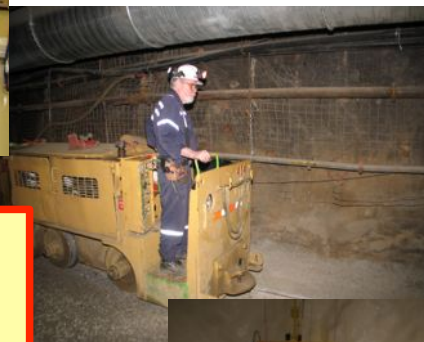
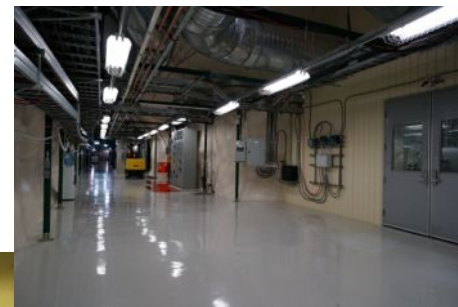




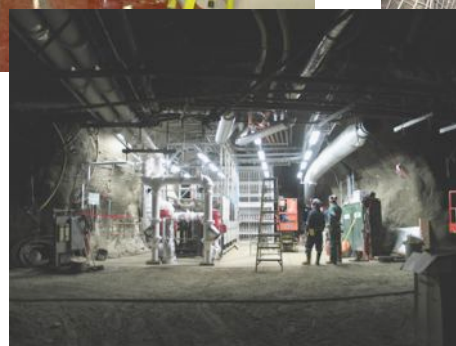
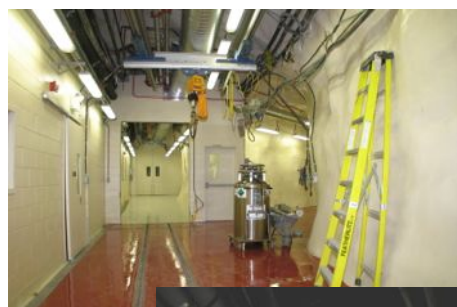
Overview of the SNOLAB Facility and The Current Program Evolution

Fraser Duncan

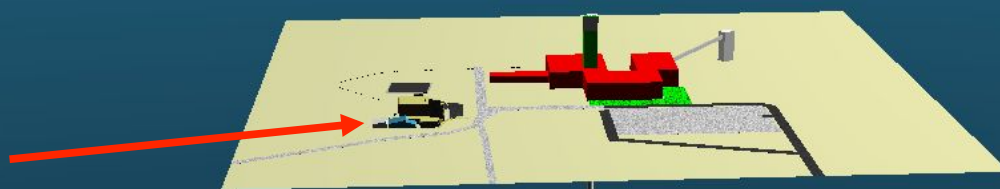
SNOLAB Future Projects Workshop 20-21 Aug 2013



SNOLAB Facility

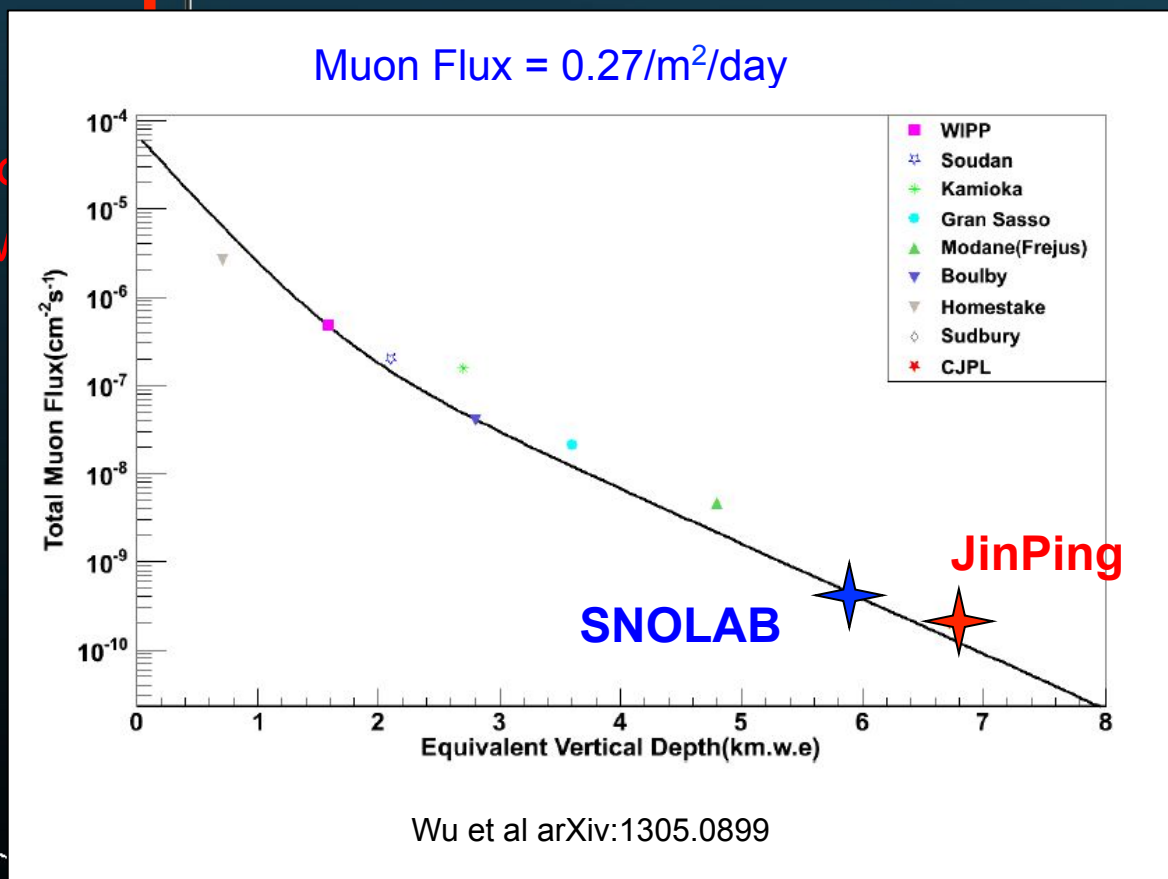
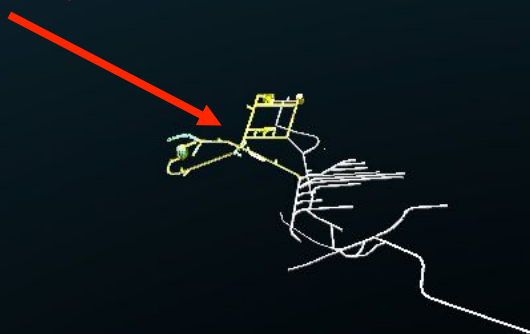


Surface Facility

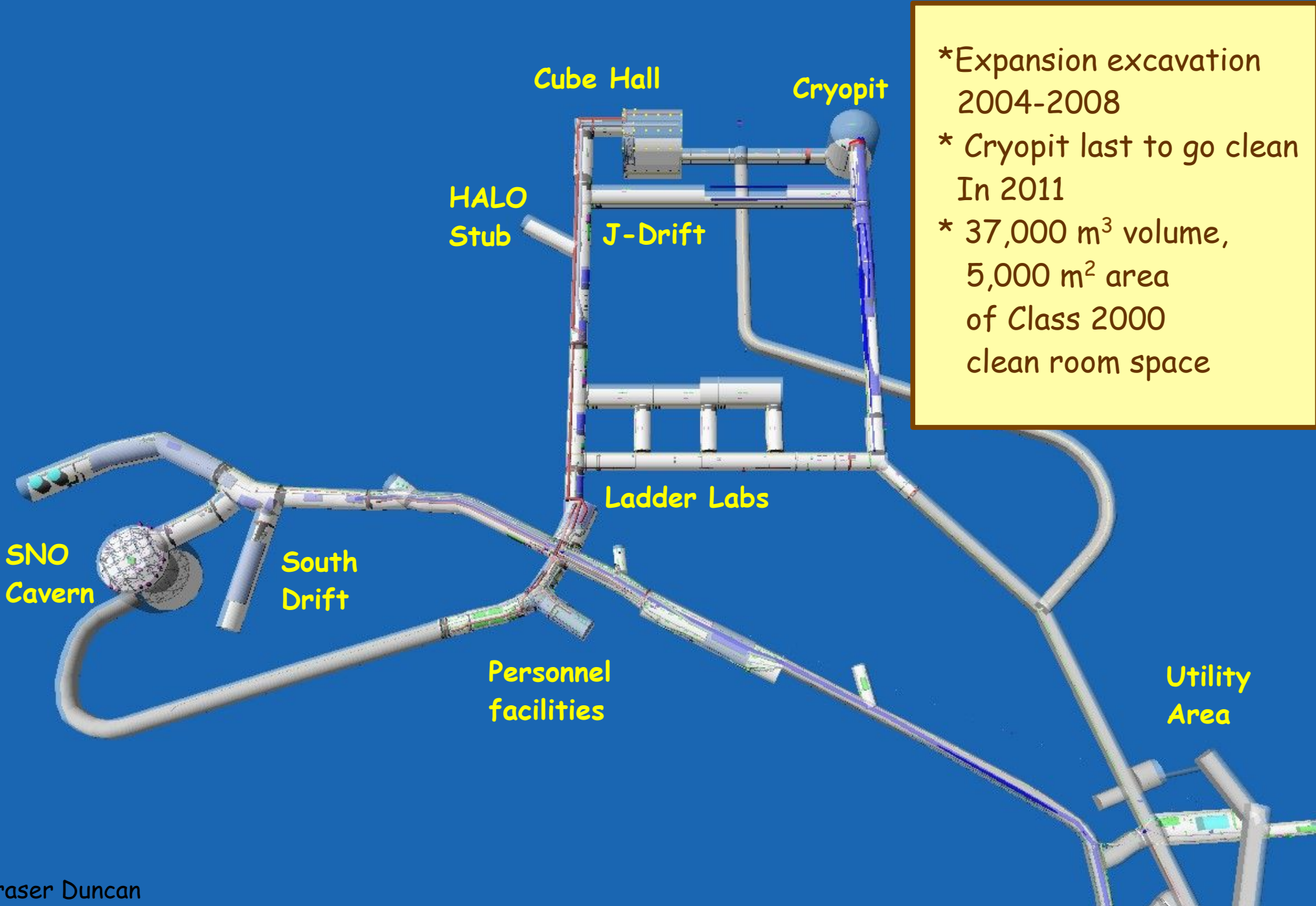


2km overburden (6000mwe)

Underground Laboratory



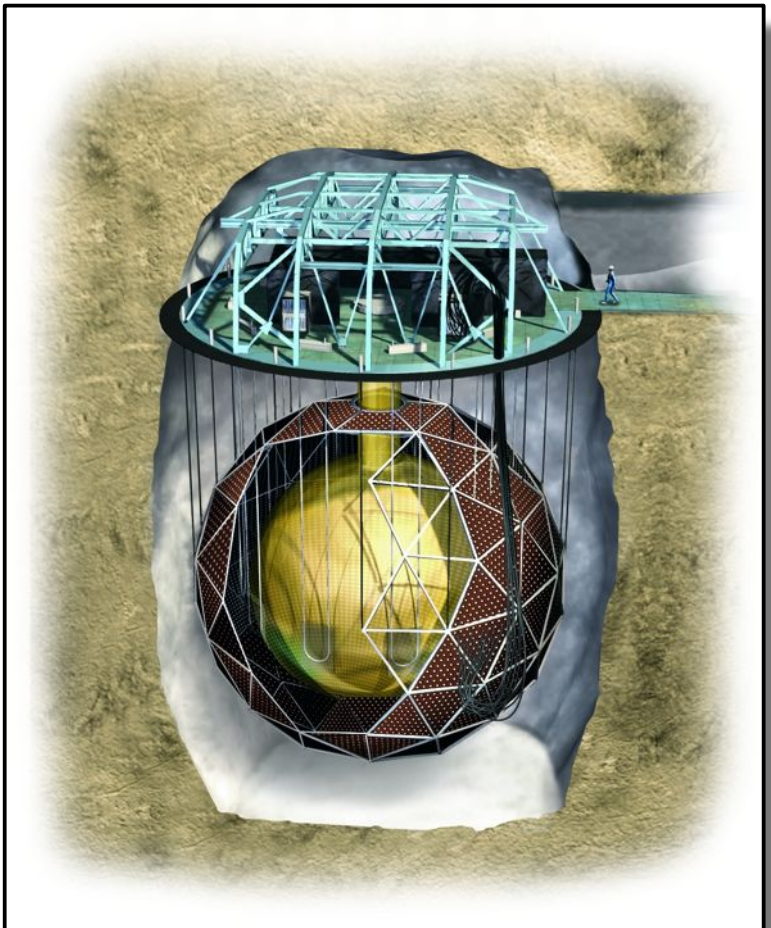
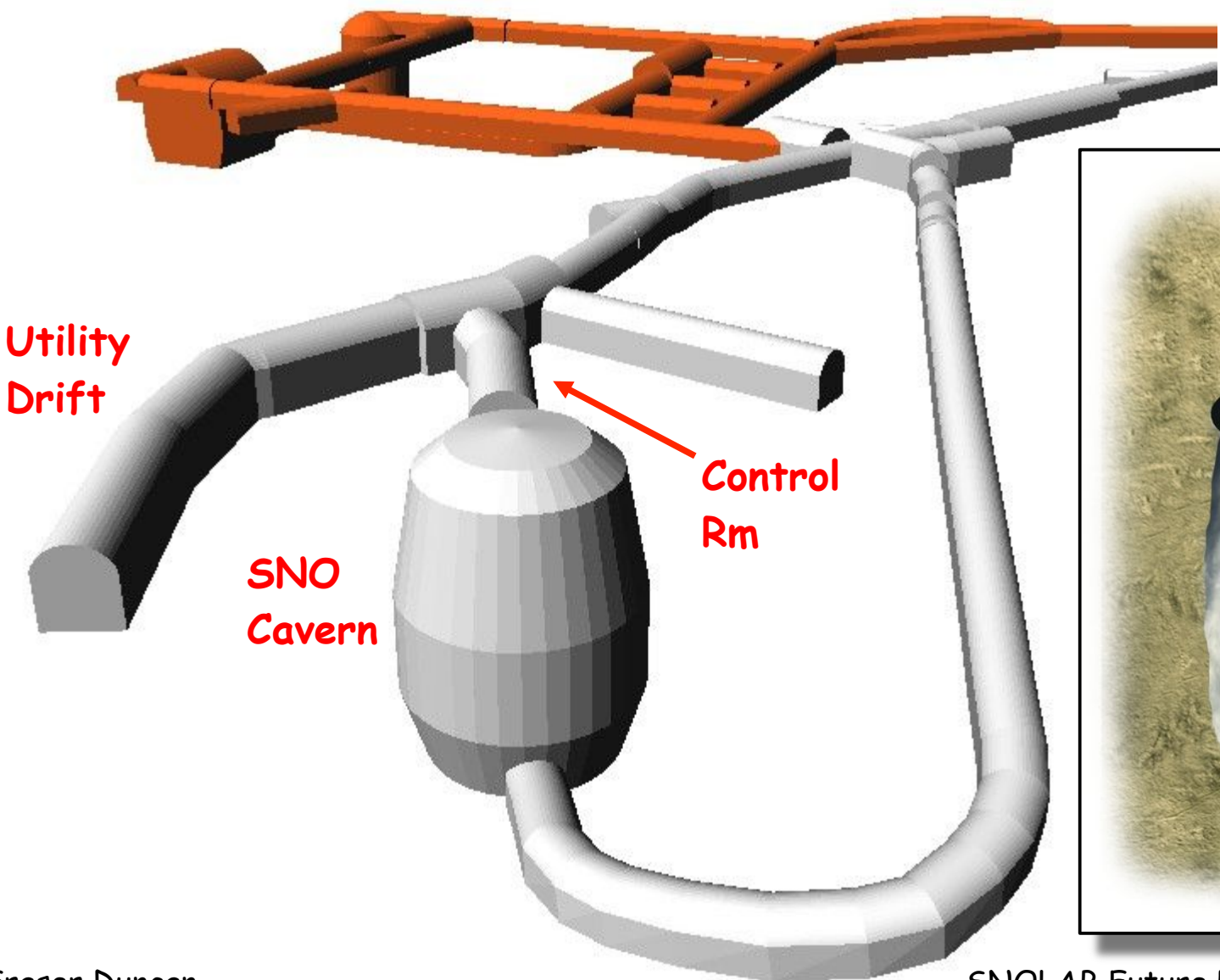
Underground Laboratory

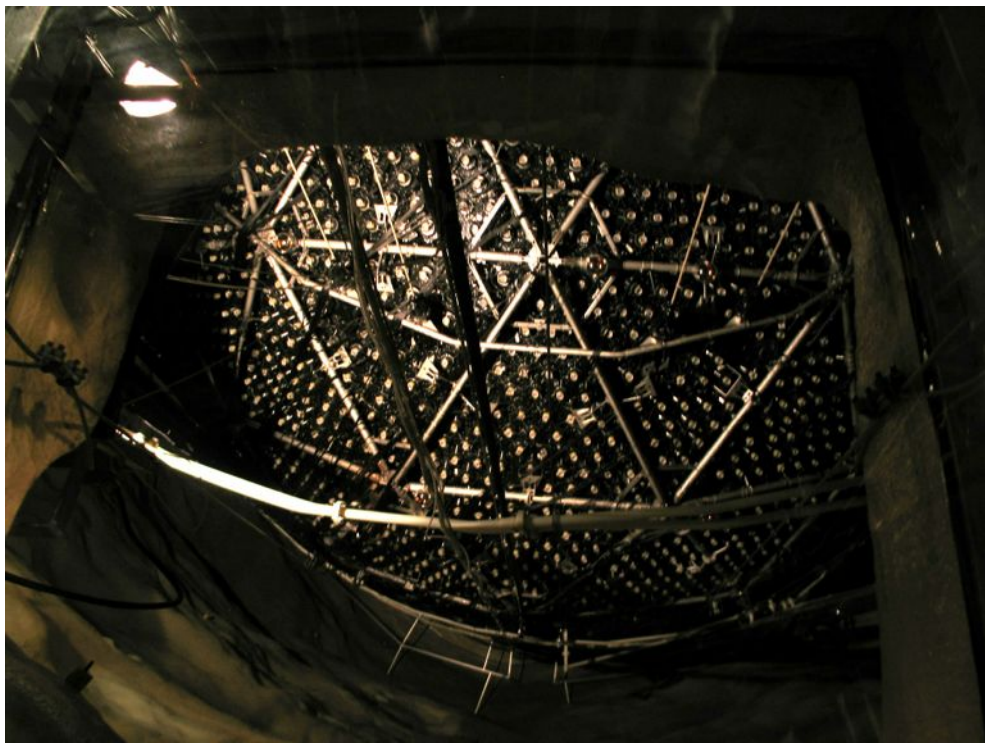


*Expansion excavation 2004-2008
 * Cryopit last to go clean In 2011
 * 37,000 m³ volume, 5,000 m² area of Class 2000 clean room space

SNO Cavern

Shape	Barrel
Dim	22 m (dia) x 30 m (h)
Area	250 m ²
Volume	9,400 m ³

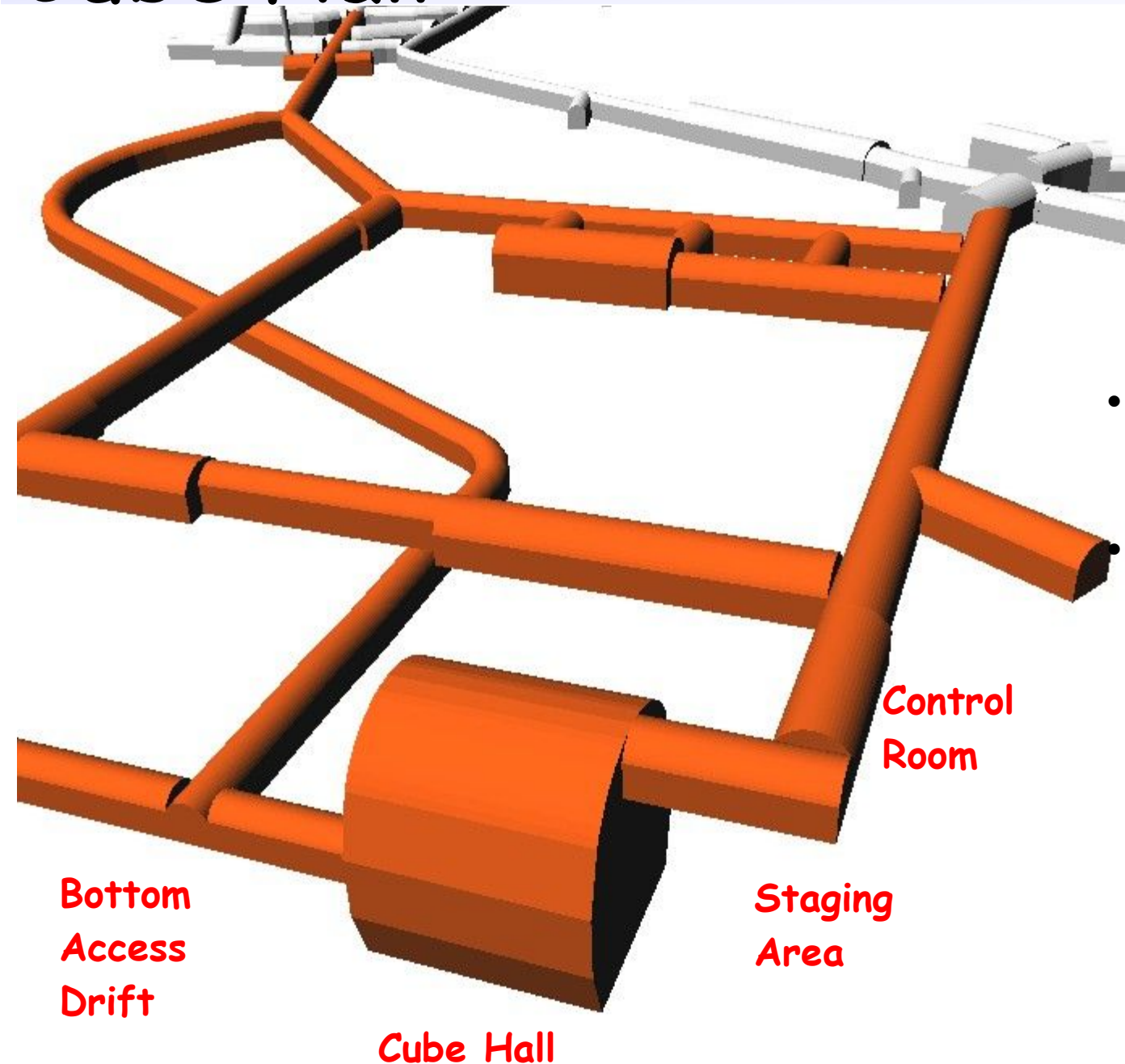


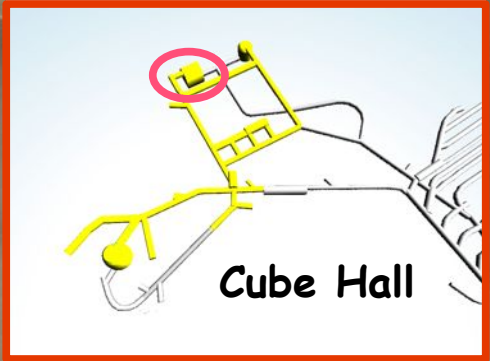


Cube Hall

Shape	Rectangular
Dim	18 m (l) x 15 m (w) x 20 m (h)
Area	276 m ²
Volume	5,600 m ³

- Top access with stairwell to floor.
- 10 T monorail for material hoisting.









Cube Hall Deck



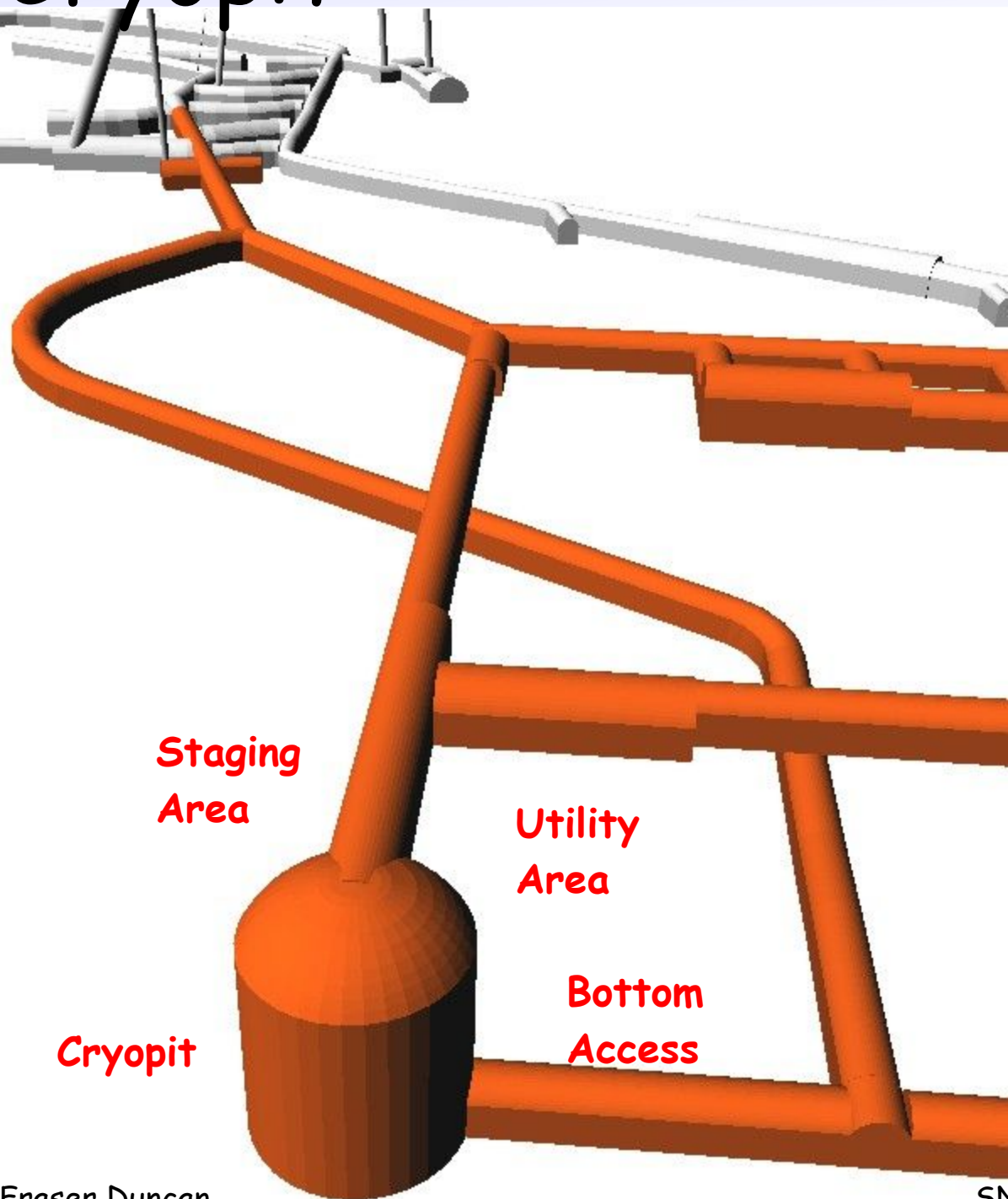
Cube Hall Staging Area



Bottom Access Drift



Cryopit



- Cavity designed to be flooded.
- 5T monorail crane for material hoisting.
- Provisions for pressure bulkheads to isolate from the rest of laboratory

Shape	Cylinder
Dim	15 m (dia) x 20 m (h)
Area	181 m ²
Volume	3,900 m ³

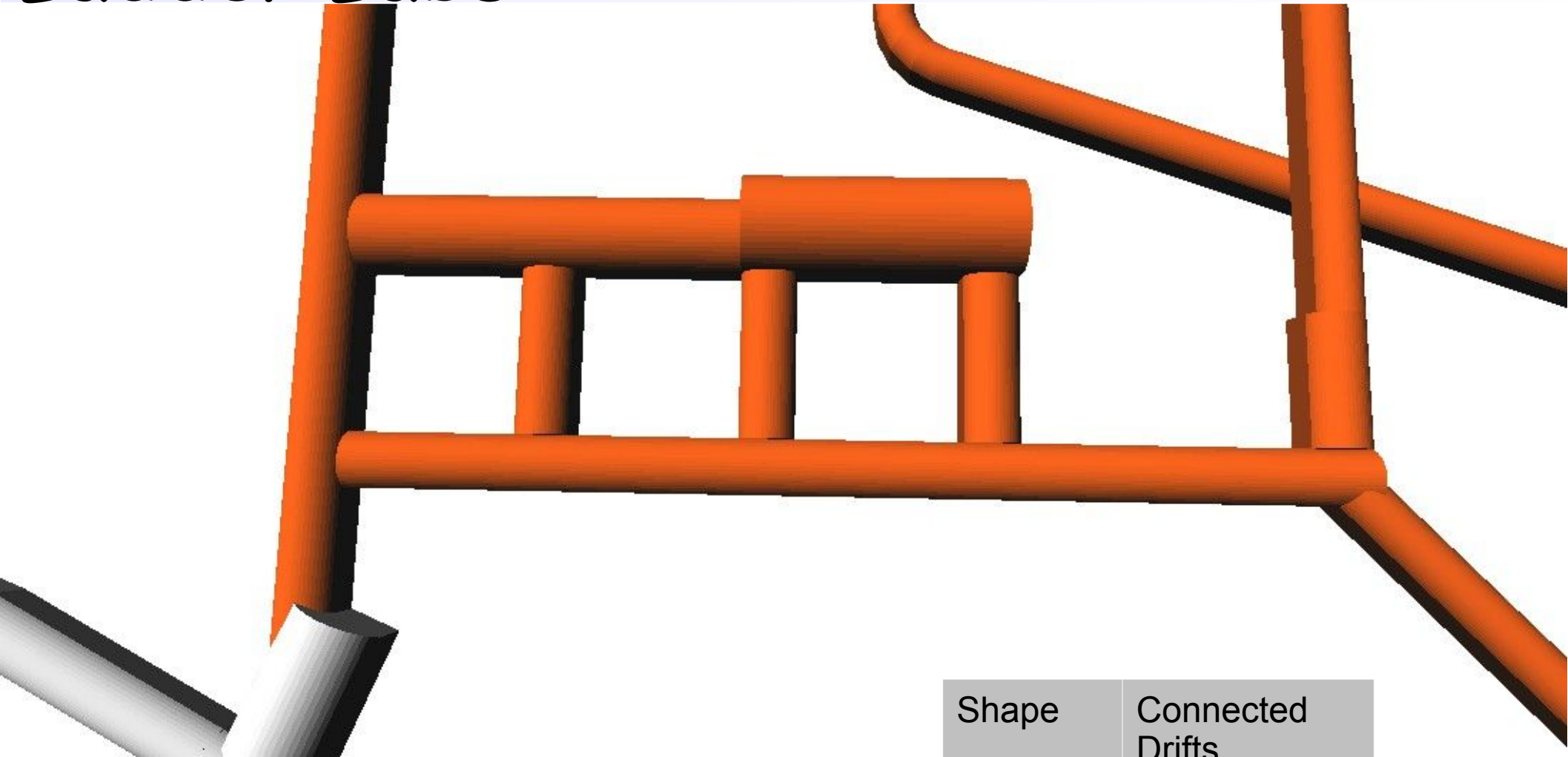








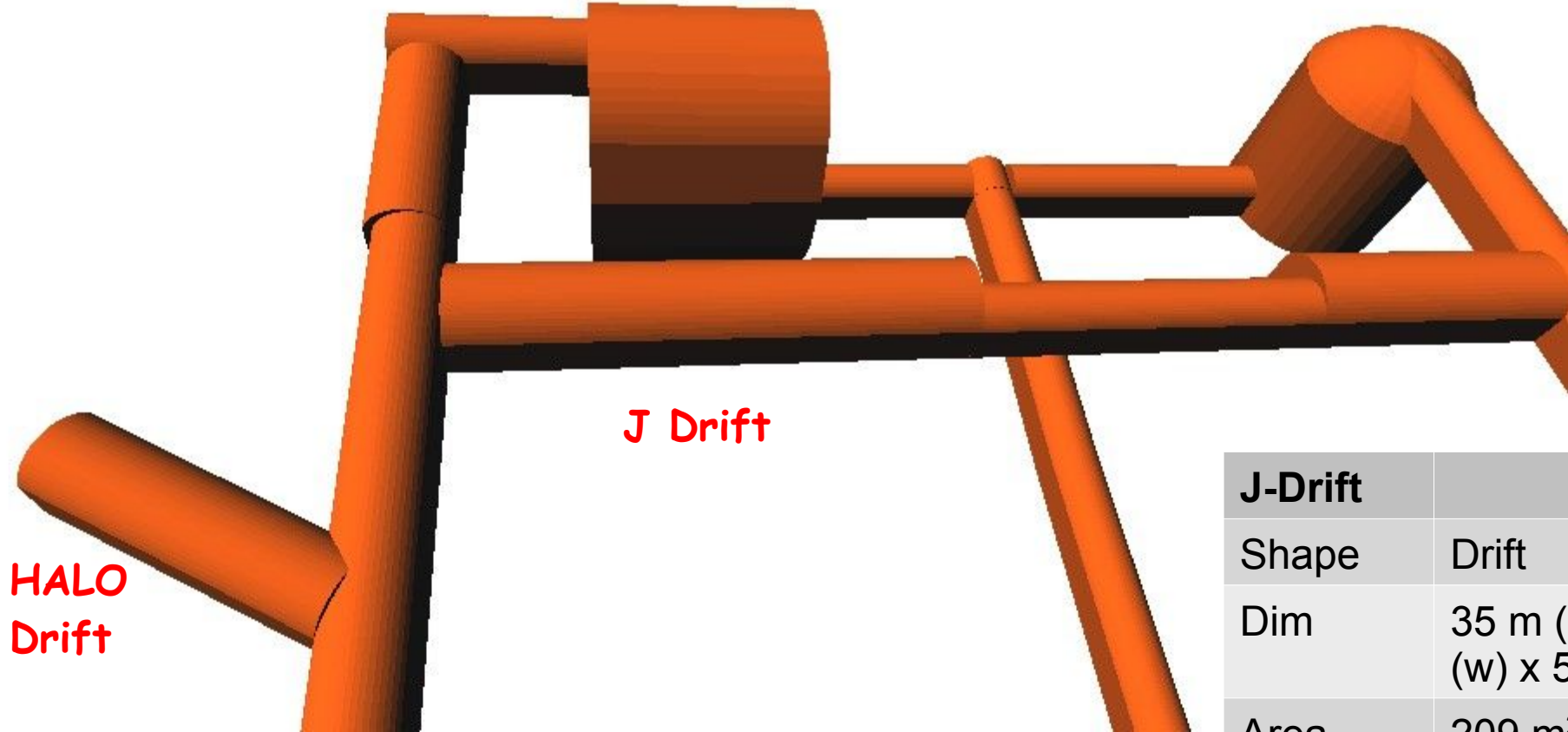
Ladder Labs



Shape	Connected Drifts
Dim	4-7.5 m (w) x 5-8 m (h)
Area	895 m ²
Volume	4,300 m ³

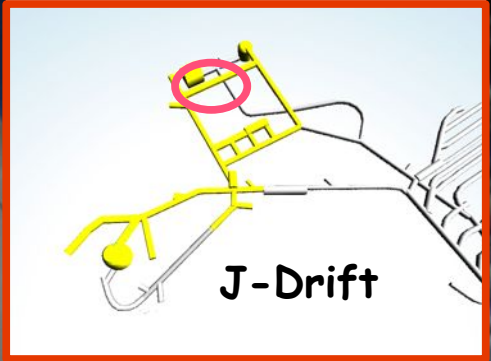


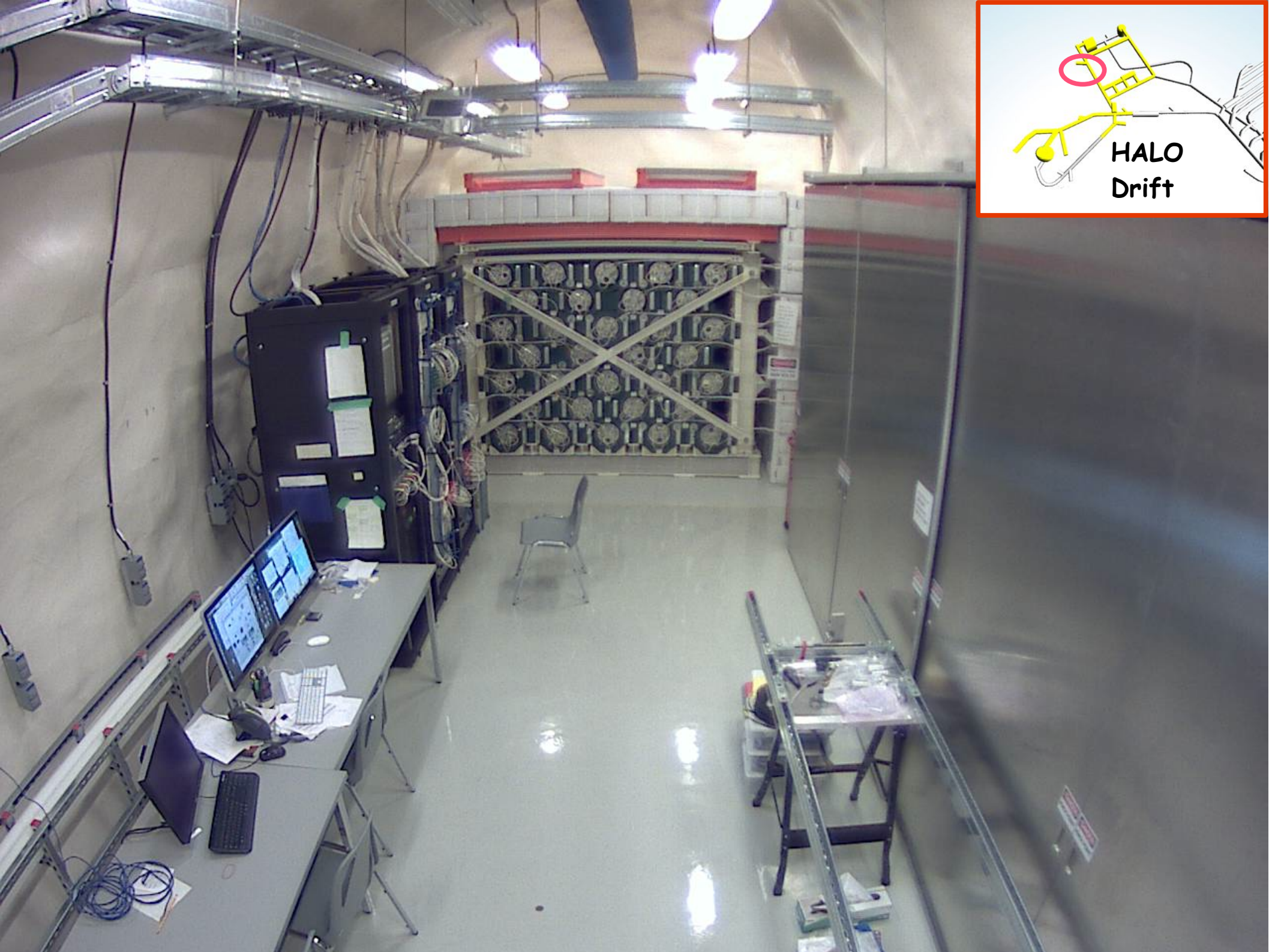
J-Drift and HALO Drift



J-Drift	
Shape	Drift
Dim	35 m (l) x 6 m (w) x 5 m (h)
Area	209 m ²
Volume	925 m ³

- J-Drift was originally intended as the utility space for the Cube Hall but has evolved into a "small experiment" space.





Common Infrastructure



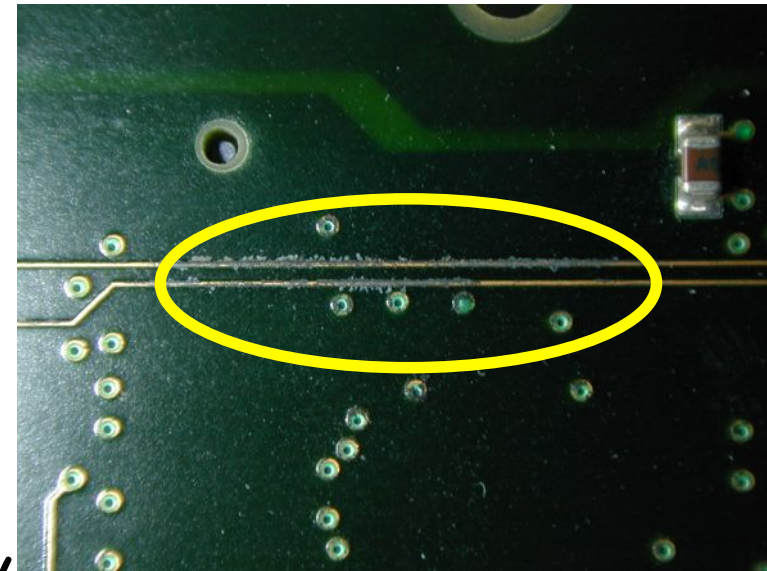
**Personnel Facilities:
Change Rms, Showers, Lunch Rm,
Meeting Rm and Laundry facility.
Refuge Station occupancy up to 120.**

Material Handling:
Most material transported underground on rail cars. Other options such as forklift or "stoneboat" possible.

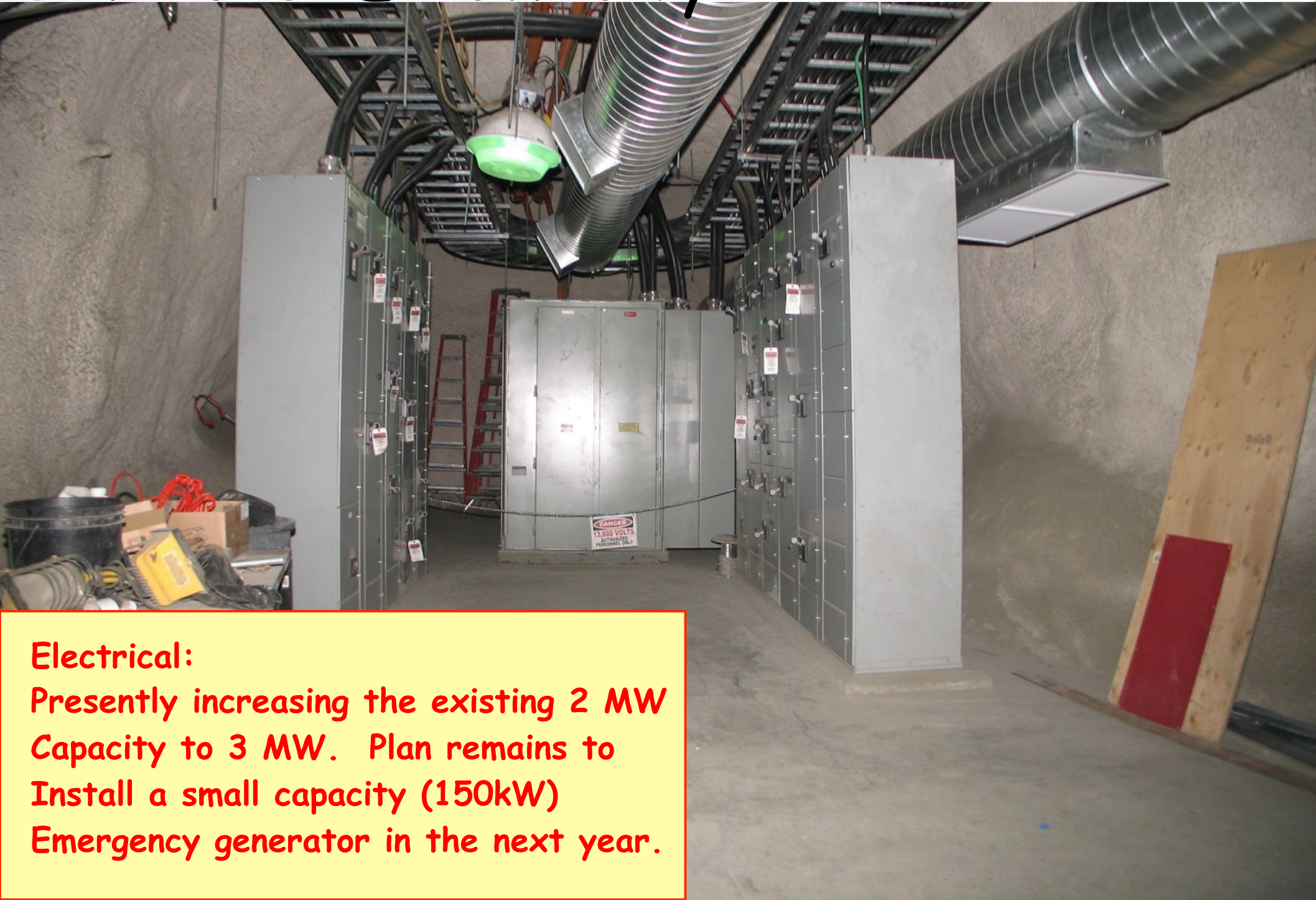


Environment

- Air Pressure: ~ 1.25 x sea level and can fluctuate by 5% . Need to design vacuum vessels accordingly.
- Radon levels in air: 3-4 pCi/L
- Small quantities of H_2S in air. Filters in the air handlers reduce it but some remains causing corrosion (for example on the copper on circuit boards).
- Seismicity: Mining induced seismic activity. Design basis event is "1 in a 100 yrs" 4.3 M_N on the Nuttli Scale ($\sim 3.4 M_R$ Richter). Designing seismically rated equipment can be challenging.



Services: Electricity



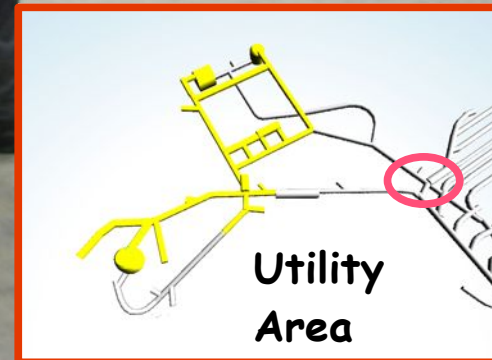
Electrical:

Presently increasing the existing 2 MW Capacity to 3 MW. Plan remains to Install a small capacity (150kW) Emergency generator in the next year.

Services: Cooling



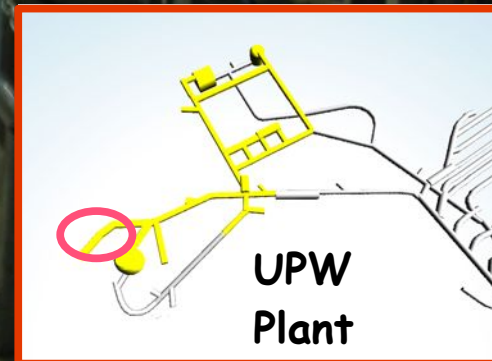
Cooling: Chilled water loop through Lab with 1 MW capacity.



Services: Ultra Pure Water



Ultrapure Water: 140 L/min capacity
From the original SNO UPW plant.
- While the plant can produce high Purity water, polishing should be Done locally.



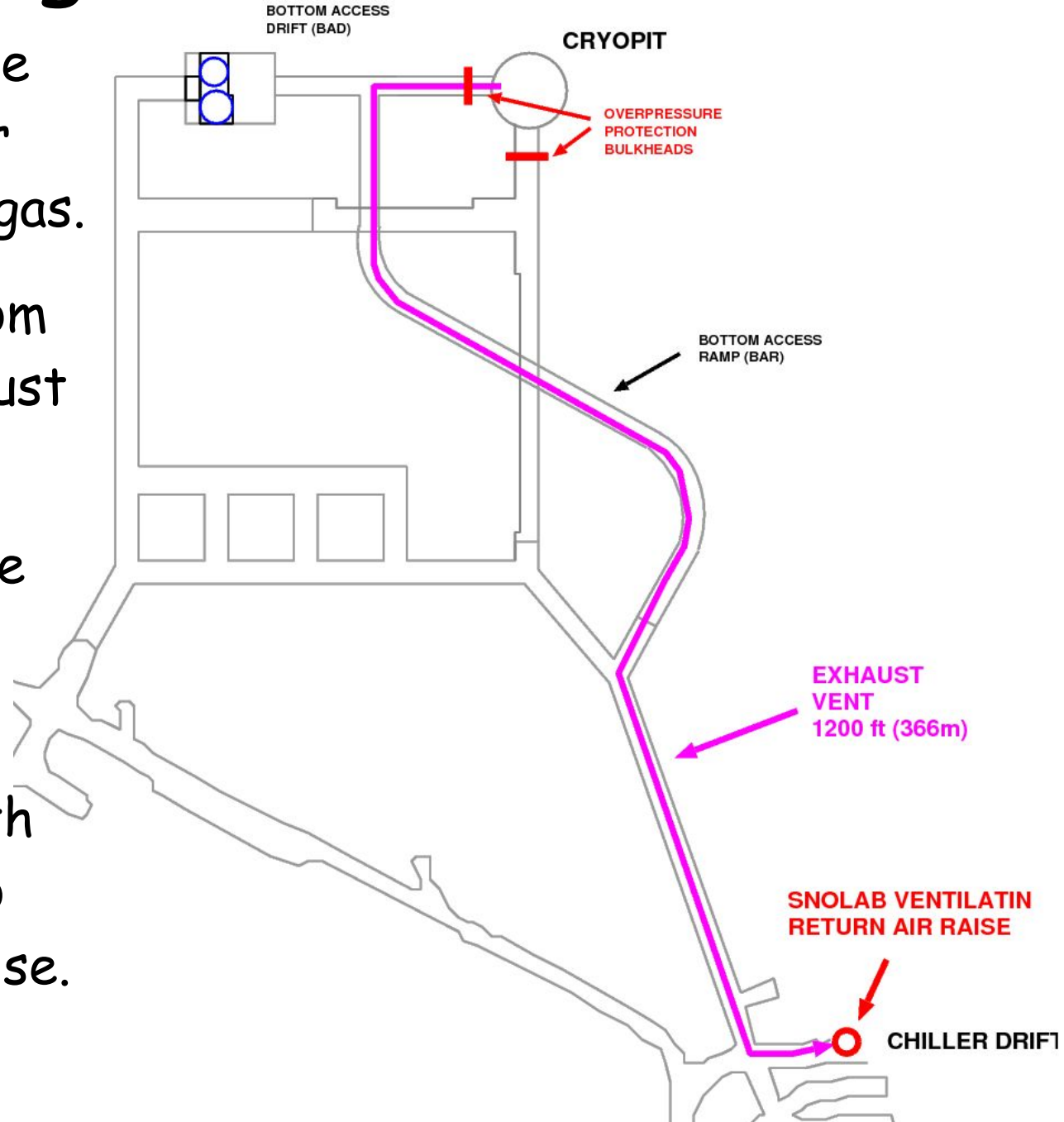
Services

- Ventilation: 5-10 air changes per hour through HEPA filters. Class 2000 clean room.
- Compressed Air: Limited supply of compressed air from surface with significantly reduced radon levels (x40). Some experiments have exploited this to create a limited size radon reduced air environment.
- Network: 200 Mb/s bandwidth being expanded to Gb/s
- Liquid Nitrogen: Dewars only.



Exhaust Venting

- Safe venting in the case of cryogenic boil off or other release of inert gas.
- 1200 ft (370m) run from Cryopit to sealed exhaust raise.
- Possibly install pressure bulkheads around the cryopit.
- Need to coordinate with other experiments also planning to use vent raise.



Low Background Counting

- Presently operating 2 Ge detectors underground
 - 1 coaxial, 1 well.
- A second coaxial detector will be installed. Developing a low background counting lab in the old SNO refuge station.



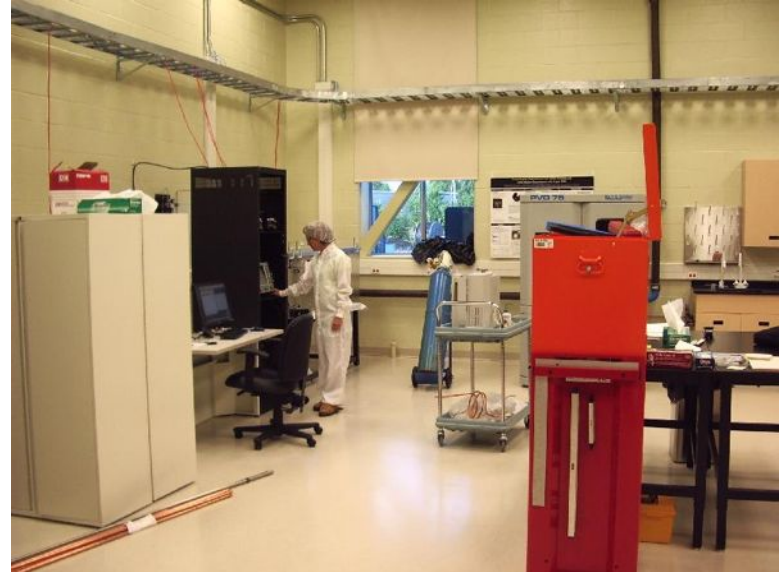
Future Additions

- 150 kW emergency generator.
- Installing a “clean” machine shop.
- Chemistry lab
- Refurbishment of old SNO refuge station:
Low Background Counting Lab. Relocate existing Ge detectors and an additional one to a dedicated lab area with preparation facilities.
 - Electronics Shop
 - Additional office space.
- Completion of airlocks at Ladder Labs and Bottom Access Drift
- Additional Excavations? Dependent on international support and funding.



Surface Facilities

- Site Surface: 4,700 ft² CLASS 1000 Clean Room Laboratories, IT Infrastructure (high speed off site), Office, Meeting Rms, Control Rms, Material handling, Machine shop. 3Rd floor still undeveloped.
- Laurentian Water Facility: Intended for spike work not appropriate for site.



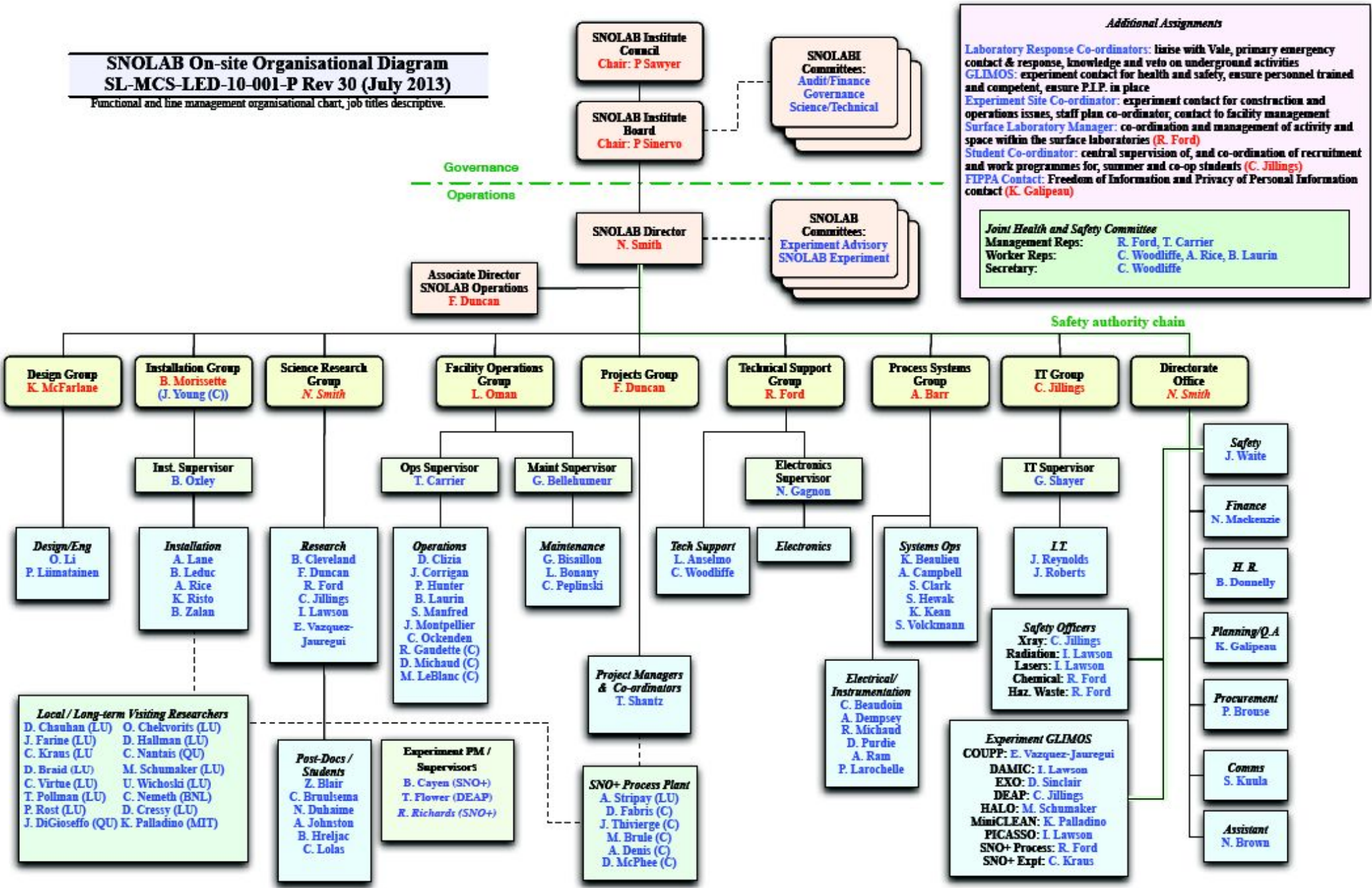
Operations

- Staff: ~60 people on staff including scientists, engineers and technicians. In addition to Directorate Office (including EH&S, procurement, finance) and IT,
 - Facility Operations (12): Lab operations, cleaning, maintenance, material transportation.
 - Process (7): Water plant, scintillator plant
 - Electrical & Instrumentation (4)
 - Installation (7): assists with installation of experiments.
 - Design (3): Design specific to experiments; assist with regulatory compliance.
 - Technical Support (3): Chemists and electronics expert
 - Projects (2): Assistance with development and deployment of experiments.
- The Research team members can act as collaborators on experiments, providing operational and scientific support.
- Access: Presently running 9 shifts per week underground 5 day and 4 evening shifts per week. Additional shifts are possible. Presently 40-60 people underground on day shifts.

SNOLAB On-site Organisational Diagram

SL-MCS-LED-10-001-P Rev 30 (July 2013)

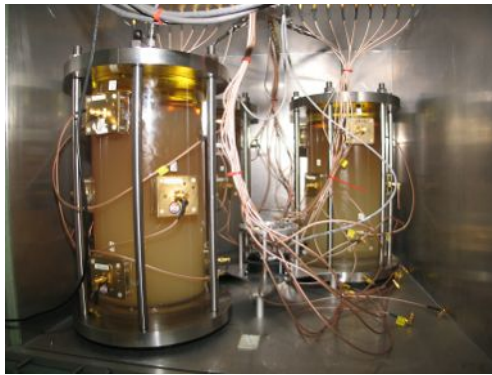
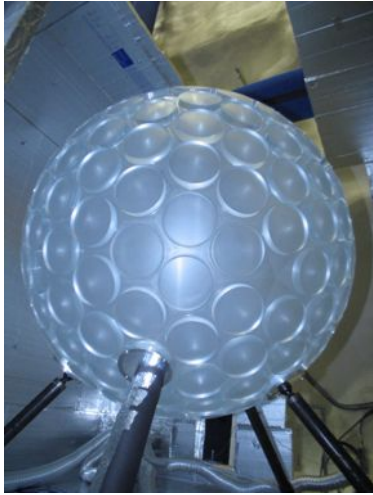
Functional and line management organisational chart, job titles descriptive.



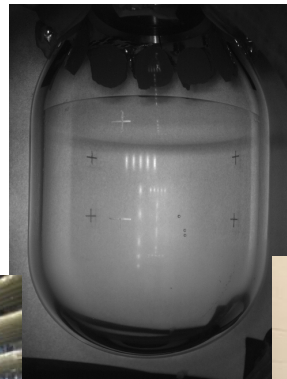
Additional Assignments

Laboratory Response Co-ordinators: liaise with Vale, primary emergency contact & response, knowledge and veto on underground activities
GLIMOS: experiment contact for health and safety, ensure personnel trained and competent, ensure P.I.P. in place
Experiment Site Co-ordinator: experiment contact for construction and operations issues, staff plan co-ordinator, contact to facility management
Surface Laboratory Manager: co-ordination and management of activity and space within the surface laboratories (R. Ford)
Student Co-ordinator: central supervision of, and co-ordination of recruitment and work programmes for, summer and co-op students (C. Jillings)
FIPPA Contact: Freedom of Information and Privacy of Personal Information contact (K. Galipeau)

Joint Health and Safety Committee
Management Reps: R. Ford, T. Carrier
Worker Reps: C. Woodliffe, A. Rice, B. Laurin
Secretary: C. Woodliffe

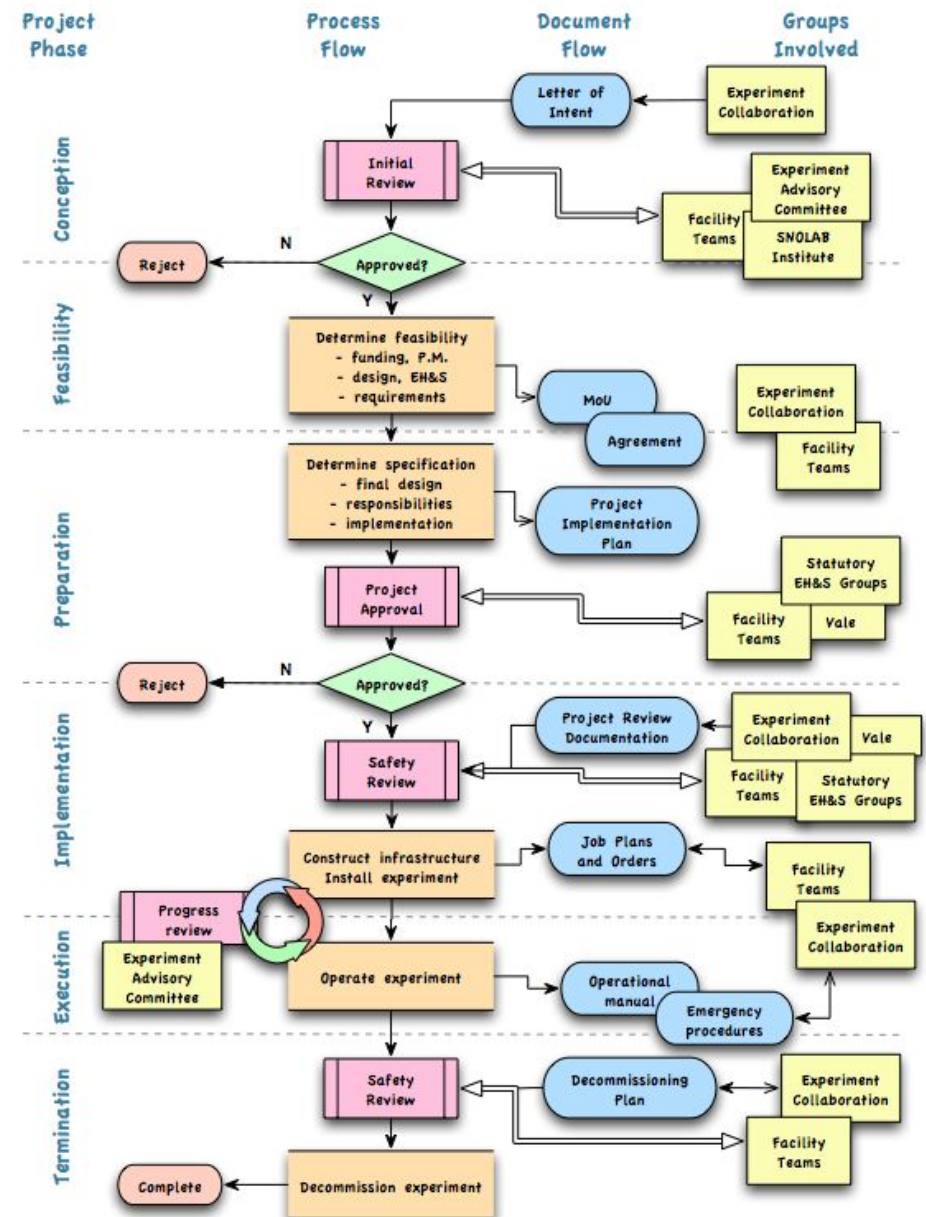


Current Program



Experiment Life Cycle

- Moving project life cycle to a more formal process including "gateway" style reviews.
- Will include structures and agreements that will have **duration of space allocation** and a space renewal process.
- QA under development (SNOLAB is moving to ISO 9001 and OSHAS 18001 accreditation).
- International Experiment Advisory Committee (EAC) used to help define program.
- H&S reviews integral to development and deployment - SNOLAB and Vale (if required).



SNOLAB Operational Model

- Traditional Nuclear Physics “free-at-the-point-of-access” model.
- Canadian support for baseline operations of the facility including life safety, power, ventilation, material handling, compressed air, UPW, IT and networking.
- Experiments charged for additional 'non-standard' costs: E.g. significant transport, high power usage, significant consumption of resources such as LN_2 .
- Experiments responsible for “improvements” on the infrastructure: E.g. clean room class better than 2000 or civil structures such as platforms.

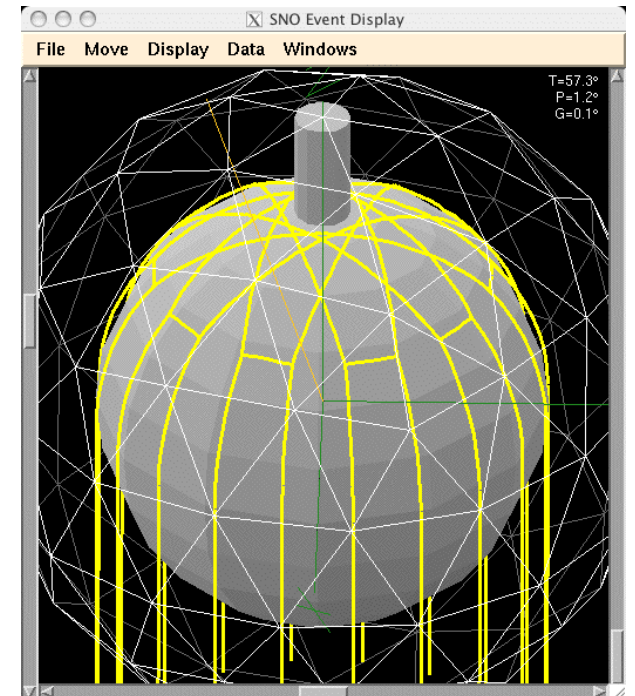
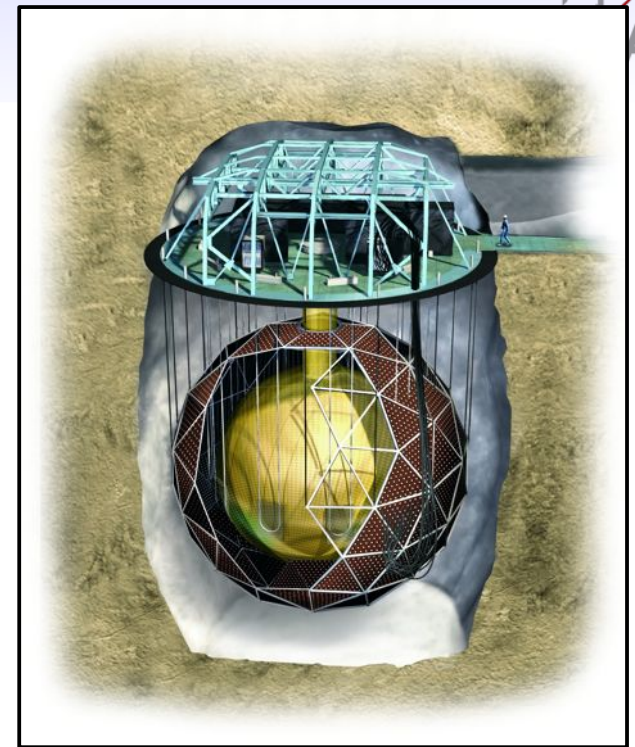
Experimental Program

Experiment	Solar Nu		Dark Matter	Super nova	Other	Space Allocated	Status
	OnuBB			GeoNu			
SNO+	X	X	X	X		SNO Cavern	Deploying
PICASSO			X			Ladder Labs	Running
DEAP-1			X			J-Drift	Paused
DEAP-3600			X			Cube Hall	Deploying
MiniCLEAN			X			Cube Hall	Deploying
COUPP-4			X			J-Drift	Finished
COUPP-60			X			Ladder Labs	Running
PICO-2L			X			J-Drift	Planning
DAMIC			X			J-Drift	Running
SuperCDMS			X			Ladder Labs	TBD
HALO				X		HALO Drift	Running
PUPS					Seismic	Various Locations	Finished

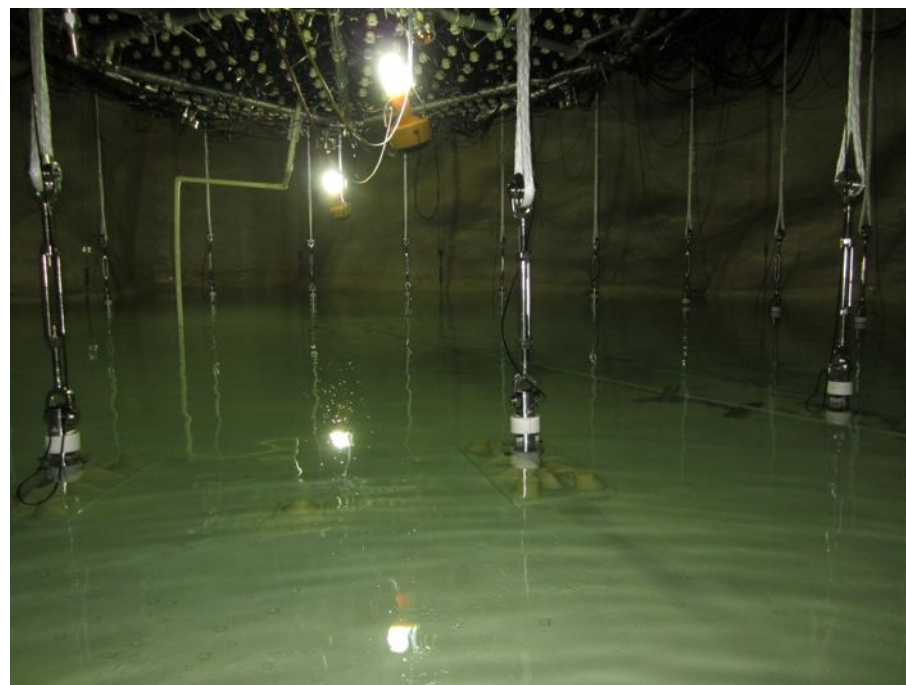
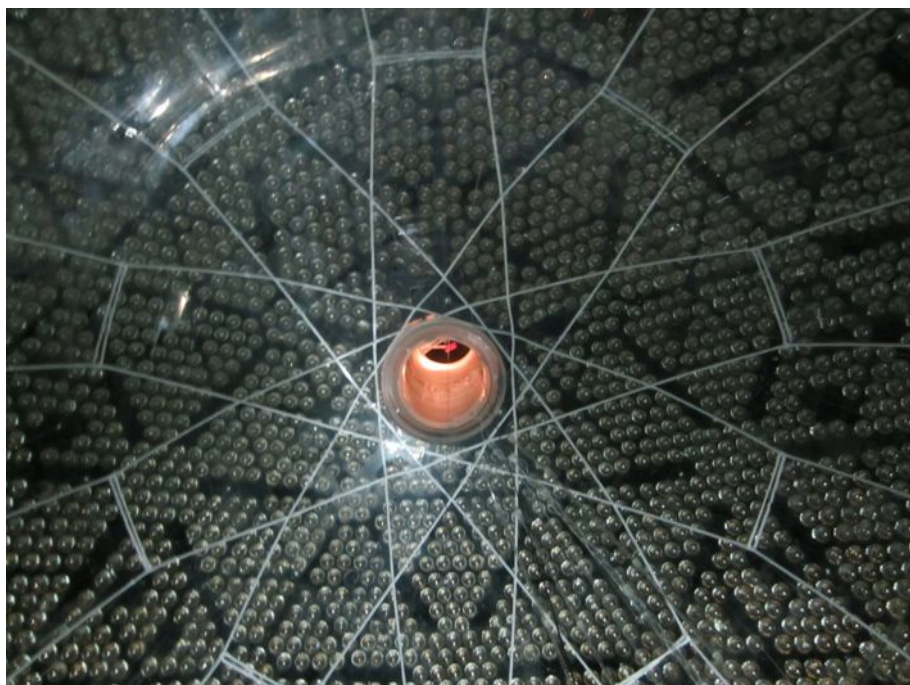
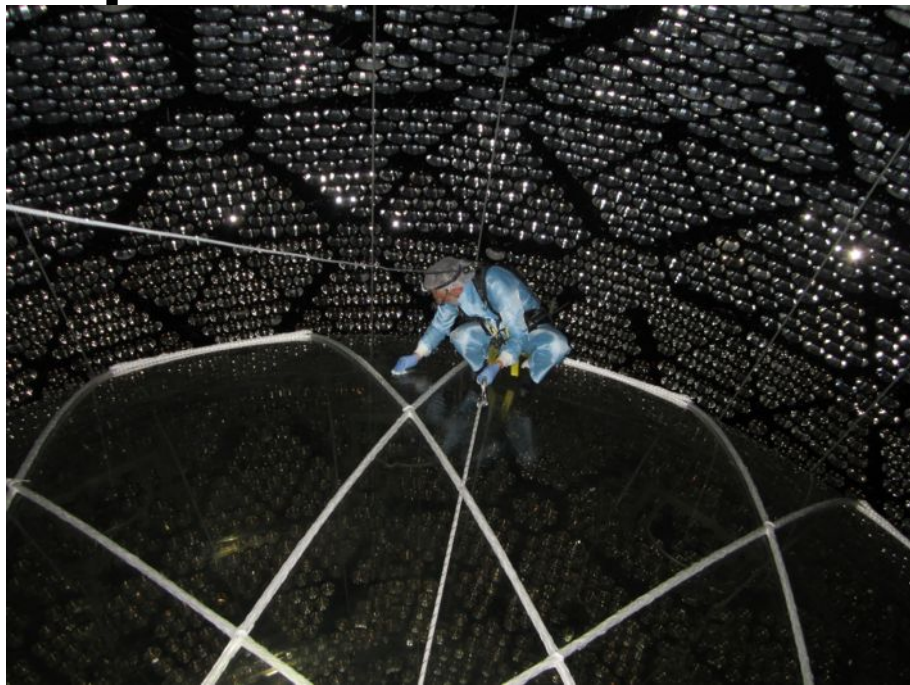
Experiments

SNO+

- Re-purposing of the SNO detector to neutrinoless double beta decay and low energy solar neutrinos by replacing the 1000 T of D_2O with 860 T of liquid scintillator loaded with 2.3T Te (~ 160 kg ^{130}Te in a 3.5 m fiducial radius).
- Installation of "hold down ropes" and a scintillator purification plant.
- Presently have 2.5 m of water in the cavity with the intent of filling with water this fall and adding scintillator in 2014.



Experiments



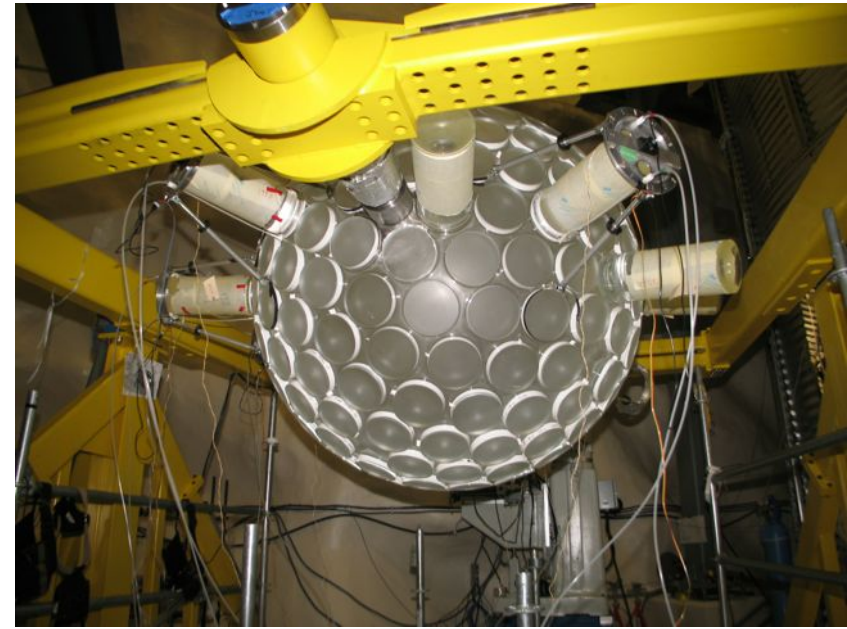
Experiments

DEAP-3600

- 3600 T L Ar dark matter experiment with a 1 T fiducial volume.
- Physics Target: 10^{-46} cm² @100 GeV
- Begin data taking in 2014

MiniCLEAN

- 150 kg fiducial volume L Ar dark matter demonstrator for a larger scale detector. Demonstration of Pulse Shape Discrimination.
- Physics Target: 10^{-46} cm² @100 GeV
- Begin data taking early 2014



Experiments

HALO

- Lead Supernova neutrino detector with ^3He neutron counters.
- Operational since 2012 and expected to join SNEWS (Supernova Early Warning System) this year.



DAMIC

- Low energy WIMP detector based on CCD technology. Went operational in 2012 with upgrade in spring 2013.



Experiments

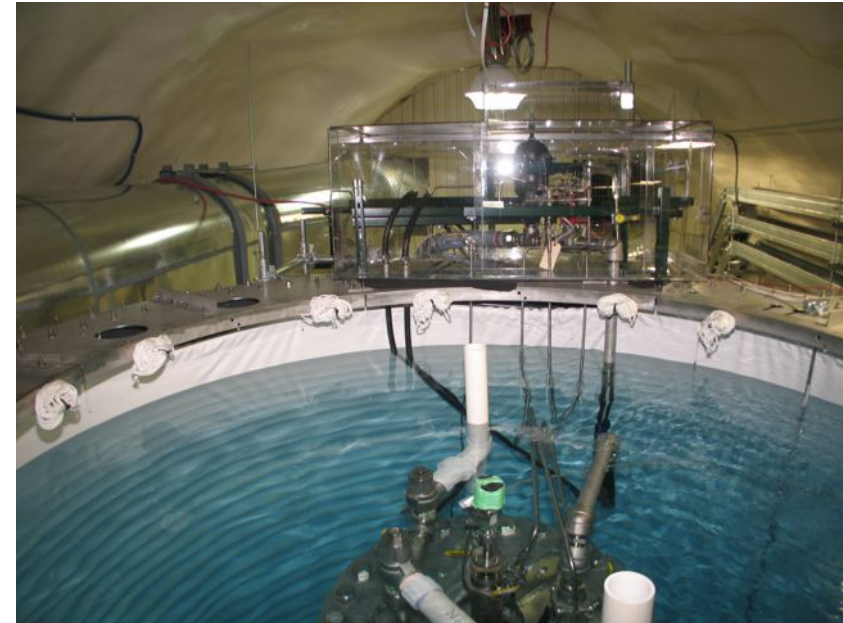
PICASSO

- Superheated droplet spin dependent dark matter detector using C_4F_{10} looking for WIMP interactions on ^{19}F .
- Running in Ladder Labs since 2010 with 32 detectors. Projecting sensitivity for SD cross section of $\sim 10^{-40} \text{ cm}^2$.



COUPP

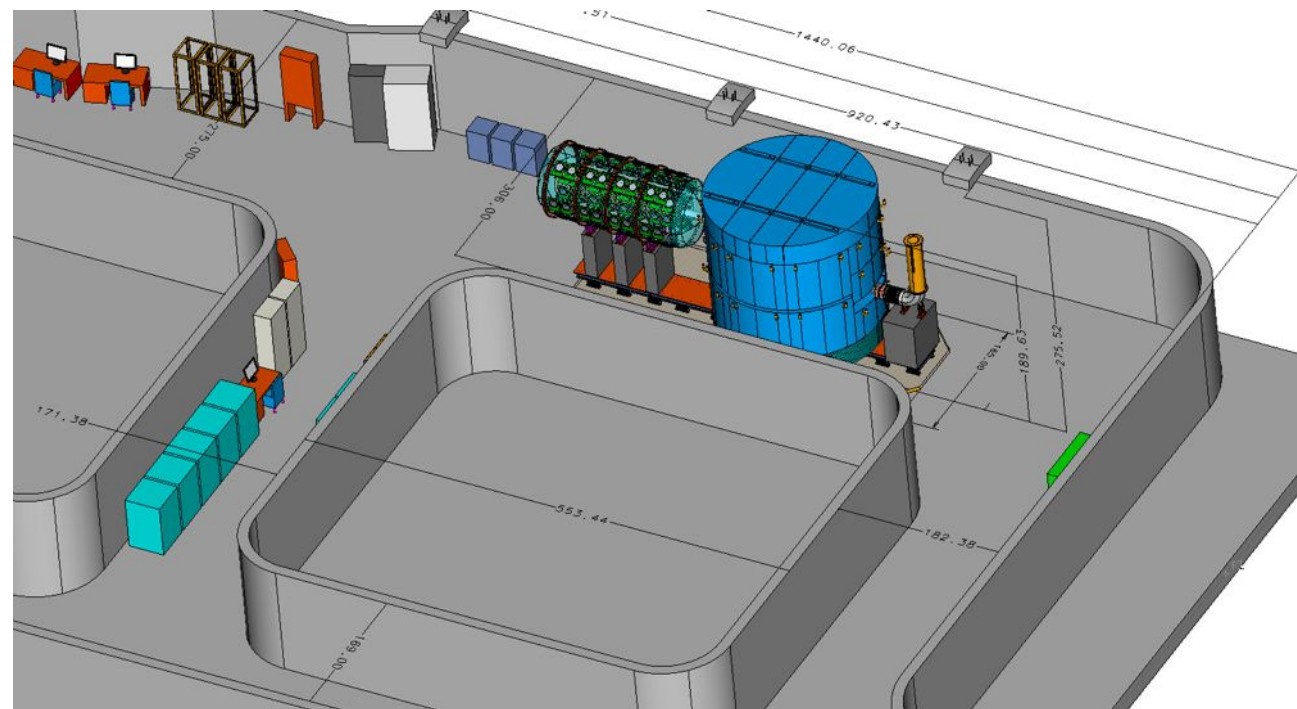
- Superheated CF_3I bubble chamber dark matter detector sensitive to both spin dependent and independent interactions.
- COUPP-60 went live in Ladder Labs spring 2013. Projecting sensitivity to $\sim 10^{-41} \text{ cm}^2$ SD and $\sim 10^{-45} \text{ cm}^2$ SI.



Experiments

SuperCDMS

- Proposal for 200 kg of Ge crystals at 50 mK. Expected sensitivity $\sim 10^{-46}$ cm². Has approval for space in the Ladder Labs.
- Waiting for the US to resolve funding issues. Some funding is available in Canada that is conditional on the release of the US funding.



Experiments - Support

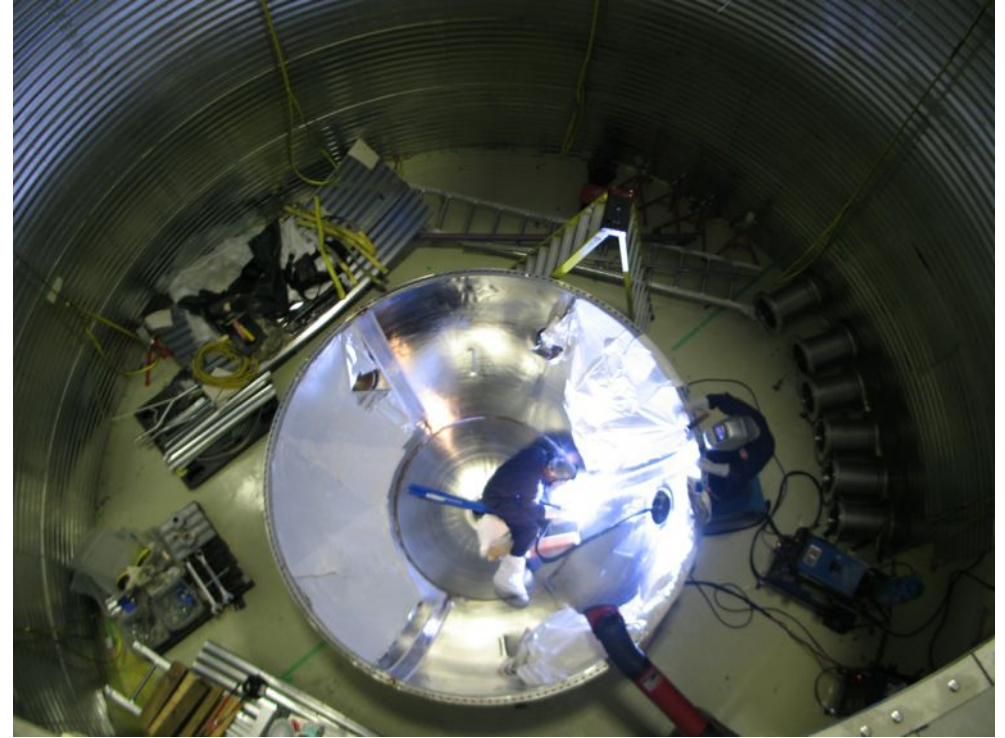
Material transport Underground



Experiments - Support



**Excavating space for the SNO+
Process Plant inside the
Clean room.**

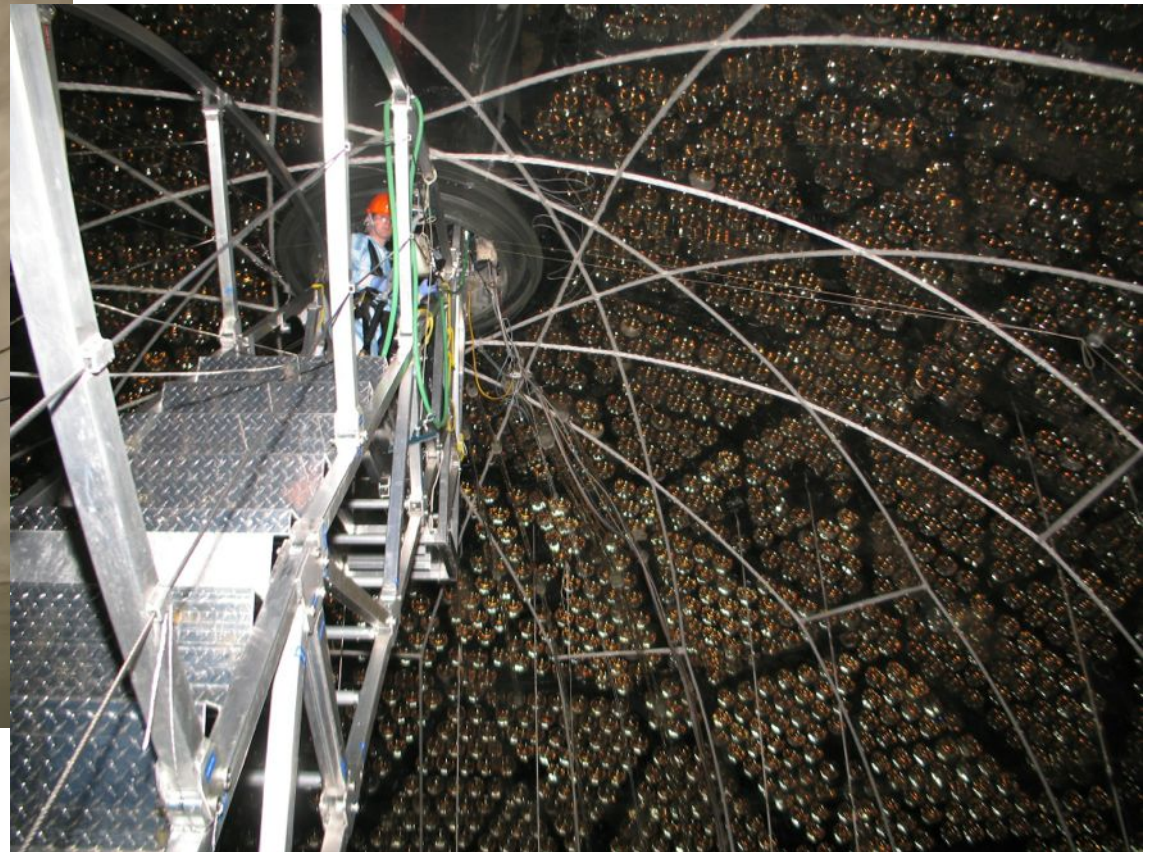


**Supervision of Contractors
Welding the DEAP containment
Vessel inside the clean room.**

Experiments - Support



"Delicate" installations
- SNO+ AV cleaning platform



Experiment SNOLAB



**Const: DEAP-3600
MiniCLEAN**

Paused: COUPP-4kg

Running: HALO

Unallocated

Running: DAMIC

Running: COUPP-60

Unallocated

Paused: DEAP-1

Unallocated

Reserved for CDMS

SNO Cavern

South Drift

Const: SNO+

Personnel facilities

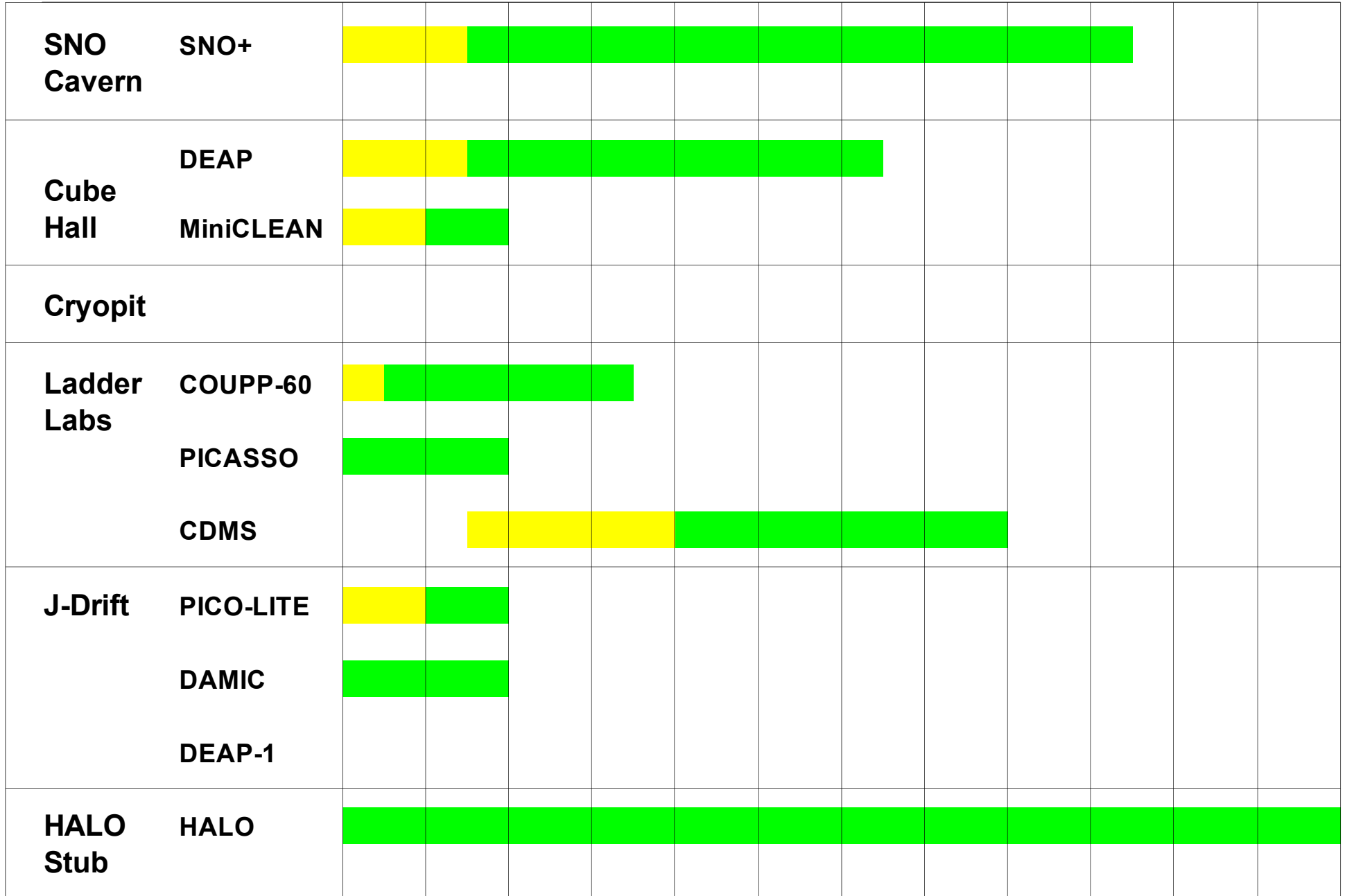
Running: PICASSO

Utility Area

Program Timeline



2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023 2024



Summary

- **Facility:** Major construction is complete but ongoing work for outfitting and renovation of old SNO spaces, upgrading electrical distribution, backup generator, machine shop etc.
- **Science Program:** 4 running experiments. 3 major experiments in the construction phase and expected to go operational in the next 12 months.
- **Future Space:** Cryopit immediately available. Space remaining for medium scale experiments in Ladder Labs. Cube Hall could potentially house one more large experiment.

End