual excited-state population at low temperature in our samples.”
- Similar discussions in the literature back to (at least) 2002
- Studying and mitigating these quasiparticles will help both dark matter searches and superconducting electronics performance
- What is this coupling to nature? Vibrations? Photons? Stray fields?

New component of nature?

Rare Event Radiation Detection

- Long history of underground science exploring regimes of backgrounds orders of magnitude below unshielded surface lab levels
- Expect history may repeat itself in this low energy regime
- Background prediction, understanding, and control

Brodzinski, Reeves, Avignone, Miley, "The impact of natural radioactivity in solder on low background experiements" NIM A254 (1987)

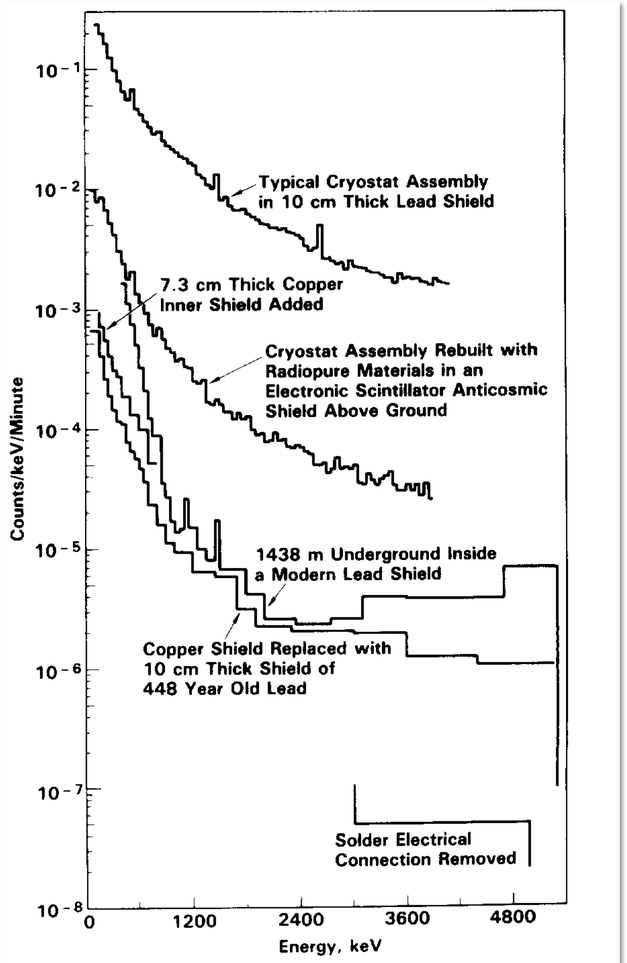


Fig. 1. Background spectra of the PNL/USC, 135 cm^3 prototype Ge spectrometer.

Discussion

Partners


LaurentianUniversity
UniversitéLaurentienne


Queen's
UNIVERSITY


Carleton
UNIVERSITY


Université
de Montréal


UNIVERSITY OF
ALBERTA


VALE