

# SNOLAB Facility & Science Programme Update

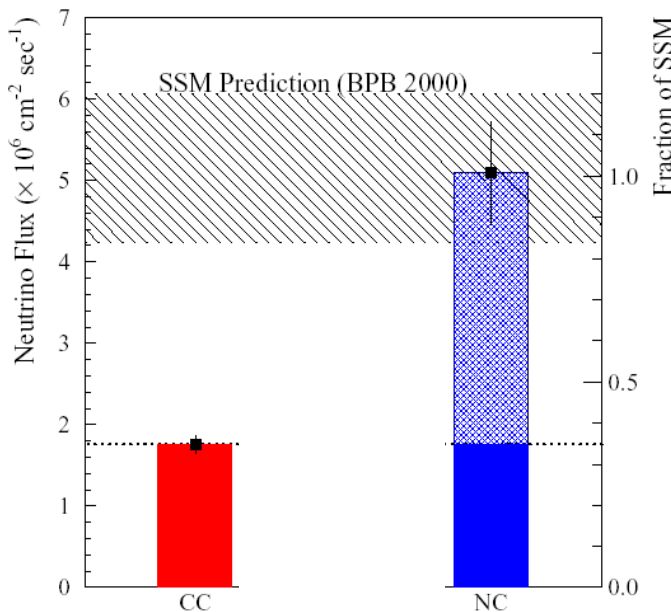
Nigel J.T. Smith  
Director, SNOLAB

- Brief update on the Science Programme
- The SNOLAB Community
- Update on SNOLAB Process
  - Facility Developments
  - Organisation
  - Project lifecycle
  - Funding status
  - Strategic planning

# Continuing the legacy...



**SOLAR  
MODEL**



**ELECTRON  
NEUTRINOS**

**ALL NEUTRINO  
TYPES**

**Excellent  
Agreement  
With the  
Solar Model  
Calculations**

**LESS THAN ONE  
CHANCE IN 10  
MILLION  
FOR “NO  
CHANGE IN  
NEUTRINO  
TYPE”**

**A CLEAR DEMONSTRATION NEUTRINOS CHANGE THEIR TYPE:  
2/3 OF THE ELECTRON NEUTRINOS HAVE CHANGED TO MU, TAU  
NEUTRINOS ON THE WAY FROM THE SOLAR CORE TO EARTH. THIS  
REQUIRES THAT THEY HAVE A FINITE MASS.**





# Current Science 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	Commissioning
DEAP-50T/CLEAN		√		Cube Hall	Letter of Intent
DMTPC		√		Ladder Labs	Concept Phase
DUST			Test Facility	Ladder Labs	Letter of Intent
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
PSB			Genomics	External Drifts	Operational
PUPS			Seismicity	Various	Completed
REPAIR			Genomics	Chem Labs	Operational
SuperCDMS		√		Ladder Labs	In Preparation
SNO+	√			SNO Cavern	Commissioning



# Progress on experiments



- SNO+: Uses existing SNO detector.
  - Heavy water replaced by scintillator loaded with  $^{130}\text{Te}$ . Modest resolution compensated by high statistical accuracy. ( $^{130}\text{Te} \rightarrow ^{130}\text{Xe} + e^- + e^-$ )
  - LAB process plant construction completed, commissioning underway. Cavity fill underway (leaks fixed, “float-the-boat” concluded), Te plant in development.
- DEAP-3600: Single phase Liquid Argon using PSD
  - target construction complete, cooling underway, expect argon fill in the next three weeks. All ancillary systems complete.
- MiniCLEAN: Single Phase Liquid Argon using PSD
  - target construction complete, cool-down underway. Ancillary systems complete.
- SuperCDMS-SNOLAB: Dark matter Si / Ge crystals with ionisation / phonon readout
  - Planning well advanced for deployment, new test facility (CUTE).
- PICO: Rapid expansion bubble chambers. Insensitive to MIPS at operating temperature, threshold devices; alpha discrimination proven;
  - PICO-60: New results posted (arXiv:1510.07754) New chamber and target fluid in deployment.
  - PICO-2: New science results posted (arXiv:1601.03729), background identified. New run underway.

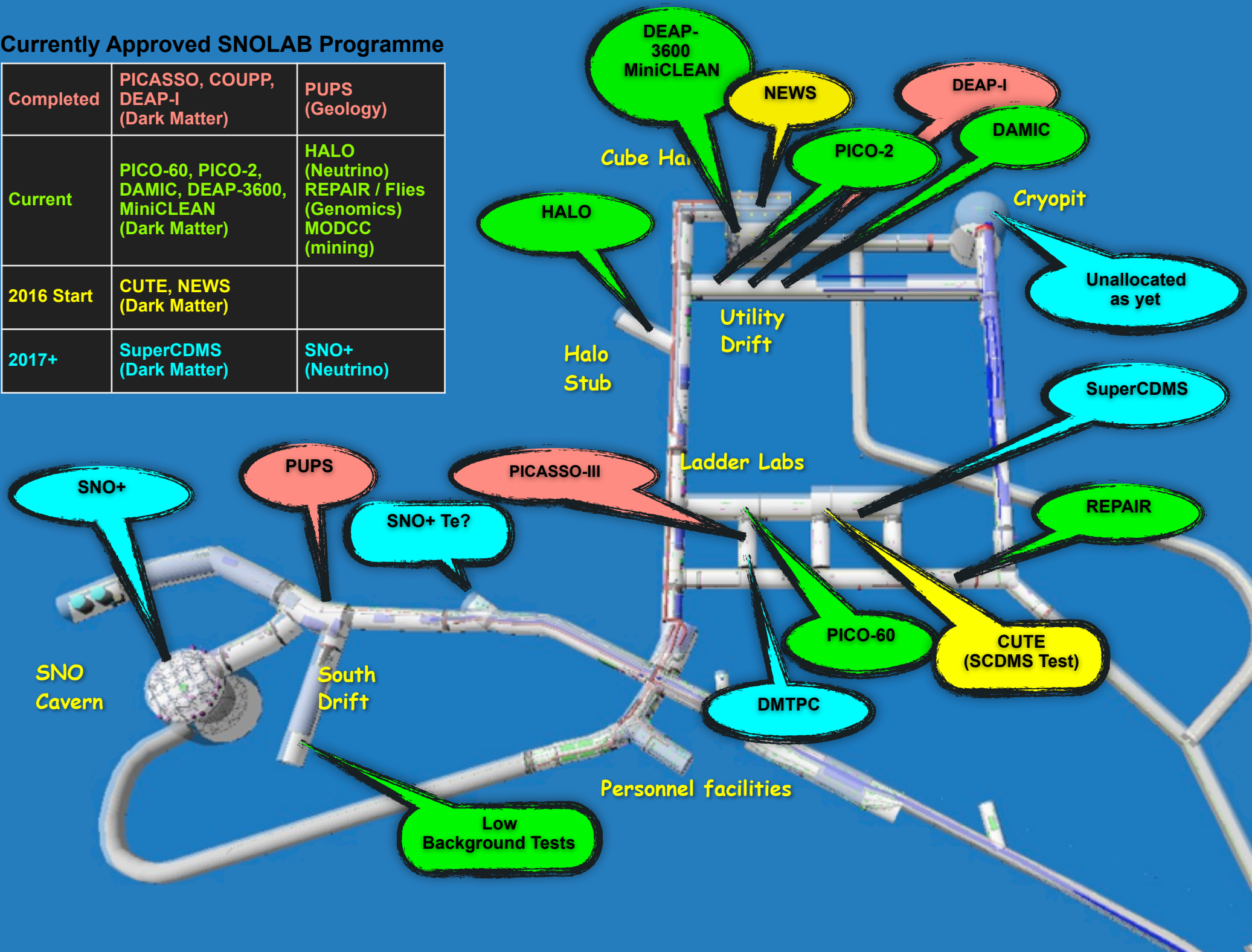
# Progress on experiments



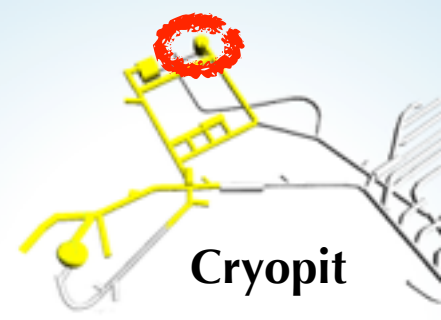
- DAMIC CCD based dark matter detector
  - Initial science run complete (arXiv:1510.02126), first 100g prototypes installed, upgrade underway.
- NEWS DM detector: high pressure spherical chamber; planning underway
- DMTPC DM directional detector: planning underway
- HALO Supernova neutrino detector
  - SNEWS connection made October 2015. Live to SN.
- MODCC Mining mining data
  - construction completed August 2015. Space is fully operational.
- Genomics:
  - Low radiation environment impact on mutations, NSERC funded project in development with NOSM;
  - Fruit fly metabolism tests complete with Laurentian. New tests planned.
- nEXO Double beta detector
  - engineering support to evaluate deployment at SNOLAB.

Currently Approved SNOLAB Programme

Completed	PICASSO, COUPP, DEAP-I (Dark Matter)	PUPS (Geology)
Current	PICO-60, PICO-2, DAMIC, DEAP-3600, MinicLEAN (Dark Matter)	HALO (Neutrino) REPAIR / Flies (Genomics) MODCC (mining)
2016 Start	CUTE, NEWS (Dark Matter)	
2017+	SuperCDMS (Dark Matter)	SNO+ (Neutrino)

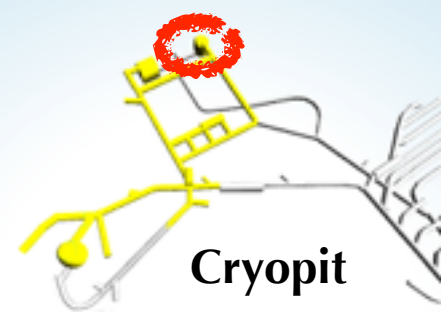






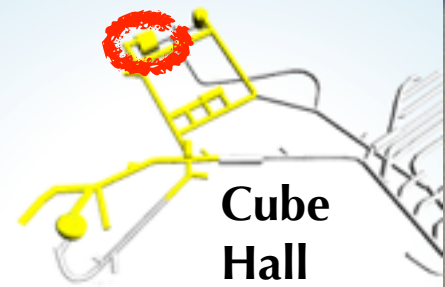
Cryopit





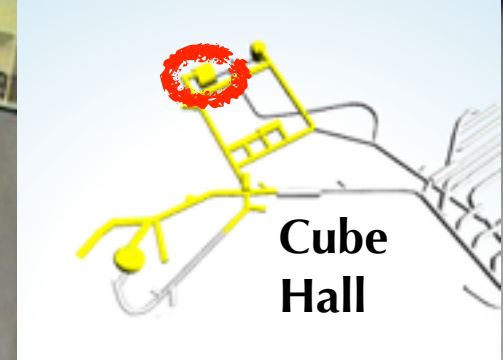
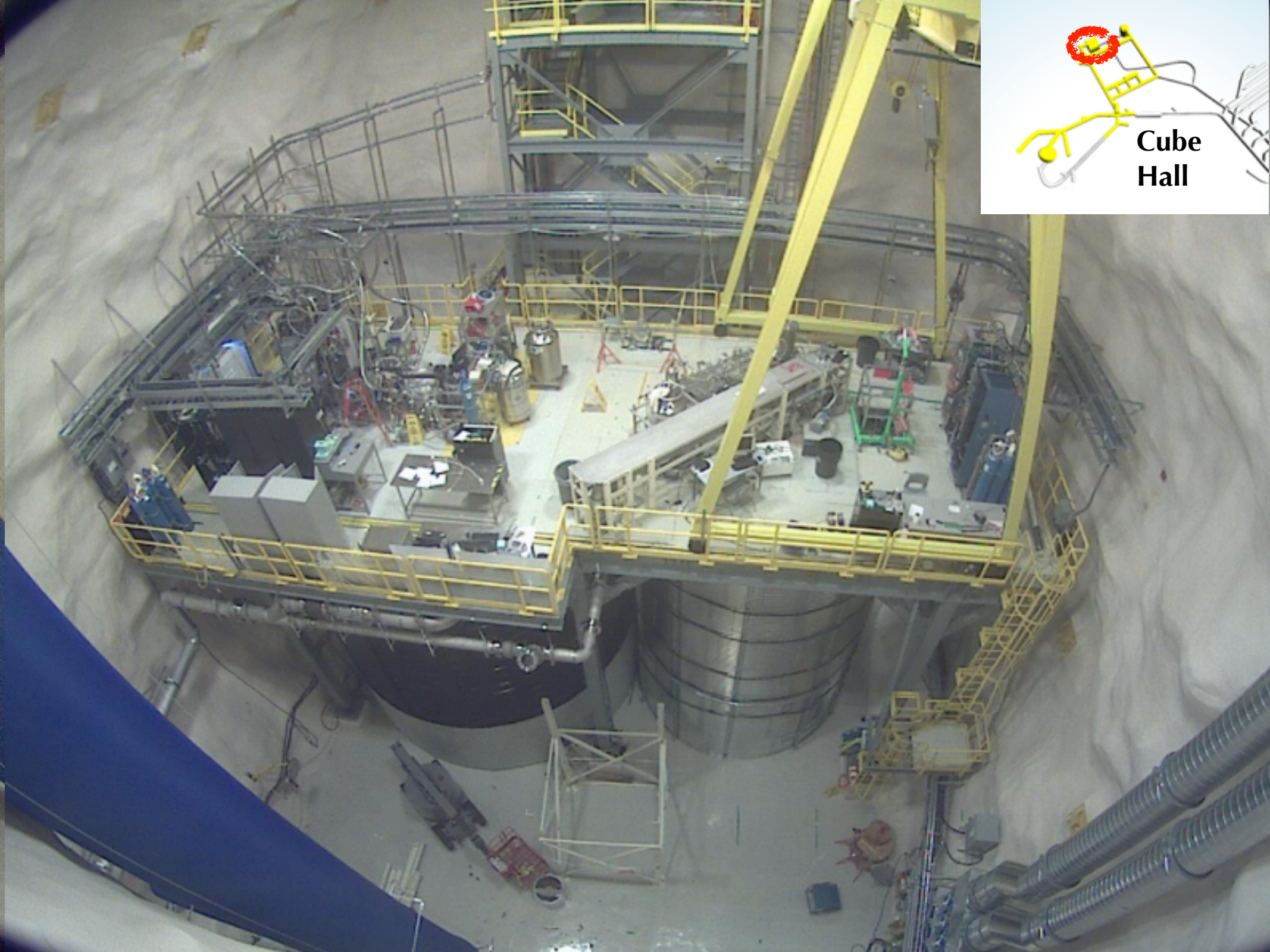
Cryopit



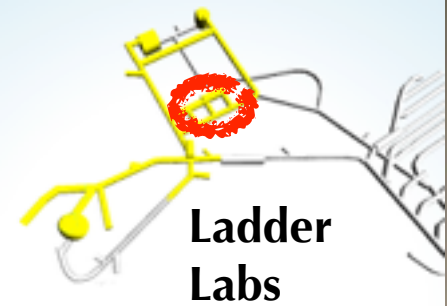


Cube  
Hall



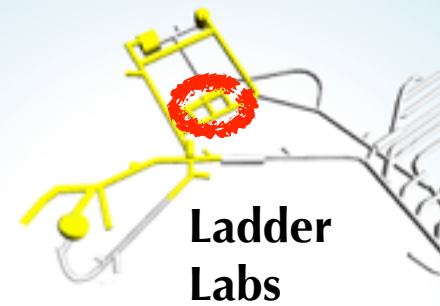


Cube Hall



**Ladder  
Labs**



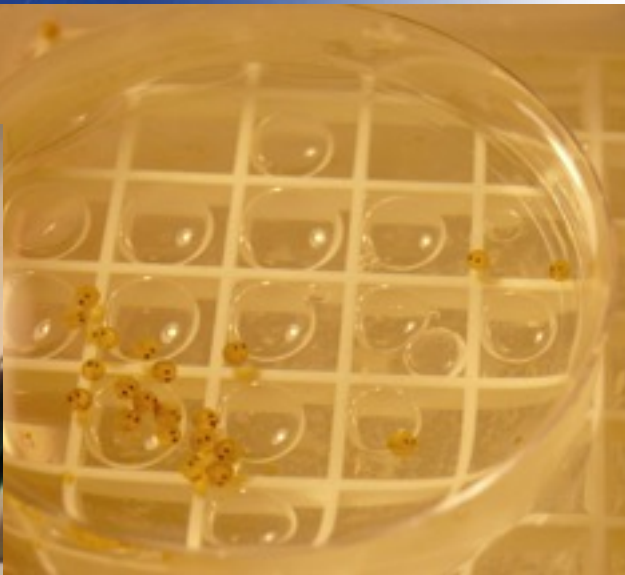




# New Directions

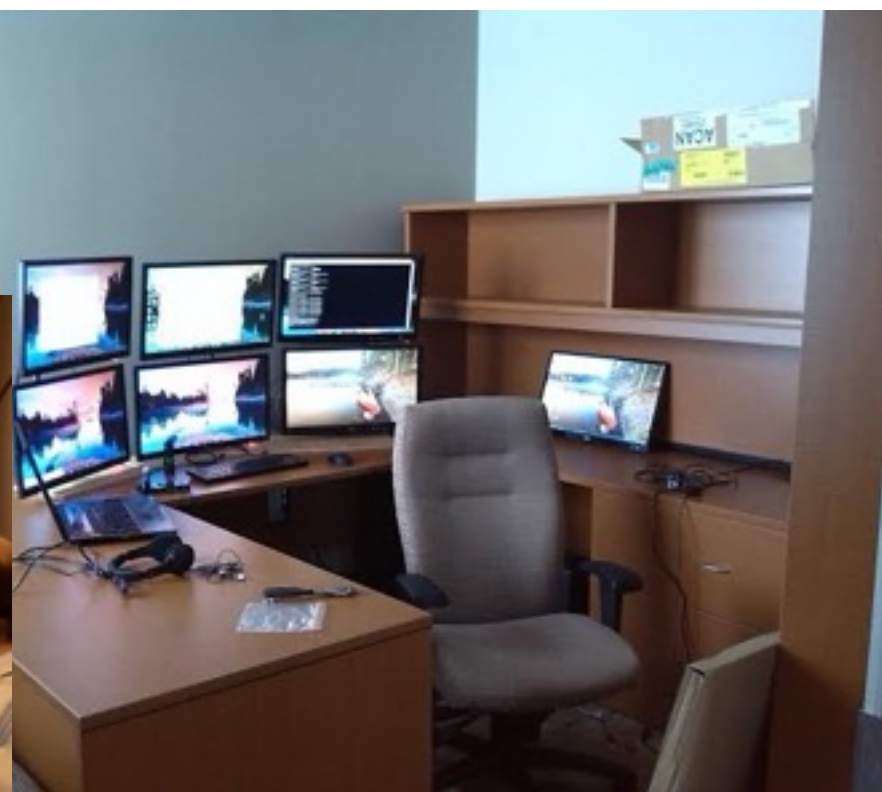


REPAIR: Low radiation genomics tests



MODCC: First occupant (Revolution) optimising mining operations

Nigel J.T. Smith



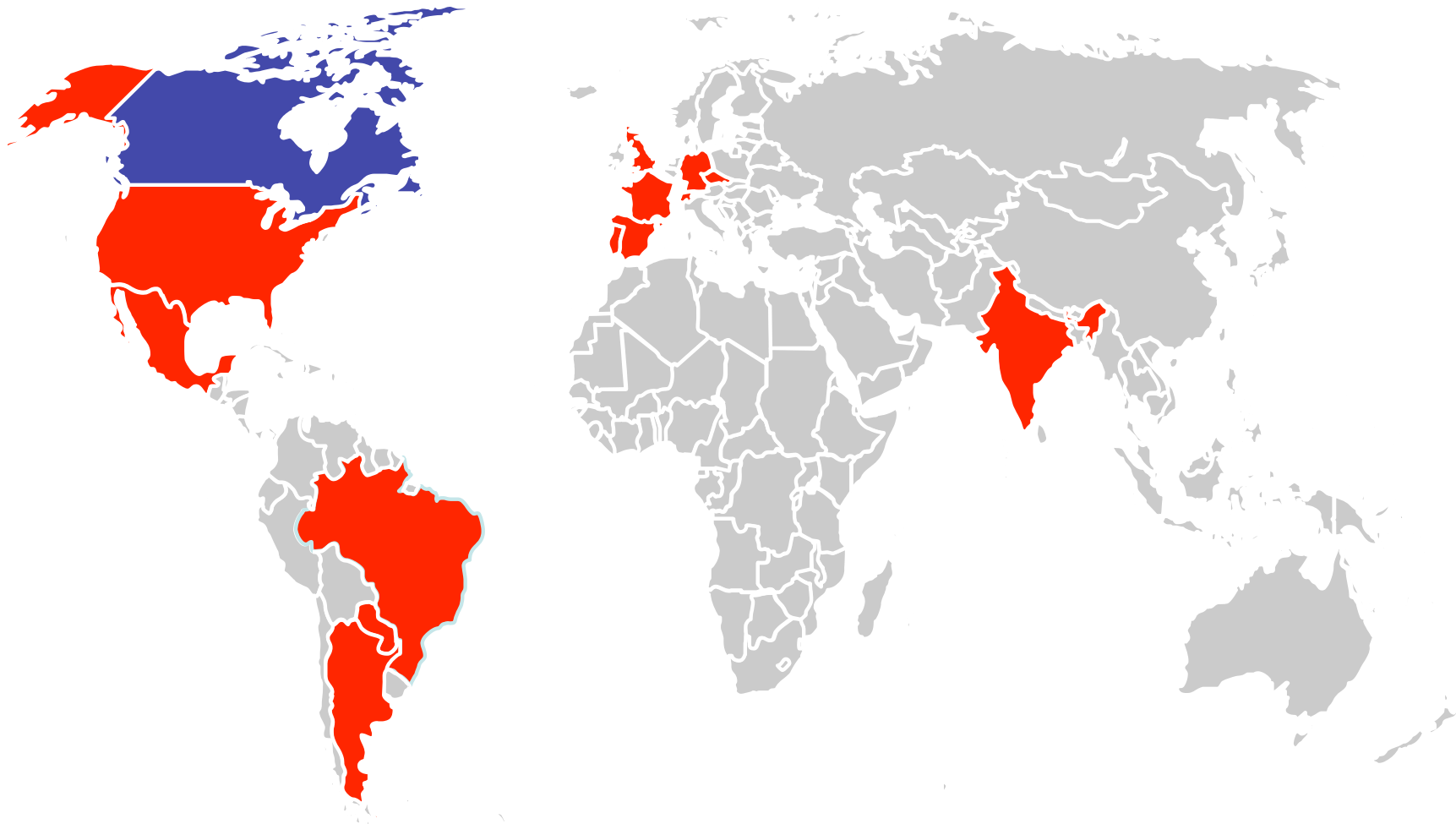
Ottawa

12<sup>th</sup> June, 2016

# Community supported



- 164 faculty researchers from 78 institutions over 15 countries
  - ~25% of faculty are Canadian
- >500 faculty, highly qualified personnel and technical support
- ~11,000 underground person-shifts per year (~50/dayshift)



# Underground visits



- Underground visits by category
  - SNOLAB Staff
  - Facility Users and Contractors
  - Visitors (inc. untrained users)
- Steady increase from 2011/12, almost to double number of shifts
- All driven by increase in user (and visitor) shifts
  - Illustration of “enhanced capacity for innovation”

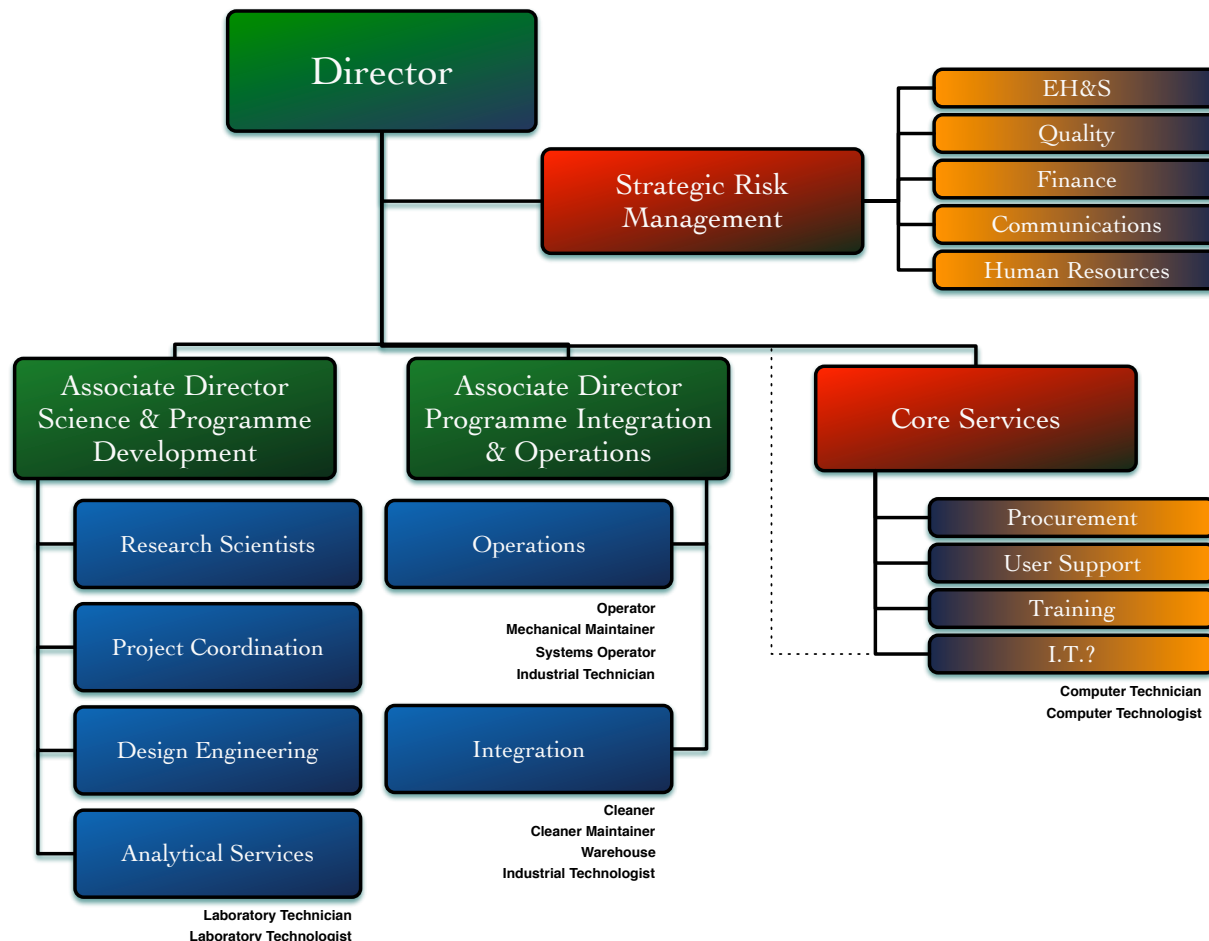
	2011/12	2012/13	2013/14	2014/15	2015/16
Staff	5000	5369	5172	4868	4900
Users	1400	2384	4371	4531	4864
Visitors	509	984	1001	1003	964
TOTAL	6909	8737	10544	10401	10748



# SNOLAB Structure



- Internal reorganisation to better support projects through project phases implemented
- Includes development of Strategic Risk Group, reporting directly to the Director



# Space developments



- Cryopit
  - Experiment not yet defined (process underway)
- Bio/Chemlab under discussion with genomics teams from NOSM
- Low background lab reprioritised and broken into two phases
  - HPGe Systems
  - Additional capabilities which are under review and finding request



# Progress on facility systems



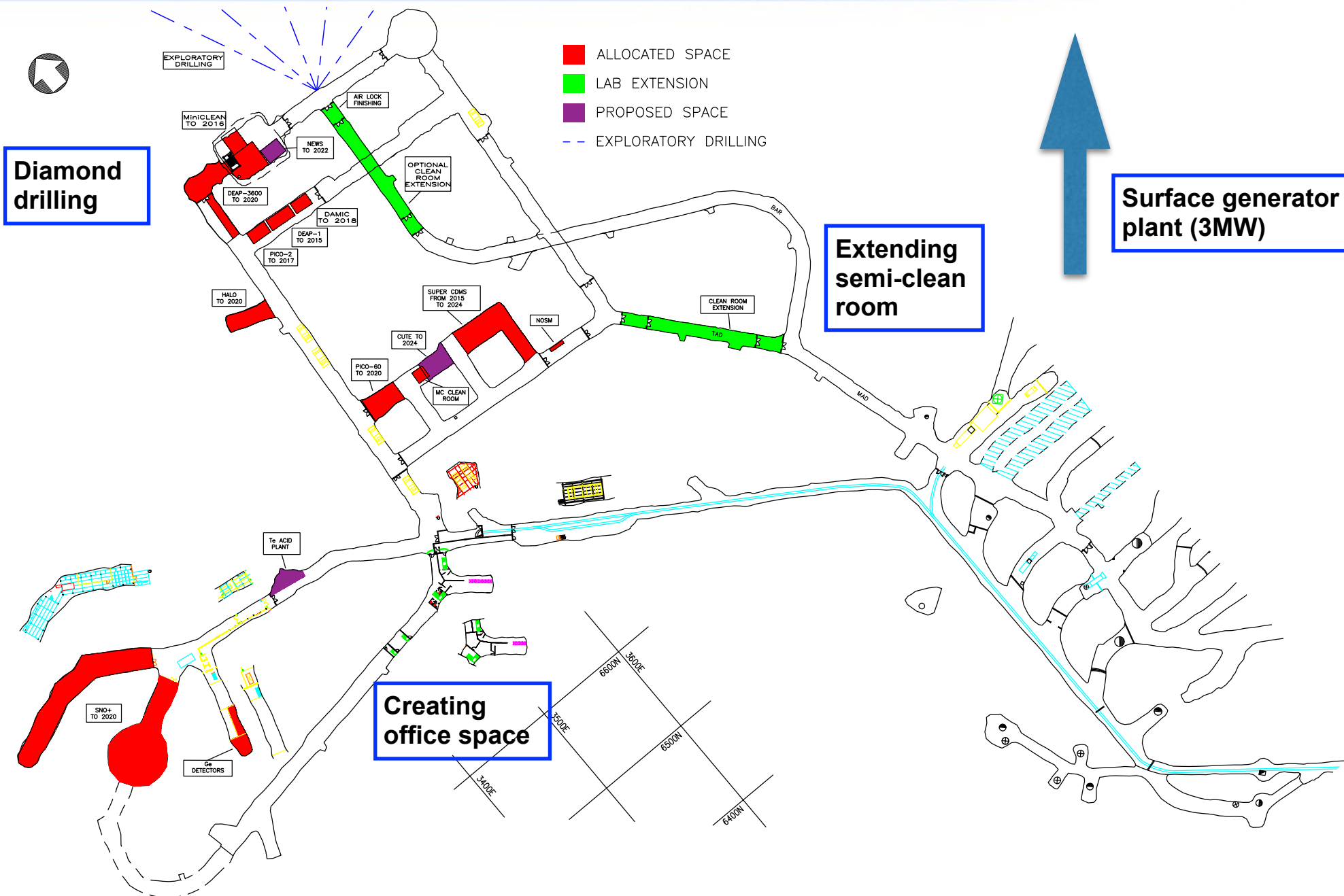
- SNOLAB Infrastructure:
  - Facility projects given reduced priority to focus on experiments
    - Low background capabilities recently increased in priority due to community needs and review feedback
  - MODCC project provided funds to refurbish surface facility third floor to provide a new research deck
  - Capital infrastructure secured for surface generator plant emergency power, in final discussion with Vale
- SNOLAB Processes:
  - Overhaul of SNOLAB operational policies/procedures continues
  - Experiment lifecycle management now implemented including gateways, with required reviews at each stage to ensure clear understanding of resource requirements



# New Research Deck is open



# Lab developments

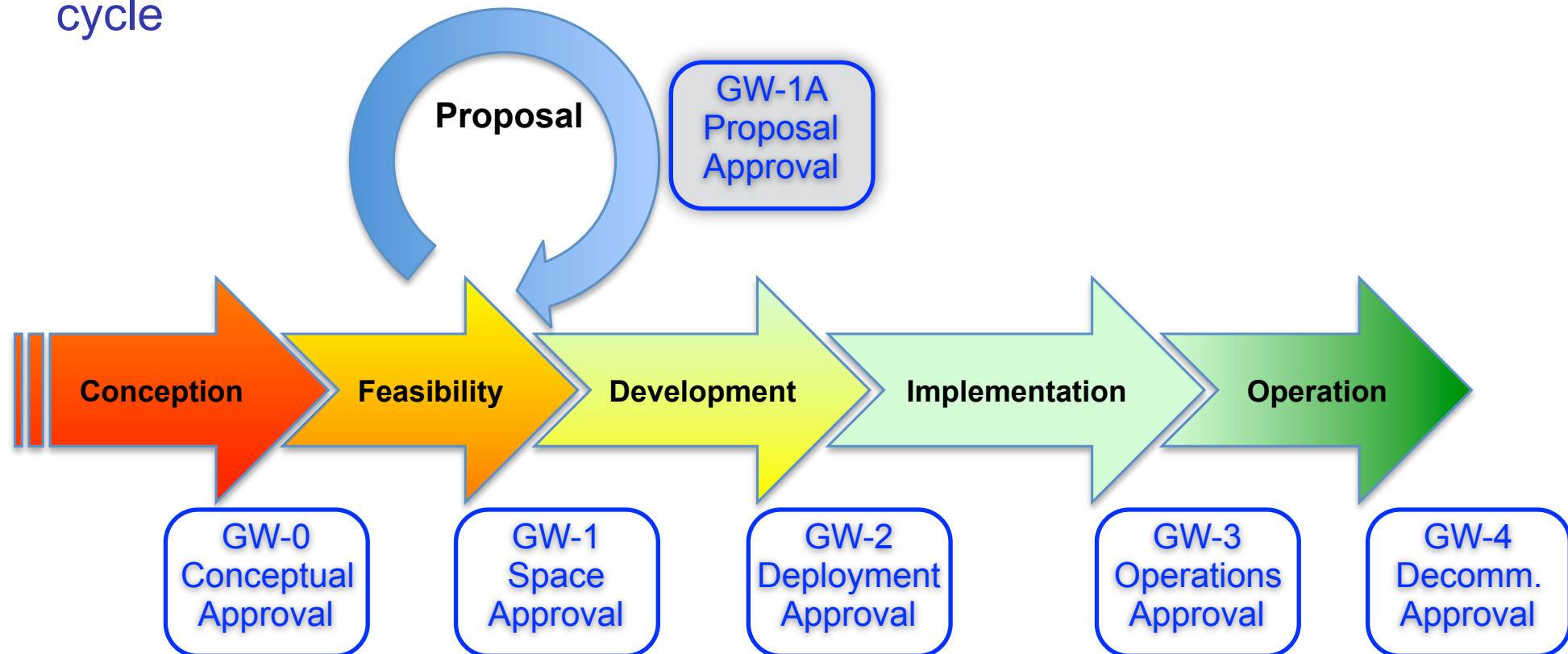




# Life Cycle Phases



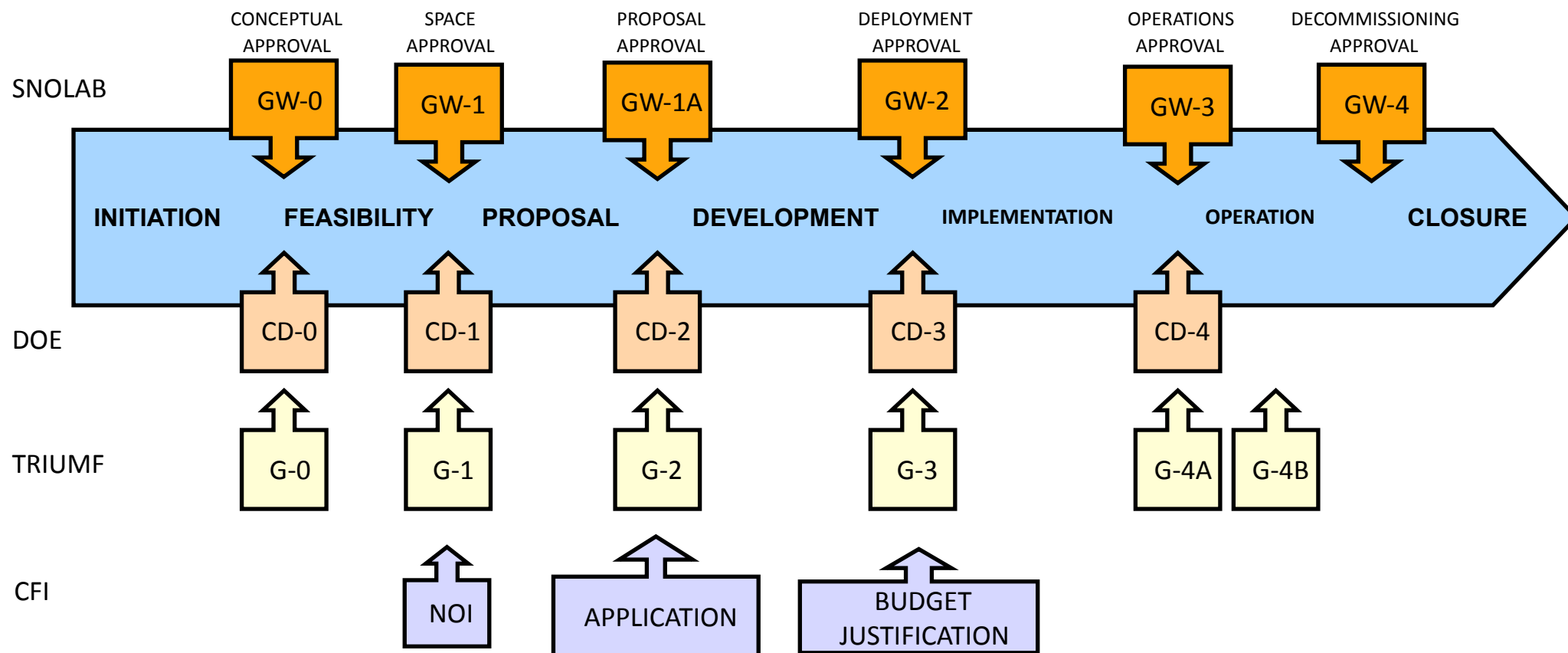
- Process implemented Fall 2015; aligns with DOE and TRIUMF
- Each phase leads to a GateWay, prior to passing to next phase
- SNOLAB Projects Office supports projects through the process; all projects have a project coordinator assigned
- Expressions of Interest accepted at any time, natural EAC biannual cycle



# Alignment with Other Processes



- The SNOLAB Life cycle aligns with other institution and agency processes including the US Department of Energy, TRIUMF, CFI.
- A key difference is that many other processes end at the beginning of operation of the Project while the SNOLAB process continues through decommissioning.



# Current Status



- All projects need to be included in life cycle process (CFI requirement as well as good practice)
- CFI IF proposals need to complete GW-1A prior to submission

Proj #	Project	GW-0	Phase 1	GW-1	Phase 1A	GW-1A	Phase 2	GW-2	Phase 3	GW-3	Phase 4	GW-4	Phase 5	
		Initiation Approval	Definition	Space Approval	Proposal	Proposal Approval	Development	Deployment Approval	Implementation	Operations Approval	Operation	Decommissioning Approval	Closure	End
025	PUPS													
019	COUPP-4													
012	PICASSO													
018	DEAP-1													
007	HALO										Running			
030	DAMIC										Running			
019	PICO-60										Running			
033	PICO-2L										Running			
041	REPAIR										Running			
042	Flys in a Mine										Running			
020	DEAP-3600													
023	MiniCLEAN													
013	SNO+													
013-A	SNO+ TeA													
013-B	SNO+ TeDiol													
001	SuperCDMS-SNOLAB													
038	NEWS													
040	DMTPC													
044	CUTE													
045	PICO-500													
046	DUST													
037	Ge-1T?													
032	nEXO													



- SNOLAB Proposal to CFI MSI programme is in review
  - Five year funding proposal April 2017 - March 2022
  - Proposal submitted April 21st, face to face review last Tuesday
  - Result to be know third week September
  - Similar timescale as (hoped for) Queen's CFREF proposal
  - Matching funds: Ontario Province Ministry Research & Innovation, Vale
- Additional funding requests made
  - Staff: additional project coordination and management
  - Staff: additional research scientists capability
  - Staff: additional expert plant operations and supervision
  - Staff: additional experiment and analytics support
  - Non-staff: low background assay capability
  - Non-staff: additional redundancy on power distribution systems (to augment generator plant)
  - Support for anticipated change in governance model (incorporation)

# Community Feedback



- SNOLAB is looking for community input
- Low background capability
  - Richard Ford co-ordinating ([richard.ford@snolab.ca](mailto:richard.ford@snolab.ca))
  - Planning new low background lab and detectors
  - What does the community need?
- Strategic Plan 2017 - 2022
  - Next strategic plan is in development
  - Will define objectives for SNOLAB to 2022
  - Aim to conclude by end September
  - Community engagement through a steering group
    - Chaired by Hiro Tanaka, U of Toronto
    - Web based survey concluded
    - Town Meeting, April 1st
  - Please let us have your thoughts!





# Community Input Steering Group



Member	Institute	Representative of
Hiro Tanaka (Chair)	University of Toronto	Physics community
Isabelle Blain	Formally NSERC VP	External stakeholders
Cliff Burgess	Perimeter Institute	Theory community
Doug Boreham	Laurentian / NOSM	Genomics community
Gabriel Orebi Gann	Berkeley University	Physics community (international)
Christine Kraus	Laurentian University	Local community
Aksel Hallin	University of Alberta	SNOLAB Board
Reiner Kruecken	TRIUMF	National facilities
Tony Noble	Queen's University	CFREF
Jocelyn Munroe	Royal Holloway, London	Physics community (international)
Isabel Trigger	TRIUMF	SNOLAB EAC
Nigel Smith (ex officio)	SNOLAB	
Blaire Flynn (ex officio)	SNOLAB	
Sonya Shorey	Consultant	

The SNOLAB Strategic Plan Steering Committee is asked to:

- engage, and solicit input to the Strategic Plan from, the SNOLAB scientific community;
- distil the community input into a coherent view, presented to the SNOLAB Director as a 'community input report';
- inform the construction of the Strategic Plan to ensure the community view is fulfilled.

# Our current Strategic Goals



- Enable and spearhead world-class underground science

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

- Develop and maintain world-class facilities and infrastructure

To ensure SNOLAB remains at the forefront of infrastructure provision for underground science.

- Educate, inspire and innovate

To develop broad economic impact to Canada and our surrounding region by educating and inspiring through both public and professional outreach, developing highly qualified personnel and delivering innovative solutions through the use of small and medium scale enterprises.

- Develop delivery systems of internationally recognised standard

To develop SNOLAB internal quality management and delivery processes, and the connections to the experiments, through internationally recognised practices and processes to ensure efficient and effective management of resources and exemplary safety standards.



# Wall Art



*Our Strategic Goals are to:*

- Enable and spearhead world-class science
- Develop infrastructure for world-class science
- Promote world-class science and inspire the next generation
- Develop world-class processes



# Programme and Future Perspectives



- SNOLAB science programme developing well:
  - New results from PICO and DAMIC in the last year
  - DEAP-3600 about to fill
  - MiniCLEAN cooling
  - SNO+ water fill in progress, rope systems tested
  - LAB plant for SNO+ completed, final commissioning
  - SNO+ TeA systems in final design
  - New projects in genomics, mining engineering
- SNOLAB infrastructure and processes under continued development
  - New surface research deck
  - New project management process implemented
- Quinquennial funding proposal under review
  - Results this Fall
  - (Also awaiting next stages of CFREF process)