2024/05/08

SNOLAB: Reaching New Heights Deep Underground

Jodi Cooley
Executive Director | SNOLAB
Professor of Physics | Queen's University
Adjunct Research Professor | SMU

Land Acknowledgement

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.

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 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.

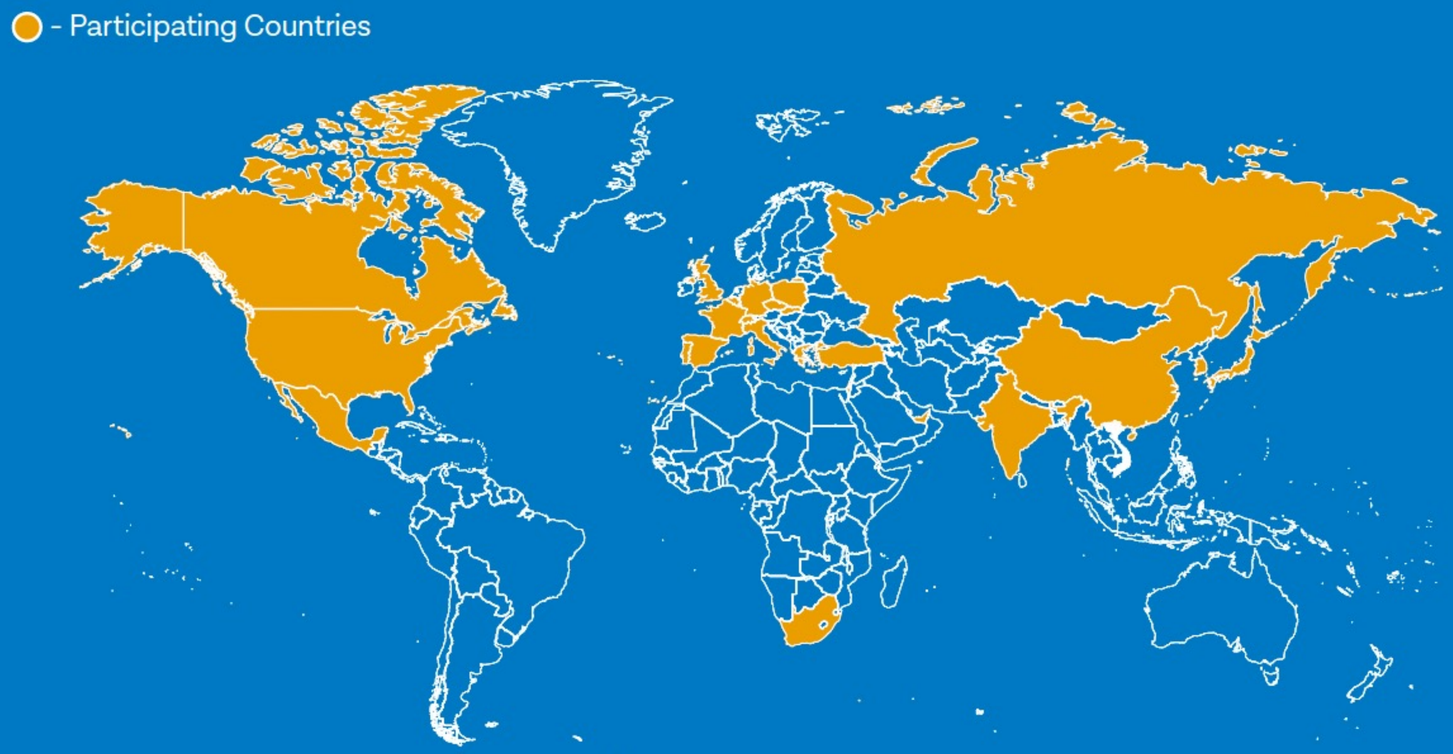
SNOLAB by Numbers

1000+
annual academic users/collaborators

25%
of those users/ collaborators are Canadian researchers

24
Our international collaborators come from 24 countries

164
Our international collaborators come from 164 institutions



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.

Our Core Pillars:

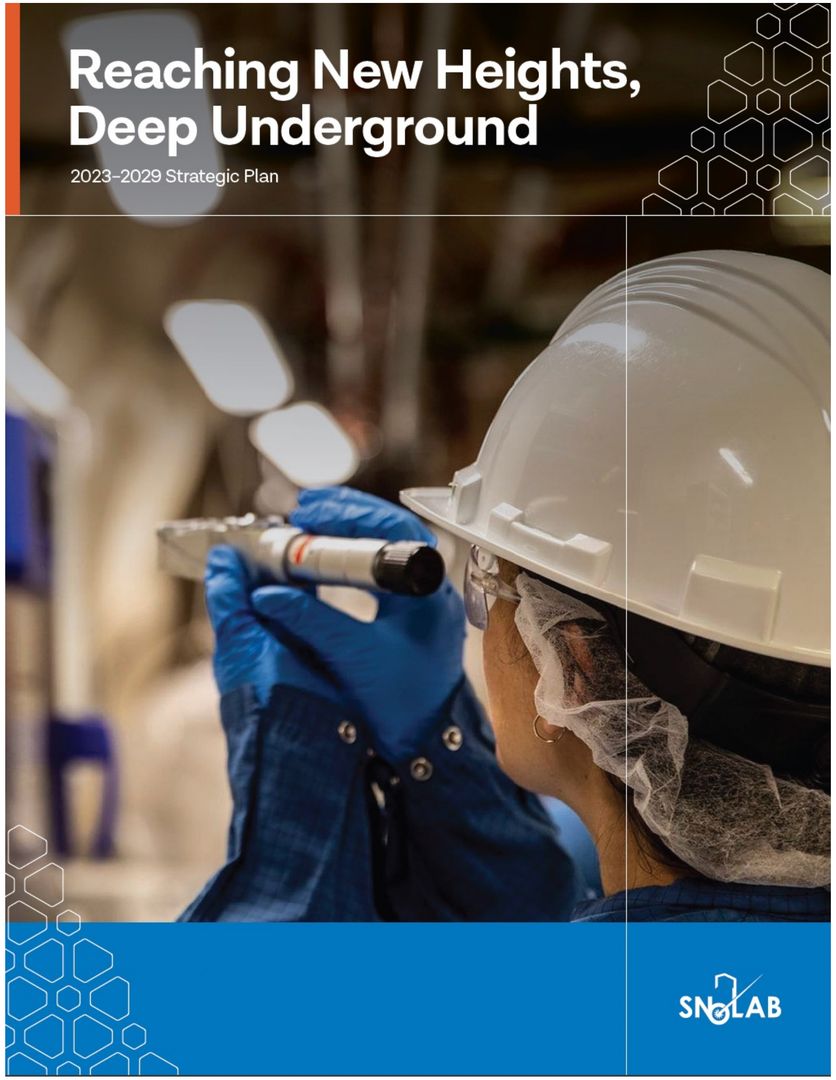
- Excellent Science
- Cutting-edge research infrastructure
- Skilled people

Our Mission

- **Enable world-class underground science**
- **Spearhead research and development**
- **Catalyze scientific collaboration**
- **Promote innovation**
- **Inspire the next generation**

Our Core Values

- **Safety**
- **Accountability**
- **Diversity**
- **Excellence**
- **Teamwork**



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

Science Strategy

The science at SNOLAB is focused on increasing our understanding of the particles and forces that have shaped the universe.

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

SNOLAB continues to collaborate in scientific research required deep underground facilities.

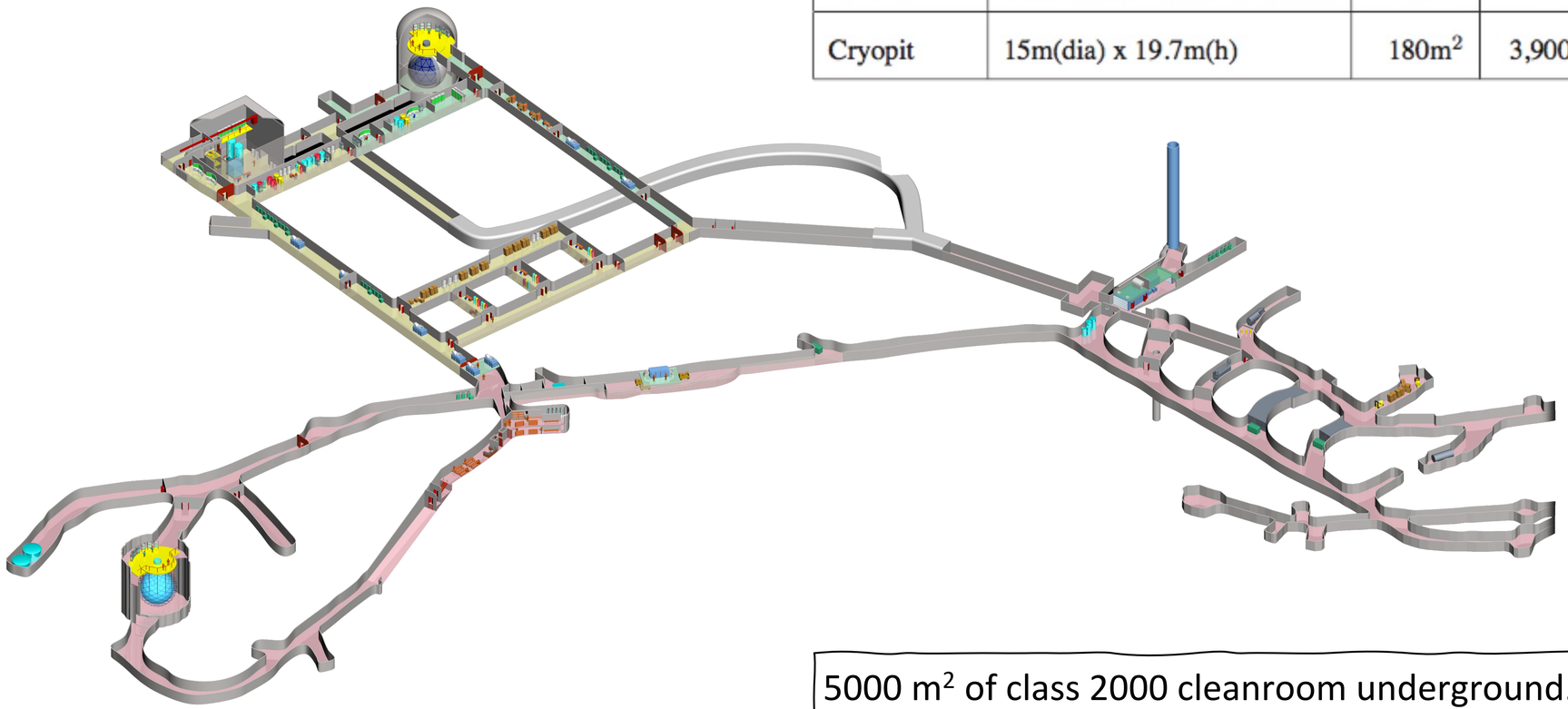
- Neutrino observatories (solar, supernovae, geo, reactor, etc.)
- Effects of radiation on biological systems
- Environmental monitoring (nuclear non-proliferation, aquifers, etc.)

SNOLAB is pursuing new collaborations and opportunities in emerging areas of underground science

- Effects of radiation on quantum technologies

SNOLAB Layout

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



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arXiv:2006.12746

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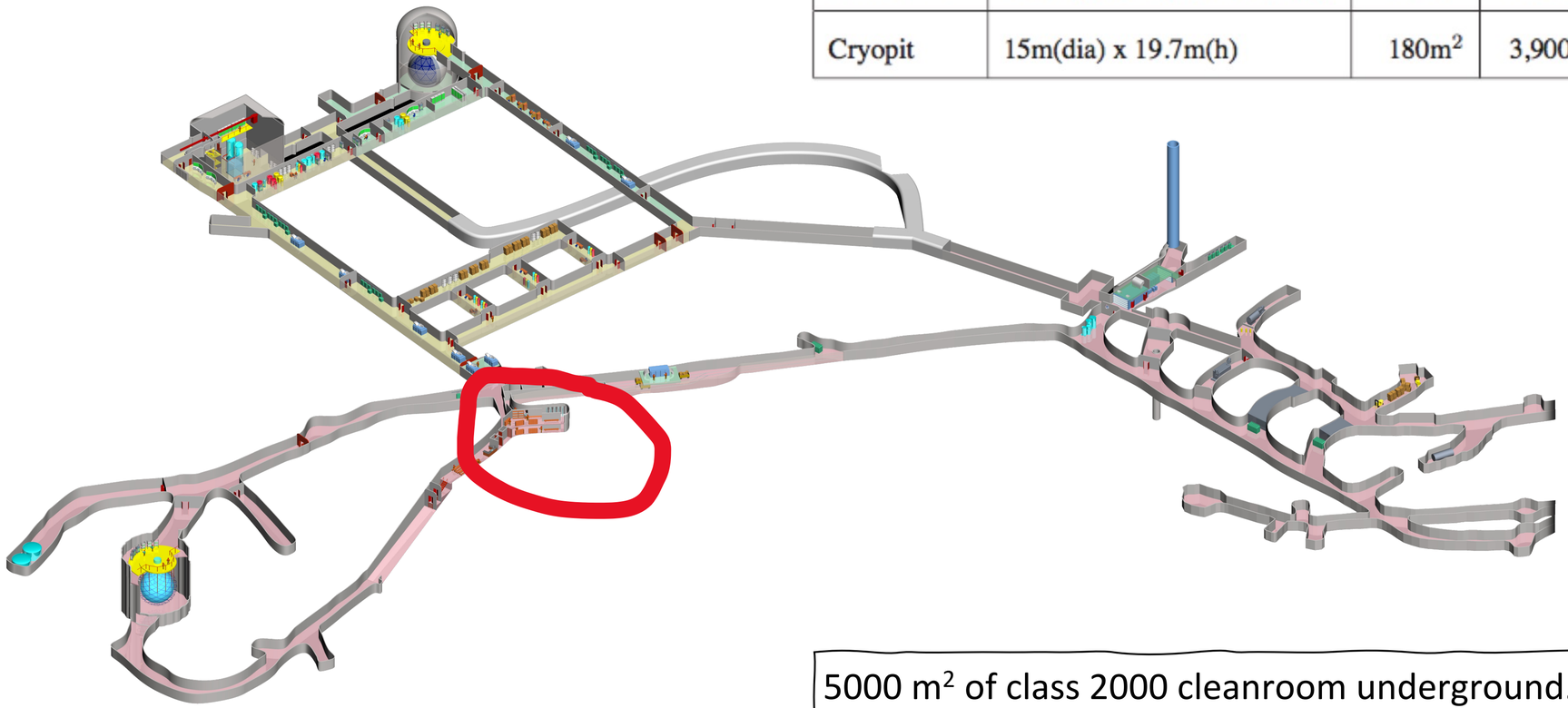

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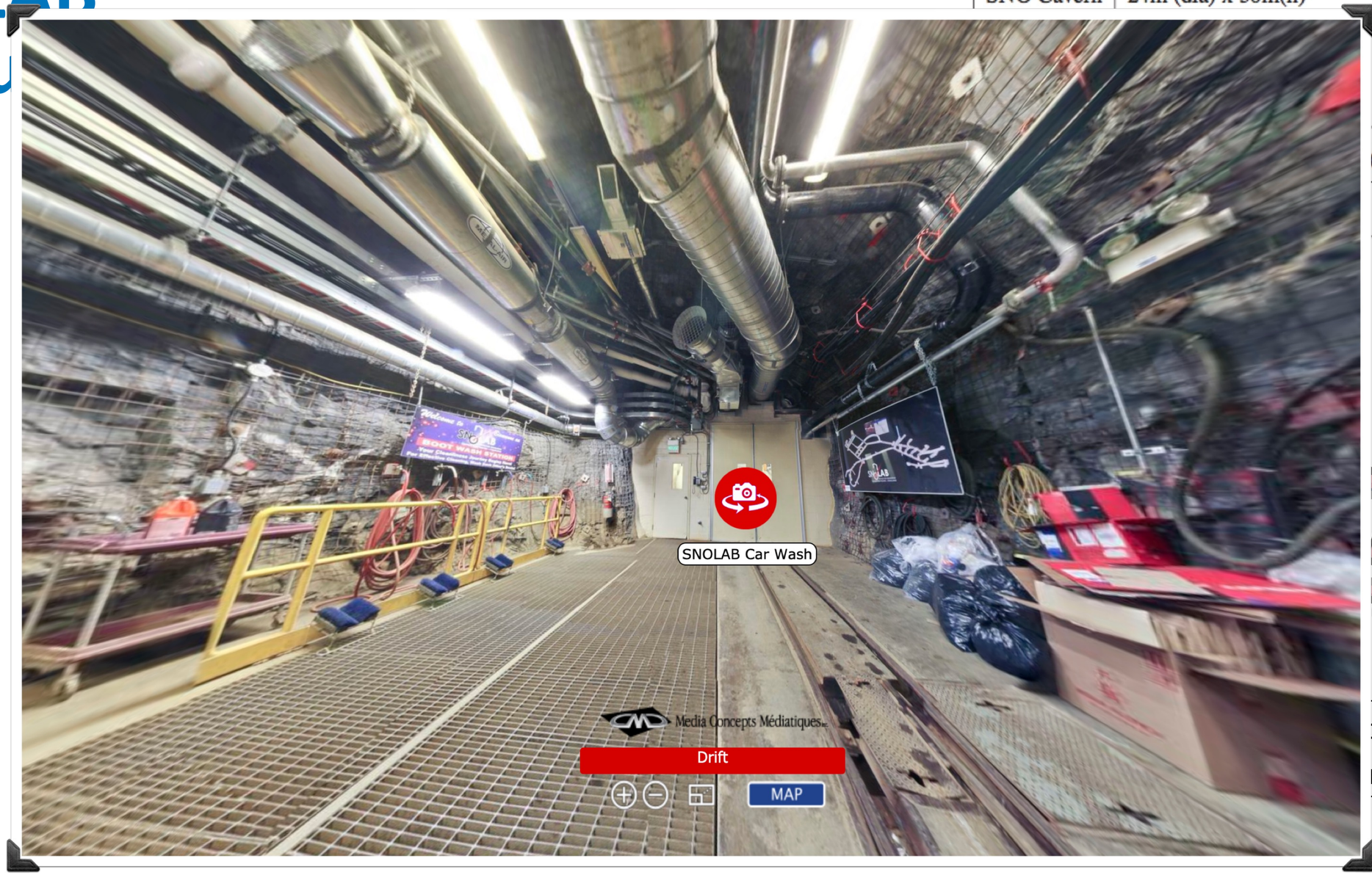

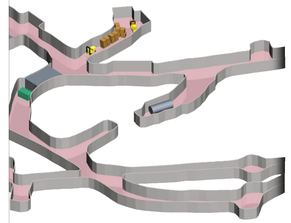

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meter per ft^3

https://www.snolab.ca/facility/virtual-tour/

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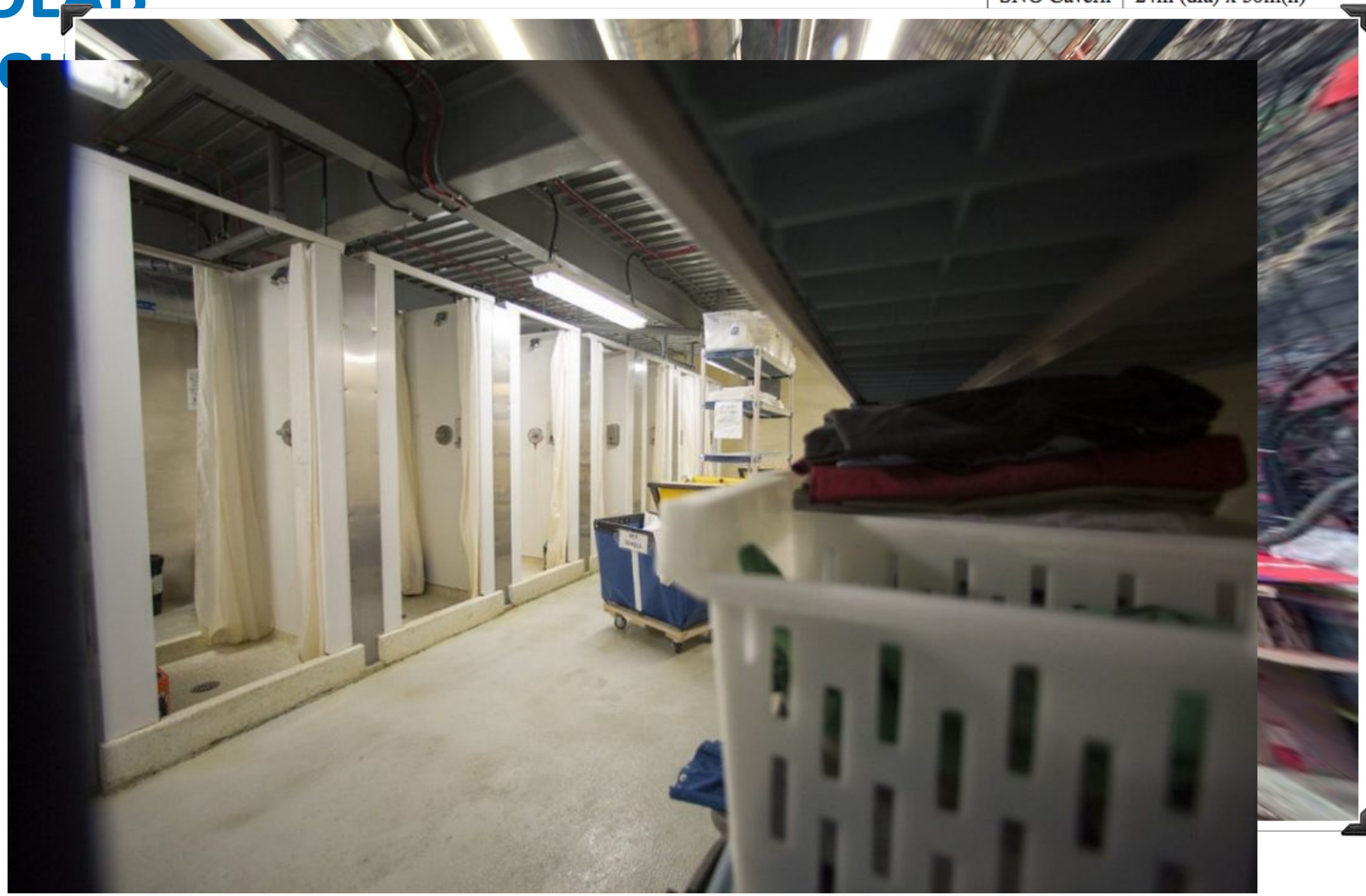

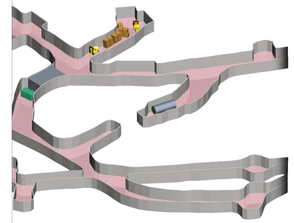

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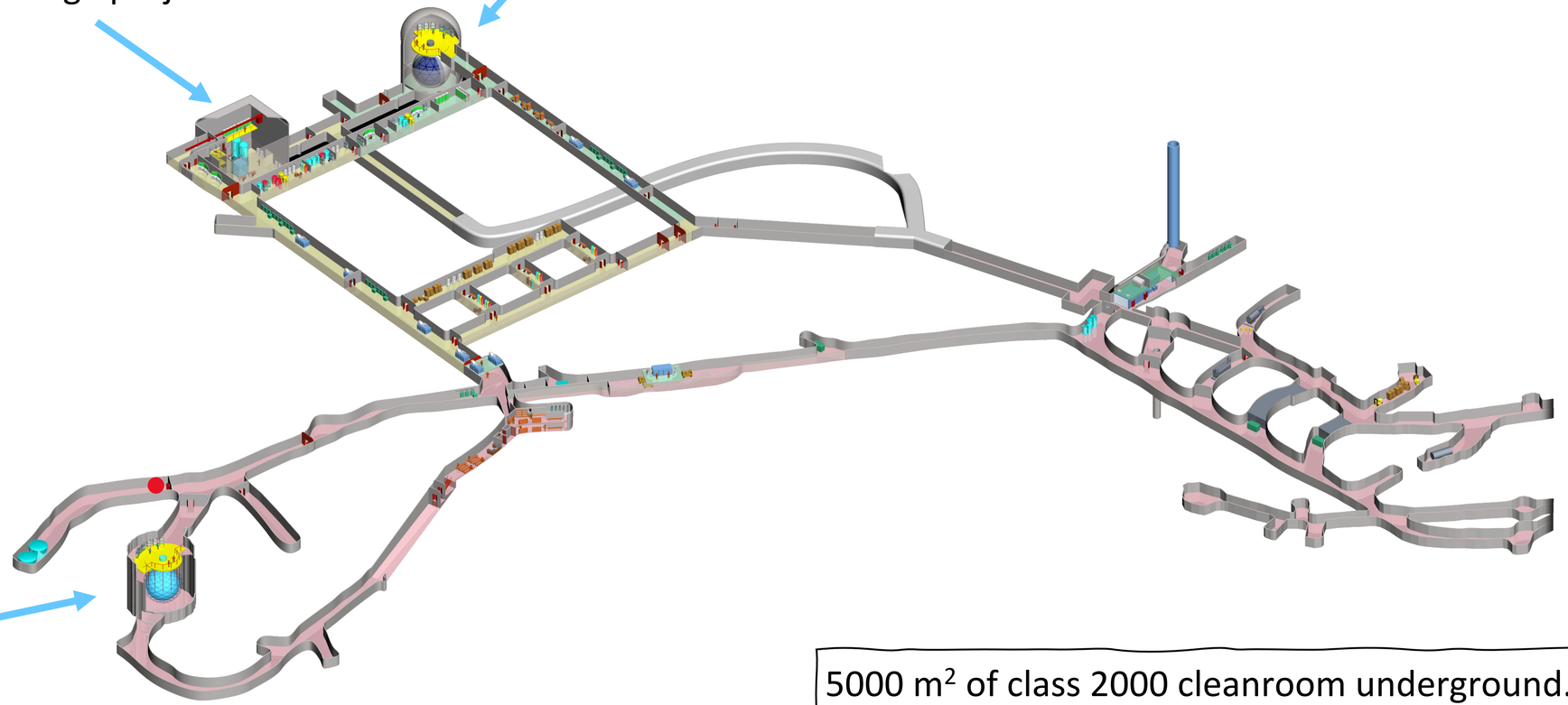
SNOLAB –
Large Cavity Status

Current Experiments
Future Experiments
Laboratory Facilities
Experiment Areas

Cube Hall
DEAP-3600, PICO500, NEWS-G
potential for large project after 2026

Cryopit
nEXO/LEGEND



SNO Cavern
SNO+, SNO+ Te
Potential for large project after 2035

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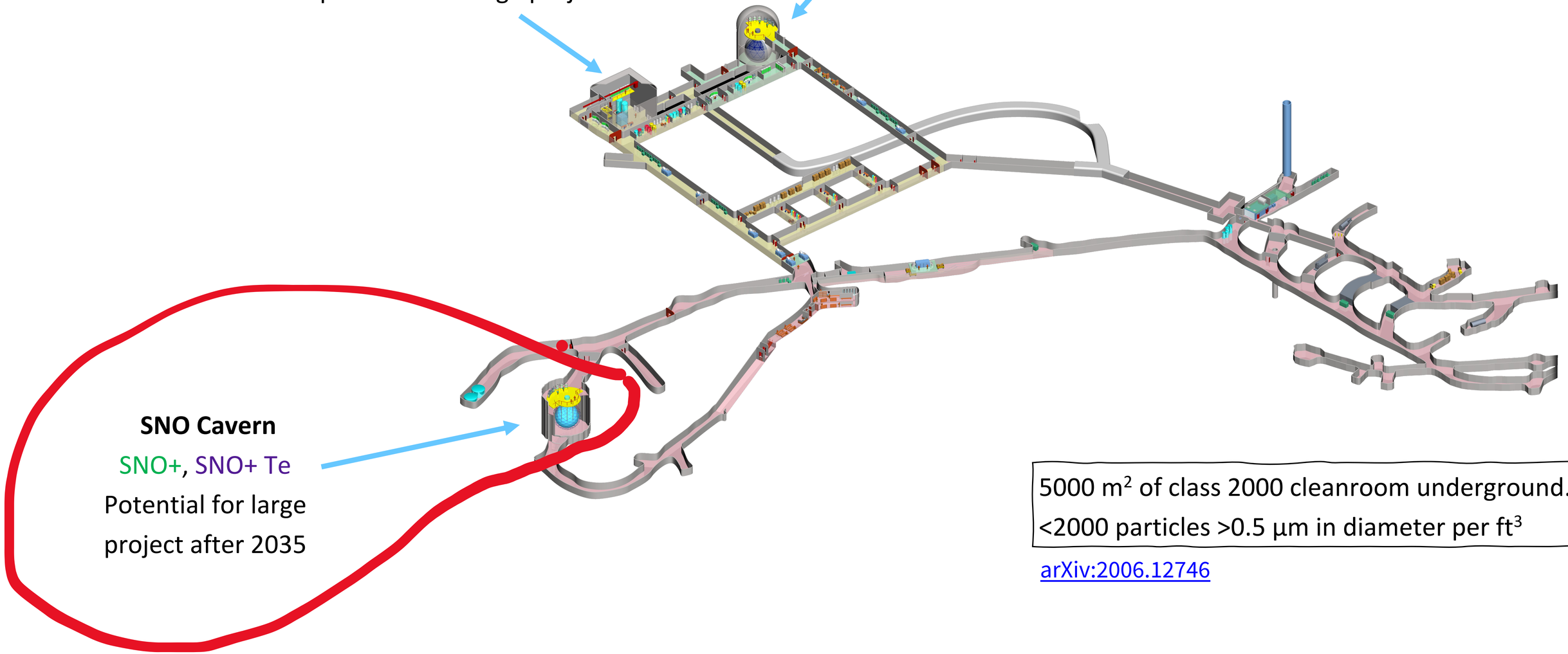

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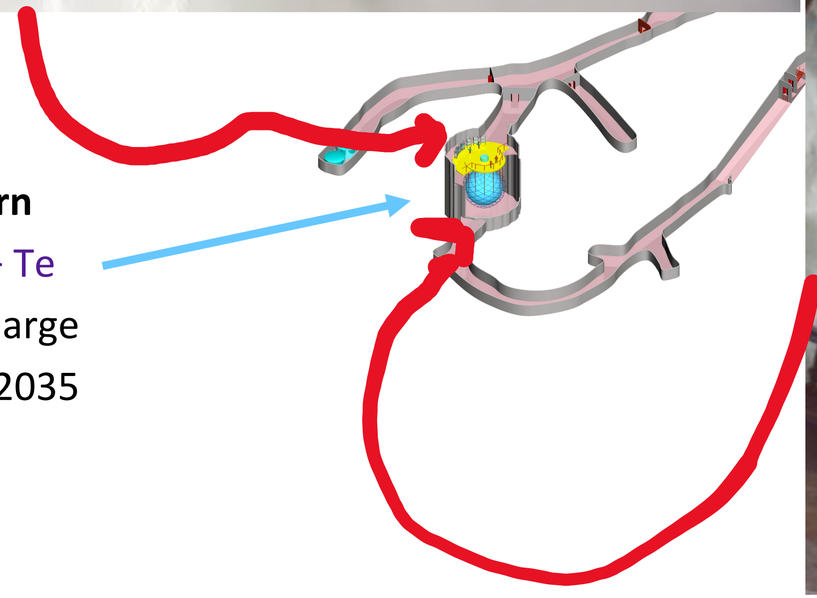

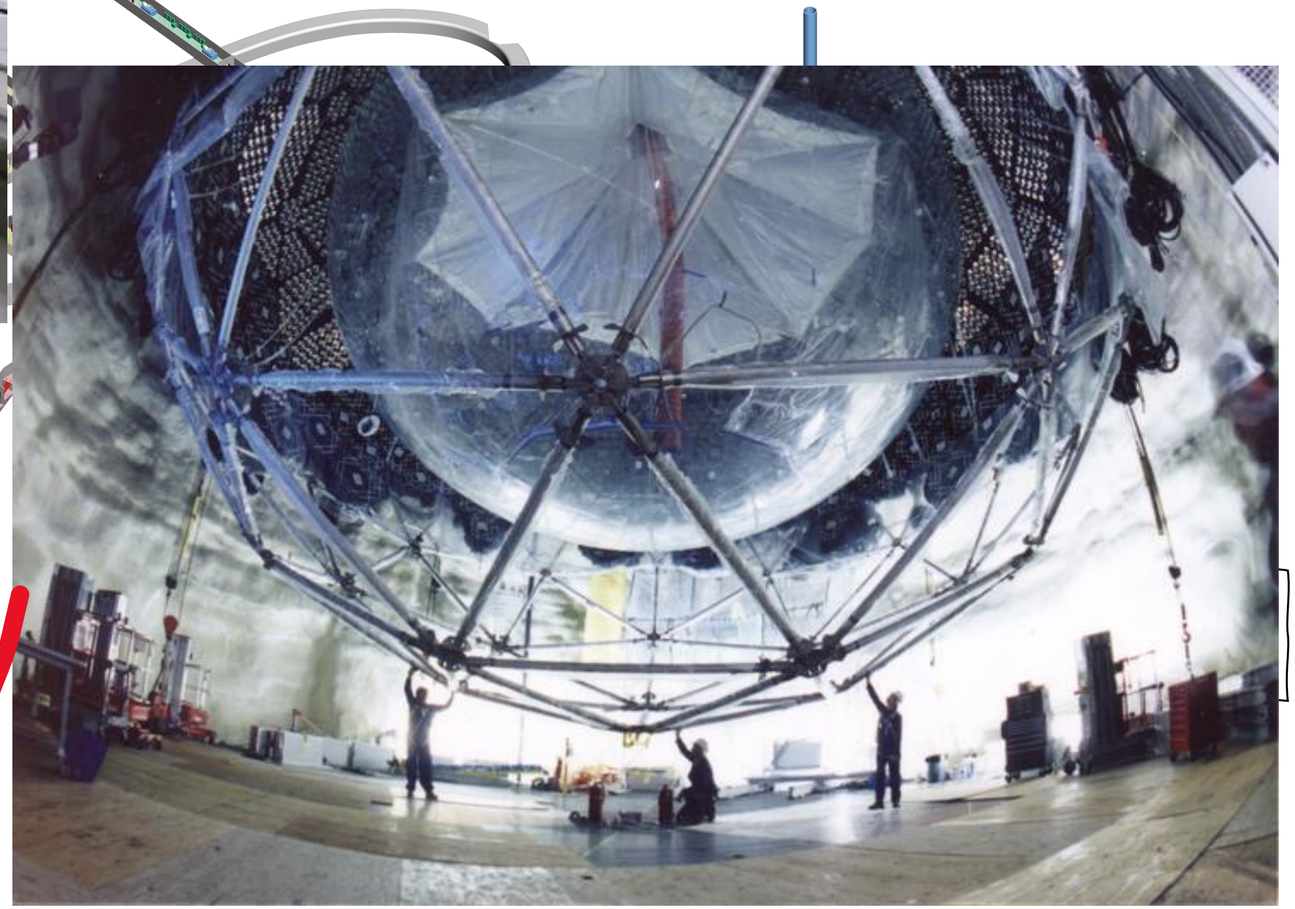

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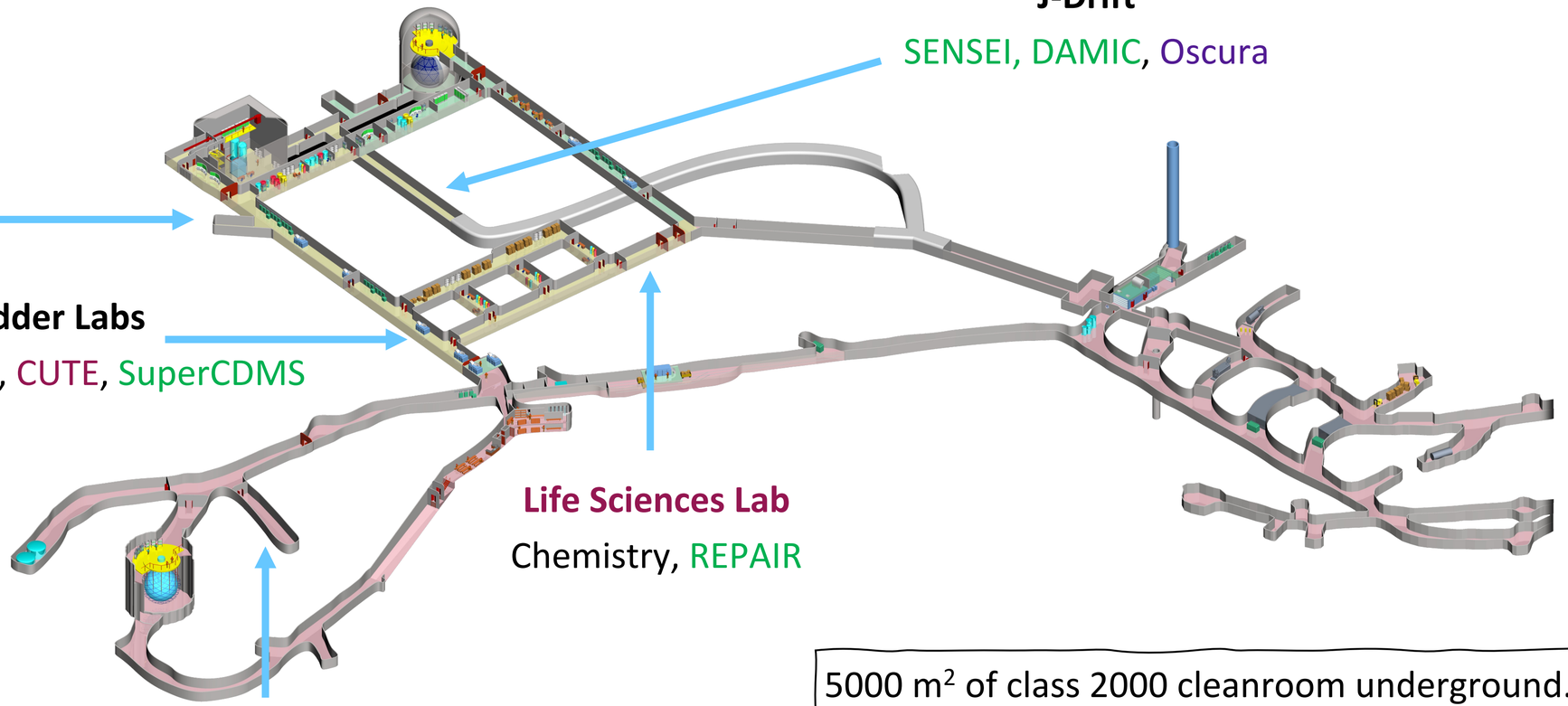
SNOLAB -
Small Cavity Status

Current Experiments
Future Experiments
Laboratory Facilities
Experiment Areas

J-Drift
SENSEI, DAMIC, Oscura

HaloStub
HALO
potential breakthrough for future expansion

Ladder Labs
PICO40, SBC, CUTE, SuperCDMS



Life Sciences Lab
Chemistry, REPAIR

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

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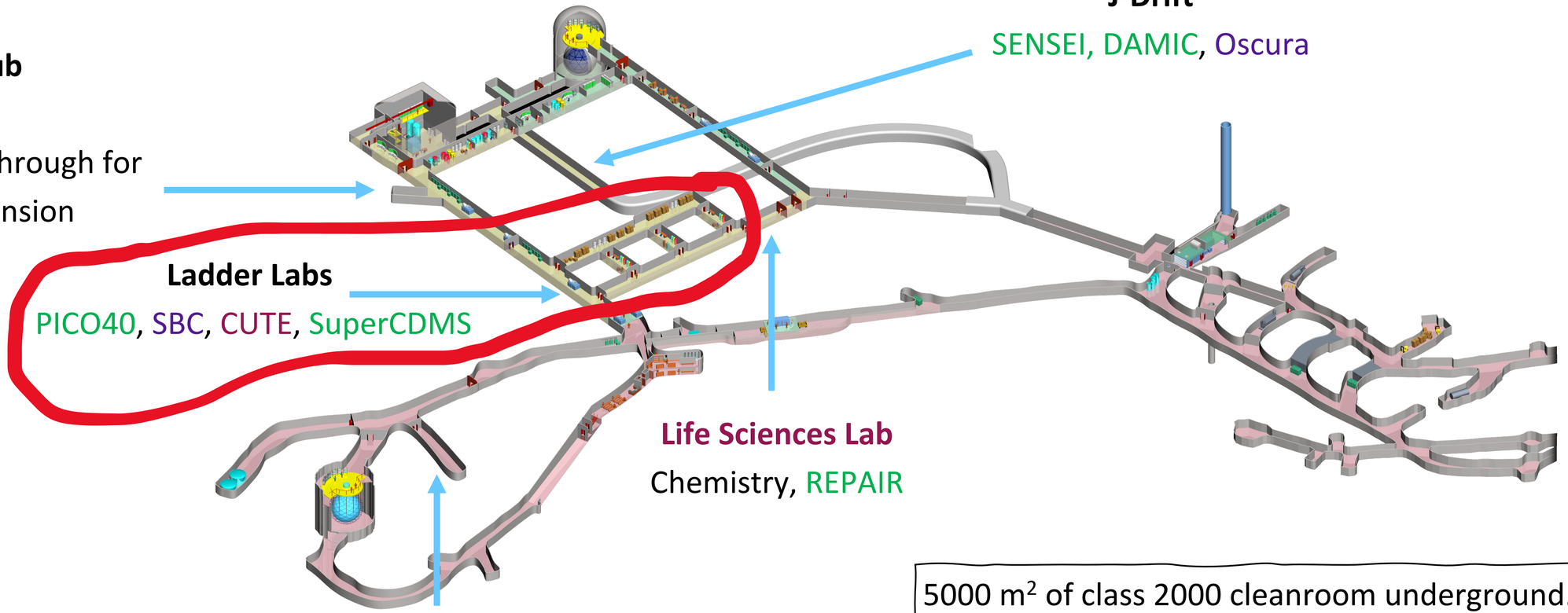

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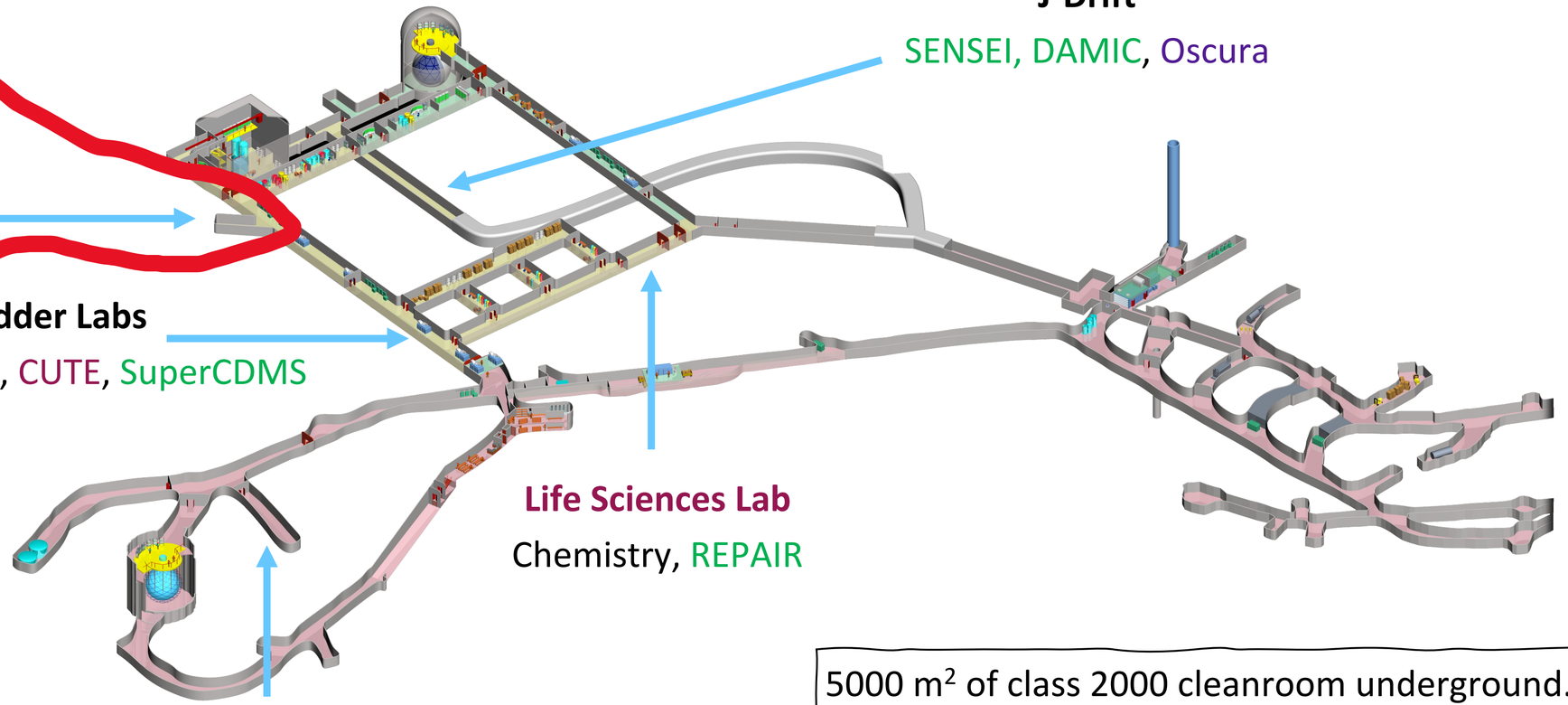

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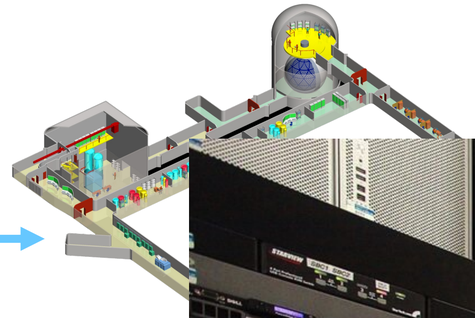

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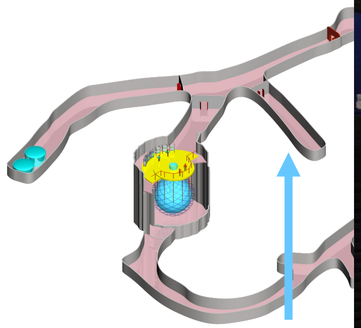
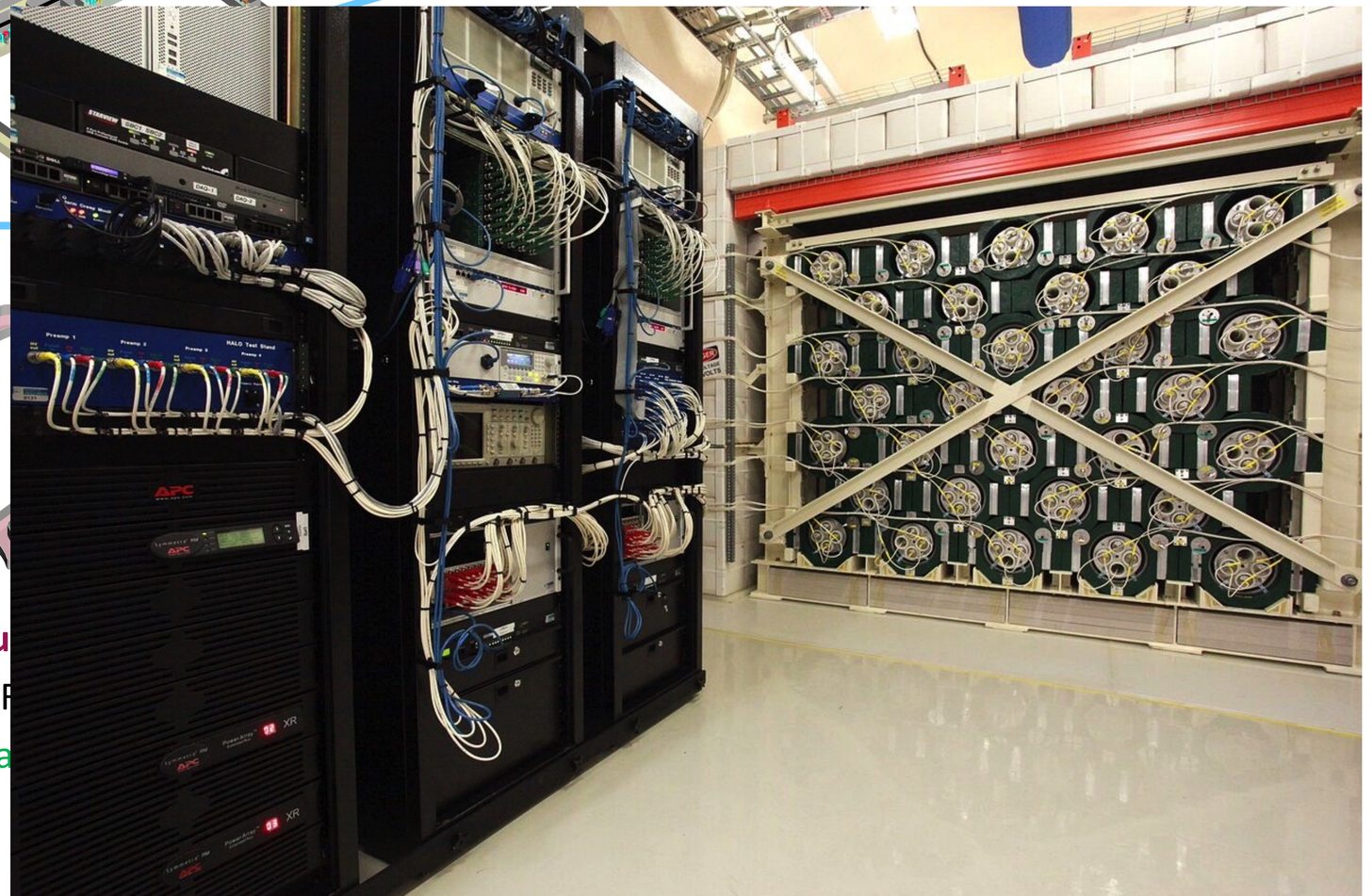


Low Backgrou

HPGe assay/screening, XRF, R

XIA, CTBT Dua



Current Experiments

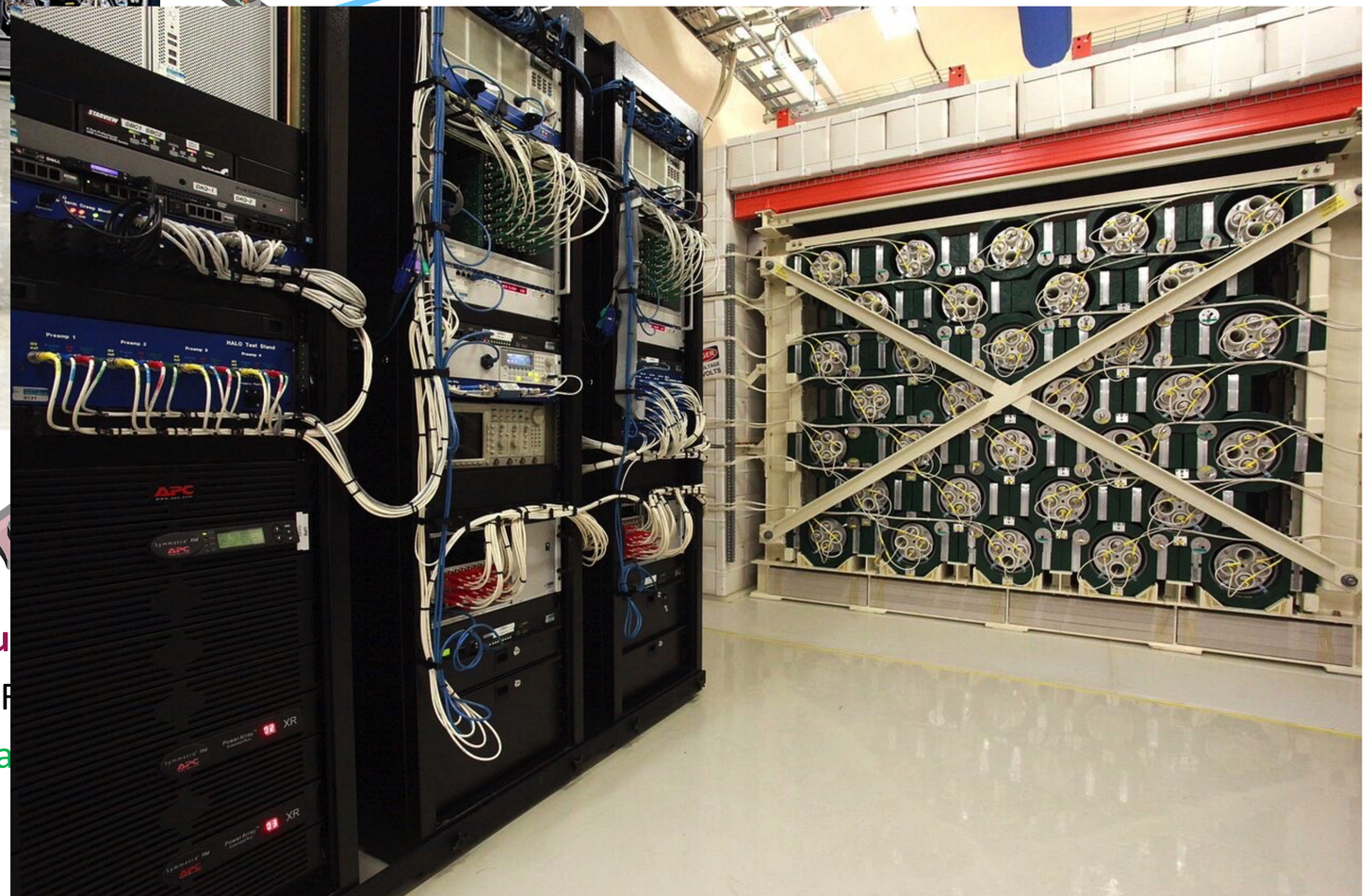
Future Experiments

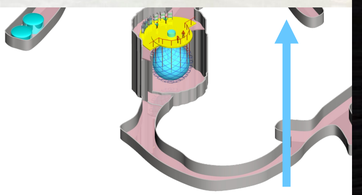
Laboratory Facilities

Experiment Areas

J-Drift

SENSEI, DAMIC, Oscura





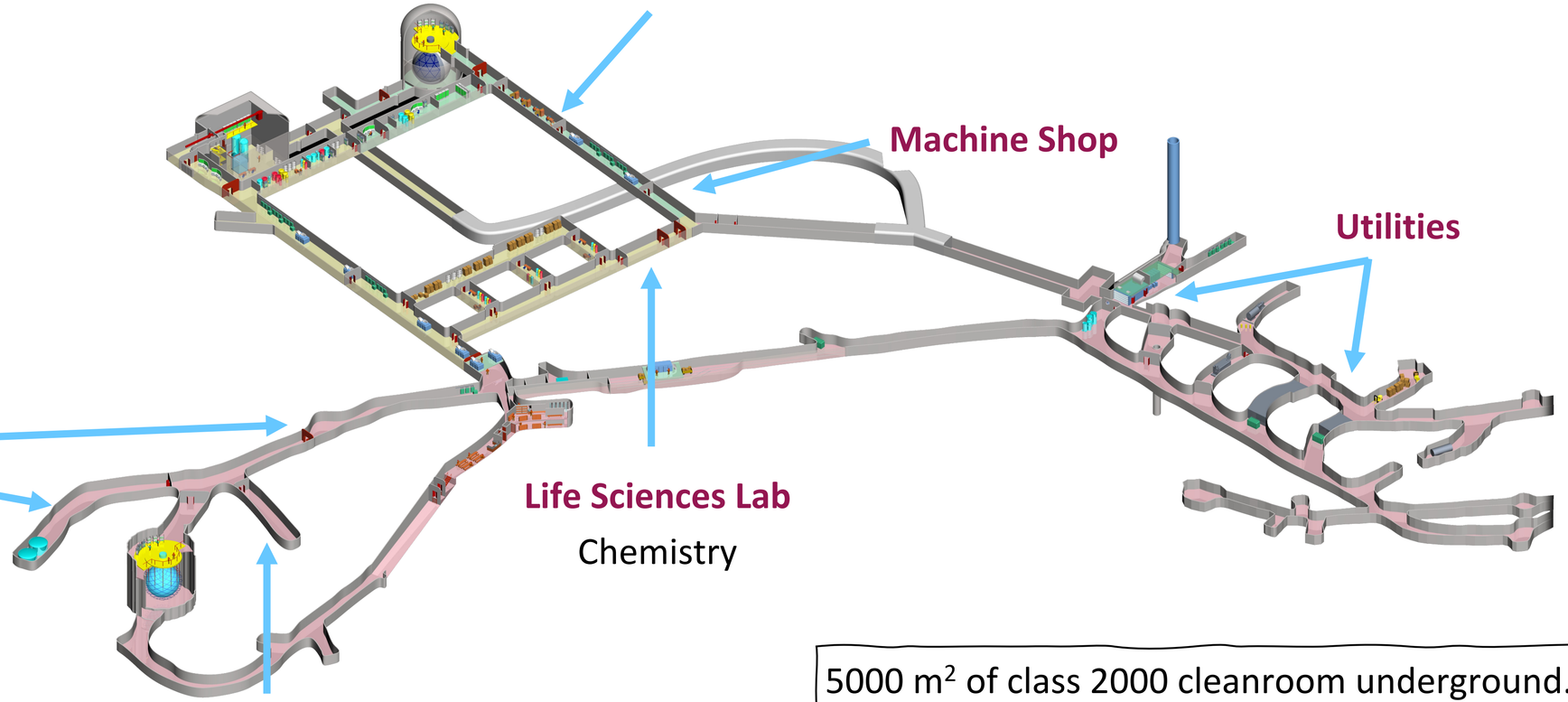
Low Backgrou

HPGe assay/screening, XRF, R

XIA, CTBT Dua

SNOLAB –
Facilities

Current Experiments
Future Experiments
Laboratory Facilities
Experiment Areas



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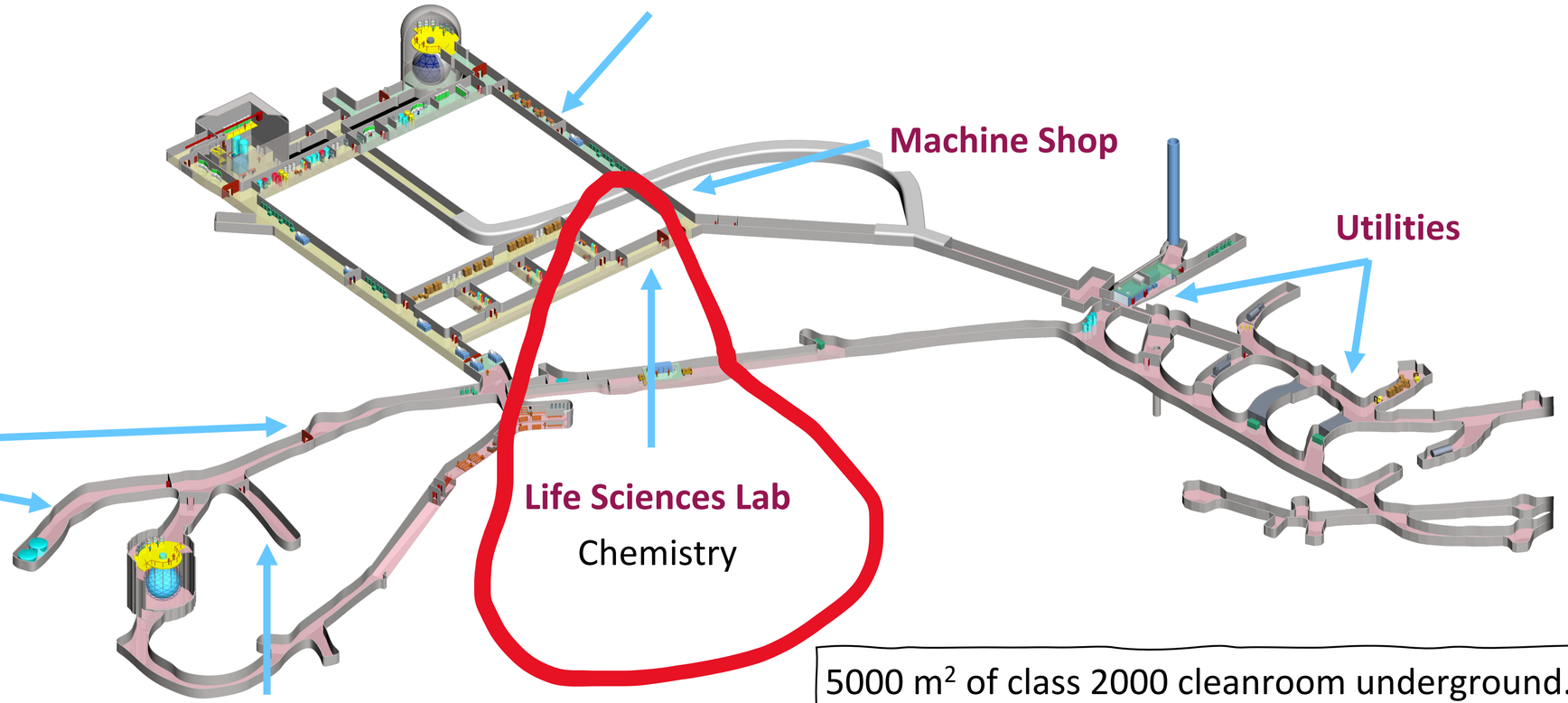

Plants

UPW, Scintillator, Te Diol, TeA

Low Background Lab

HPGe assay/screening, XRF, Radon Boards, FLAME

XIA, CTBT Dual HPGe

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SNOLAB –
Facilities

Current Experiments
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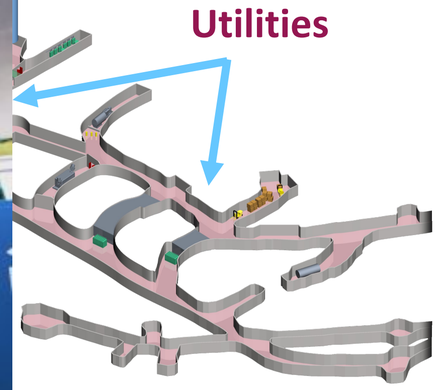
Experiment Areas

P

UPW, Scintill

Utilities



cleanroom underground.
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Facilities

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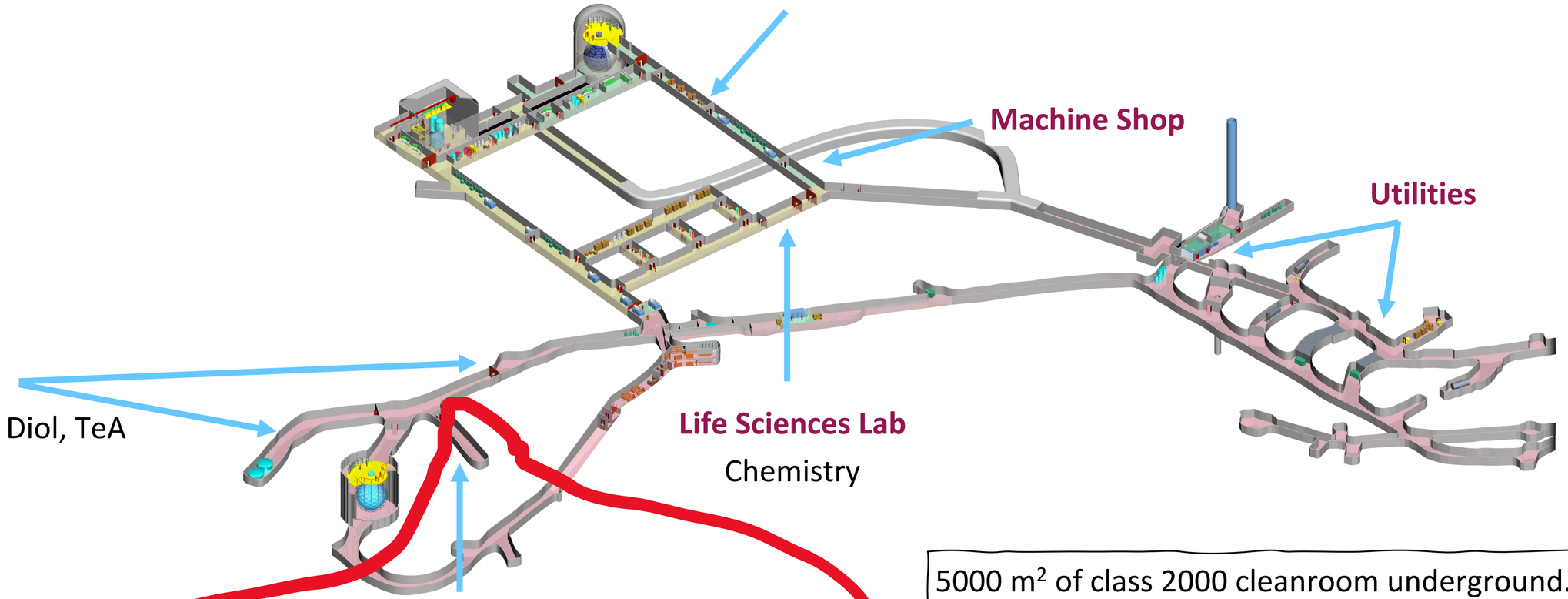

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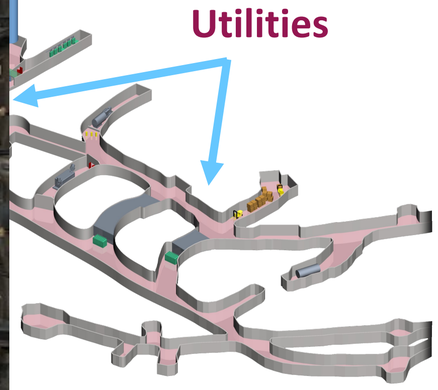
SNOLA
Facilities

Plan

UPW, Scintillato



cleanroom underground.
m in diameter per ft^3

SNOLAB –
At a Glance

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Future Experiments
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Experiment Areas

Cube Hall
DEAP-3600, PICO500, NEWS-G
potential for large project after 2026

Cryopit
nEXO/LEGEND

Electrical Shop

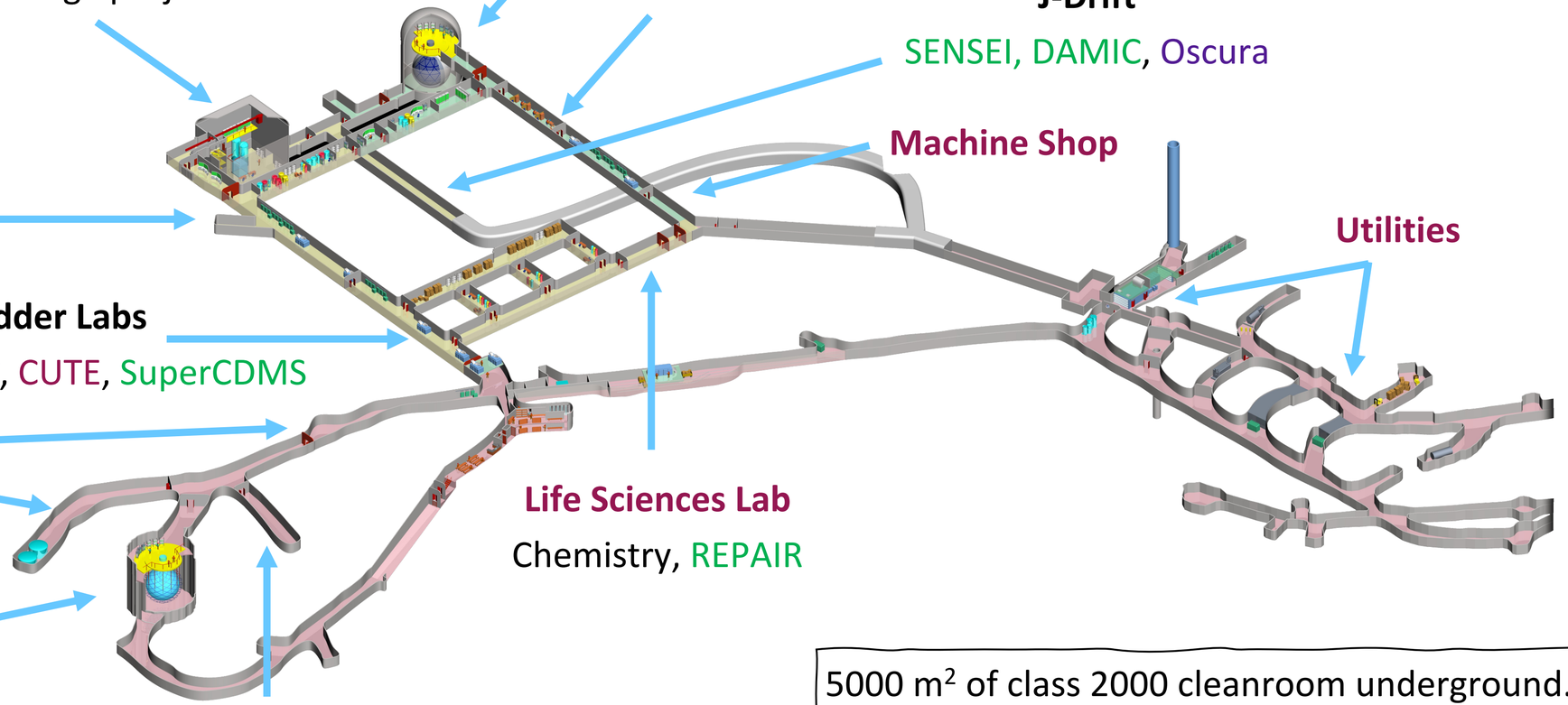
J-Drift
SENSEI, DAMIC, Oscura

Halo Stub
HALO
potential breakthrough for future expansion

Machine Shop

Utilities

Ladder Labs
PICO40, SBC, CUTE, SuperCDMS



Plants
UPW, Scintillator, Te Diol, TeA

Life Sciences Lab
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Summer at SNOLAB

SNOLAB Underground Science Institute

Become an intellectual hub that fosters collaboration and connection.

- Pilot a program designed around experimentalists at SNOLAB, ***June 24 – August 16***.
- Three core thematic lecture periods (aimed at graduate students and postdocs, all invited)
  - The Dark Cosmos
  - Neutrino Science
  - Quantum Technology

  Each period is two weeks in length and has 5 lectures.
- SNOLAB events around the lecture period:
  - User Meeting: June 26-27
  - TRISEP: July 8-19
  - Collaboration meetings: SNO+, SuperCDMS, DEAP, …
- More information and application details: https://indico.snolab.ca/event/3/

Economic Impact

2017-2022

$464M - In gross output to the Canadian economy

$270M - Contribution to Canada's GDP

$250M - Contribution to Ontario's GDP

$3.45 - Return on each dollar invested in SNOLAB

3,300 - Highly-qualified personnel have contributed to SNOLAB

12,000 - Individuals involved in our outreach programs

KPGM SNOLAB Economic Impact Assessment, May 2022

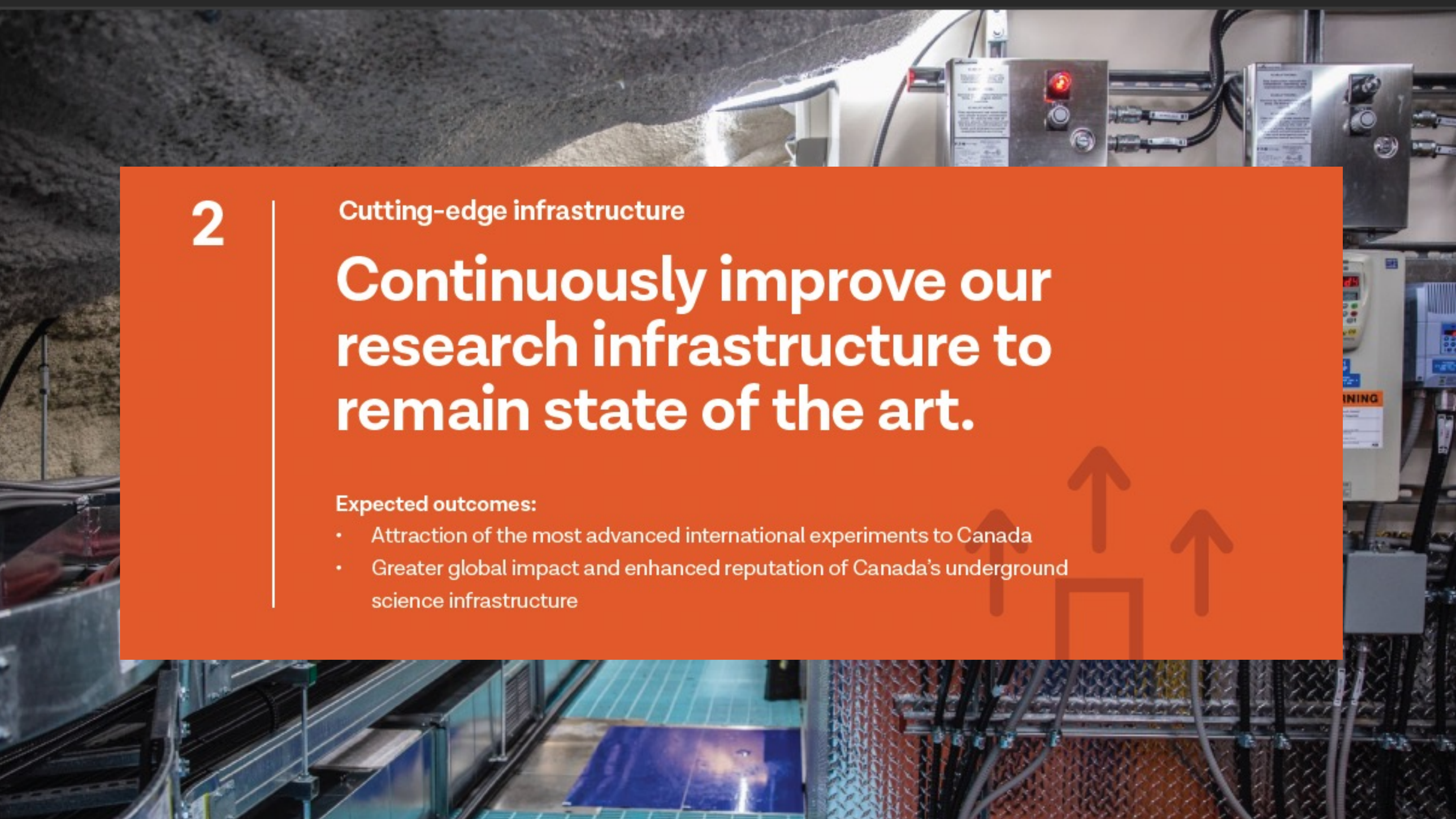
Conclusions

- SNOLAB is a clean, underground laboratory hosting a variety of world-leading experiments. These experiments vary in their size and the science they address.
- Experimental collaborations at SNOLAB have produced many scientific results at SNOLAB and many more world-leading results are expected over the next decade
- We have released 2023-2029 Strategic Plan that focuses on three pillars: Excellent Science, Cutting-edge infrastructure, and Skilled people.
- We are launching the Sudbury Underground Science Institute (SuSi) with a lectureship program this summer!
- I am very excited about the opportunities that SNOLAB provides the scientific community. I believe SNOLAB well positioned to attract world-class experiments and support major discoveries in the next decade.

Thank you!

Questions?

Back up Slides



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

Infrastructure Strategy

Explore the full potential of cryogenics systems, building on our previous cryogenics successes for research and develop future infrastructure, operational capacity, and expertise.

- Scale up our underground production capacity for liquid nitrogen.
- Develop innovative testing facilities for quantum computing and technologies.

Innovate new technologies and tools for ultra-low background experiments.

- Expand our ultra-low radiogenic background program by developing innovative tools and techniques for screening.

Infrastructure Strategy

Continue upgrading our operational systems.

- Support and use new techniques and technologies to further improve the automation of experiments and remote operability.

Deepen our focus on safety and sustainability.

- Maintain our excellent safety record and standards and incrementally reduce our environmental footprint.

Export our underground infrastructure expertise around the world.

- Seek to increase our collaborations with new and existing underground laboratories.

https://www.snolab.ca/facility/underground-facilities/

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

Skilled People

- **Embed equity, diversity, and inclusivity into everything we do.**
  - Working towards gender parity and significant representation of equity-deserving groups, both in our staff and Board of Directors
  - Create multi-purpose wellness spaces in the surface building and underground labs.
  - Create a standing EDI committee that reports directly to the Executive.

Skilled People

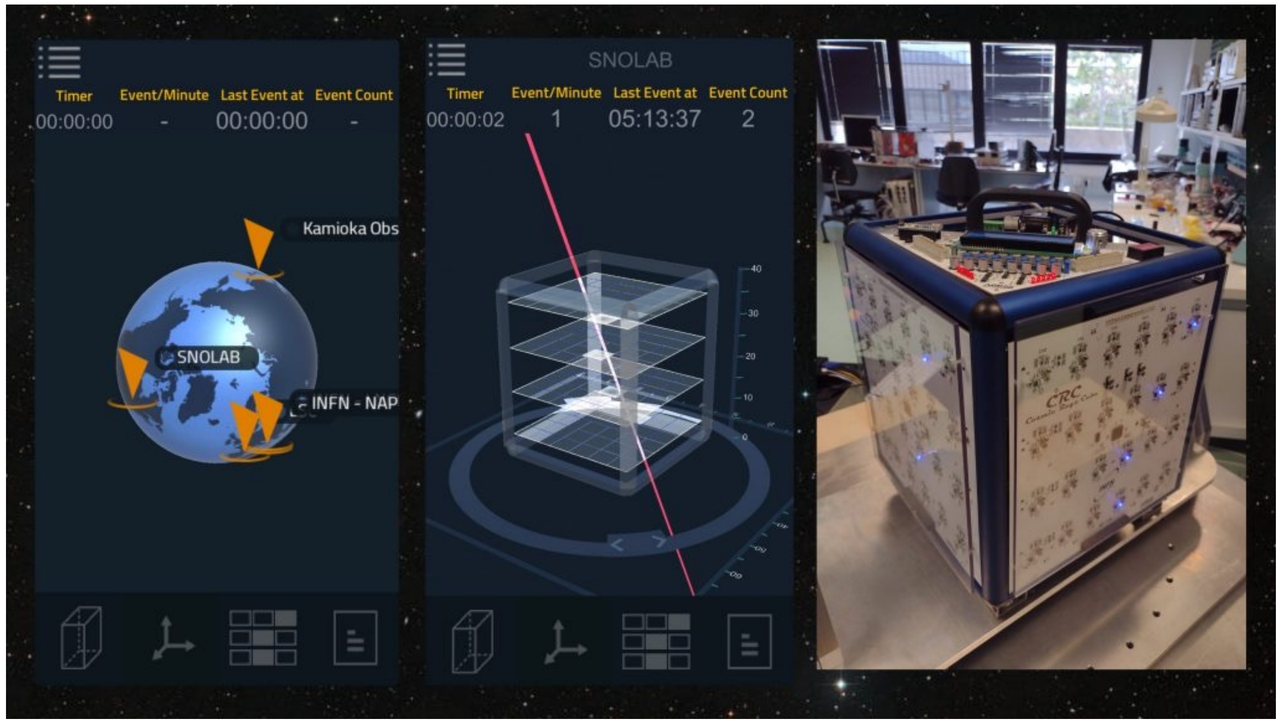
Increase professional development and training opportunities.

- EIT and skilled trade apprentice programs
- SNOLAB student training (internship and coop programs)
- Institutional support of community E&O and professional development efforts (summer schools, conferences, workshops, CASST competition, etc)

Skilled People

Public engagement and focused efforts on K-12 students

- In partnership with the Ontario Association of Physics Teachers, develop educational resources for K-12 classrooms
- Collaboration with Science North to create an interactive exhibits.
- Leadership in organizing international events, such as the annual International Dark Matter Day.



https://www.snolab.ca/outreach/