



Strategic plan

2017 - 2022





Strategic plan

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SNOLAB is enabled by an alliance of visionary partners.

This includes the six founding partners that provide direction in all affairs of the organization to ensure that SNOLAB has the means, quality, depth and continuity of management required to realize its major scientific and operational objectives.

SNOLAB also extends sincere thanks to the many funding partners that contribute essential investment for its facilities, research capabilities, infrastructure and operations that support leading-edge discovery, physics research and innovation to the benefit of all Canadians.

SNOLAB extends thanks to all our stakeholders who contributed to the development of the SNOLAB Strategic Plan. We welcome your ideas and feedback, please contact the SNOLAB Communications Office at communications@snolab.ca



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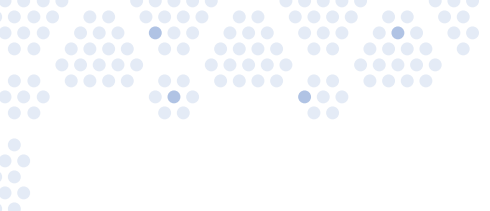
Executive summary

SNOLAB is an epicentre of global deep underground science and discovery, located 2 kilometres below the Earth's surface in the operational Vale Creighton nickel mine near Sudbury, Ontario, Canada. One of the deepest, cleanest underground laboratories in the world, with an experienced and skilled support staff, SNOLAB is an expansion of the existing facilities constructed for the Nobel Prize-winning Sudbury Neutrino Observatory (SNO) solar neutrino experiment.

The combination of SNOLAB's great depth, cleanliness, in-house expertise, and specialized technical and project management support allows researchers to build underground experiments;

study extremely rare interactions and weak processes; and deliver world-class science in a highly productive way. While particle astrophysics is the principle focus for SNOLAB, there is a growing interest in other scientific fields to exploit the deep underground space and associated infrastructure.

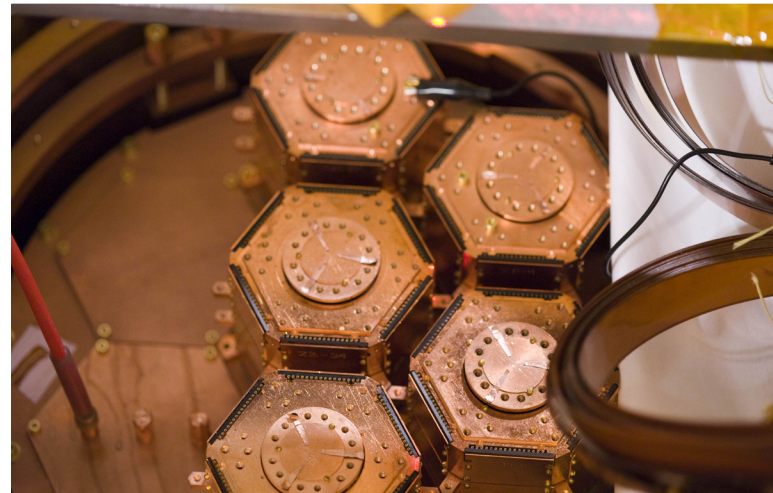
In particular, there have been growing developments in the field of mining innovation, where SNOLAB supports data analytics for mining innovation, and biology/genetics, where SNOLAB supports projects studying the impact of underground low radiation environments on biological systems.



SNOLAB also has multiple germanium detectors used to measure background radiation level in materials, an ultra-pure water plant that produces incredibly clean H₂O, a precision radon gas measuring system and a newly constructed scintillator processing plant.

The elements that make SNOLAB unique enable a world-class science programme currently focused on neutrino and dark matter investigations but expanding to include a broader science base – and it is attracting internationally renowned scientists and experiments from across Canada and around the world.

SNOLAB has established a bold vision: to be an internationally recognized laboratory and partner of choice for deep underground science, delivering world-class research, scientific discovery and benefits to Canada and her global partners, by facilitating national and international access to its unique capabilities, facilities and expertise.



This Strategic Plan and accompanying Implementation Plan for 2017 to 2022 outlines how SNOLAB will work closely and collaboratively with the research community to build on the scientific, technical and operational accomplishments achieved to date, and further realize these goals. It builds directly on guidance, feedback and recommendations from a Strategic Planning Committee established by SNOLAB, comprising members of its community.

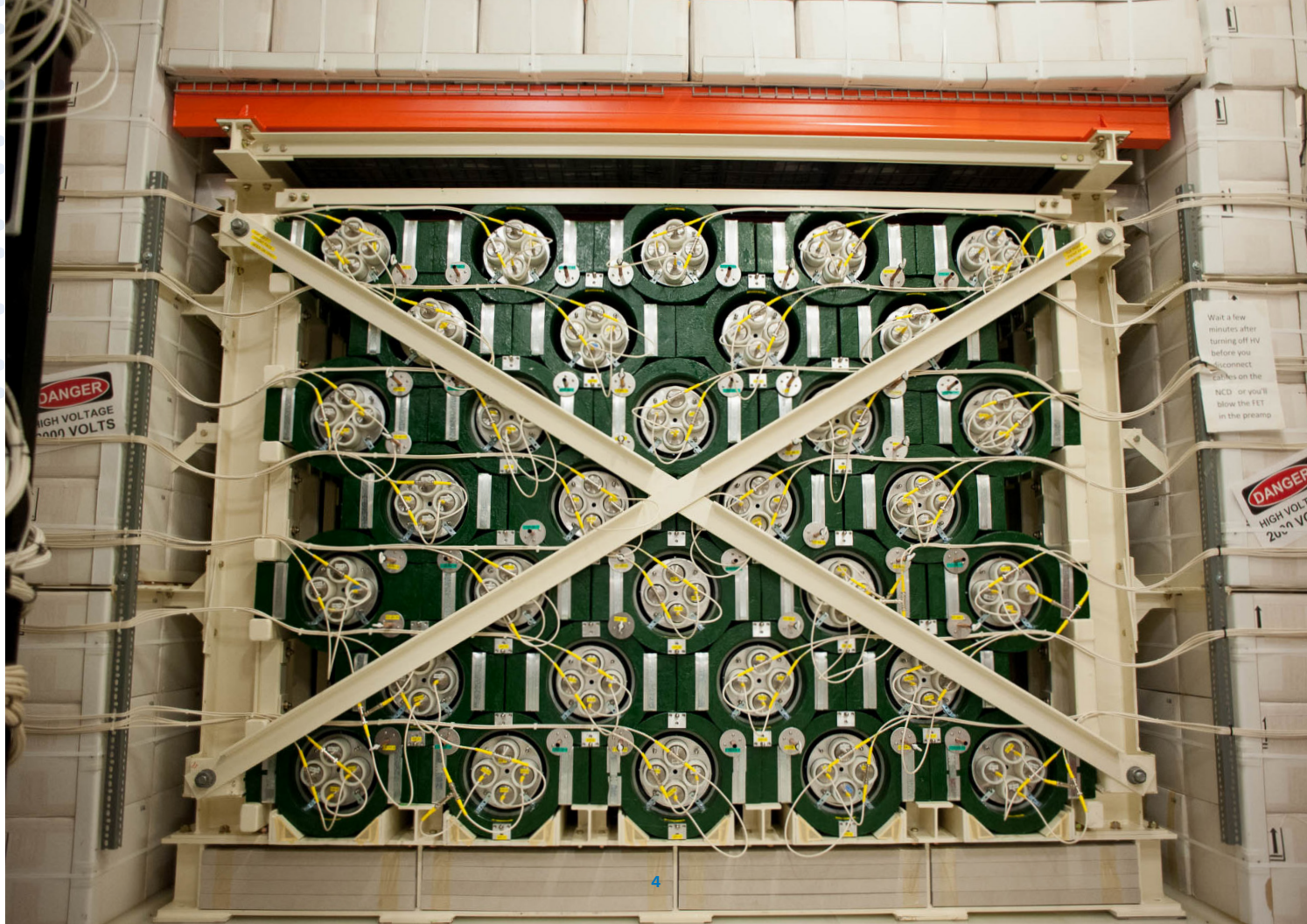
Our research community drives our actions, decisions and priorities.

Over the next five years, SNOLAB will:

- Remain at the forefront of sub-atomic and astroparticle physics by delivering world-class science and demonstrating scientific leadership;
- Develop, attract and retain exciting experiments from around the world;

- Play a pivotal role in bringing the Canadian particle astrophysics research community together to define its vision for the future;
- Maintain a strong focus on the delivery of science, and directly contribute to the continued progress of current and future experiments;
- Facilitate increased collaboration with fellow Canadian science leaders;
- Establish new global partnerships that promote Canada's reputation in world-class physics research to the world;
- Catalyze new discoveries that translate into scientific knowledge, future applications and associated benefits in industry sectors such as mining, geology, biology and medicine; and
- Enable economic impact that helps to create a high quality of life for generations to come.

This plan lays out the vision and goals for the next five years and links to the more detailed implementation plan that describes how we will reach these targets.



DANGER
HIGH VOLTAGE
HUNDREDS OF VOLTS

Wait a few
minutes after
turning off HV
before you
connect
cables on the
HCD, or you'll
blow the FET
in the preamp

DANGER
HIGH VOLTAGE
200 kV

Letter from the Chair

Dear Colleagues,

It is with great pleasure that, on behalf of the SNOLAB Institute Board of Directors, I present to you the SNOLAB Five-Year Plan for 2017 - 2022. This plan articulates a bold vision for SNOLAB to capitalize on its unique combination of depth and cleanliness to be an international leader, and partner of choice, in deep underground science.

It will enable a broad range of scientific initiatives, from core subatomic physics research into the properties of neutrinos and the search for dark matter to mining data analytics and deep underground studies of biology, engineering, and geology, that will be pursued by SNOLAB scientists



and staff, researchers from the five partner Universities of the SNOLAB Institute, and colleagues from across Canada and abroad.

The process leading to this Strategic Plan was initiated by the SNOLAB Institute Board of Directors in 2015 and was guided by a Strategic Planning Committee comprised of members of the Canadian and international research communities. Following broad consultation, including a Town Hall meeting at SNOLAB in April 2016, a draft report was circulated to the stakeholder communities for further feedback and consultation. The final Strategic Plan was approved by the SNOLAB Institute Board of Directors in February 2017.

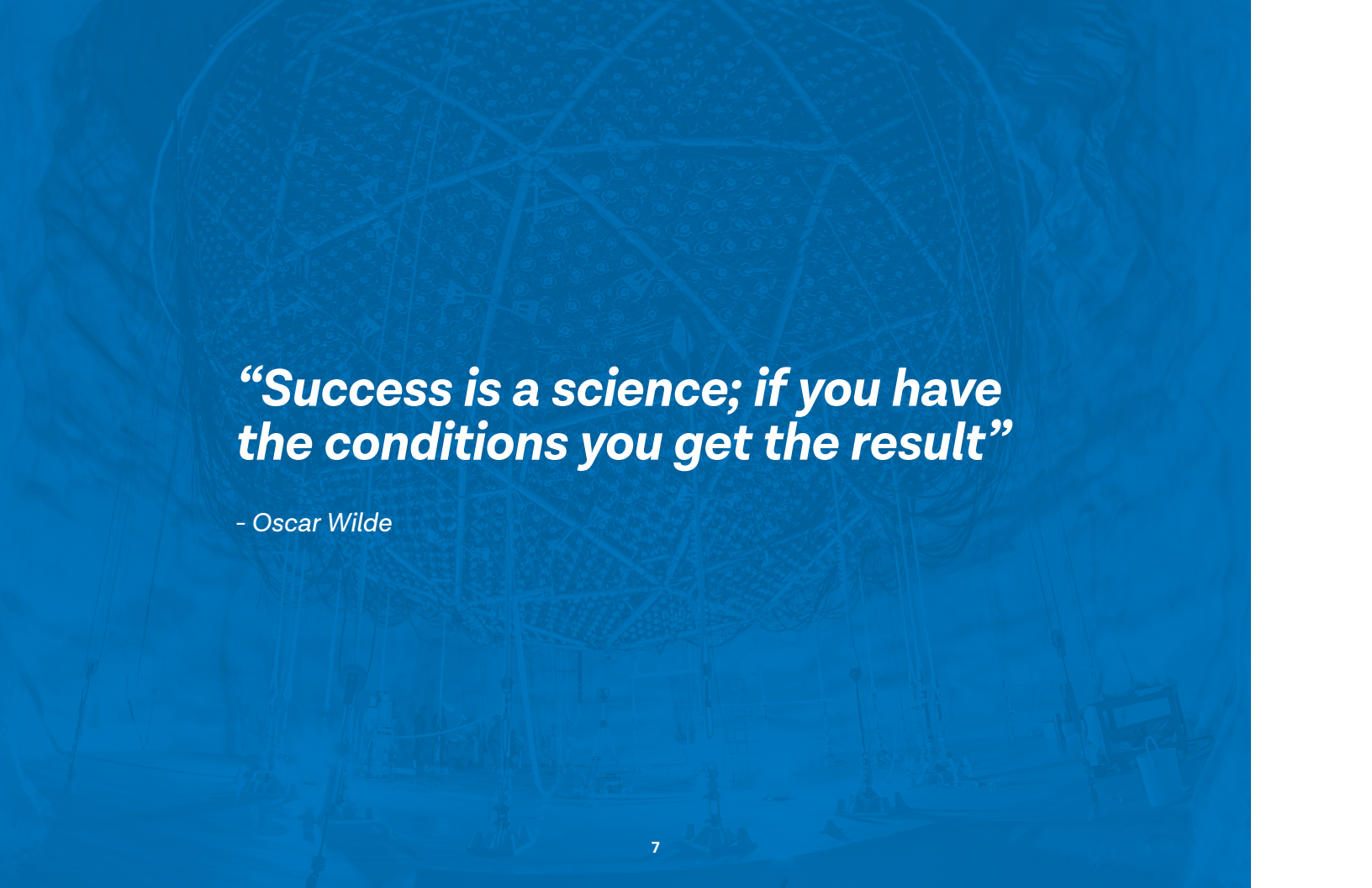
This Strategic Plan defines the vision and goals of SNOLAB for the next five-year period. It is complemented by a more detailed Implementation Plan that describes how SNOLAB will achieve these goals. Together, they will ensure that SNOLAB continues to bolster Canada's reputation as an international leader in deep underground science.

Sincerely,



Carl Svensson

Chair, SNOLAB Institute Board of Directors



***“Success is a science; if you have
the conditions you get the result”***

- Oscar Wilde

Foundational drivers

SNOLAB vision

To be an internationally recognized laboratory and partner of choice for deep underground science, delivering world-class research, scientific discovery and benefit to Canada, and her global partners, by enabling national and international access to our unique capabilities, facilities and expertise.

SNOLAB mission

In support of its vision, SNOLAB will:

- Enable world-class science
- Spearhead world-class science
- Catalyze world-class science
- Promote world-class science
- Inspire and innovate



Impact

SNOLAB provides a distinct competitive scientific advantage to Canada by enabling ease of access to very deep, clean experimental halls capable of hosting kilo-tonne scale projects, providing expert technical and administrative support and maintaining and developing infrastructure and research capabilities.

This is a unique combination within the global community of deep underground facilities. As the community develops more sensitive scientific experiments, the requirements for great depth and low radiological backgrounds become even more stringent, positioning SNOLAB as a leading site to undertake these research fields.

Since its inception, SNOLAB has bolstered Canada's reputation and profile as an international leader in science. This is underscored by SNOLAB's association with the Nobel and Breakthrough Prizes awarded to Dr. Arthur MacDonald and the Sudbury Neutrino Observatory Project respectively, and the substantial interest in the SNOLAB programme from the international research community, public and science outreach bodies, media organizations and new international collaborations wishing to deploy projects at SNOLAB

In March 2016, KPMG conducted an independent assessment of SNOLAB's economic impact on the Province of Ontario, and on Canada more broadly.

Based on economic impact models developed by Statistics Canada, the total (gross) economic activity generated by SNOLAB in Ontario and Canada over the past three years, and forecasted over the next five years, is estimated to be in the order of \$358 million.

This includes a contribution of:

- *\$159 million to Ontario's gross domestic product (GDP);*
- *\$176 million to Canada's GDP.*

This translates into a host of economic and social benefits for Sudbury, Ontario and Canada through job creation, the attraction of scientists and their families to the area and the provision of custom manufacturing and fabricating requirements to local companies.

SNOLAB has achieved a substantial increase in the highly qualified people trained to work underground, exceeding original targets proposed in the initial SNOLAB Strategic Plan (2011 to 2016).

The 488 highly qualified personnel trained by SNOLAB over the last six years includes:

- **210 Canadians;**
- **278 Non-Canadians.**

SNOLAB's unique combination of research capabilities, supported access, expanding project management capacity, and expertise in the design, development and implementation of complex experiments differentiates SNOLAB among underground laboratories around the world. Over the next five years, SNOLAB will work with the community to create even more robust infrastructure and research capabilities that address the needs of physics researchers at the leading edge of our scientific fields.

Framework for success

In support of its vision, SNOLAB will:

1

Enable world-class science performed at SNOLAB by national and international collaborative research and experimentation teams that specialize in underground research;

2

Spearhead world-class science at SNOLAB through its own research group as part of the international and national scientific community, developing synergies with other groups worldwide;



3

Catalyze world-class science at SNOLAB by being a sought after collaborator in its own right and through providing transformational opportunities for collaboration and knowledge exchange to other groups through workshops, external connections and local interactions;

4

Promote world-class science and societal benefits through strong public and professional outreach programmes, and through technical knowledge development and transfer; and

5

Inspire the next generation of innovators through strong educational outreach, knowledge transfer and the training of highly qualified personnel.

Our 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 - SNOLAB is committed to fostering a culture in which individuals make full use of their skills and knowledge, and provides opportunities to develop through continual improvement. Our focus is on delivering high-quality research, through driving, supporting and enabling excellence in research and operations.



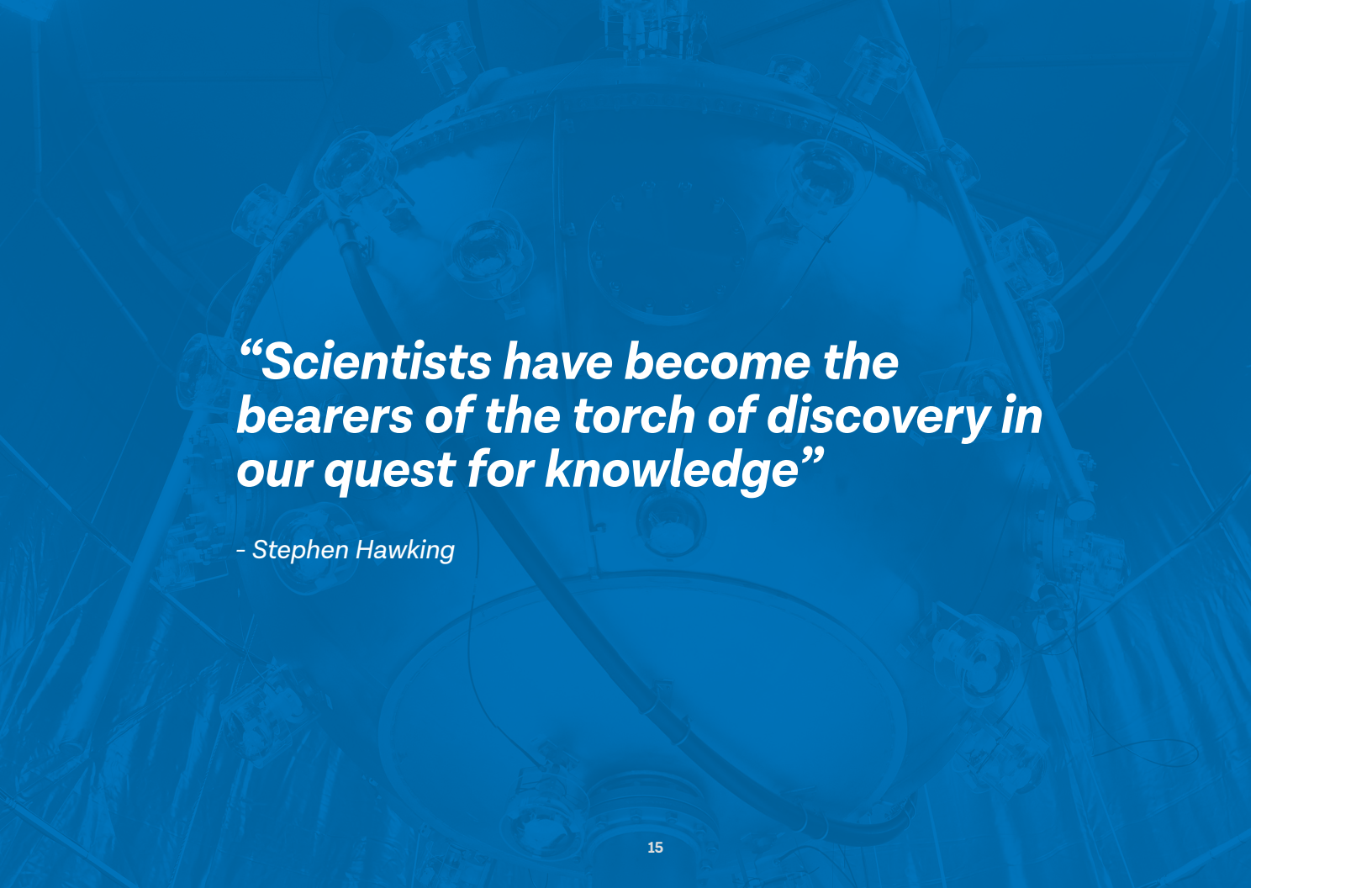
Teamwork - Our approach to teamwork is based on the belief that each member brings unique experience and important expertise to the workplace, allowing project challenges to be resolved and creating a work environment that supports cooperation and collaboration in all aspects of work.



Inspiration - We strive to educate and inspire as a core component of our commitment to our public sponsors. To showcase the enthusiasm of our staff and users, and the excitement of the research undertaken, SNOLAB will continue to engage fully in professional and public outreach.



Accountability - SNOLAB is committed to upholding an environment of trust, responsibility and accountability to our stakeholders. Accountability to our 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.



***“Scientists have become the
bearers of the torch of discovery in
our quest for knowledge”***

- Stephen Hawking

Research Focus

The SNOLAB science programme has expanded significantly over the last five years. Although approximately 95% of SNOLAB's scientific programme is dedicated to the conduct of sub-atomic and particle astrophysics experiments, it also increasingly facilitates research and discovery in other scientific fields such as biology, geo-physics and seismology.

Overall, the SNOLAB programme now encompasses subatomic and nuclear physics, astrophysics, genomics, and mining innovation. Specifically, SNOLAB now has dark matter, neutrinoless double-beta decay, natural sources of neutrinos such as solar, terrestrial and supernova, low-dose radiation

genomics, bioinformatics and mining engineering experiments within its underground laboratory.

Key areas of focus include:

- Astro-particle and Particle Physics – Dark Matter Studies;
- Astro-particle and Particle Physics – Neutrino Studies;
- Mining data analytics – Mining Observatory Data Control Centre;
- Biology, Engineering and Geology; and
- Centre of Excellence for Low Background Studies.

Partnerships

SNOLAB recognises the power of partnership to advance scientific discovery. We know we are stronger when we work together, harnessing the expertise and resources of our academic, government and industry partners from around the world to deliver scientific research, innovation and societal impact.

SNOLAB operates within a framework that includes a scientific user base from 79 institutions in 15 countries. We have strong ties to several U.S. National Laboratories due to their specialties including the Fermi National Accelerator Laboratory in areas of Project Management, Pacific Northwest National Laboratory for

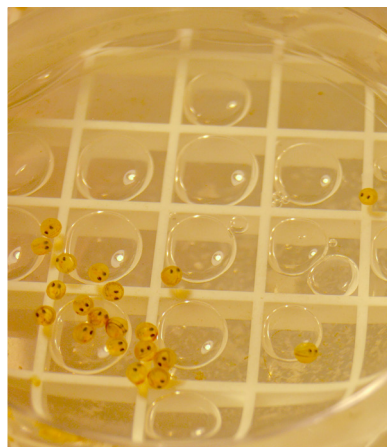
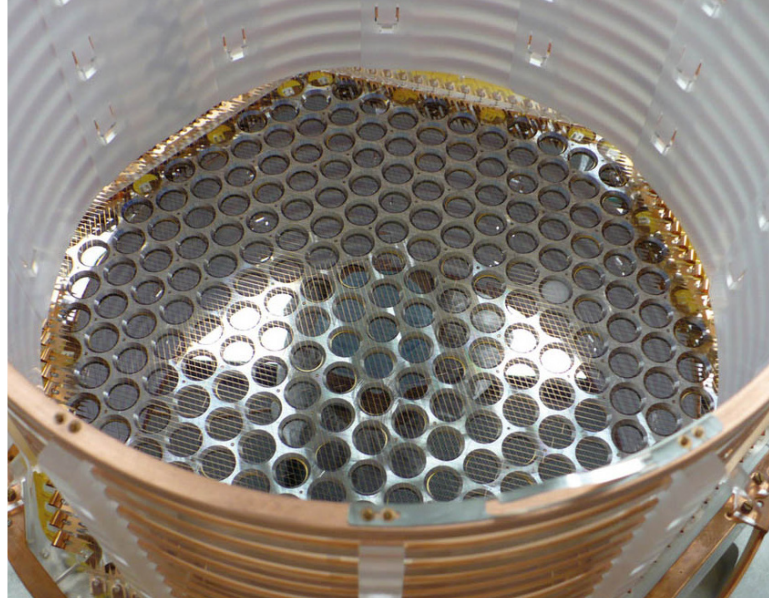
their study in low background radiation, SLAC National Accelerator Laboratory and Sanford Underground Research Facility (SURF). Outside North America, SNOLAB has developed close ties to other deep underground research facilities including Gran Sasso (Italy), Boulby (U.K.), Canfranc (Spain), CJPL (China) and Modane (France).

SNOLAB also invests in the development of strong collaboration with universities and other large facilities within Canada. There are currently (as of September 2016) 15 Canadian universities and research institutions engaged in SNOLAB-supported research projects and governance.

SNOLAB also continues to strengthen its relationship and linkage to TRIUMF, Canadian Light Source (CLS) and Perimeter Institute at a technical and management level.

SNOLAB is one of the National Research Facilities supported by the Major Science Initiative's (MSI) Fund through the Canada Foundation for Innovation. The facilities supported as MSIs require robust governance, management and stewardship mechanisms to ensure that they are funded, managed and operated for success. As a result, they are better positioned to contribute to the Canadian economy and society at large.

TRIUMF, as Canada's national laboratory for particle and nuclear physics, specializes in large detector development and construction, and naturally augments the capabilities of SNOLAB. Building on its collaboration to date and its highly relevant capabilities and expertise, SNOLAB aims to further develop impactful opportunities with TRIUMF over the next five years.





The Canadian Light Source is a synchrotron radiation source and the “brightest light” in Canada. As a fellow science institution with national reach, research infrastructure and physical assets, SNOLAB works closely with CLS on national science opportunities and challenges, advocacy, management and operational issues.

The Perimeter Institute, renowned as a centre for Canada’s theoretical physics activities, provides theoretical support for the experimental programs, especially in the area of Dark Matter, which is quickly emerging as a key area of focused research activity at the national and global level.

The collective and complementary research capabilities and expertise provided by SNOLAB, TRIUMF, CLS and the Perimeter Institute provide a solid and consistent foundation on which to grow the talent required to provide Canada with a truly global advantage in the rapidly evolving field of sub-atomic physics and related

underground scientific disciplines. SNOLAB supports leading-edge research and technology development, and promotes the mobilization of knowledge and transfer of technology to society.

Locally, SNOLAB has become a pivotal member of the research community and has partnered with institutions such as Science North, the Centre for Excellence in Mining Innovation and the City of Sudbury. As a member of the Anchor Institutions of Sudbury, SNOLAB is recognised as one of the drivers of the local research ecosystem. This community and stakeholder support from all geographic levels make SNOLAB the location of choice for deep underground science.

The Canadian Particle Astrophysics Research Centre

In September 2016, Queen's University announced the receipt of \$63.7 million from the Government of Canada's Canada First Research Excellence Fund to support the creation of the Canadian Particle Astrophysics Research Centre (CPARC). This new research centre will engage seven Canadian universities, and partner with five Canadian research institutions including SNOLAB.

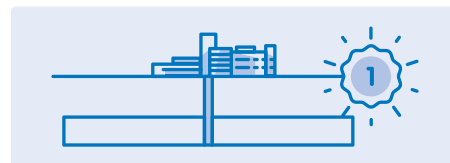
The funding will support 41 new positions for researchers, engineers, designers and technicians while supporting numerous graduate and postgraduate students. CPARC will expand the pool of Canadian physics research expertise, and enable more scientists to exploit and benefit from the unique capabilities offered by SNOLAB. This will help to facilitate a new generation of scientific discoveries.



Realizing the vision

SNOLAB will consistently assess its performance against the goals outlined in this section. It will establish and incorporate targets into its Key Performance Indicators and programme management dashboard on an annual basis, and routinely measure, track and report its performance to the Board of Directors and stakeholders

Strategic Goal 1

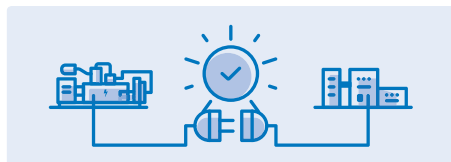


Enable and Spearhead World-Class Underground Science

Ensure SNOLAB supports, maintains and executes a world-class research programme and plays its own significant role in the shaping and delivery of science.

SNOLAB will continue its advance of scientific discovery by supporting our major experiments to achieve publishable results by 2018 and securing a next-generation experiment for the Cryopit. SNOLAB will also work to wrap up the initial science goals and deliver on the existing projects. A secondary objective is to continue to expand our science programme to include additional multidisciplinary projects that complement our current underground expertise.

Strategic Goal 2



Develop and Maintain World-Class Facilities and Infrastructure

Ensure SNOLAB remains at the forefront of infrastructure provisions for underground science. SNOLAB will develop the required infrastructure to support existing and incoming experiments including the development of robust and continuous power distribution systems, upgrades to highspeed networking, and safety systems. We will expand the low background counting programme by expanding the capabilities of the current facility underground, maximizing expertise available locally.

Strategic Goal 3



Educate, Inspire and Innovate

SNOLAB will strengthen Canada's reputation and profile as an international leader in science and contribute a broad economic impact to Canada and the local community by educating and inspiring through public and professional outreach activities, developing HQP and delivering innovative solutions through universities and small-medium enterprises.

Strategic Goal 4



Develop Delivery Systems of Internationally Recognized Standard

To continue to develop SNOLAB internal project and programme management capacity to enable and optimize its impact on the effective and efficient design, development and implementation of science experiments and to contribute to the achievement of research outcomes. SNOLAB will continue to pursue ISO and OSHAS designations that demonstrate the depth and breadth of our quality assurance.



Current experimental programmes

Experiment

Focus

SNO+

A tonne-scale double beta decay detector making use of the existing SNO detector and loading liquid scintillator with tellurium. The collaboration extends across 23 institutions.

SuperCDMS

A second generation dark matter detector using cryogenic germanium and silicon crystals supported by 135 researchers from 26 institutions.

HALO

An experiment to detect neutrinos from supernovae that is part of the global network SNEWS using 79 tonnes of lead and 128 tubular He-3 detectors.

Experiment

Focus

DEAP-3600

A second-generation dark matter experiment and collaborative effort with 65 researchers from 10 institutions in Canada, the United Kingdom and Mexico using 3.6 tonnes of liquid argon.

MiniCLEAN

An alternative technology detector with researchers from 7 US institutions using 500kg of liquid argon.

PICO

A second generation detector using super heated fluids to search for dark matter across 17 institutions worldwide.

DAMIC

A dark matter experiment using charged couple devices with a worldwide collaboration of scientists.

NEWS-G

A Canada-France collaborative effort in dark matter detection in the low mass range using high pressure gases.

Experiment

Focus

FLAME (Flies in a MinE)

A genetics experiment that takes advantage of the increased pressure to study the impacts of working deep underground using fruit flies as a model organism.

REPAIR

A Canadian bioinformatics experiment that explores cellular mutations in low radiation environments.

Cryogenic Underground Test Facility (CUTE)

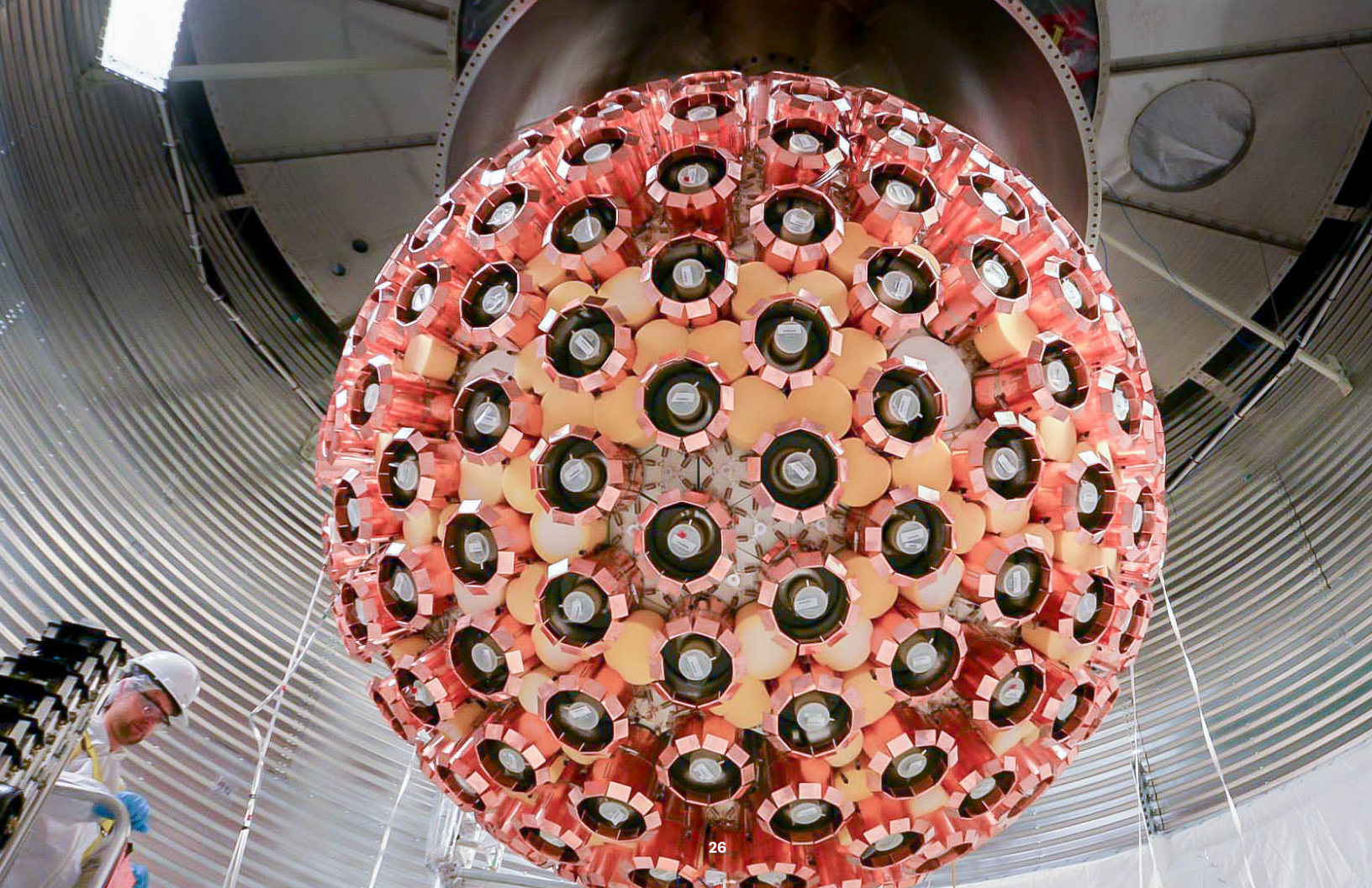
A Cryogenic Underground Test Facility (CUTE) to be installed at SNOLAB with the goal to do performance tests, calibrations and background measurements.

Low Background Counting

SNOLAB is developing a low background centre of excellence, which will incorporate the local expertise and capitalises on the low background HPGe detectors currently at SNOLAB while adding additional hardware to this suite.

Mining Operations Data Control Centre (MODCC)

This co-located centre will capitalize on existing data integration and sharing expertise at SNOLAB as well as the significant investments already made in its deep underground facility to look at large data collection, integration and storage.



Looking ahead

SNOLAB has continued to strengthen its position as one of the premier underground laboratories in the world. It is poised to increase its scientific leadership and contributions to fundamental research in sub-atomic particle physics and astrophysics. SNOLAB will drive significant progress for Canadian physics in four areas: cryogenic and liquid noble dark matter detectors, bubble chambers and double-beta decay research.

SNOLAB maintains a competitive advantage for next-generation projects due to accessibility, depth and cleanliness and will advance the development plans for the Cryopit space. The neutrinoless double beta decay projects will continue to require greater

sensitivity to probe the potential mass range and nature of the neutrino, especially if the normal hierarchy of neutrino flavours is favoured. SNOLAB is ideally placed to support these kilo-tonne scale projects through deployment in the Cryopit.

SNOLAB enables research that will accrue benefits in the future. These include technology developments in high-efficiency photon sensors that are expected to have application in medical imaging, national security, public safety solutions and are also expected to facilitate the development of low background techniques.



SNOLAB-supported initiatives such as the Mining Observatory Data Control Centre (MODCC) will deliver direct benefits to the Canadian mining industry by stimulating innovation in mine development and production

SNOLAB will drive significant progress for Canadian physics in four areas:

- ***cryogenic dark matter detectors***
- ***liquid noble dark matter detectors***
- ***bubble chambers***
- ***double-beta decay research.***

efficiency by fostering the development of new research and innovation threads in local Small and Medium Enterprises. Downstream, the application of these novel technologies will enhance the productivity of Canadian mining operations and support job creation.

SNOLAB has established a bold vision: to be an internationally recognized laboratory and the partner of choice for deep underground science, delivering world-class research, scientific discovery and benefits to Canada and her global partners, by enabling national and international access to its unique capabilities, facilities and expertise.

The successes at SNOLAB are not an endpoint but a starting point upon which to continue building. This strategic plan for 2017 to 2022 will guide SNOLAB's collaborative and coordinated action with the scientific community to further realize these goals.

Development of the plan

The plan is owned by the SNOLAB Board, and it will serve as a benchmarking document for oversight, to assess the effectiveness and impact of the facility and the management team. The entire SNOLAB community drives the strategic direction, and, as such, this document provides a vehicle for continued engagement and alignment with the community we serve. It builds directly on guidance, feedback and recommendations from a Strategic Planning Committee established by SNOLAB, and members of its research community.

As part of the Strategic Planning process, SNOLAB commissioned and executed a stakeholder survey; hosted a town hall and team-based consultations; and conducted individual interviews. This enabled SNOLAB to gather critical feedback on key objectives and programs to date; and solicit input to the next five-year strategic planning process.

SNOLAB would like to thank the members of the SNOLAB Strategic Plan Steering Committee:

Hiro Tanaka (Chair)

University of Toronto

Isabelle Blain

Former Vice-President, NSERC

Cliff Burgess

Perimeter Institute

Doug Boreham

Laurentian University, NOSM

Gabriel Orebi Gann

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Christine Kraus

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