

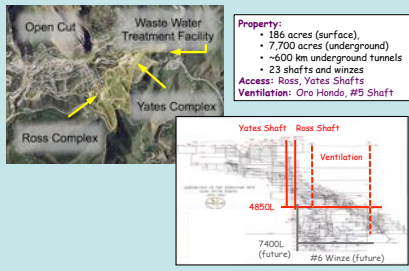
Sanford Underground Laboratory at Homestake

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on behalf of the Sanford Underground Laboratory

Abstract: The status of the Sanford Underground Laboratory at Homestake in Lead, South Dakota will be presented. Excavation of new underground facilities at 4850 feet (about 1480 m) has been completed. Outfitting of the excavated space to house and support the Large Underground Xenon (LUX) detector searching for dark matter and the MAJORANA DEMONSTRATOR neutrinoless double-beta decay experiment is underway and is anticipated to be complete by early 2012. The capability to produce very low background copper by electroforming for the MAJORANA DEMONSTRATOR experiment is now operational at the 4850-foot level. Experiments associated with research in underground biology and geosciences are underway or planned at the Sanford Laboratory.

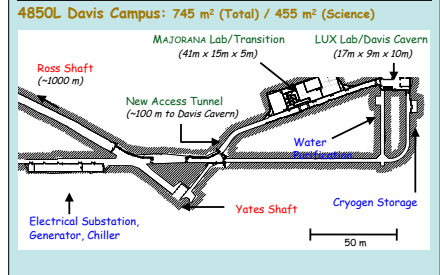
1. Laboratory Footprint



5. Current Laboratory Science



9. New Laboratory Infrastructure

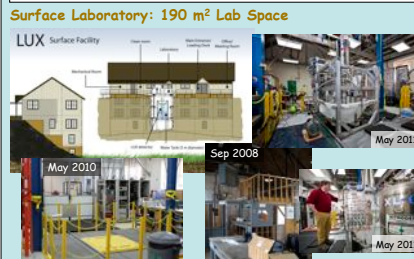


2. Laboratory Operations Status

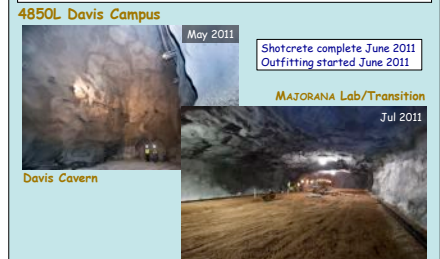
Personnel: ~140 full-time, ~20 part-time

- Refurbishment:**
 - Structural rehabilitation continues in Ross, Yates shafts
 - Ross shaft:
 - Legacy pipe removal (12 km), old power/communication cable (2 km)
 - Ongoing steel beam and connector replacement (until Nov 2014)
 - Yates shaft:
 - New cage, auto-brake system (~Dec 2011) to support Science access
 - Ongoing timber and guide replacement (until May 2017)
- Dewatering:**
 - Pumps:
 - Sites for pumps and storage: 1250L, 2450L, 3650L, 5000L
 - Deep well pump installed in #6 Winze at 7800 feet (controls at 4850L)
 - Water inflow = ~700 gpm (average), pumping outflow = 1000-1300 gpm
 - Water level currently ~1725 m (5658 feet) below surface:
 - Pumps turned off June 2003, re-entry dewatering started June 2008
 - Currently 1128 feet lower than highest level in Aug 2008 (4930 ft)
 - Expect to dewater 7400L by late-2013, 8000L by early-2014

6. New Laboratory Infrastructure



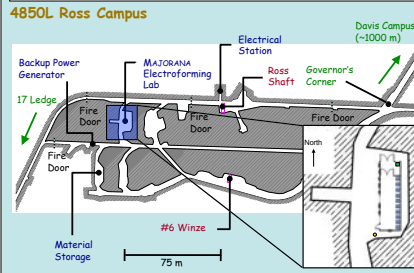
10. New Laboratory Infrastructure



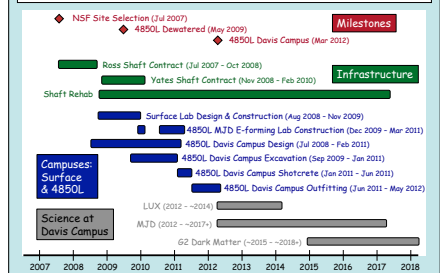
3. Current Laboratory Science

Initial Science Research Groups	
Physics	<ul style="list-style-type: none"> LUX-350 - Dark Matter MAJORANA DEMONSTRATOR - $0\nu\beta\beta$ CUBED - Crystal growth Bkgd Characterization - JUKY, Rn (late Screening lab in future) (J, S) Vertical Facility - N-Near, others (currently magnetic field bkgd)
Geology	<ul style="list-style-type: none"> CO₂ Sequestration - Environment DUGL - Seismic characterization (3) Fiber Sensors - Extensometer, Temp Hydrology - SDSMT/Sanford/DUSEL Hydro-gravity - USGS (SD-AZ) PODS - Petrology, oil exp. structure Tiltmeter - Rock deformation Transparent Earth - Seismic
Biology	<ul style="list-style-type: none"> Biodiversity - BHSU, SDSMT (4,5) Lignocellulose - SDSU Manifold Sampling - Princeton, UTK Microbiology/Cellulose - SDSMT (6,7,8)
Other	<ul style="list-style-type: none"> Cummingtonite - Geology (NIEHS) Site Vertical Array - Geology (San Diego) Selection THMCD - Geology (DUSEL S4) Fracture Group - Geology (DUSEL S4) Ecoklyda Group - Geology (DUSEL S4)
Engineering	<ul style="list-style-type: none"> Signal Propagation - SDSMT Submersible - SDSMT
Total Active = ~19 groups (Plus Others)	

7. New Laboratory Infrastructure



11. Schedule and Milestones



4. Current Laboratory Science

Research Groups and Laboratory Footprint	
Surface	<ul style="list-style-type: none"> USD/BHSU - Gamma, Rn Regis - Muon SDSMT - Climate station UT/BHSU - Mag Field, Ross/Yates USGS - Microgravity
300L	<ul style="list-style-type: none"> DUGL - Low-freq seismometer USD/BHSU - Rn SDSMT - Signal propagation BHSU - Biology baseline samples
800L	<ul style="list-style-type: none"> DUGL - Low-freq seismometer USD/BHSU - Gamma, Rn Regis - Muon/neutron LNBL - CO₂ sequestration MAJORANA - Pb, Cu storage PODS - Geology (get one dep. struct)
1250L	<ul style="list-style-type: none"> SDSMT - Climate station USD/BHSU - Rn
1700L	<ul style="list-style-type: none"> SDSU - Bio samples
2000L	<ul style="list-style-type: none"> SDSMT/FNAL/UW - Water-level tiltmeters (x3), climate
2000L (cont)	<ul style="list-style-type: none"> SDSMT/UJC - Seismo/tilt (x2) DUGL - Low-freq seismometer (x3) USD/Regis - Gamma, Rn and muon/neutron BHSU - Seeps, fungus samples (x2) LNBL - CO₂ sequestration
2600L	<ul style="list-style-type: none"> SDSMT - Climate station (x2)
3350L	<ul style="list-style-type: none"> Uha - Extensometers
4100L	<ul style="list-style-type: none"> DUGL - Low-freq seismometer (x3) UW/LMT - Optical extensometers SDSMT/UJC - Seismometers/tilt BHSU, Many - Biology sampling
4550L	<ul style="list-style-type: none"> USD - Gamma, Rn Many - Bio samples pump water
4850L	<ul style="list-style-type: none"> SDSMT - Hydrometry probes LNBL - CO₂ sequestration (removed) BHSU, Many - Biology samples USD/BHSU - Rn Many - Core holes (hydrology, bio)

8. New Laboratory Infrastructure



12. Laboratory Summary

Sanford Lab

- Infrastructure:**
 - Water level currently ~5658 feet below surface, continue to 8000L
 - Major Projects: Ross/Yates shafts, pumping, hazard mitigation
- Current and Near-Term Science at Sanford Laboratory:**
 - Geology, biology, physics, engineering research on a dozen levels now
 - Approximately 19 active groups, ~8- papers written
 - Two large physics experiments onsite now:
 - LUX in Surface Lab Dec 2009, first detector cool-down May 2011
 - MAJORANA in 4850L cleanroom Dec 2010, electroforming July 2011
 - 4850L Davis Campus:
 - Excavation and shotcrete complete, outfitting started Jun 2011
 - LUX/MAJORANA DEMONSTRATOR occupancy expected March 2012
- Future Science at Sanford Laboratory:**
 - Current physics experiments: LUX until ~2014, MJD until ~2017
 - Generation-2 dark matter: ~2015 until ~2018+
 - Leading scientific program at Sanford Lab possible through ~decade

[1] Mei, Zhang, Thomas, *Astroparticle Physics* 34, 33-39 (2010)
 [2] Gray, Raybel, Tolushek, Mei, Thomas, Zhang, *NIM A* 638, 63-66 (2011)
 [3] Horne et al., *Classical and Quantum Gravity* 27, 225011 (2010)
 [4] Waddell, Elliott, Vahrenkamp, Roggenthen, Sani, Anderson, Bang, *Environmental Technology*, 31 (8-9), 979-991 (2010)
 [5] Rastogi, Magdiel, Garmm, Adhikari, Bischoff, Hughes, Appel, Bang, Dixon, Sani, *Journal of Industrial Microbiology and Biotechnology* 36, 585-598 (2009)
 [6] Rastogi, Bhalla, Adhikari, Bischoff, Hughes, Christopher, Sani, *Bioresource Technology*, 101, 8798-8806 (2010).
 [7] Rastogi, Osman, Kulkadapu, Engelhard, Vaishampayan, Andersen, Sani, *Microbial Ecology*, 60 (3) 539-550 (2010)
 [8] Rastogi, Stefler, Peyton, Sani, *Journal of Microbiology* 47, 371-384 (2009)