2018/06/14

SNOLAB Update:

Nigel Smith

Physics in Canada

The Bulletin of the Canadian Association of Physicists

Bulletin de l'Association Canadienne des Physiciens

Vol. 20, No. 2, June 1964

ANNUAL CONGRESS, JUNE 10-13

THURSDAY, June 11, 9:00 a.m.

Session 1. INVITED PAPERS ON PHYSICS IN CANADA Room 117
Paul Lorrain, Chairman

1.1 THE ROLE OF FUNDAMENTAL PHYSICS IN CANADA
by G. Laurence, President, Atomic Energy Control Board.
(45 minutes)

1.2 WHITHER CANADIAN PHYSICS?
by L. E. Howlett
(45 minutes)


SNOLAB
Strategic plan
2017 - 2022

Our 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.

Strategic Goals - Realising the Vision

Strategic Goal 1

Enable and Spearhead World-Class Underground Science

Strategic Goal 2

Develop and Maintain World-Class Facilities and Infrastructure

Strategic Goal 3

Educate, Inspire and Innovate

Strategic Goal 4

Develop Delivery Systems of Internationally Recognized Standard

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

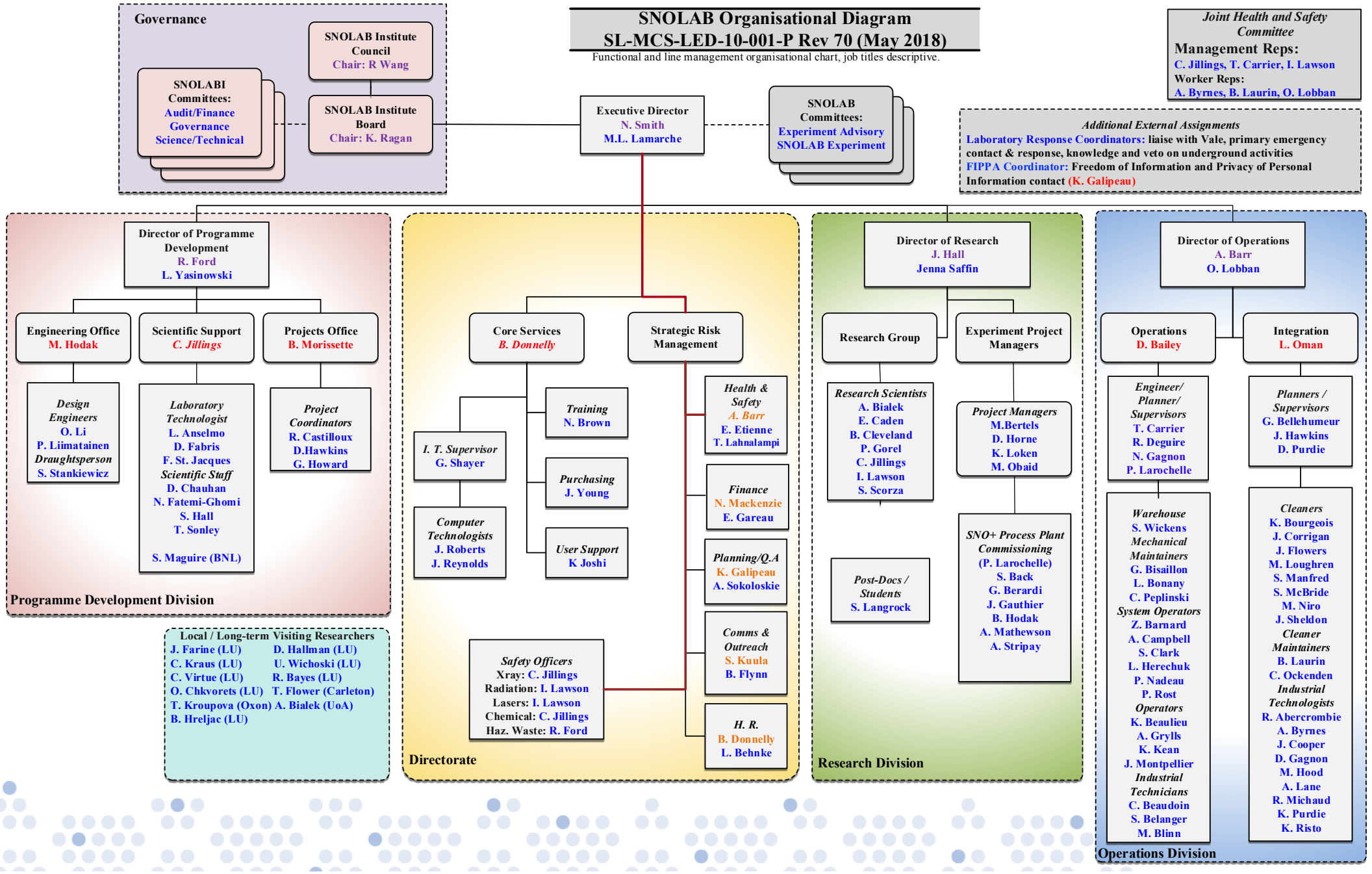
SNOLAB is committed to upholding an environment of trust, responsibility and accountability to our stakeholders. Accountability to our internal governance structures, external research communities, funding agencies and public sponsors is an ongoing goal. Strong governance and effective management will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

Funding Update

SNOLAB MSI Proposal

- Request fully funded:
  - CFI MSI Proposal funded for three years at $28.6M (Request was five years)
  - $28.8M co-funding secured from Province of Ontario, over five years to 2022
- MSI Requirements for 2020
  - SNO+ should have achieved publishable results from its water and LAB phases, and should be running stably and reliably with 0.5% Te loading.
  - DEAP−3600 should have published results on dark−matter limits (or discovery!) from its 2016−2018 running.
  - SuperCDMS should have progressed to a final decision on siting at SNOLAB, and be in its installation phase.
  - A major experiment should be identified for installation in the Cryopit, with conceptual and engineering studies completed, and the start of installation imminent.
  - Several smaller multi−disciplinary projects should have achieved publishable (or actionable, in the case of commercially−oriented projects) results.
  - SNOLAB should produce, in consultation with the research community, a vision, a strategic long term plan and a proposal for the facility beyond 2022.

SNOLAB Organisational Chart



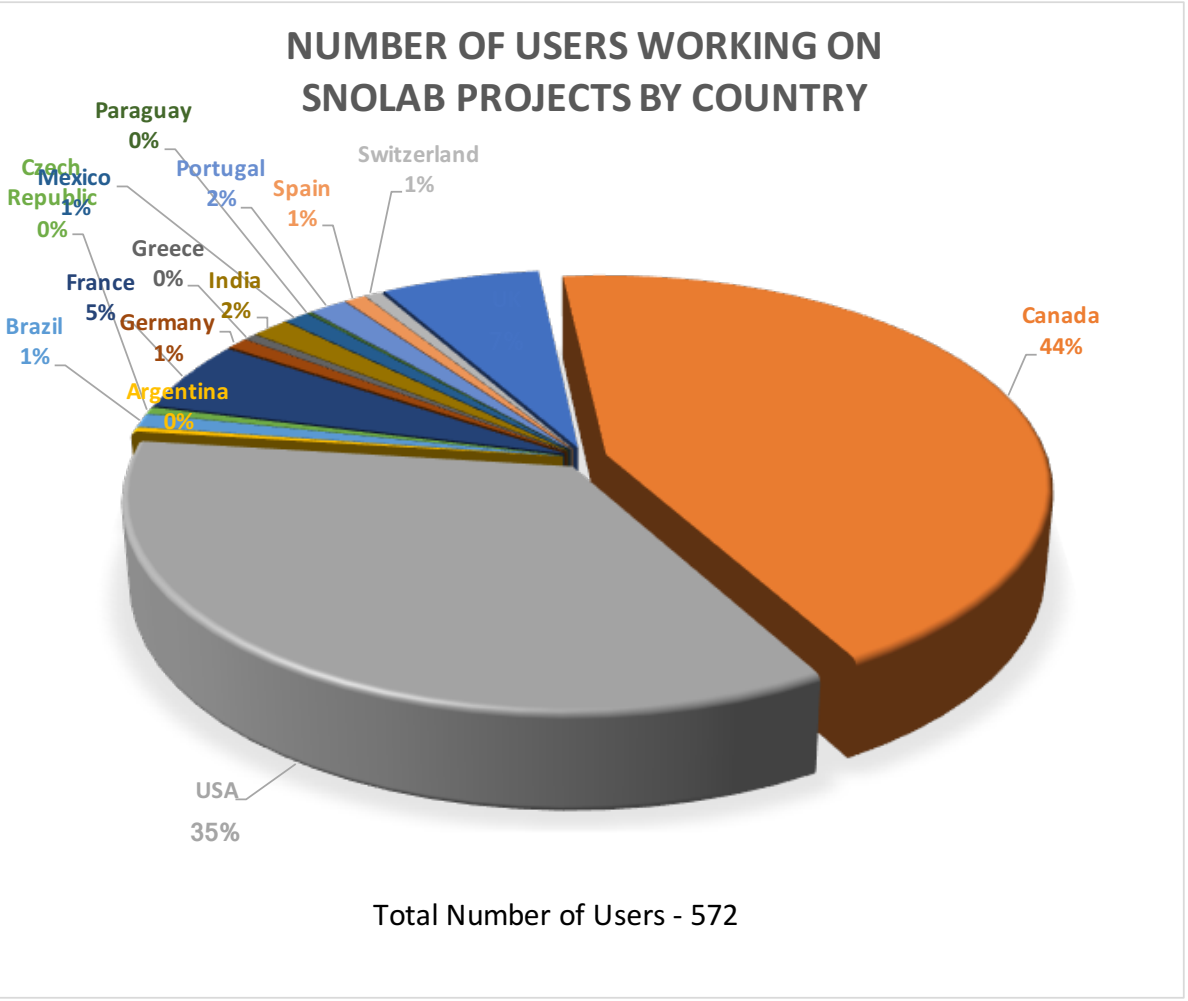
SNOLAB Programme

Experiment	Neutrino	Dark Matter	Other	Space allocated	Status
COUPP-4		√		"J"-Drift	Completed
CUTE		√	Test Facility	Ladder Labs	In Preparation
DAMIC		√		"J"-Drift	Operational
DEAP-1		√		"J"-Drift	Completed
DEAP-3600		√		Cube Hall	Operational
DEAP-50T/CLEAN		√		Cube Hall	Letter of Intent
DMTPC		√		Ladder Labs	Concept Phase
DUST			Test Facility	Ladder Labs	Letter of Intent
FLAME			Genomics	External Drifts	Operational
Ge-1T	√			Cryopit	Letter of Intent
nEXO	√			Cryopit	Concept Phase
nEXO Shield	√			Cryopit	Concept Phase
HALO	√			Halo Stub	Operational
MiniCLEAN		√		Cube Hall	Commissioning
MODCC			Mining Data Centre	Surface Facility	Operational
NEWS		√		Cube Hall	In Preparation
PICASSO-III		√		Ladders Labs	Completed
PICO-2L		√		"J"-Drift	Operational
PICO-60		√		Ladder Labs	Operational
PICO-500		√		Ladder Labs	Letter of Intent
PUPS			Seismicity	Various	Completed
REPAIR			Genomics	Chem Labs	Operational
SuperCDMS		√		Ladder Labs	In Preparation
SNO+	√			SNO Cavern	Commissioning

Three EoI Received in 2017/18

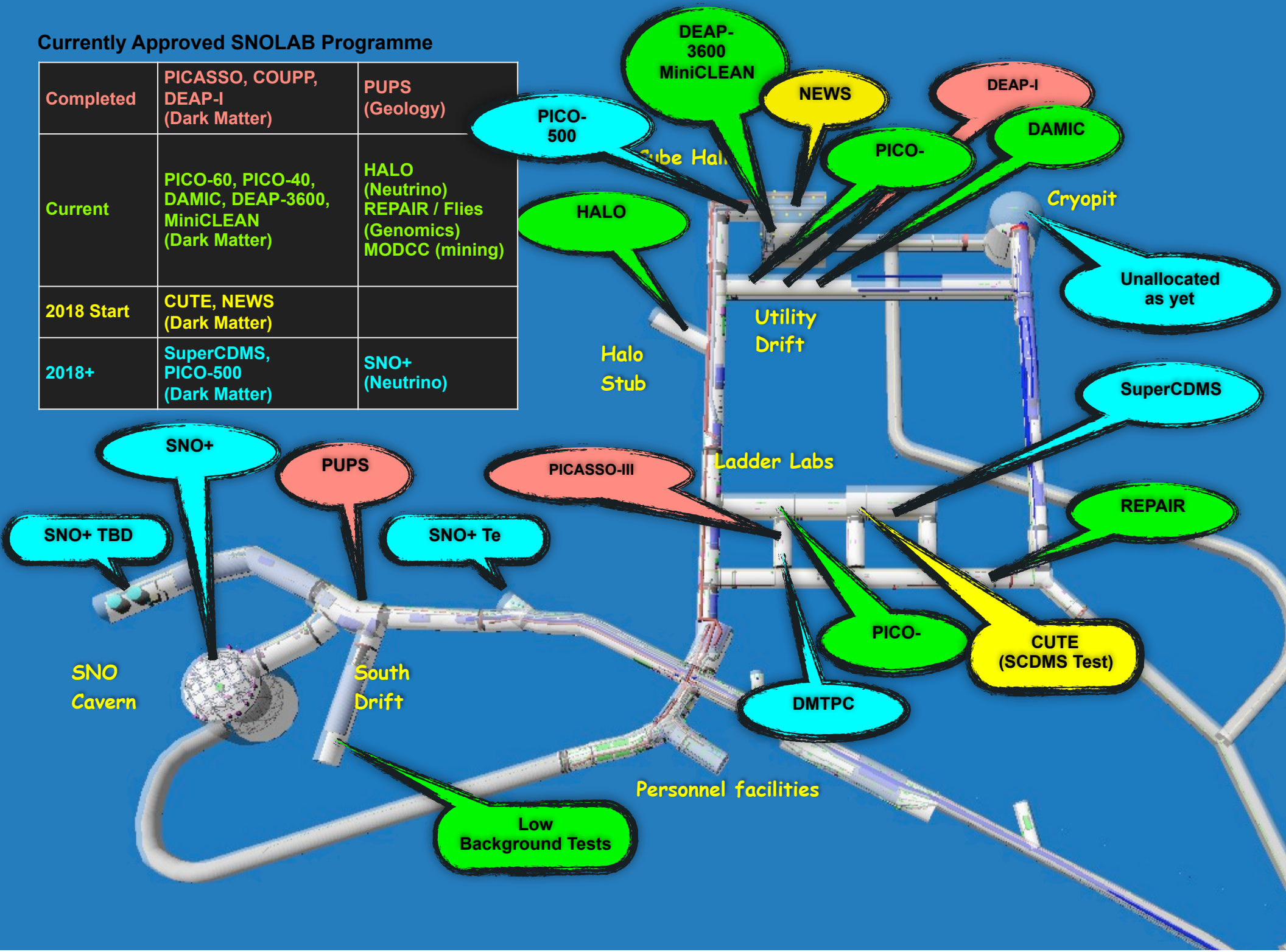
Global connections

Country	N_Institutes	Total	Academics
Canada	17	249	54
USA	37	201	74
Argentina	1	2	1
Brazil	1	6	1
Czech Republic	1	3	1
France	7	31	8
Germany	3	5	3
Greece	1	3	2
India	2	9	5
Mexico	2	6	3
Paraguay	1	1	1
Portugal	1	9	4
Spain	3	5	3
Switzerland	1	4	1
UK	11	38	18
TOTAL	89	572	179



Currently Approved SNOLAB Programme

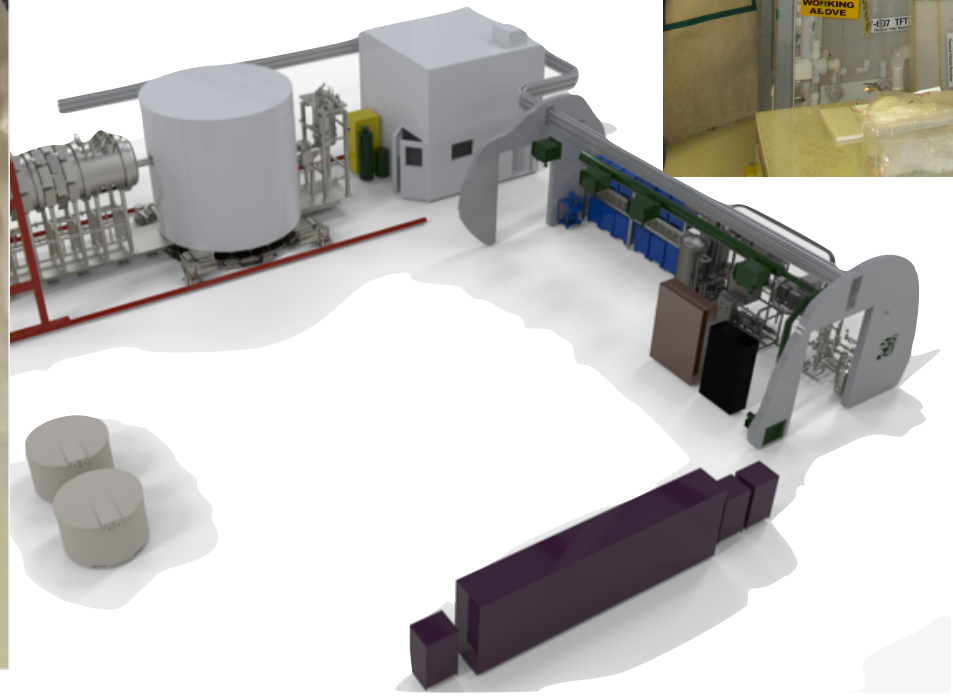
Completed	PICASSO, COUPP, DEAP-I (Dark Matter)	PUPS (Geology)
Current	PICO-60, PICO-40, DAMIC, DEAP-3600, MiniCLEAN (Dark Matter)	HALO (Neutrino) REPAIR / Flies (Genomics) MODCC (mining)
2018 Start	CUTE, NEWS (Dark Matter)	
2018+	SuperCDMS, PICO-500 (Dark Matter)	SNO+ (Neutrino)



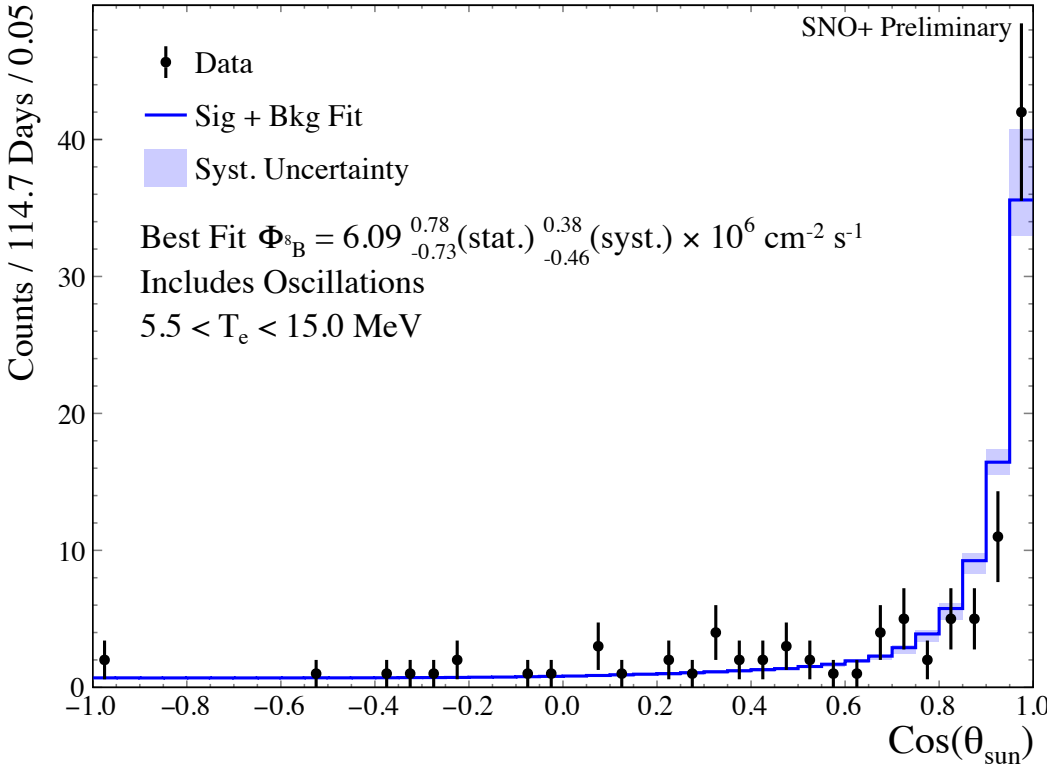
Progress on experiments

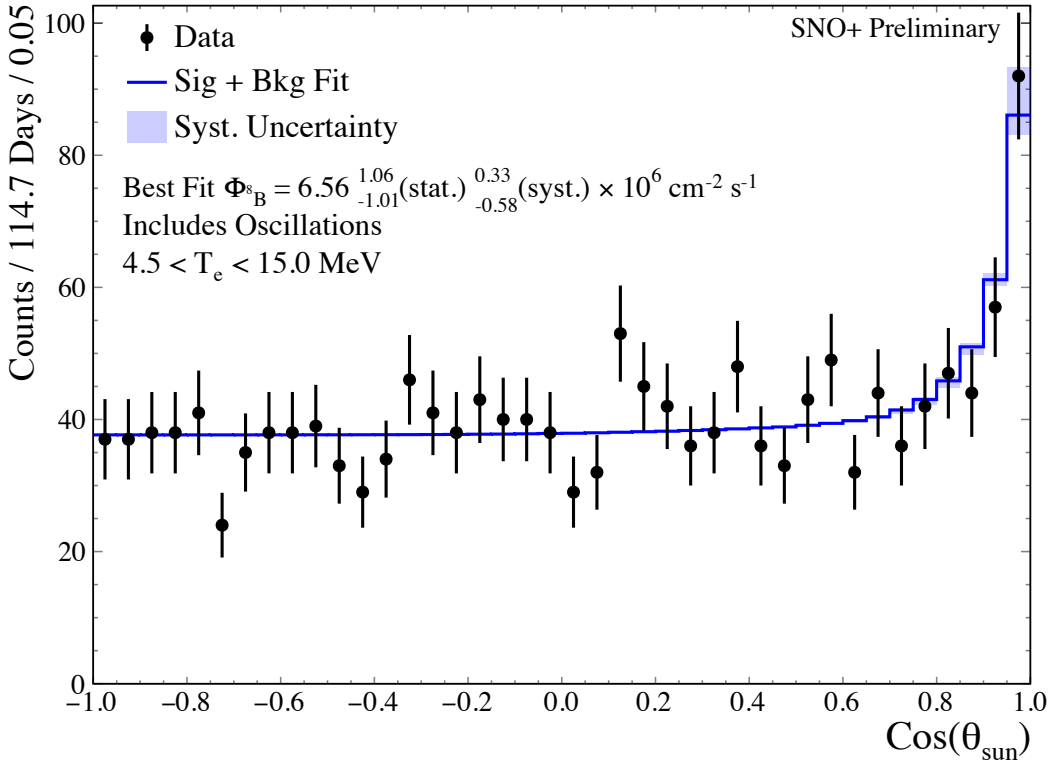
- SNO+: Uses existing SNO detector. Heavy water replaced by scintillator loaded with ^{130}Te. ($^{130}Te \rightarrow {}^{130}Xe + e^- + e^-$)
  - Nucleon decay run started May 2017 (water phase)
  - LAB process plant in final commissioning - expect fill to start this summer
  - TeA plant constructed, TBD plant construction started. Tellurium loading 2019
- DEAP-3600: Single phase Liquid Argon using PSD
  - Detector collecting dark matter data continuously from Nov 2016. First publication summer 2017 on 4 day engineering run; analysis well advanced for publication of year-long run
  - DarkSide/DEAP/MC forged Global Argon DM group to develop next generation of detectors. DS-20k first objective, then (SNOLAB) 300t detector. Connected to CERN Neutrino Platform.
- MiniCLEAN: Single Phase Liquid Argon using PSD
  - Argon fill underway.
  - Will complete project this year

SNOLAB



Solar Neutrino Flux Measurement





Solar neutrino PDF from MC, includes oscillations

1D fit, backgrounds assumed flat in $\cos(\theta_{\text{sun}})$

114.7 days of data

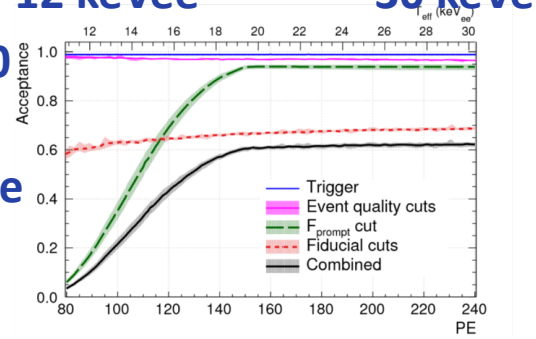
DEAP-3600 released the results of a 9.87 tonne day exposure at TAUP-2017 in Sudbury.

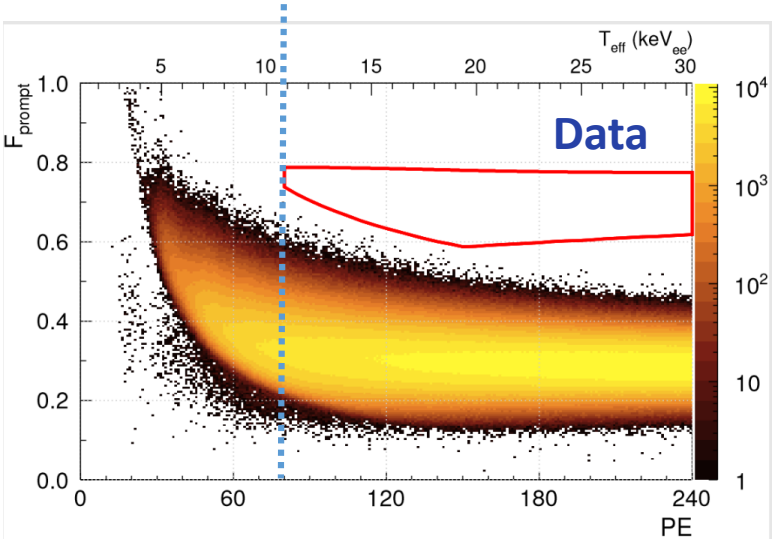
12 keVee **30 keVee**

1.0

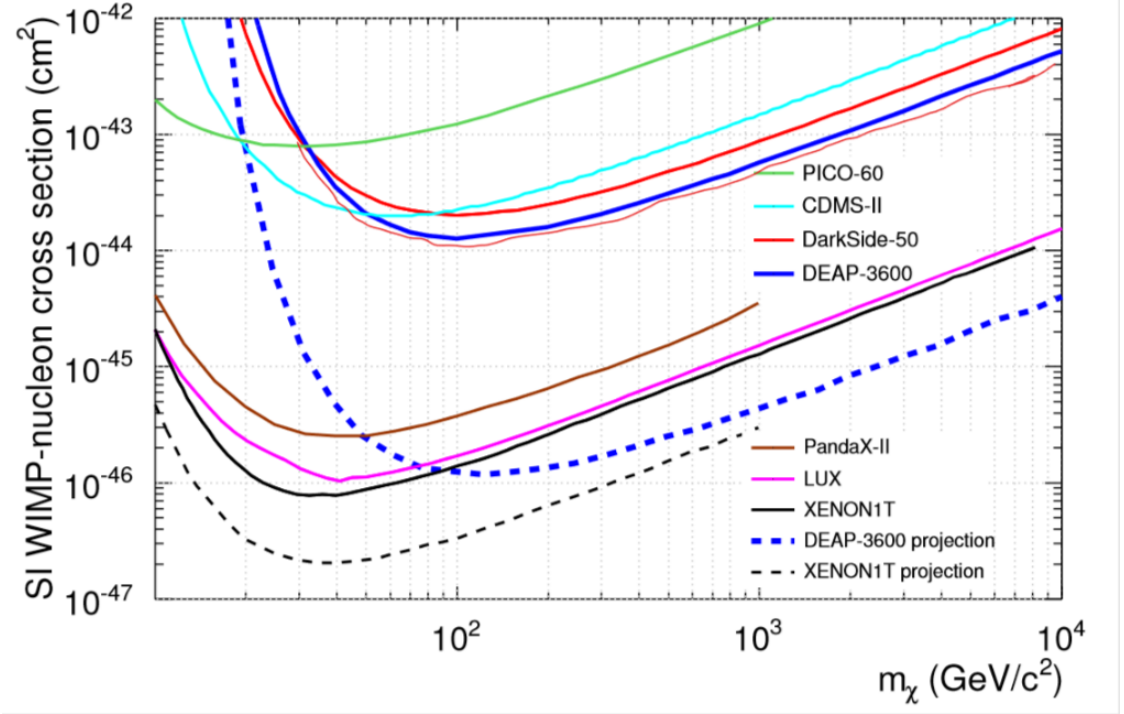
NR Acceptance

0



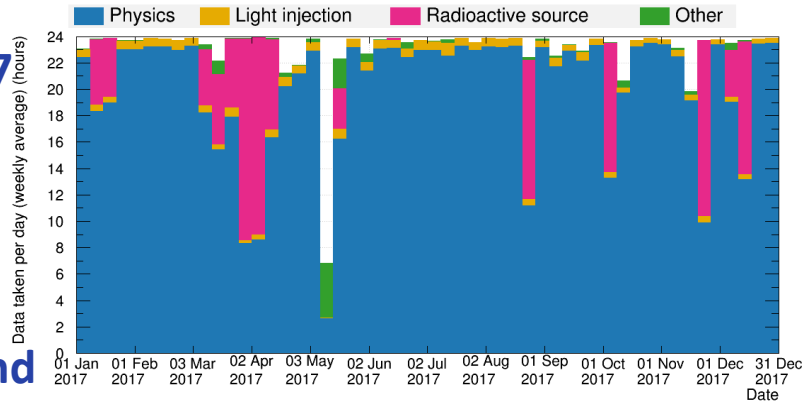


(Darkside-50 new results "pencilled in" below DEAP limit.)



Stable second-fill running since November 2016.

Calendar 2017 data-taking: High uptime with routine optical monitoring and regular source data.



Analysis of <u>open</u> data set from November 2016 to Dec 31, 2017 proceeding well.

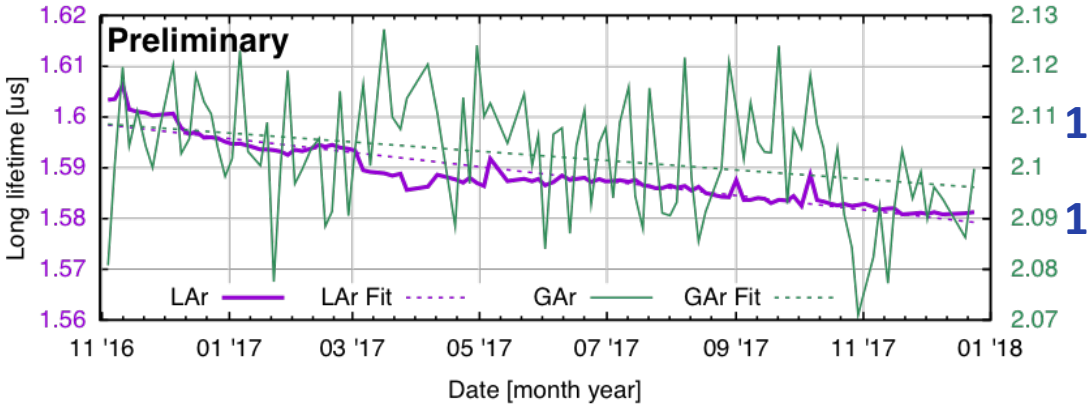
Blinding scheme imposed Jan 1, 2018.

PMT data not available for ROI in (almost all) physics data.

Nested boxes for stepped removal to test background models.

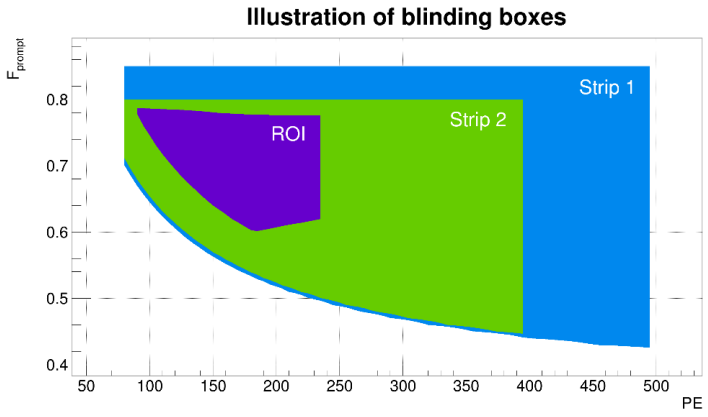
Long lifetime in LAr (triplet ⊗ TPB ⊗ …) stable without re-circulation

Nov 2016 **Jan 2018**



1.6 micro s

1.58 micro s



A global liquid argon collaboration has developed and the DEAP-3600 experiment has expanded as part of that.

A coming together of ArDM, CLEAN, DEAP, and Darkside programs:

As part of this effort, members of these other collaborations have been invited to join DEAP-3600:

- **participate in DAQ shifting**
- **participate in service analysis**
- **participate in high-level analysis**

Princeton, UMass Amherst, and INFN institutions have joined

- **includes active students and postdocs**

Has increased strength of DEAP-3600 data-taking and analysis teams.

DEAP-3600 team is in turn supplying knowledge and lessons learned to the Darkside 20t detector design. Canadians involved in depleted argon work, DAQ, neutron veto, low-background, …

Whole collaboration will work towards as 300t-scale detector.

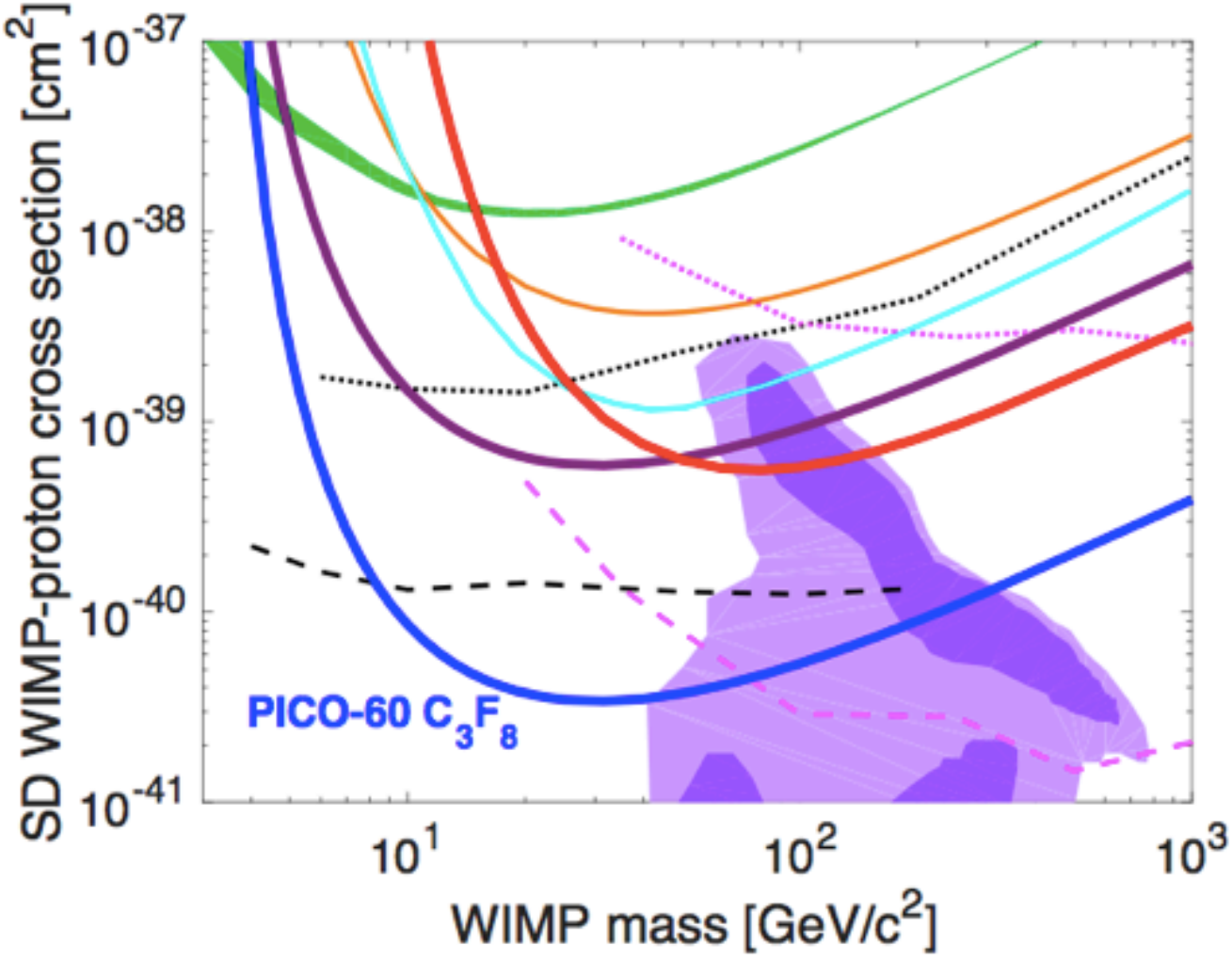
Canadians interested should contact the chair of the DEAP scientific board, Aksel Hallin (University of Alberta)

Progress on experiments

- SuperCDMS-SNOLAB: Dark matter Si / Ge crystals with ionisation / phonon readout
  - CUTE test facility in construction
  - SuperCDMS-SNOLAB CD2/3 review held last week, positive feedback.
- PICO: Rapid expansion bubble chambers. Insensitive to MIPS at operating temperature, threshold devices; alpha discrimination proven;
  - PICO-60: New results Summer 2017, additional calibration and technique tests, now being dismantled.
  - PICO-40 under construction (right-side up chamber)

First experimental infrastructure from DOE CD-process experiment (G2) SNOLAB viewed as a "location of choice"

PICO-60 Results



The 90% C.L. limit on the SD WIMP-proton cross section from PICO-60 C3F8 blue, along with limits from PICO-60 CF3I (red), PICO-2L (purple), PICASSO (green), SIMPLE (orange), PandaX-II (cyan), IceCube (dashed and dotted pink), and SuperK (dashed and dotted black)

Progress on experiments

- DAMIC CCD based dark matter detector
  - DAMIC-100 in operation. DAMIC-1k -> Modane,
  - DAMIC-CF to be provided to SNOLAB for alpha assay.
- NEWS DM detector: high pressure spherical chamber; construction in planning stages (layout underway)
- HALO Supernova neutrino detector
  - SNEWS connection made October 2015. Live to SN.

Progress on experiments

- MODCC Mining mining data
  - construction completed August 2015. Space is fully operational (2 SME)
- Genomics:
  - REPAIR low radiation environment impact on mutations underway;
  - FLAME Fruit fly metabolism tests continue with Laurentian.
- nEXO Double beta detector
  - engineering support to evaluate deployment at SNOLAB.
- Continued discussions with DOE/NSF/CFI/NSERC on double beta programme and target detector for Cryopit

Project Lifecycle Process

- All experiments now within Project Lifecycle planning
- Process is under review to maximise efficiency of taking projects through the lifecycle
  - 16 Gateway reviews held since last LPDText

Project Status Rev 04 BAM Jan-18			Phase 0 Initiation					Phase 1 Definition					Phase 1A Proposal			Phase 2 Development				Phase 3 Implementation									Phase 4 Operation	
		Risk Level					GW-0					GW-1			GW-1A				GW-2						GW-3					
Proj #	Project		EOI or Proposal	Facility Impact Assessment	EAC Assessment	General Terms & Conditions & MOUs	Initiation Approval	Road Map	Conceptual Design	Conceptual Design Review	Space Allocated	Space Approval	Preliminary Design	Preliminary Design Review	Proposal Approval	Final Design	Technical Design Review	Deliverables & Liability Agreements	Deployment Approval	Installation Plan	Installation Review	Installation Approval	Installation	Safety Report, Ops Man, Emerg P&Ps	External Reviews & Approvals	Operational Readiness Review	Operations Approval	Commissioning	Operation
007	HALO	Low	Yes	WNBD	Yes		Yes	WNBD	Yes	Yes	Yes	Yes	N/R	N/R	N/R				Yes			Yes					Yes		Running
030	DAMIC	Low	?	WNBD	?		Yes	WNBD	Yes	Yes	Yes	Yes	N/R	N/R	N/R				Yes			Yes					Yes		Running
019	PICO-60	Med	Yes	WNBD	Yes		Yes	WNBD	Yes	Yes	Yes	Yes	N/R	N/R	N/R				Yes			Yes					Yes		
019-A	PICO-40	High	Yes	Yes	Yes	IP		Yes	Yes	Yes	Yes	Yes	N/R	N/R	N/R				Yes										
033	PICO-2L	Low	?	WNBD	?		Yes	WNBD	Yes	Yes	Yes	Yes	N/R	N/R	N/R				Yes			Yes					Yes		
041	REPAIR	Low	Yes	Yes	N/A		IP	Yes	Yes	Yes	Yes	IP	N/R	N/R	N/R				Yes			Yes					Yes		Running
042	FLAME		Yes		N/A		Yes		Yes	Yes	Yes	Yes	N/R	N/R	N/R				Yes			Yes					Yes		Running
020	DEAP-3600	High	Yes	WNBD	Yes		Yes	Yes	Yes	Yes	Yes	Yes	N/R	N/R	N/R		WNBD		Yes			IP	Yes	Yes	Yes	Yes	Yes		Running
023	MiniCLEAN	High	Yes	WNBD	Yes		Yes	Yes	Yes	Yes	Yes	Yes	N/R	N/R	N/R		WNBD		Yes			Yes	IP	Yes	Yes	Yes	Yes	Yes	
013	SNO+	High	Yes	WNBD	Yes	IP	Yes	Yes	Yes	Yes	Yes	Yes	N/R	N/R	N/R		IP	IP	Yes			Yes	IP	IP	IP	IP			
013-A	SNO+ TeA	High	OCBE	WNBD	N/A	IP	OCBE	Yes	Yes	Yes	Yes	Yes	N/R	N/R	N/R	IP	Yes	IP	Yes			Yes	IP						
013-B	SNO+ Te-Diol		OCBE	WNBD	N/A	IP	OCBE	Yes	Yes	Yes	Yes	IP	N/R	N/R	N/R	IP		IP	IP	IP	Yes	Yes	IP						
001	SuperCDMS-SNOLAB	High	Yes	WNBD	Yes	Yes	OCBE	Yes	Yes	Yes	IP	Yes	N/R	N/R	N/R	IP		IP	IP										
044	CUTE	Low	Yes	Yes	N/A		Yes	Yes	Yes	Yes	Yes	Yes	N/R	N/R	N/R	IP		IP	Yes		Yes								
038	NEWS-G	Med	Yes	Yes	Yes		Yes	Yes	IP	Yes	Yes	Yes	N/R	N/R	N/R	IP													
040	DMTPC	Low/Med	Yes	Yes	N/A		IP	IP					N/R	N/R	N/R														
032	nEXO	High	Yes		Yes		Yes	Yes						R	R														
045	PICO-500	Med/High	Yes	Yes	Yes		Yes	Yes			Yes		R	R	R														
046	DUST	Low	Yes	Yes	Yes		Yes						R	R	R														

Community Strategic Planning

- SNOLAB CFI MSI requirement includes development of strategic plan beyond 2022
- Engagement this year with community to develop (Future Projects Meeting)
- Following first community meeting (at inauguration) McDonald Institute developing ‘Snowmass’ type process

Planning for CFI IF round

To: Canadian SNOLAB Research Community

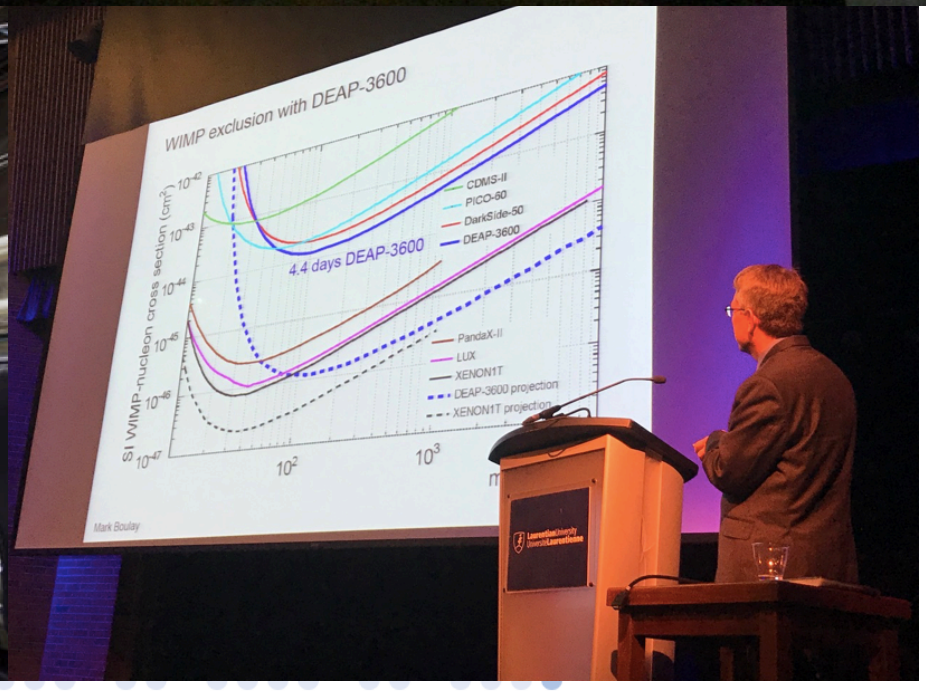
From: Richard Ford, Director Program Development, SNOLAB

SNOLAB Project Proposals to next CFI IF Competition

This note is to clarify the timeline and requirements for any potential SNOLAB based applications to the anticipated 2019 Canada Foundation for Innovation (CFI) Innovation Fund (IF) competition. Following the most recent federal budget allocation to CFI, we now anticipate an Innovation Fund competition launching in late 2018, with probable submission deadline being the summer of 2019.

Applications for CFI IF funds for SNOLAB based projects are required to undergo a top-level review by SNOLAB (the gateway GW-1A review) and then be supported by a letter from SNOLAB to CFI. Progression to this point in the project lifecycle process is required and will ensure a strengthened CFI application, including a reviewed conceptual design, agreement on scope and deliverables, a work breakdown structure, a preliminary resource-loaded schedule, and cost-estimated budget.

Outreach and Engagement



Lab Co-ordination efforts

- Co-ordination efforts between deep underground facilities are strengthening
  - LNGS/SNOLAB initiated G7 GRO GRI proposal
    - https://www.bmbf.de/files/151109_G7_Broschere.pdf
  - DULIA: attempt for EU coordination (funding) between LNGS, LSC, Boulby, LSM, CallioLab
  - Coordination and links on outreach and comms
    - LNGS/LSC deploying muon counters available to public
  - Sharing of best practice
    - Developing in operational matters, EH&S, expt. management, expt. reviews, governance
    - low background counting/assay (LRT series), shared databases
  - Sharing of work loads
    - 'blitzes' on low background counting
  - Can this extend to science projects?
    - e.g. Cygnus distributed array of detectors for DM
- IUPAP WG9 and Neutrino Panel w/ inclusion of $0\nu\beta\beta$
  - Forms a major part of the drivers for deep underground facilities as **infrastructure** for the delivery of this science field
  - Connecting to ApPIC working group

Global Argon Collaboration

- An example of the deep underground laboratories coordinating together to support a major community global initiative
  - LNGS, LSC, SNOLAB supporting assay programme
  - Coordinated approach for UAr extraction, assay and storage
  - Coordinating with collaboration on engaging funding agencies

Deep underground laboratory support for global collaboration towards discovery of dark matter utilising liquid argon detectors.

To whom it may concern;

As hosts of the existing operational liquid argon direct dark matter detectors, and as proponents and supporters of the Underground-GRI initiative, the LNGS, SNOLAB and LSC deep underground research facilities are pleased to recognize the collaborative developments within the global liquid argon dark matter community. The DarkSide project at LNGS, the DEAP project at SNOLAB and the ArDM project at LSC are all developing new technologies and capabilities to search for WIMP dark matter, and are beginning to coalesce into one collaboration to develop future, larger generations of liquid argon direct dark matter detectors. We encourage and support the development of this global community, with a focus on the development of DarkSide-20k at LNGS in the first instance, and a larger detector at a location to be determined from scientific requirements, in the future. Using available assay and research infrastructure, the three deep underground research facilities will support the activities and development of the various generations of liquid argon detectors.

Stefano Ragazzi
Director, LNGS

Aldo Ianni
Director, LSC

Nigel J.T. Smith
Director, SNOLAB

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SNOLAB

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Executive Director

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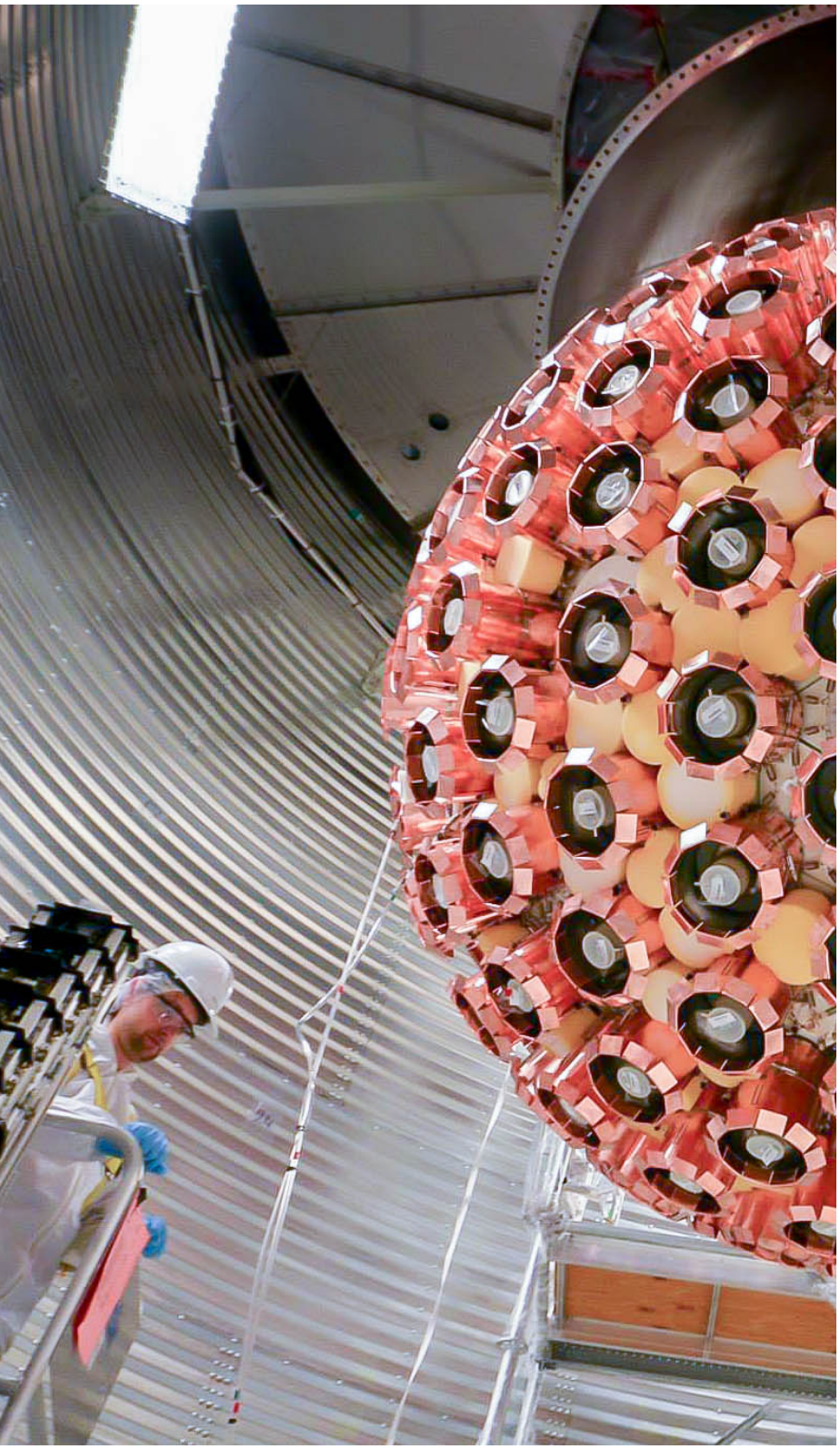
Recruiter	SNOLAB
Location	Ontario (CA)
Posted	Tuesday, 5 June 2018
End of advertisement period	Thursday, 5 July 2018
Job Type	Senior Management & Heads of Department, Directors
Contract Type	Permanent
Hours	Full Time

Executive Director, SNOLAB

SNOLAB is a unique, world-class, international facility for deep underground scientific research. Located 2km underground in the Vale Creighton mine, near Sudbury, Ontario, SNOLAB hosts a suite of science facilities including a 5000m2 underground clean room and surface laboratories. The science programme at SNOLAB is primarily focussed on subatomic and astroparticle physics, specifically the search for dark matter and neutrino studies.

The vision of SNOLAB is to be the partner of choice for underground physics, providing world-class infrastructure and thereby delivering world-class science. To realize this vision, our mission is to enable, spearhead, catalyze and promote underground science, whilst inspiring both the public and future professionals in the field. To deliver the mission, and place SNOLAB in a position to realize the long-term vision, four goals have been identified, with associated objectives and critical



SNOLAB ED Search Committee

Dr. Reiner Kruecken, TRIUMF (Chair)
Dr. Clarence J. Virtue, Laurentian University
Dr. Laura Baudis, University of Zurich
Dr. David Sinclair, Carleton University
Mr. Mike Headley, SURF
Dr. Katherine Freese, University of Michigan
Ms. Mary Purcell, Queen's University
Dr. Aksel Hallin, University of Alberta
Prof. Dean Chapman, Canadian Light Source
Ms. Julie Moskalyk, Science North | SNOLABI Board
Dr. Soo-Bong Kim, Seoul National University
Ms. Stephanie Simpson, Queen's University

SNOLAB ED Search: Timeline

February 2018	Search Committee struck
June 2018	Advertisements placed
Summer 2018	Short-list prepared
Summer 2018	Candidates contacted and preliminary interviews
Fall 2018	Presentations at SNOLAB, Consultation with stakeholders
Fall 2018	Offer and negotiations with successful candidate
June 1, 2019	New Director starts (some overlap anticipated)

My Term ends: July 31, 2019…

Questions?