Status of SNOLAB Infrastructure and Science Preparations

Friday, 9 October 2009
SNOLAB Objectives

- To promote an International programme of Astroparticle Physics
- To provide a deep experimental laboratory to shield sensitive experiments from penetrating Cosmic Rays
- To provide a clean laboratory
  - Entire lab at class 2000, or better, to mitigate against background contamination of experiments.
- To provide infrastructure for, and support to, the experiments
- Focus on dark matter, double beta decay, solar & SN experiments requiring depth and cleanliness.
- Also provide space for prototyping of future experiments.
- Large scale expt’s (ktonne, not Mtonne)
- Goal has been to progressively create a significant amount of space for an active programme as early as possible.
Muon Flux = 0.27/m²/day

Friday, 9 October 2009
SNOLAB Overall Status

- Surface Facility
  - Operational from 2005.
  - Provides offices, conference room, dry, warehousing, IT servers, clean-room labs, detector construction labs, chemical + assay lab

- Underground Construction (Cube Hall, Cryopit, Ladder Labs, Lab Entrance)
  - Excavation complete and outfitting began June 2007.
  - General outfitting in Phase I areas almost complete + Cryopit 5T crane/access.
  - Final infrastructure (Chiller, MPC, HVAC, waste water plant) commissioned
  - First experimental infrastructure installation underway in Cube Hall
  - Ladder labs opened as clean areas, final clean underway

- Experimental Programme
  - Continued operation of DEAP-1 and PICASSO.
  - Current allocations to: PICASSO, DEAP-I, SNO+, DEAP-3600, MiniCLEAN, CDMS, HALO.
  - Anticipated or under discussion: EXOgas 200, COUPP, DarkSide, low background counters to measure 39Ar, future Cobra upgrade…
Surface Facilities
All clean spaces to be operated as Class 2000 clean room.

<table>
<thead>
<tr>
<th>Laboratory Space</th>
<th>Excavation Area</th>
<th>Volume</th>
<th>Clean Rm Area</th>
<th>Volume</th>
<th>Laboratory Area</th>
<th>Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>Original SNO Areas</td>
<td>20,049 ft²</td>
<td>582,993 ft³</td>
<td>12,196 ft²</td>
<td>470,360 ft³</td>
<td>8,095 ft²</td>
<td>412,390 ft³</td>
</tr>
<tr>
<td></td>
<td>1,863 m²</td>
<td>16,511 m³</td>
<td>1,133 m²</td>
<td>13,321 m³</td>
<td>752 m²</td>
<td>11,679 m³</td>
</tr>
<tr>
<td>Original + Phase I</td>
<td>65,340 ft²</td>
<td>1,367,488 ft³</td>
<td>41,955 ft²</td>
<td>1,049,393 ft³</td>
<td>26,117 ft²</td>
<td>837,604 ft³</td>
</tr>
<tr>
<td></td>
<td>6,072 m²</td>
<td>38,728 m³</td>
<td>3,899 m²</td>
<td>29,719 m³</td>
<td>2,427 m²</td>
<td>23,721 m³</td>
</tr>
<tr>
<td>Original + Phase I&amp;II</td>
<td>77,636 ft²</td>
<td>1,647,134 ft³</td>
<td>53,180 ft²</td>
<td>1,314,973 ft³</td>
<td>32,877 ft²</td>
<td>1,043,579 ft³</td>
</tr>
<tr>
<td></td>
<td>7,215 m²</td>
<td>46,648 m³</td>
<td>4,942 m²</td>
<td>37,241 m³</td>
<td>3,055 m²</td>
<td>29,555 m³</td>
</tr>
</tbody>
</table>
SNO Access Drift

Friday, 9 October 2009
Cryopit

Friday, 9 October 2009
Construction Status

- With the “going clean” of the Ladder Labs there is now 40,000 ft² (3,700 m²) of space inside the clean room boundary of the lab. For comparison the surface building is 32,000 ft².
- Ladder Labs still require a “fine clean” to bring them to final clean room conditions.
Facility Construction Schedule

- Contractor work almost done (still some “building automation” and fire alarm tasks).
- Remaining work will be done primarily by SNOLAB personnel (with contractors as necessary).
- Next facility construction activities:
  - Fine cleaning of Ladder Labs
  - Installation of services (plumbing, electrical) in Ladder Labs and Cube Hall.
  - Cryopit: prepare and paint.
  - Renovation of old Personnel Area (reclaim for experiments or infrastructure).
**Experimental Programme**

<table>
<thead>
<tr>
<th>Experiment</th>
<th>Solar nu</th>
<th>0nuBB</th>
<th>Dark Matter</th>
<th>SuperNovae</th>
<th>Geo nu</th>
<th>Other</th>
<th>Space allocated</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>SNO+</td>
<td>√</td>
<td></td>
<td></td>
<td>√</td>
<td></td>
<td></td>
<td>SNO Cavern</td>
<td>Underway</td>
</tr>
<tr>
<td>PICASSO</td>
<td></td>
<td>√</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>SNO Utility</td>
<td>Running</td>
</tr>
<tr>
<td>DEAP-1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>SNO Control</td>
<td>Running</td>
</tr>
<tr>
<td>DEAP-3600</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Cube Hall</td>
<td>Underway</td>
</tr>
<tr>
<td>miniCLEAN</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Cube Hall</td>
<td>Underway</td>
</tr>
<tr>
<td>HALO</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>√</td>
<td></td>
<td>Halo Stub</td>
<td>Underway</td>
</tr>
<tr>
<td>PUPS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Seismicity</td>
<td>Completed</td>
</tr>
<tr>
<td>SuperCDMS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Ladder Labs</td>
<td>Request</td>
</tr>
<tr>
<td>EXO-gas</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Ladder Labs</td>
<td>Request</td>
</tr>
<tr>
<td>COUPP</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Ladder Labs</td>
<td>Request</td>
</tr>
<tr>
<td>DarkSide</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Ladder Labs</td>
<td>Request</td>
</tr>
<tr>
<td>PICASSO-III</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Ladder Labs</td>
<td>Planning</td>
</tr>
</tbody>
</table>
Experimental Programme

Friday, 9 October 2009
Experimental Programme

2009: DEAP/CLEAN 3600, MiniCLEAN 360

2009 HALO

2010: SuperCDMS

Now: PICASSO-III

Now: DEAP-3

Now: PUPS

Now: SNO+ 2009

SNO Cavern

South Drift

Cube Hall

Cryopit

Phase III Stub

Utility Drift

Ladder Labs

Personnel facilities

Utility Area

Friday, 9 October 2009
Experiments currently requesting ladder lab space:

→ EXO 200 Gas
→ PICASSO-III
→ COUPP
→ LAr 2phase (DARKSIDE)
$0\nu\beta\beta$ at SNOLAB

- **SNO+**: $^{150}\text{Nd} \rightarrow ^{150}\text{Sm} + e^- + e^-$
  - Uses existing SNO detector. Heavy water replaced by scintillator loaded with $^{150}\text{Nd}$. Modest resolution compensated by high statistical accuracy.
  - Requires engineering for acrylic vessel hold down and purification plant. Technologies already developed.
    - SNO Cavity: repairs to cavity liner and modification of detector support to hold down the Acrylic Vessel for liquid scintillator.
    - SNO Utility Room: Excavation of pit for liquid scintillator purification system.
  - Capital funding received June 2009.

- **EXO-gas**: $^{136}\text{Xe} \rightarrow ^{136}\text{Ba}^{++} + e^- + e^-$
  - Ultimate detector = large volume Xe Gas TPC
  - Developing technique to tag Ba daughter. Electron tracking capability.
  - Development work at SNOLAB surface facility
Dark Matter at SNOLAB

- **Noble Liquids: Deap-I, MiniCLEAN, & DEAP-3600, (DarkSide)**
  - Single Phase Liquid Argon uses pulse shape discrimination. Two-phase (DarkSide)
  - Prototype DEAP-I operational in SNOLAB now. Successful demonstration of PSD and test bench for DEAP/CLEAN design/operations.
  - Construction for DEAP-3600 and MiniCLEAN underway. DEAP-3600 capital funding granted (CA$26M with SNO+)
  - Will measure Spin Independent cross-section.

- **Superheated Liquids: PICASSO (COUPP)**
  - Superheated droplet detectors. Insensitive to MIPS radioactive background at operating temperature, threshold devices
  - PICASSO Currently operational in SNOLAB, demonstration of alpha rejection and test bench for scale-up of detector volumes
  - Will measure Spin Dependent cross-section.

- **Solid State: SuperCDMS**
  - State of the art Ge crystals with ionisation and phonon readout.
  - Currently operational in Soudan. Next phase will benefit from SNOLAB depth to reach desired sensitivity. Test facility in Ladder Labs under discussion
  - Most sensitivity to Spin Independent cross-section.
DEAP-3600/MiniCLEAN Underway
Other systems

- **SNO+**: As discussed yesterday, will also measure solar neutrino pep, geo-neutrinos, Supernovae bursts and reactor neutrinos.

- **HALO**: Dedicated Supernova watch experiment
  - Charged/neutral current interactions in lead
  - Materials prepared for underground installation (Pb, NCD, DAQ)
  - Infrastructure design completed
  - Installation in 2009.

- **PUPS**: Seismicity Deep Underground
  - Completed operational cycle and now decommissioning
  - Seismic wave propagation at various levels deep underground
Status of SNOLAB

- SNOLAB Phase I infrastructure complete
  - Surface facility, Cube Hall, Ladder Labs
  - Final outfitting and cleaning underway

- Facility is now in transition to experimental programme
  - Deployment of support systems for first experiments underway
    (SNO+, DEAP-3600, MiniCLEAN, HALO)
  - Smaller scale experiments continue operations (DEAP-I, PICASSO)
  - Design/discussions on additional systems advanced (COUPP, CDMS, DarkSide)

- Additional space available, especially when Phase II (Cryopit) completed

- SNOLAB is looking forwards to contributing to the world programme of underground research facilities