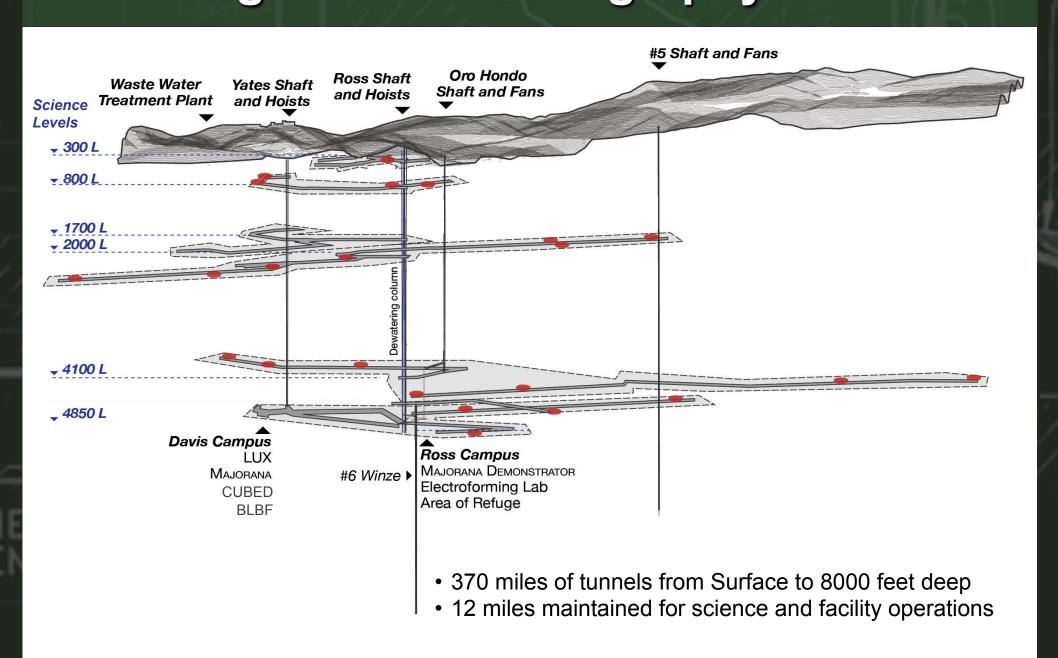
The Sanford Underground Research Facility at Homestake J. Heise on behalf of SURF

Abstract: The former Homestake gold mine in Lead, South Dakota has been transformed into a dedicated laboratory to pursue underground research in rare-process physics, as well as offering research opportunities in other disciplines such as biology, geology and engineering. A key component of the Sanford Underground Research Facility (SURF) is the Davis Campus, which is in operation at the 4850-foot level (4300 m.w.e.) and currently hosts two main projects: the LUX dark matter experiment, the MAJORANA DEMONSTRATOR neutrinoless double-beta decay experiment. Screening capabilities are also coming online with installation of the CUBED and Berkeley (formerly Oroville) low background counters at the Davis Campus. Plans for possible future experiments at SURF are well underway and include long baseline neutrino oscillation experiments, future dark matter experiments as well as nuclear astrophysics accelerators. Facility upgrades to accommodate some of these future projects have already started. SURF is a dedicated facility with significant capacity for expansion, and applications from other experiments are welcome.

1. Underground Lab Geography



2. Overall Status

Facility

- Ross Shaft Rehab
- Strip and re-equip underway, new steel installed to 1615' Expect completion Summer 2017 to meet LBNE schedule
- Yates Shaft
- Provides main access, ongoing maintenance
- Dewatering
- Current level is ~5750 feet below surface
- Strategy is to hold water level ~1000' below 4850L (cost, safety) Laboratories
- Multiple groups active at Surface Lab, Ross and Davis Campuses
 - Expansion plans for the Ross Campus

- LUX and MAJORANA: LUX initial results, preparing for ~300 live-day run; I prototype commissioned, main Cu+Pb shield complete
- CUBED and Berkeley Low-background Counters: Crystals, shielding installed, eventually move to Ross Campus to accommodate LZ
- CASPAR: 60% Ross Campus design received, safety review Feb 2014
- LZ: Submitted for funding for Davis Campus, down-select process
- LBNE: NEPA EA advanced, 4850L geotech drilling completed Apr 2014

3. Current Science Program

Physics LUX – Dark matter using Xe MAJORANA DEMONSTRATOR - Neutrinoless double-beta decay using Ge, also copper electroforming

CUBED - Low-bkgd counting, isotope separation, bkqd characterization (possibly future Crystal Growth)

Berkeley LBF - Low-bkgd counting CASPAR - Neutron bkgds, lab design LBNE - Cleanliness tests on surface and underground, lab design DUGL - Seismic characterization for future gravity-wave detector

Plus interest from others (eg., R&D)

Total Active = ~16 groups (Plus Others)

Geology GEOXTM – Optical fiber applications, Hydro Gravity - Local gravity for

water tables, densities PODS - Petrology, ore deposits, structure (mainly core) Transparent Earth - Seismic arrays

Biology Biodiversity – BHSU, SDSMT Biofuels - SDSMT Bioprocessing R&D - SDSMT

NASA Astrobiology Institute - USC/DRI

Plus interest from others

Syngas/Biofuels - SDSMT

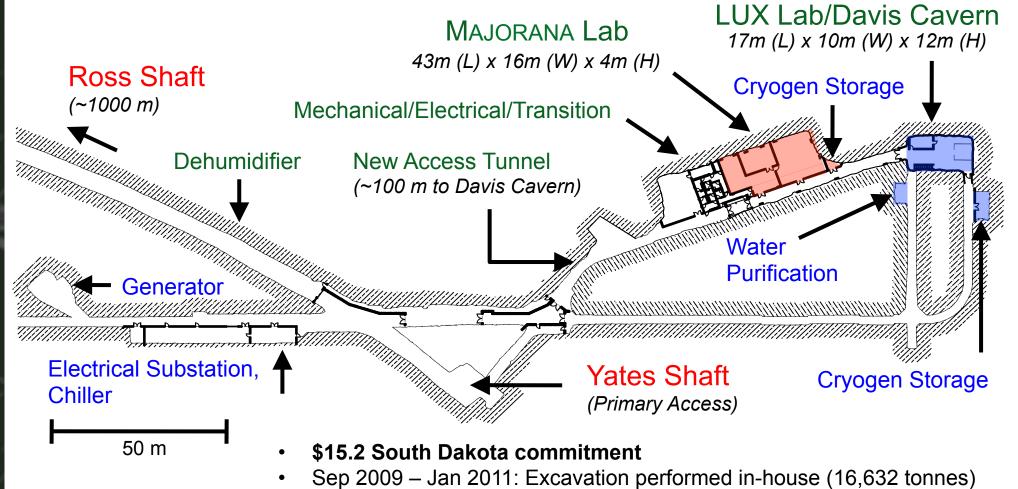
Plus interest from others

Engineering None currently, but interest from geothermal, Xilinx

Previous include: - Signal Propagation - Submersible

EXCAVATION LIMITS SHOWN

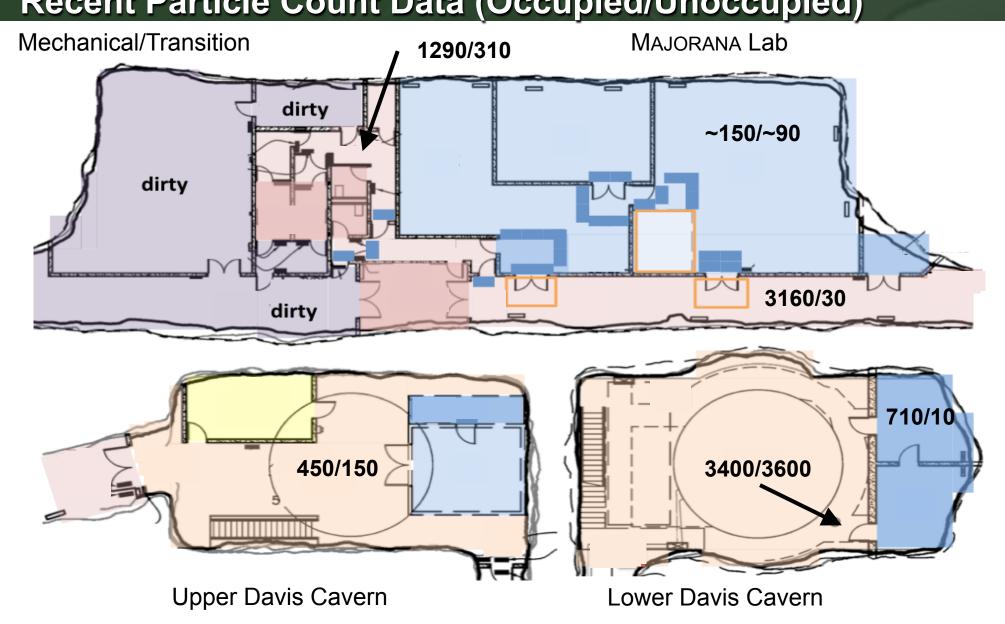
4. 4850L Davis Campus 2,732 m² (Total) / 927 m² (Science)



- Jan 2011 Jun 2011: Low-activity shotcrete (1,264 2,000 lb bags)
- Jun 2011: Outfitting contractor mobilized
- May 2012: Substantial completion (Dedication May 30)
- Zero lost-time injuries

5. Davis Campus Cleanliness

Recent Particle Count Data (Occupied/Unoccupied)



6. Low-Background Counting

CUBED and Berkeley (Oroville) Installed at 4850L Davis Campus

CUBED HPGe counter:

- ORTEC 1.2 kg crystal, n-type coaxial, 60% relative efficiency
- Shield established in early April 2014 (incl Cu, Pb and Rn purge)
- Currently gathering baseline background and calibration data
- Predicted sensitivities: ~200 uBq/kg U/Th

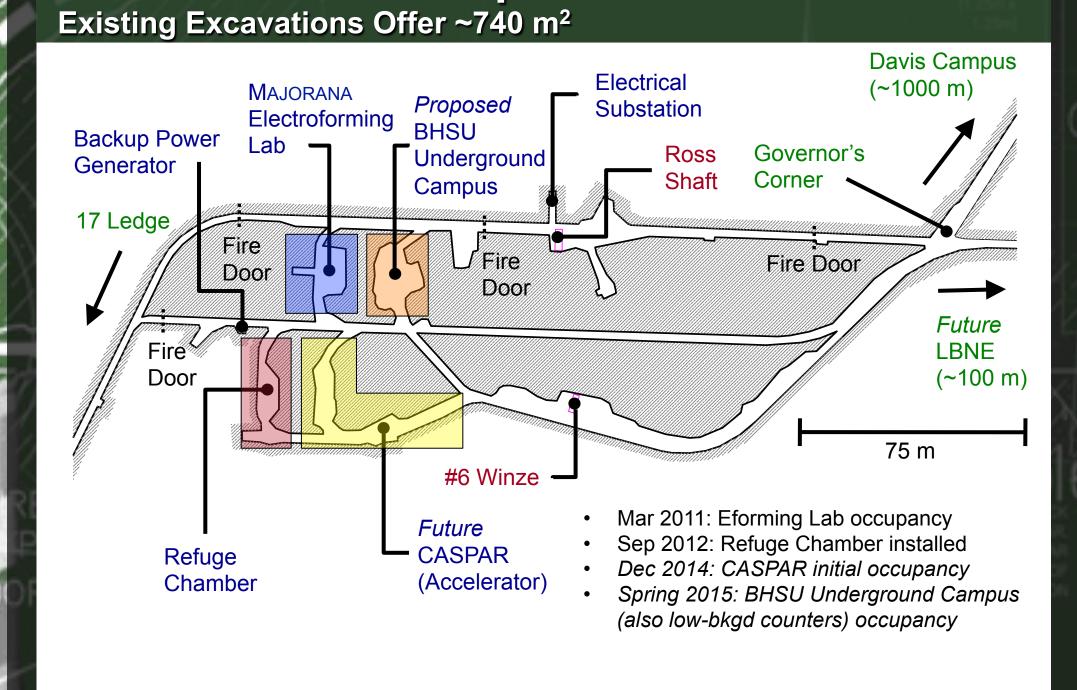
Berkeley HPGe counter:

- ORTEC 2.1 kg crystal, p-type coaxial, 85% relative efficiency
- Shield established May 2014 (incl Cu, Pb and Rn purge)
- Currently commissioning Sensitivities (~1 week): 600 uBq/kg (U), 800 uBq/kg (Th)

CUBED LBC



7. 4850L Ross Campus

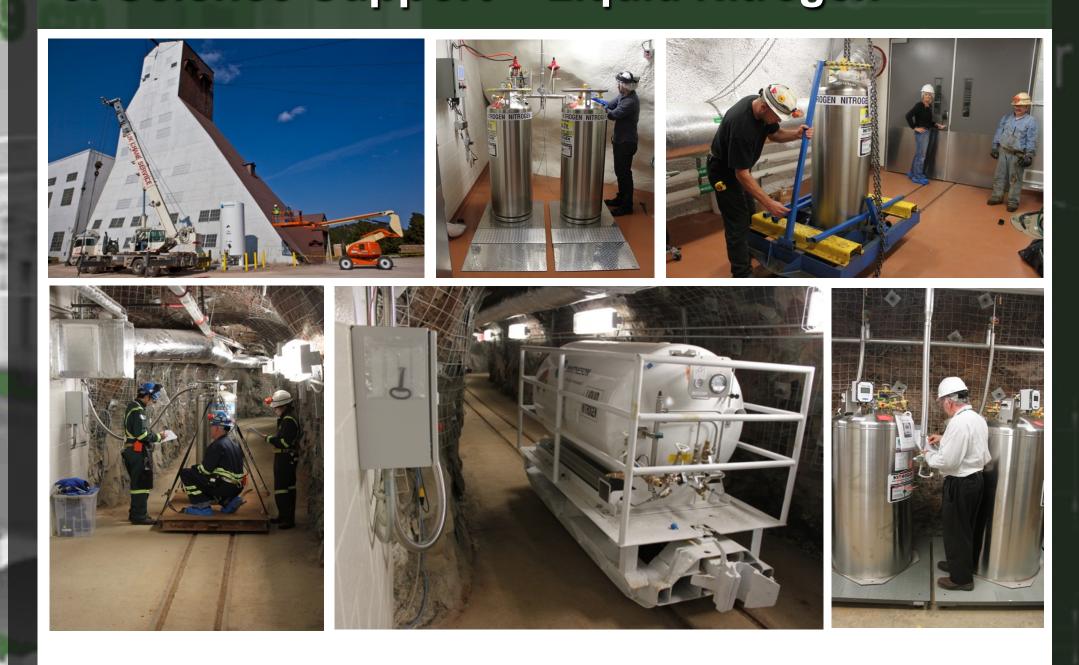


8. Science Opportunities – Space

- Surface Laboratory:
- 190 m² lab space (lower 3 levels not fully developed)
- Cleanroom (incl anteroom, 9' ceiling), water shield tank (~3-m diameter)
- Davis Campus and Vicinity:
- Inside Davis Campus clean space, Lower Davis room: ~17 m² (14' ceiling height)
- Two cutouts outside clean space: ~33-50 m² (with 12' avg ceiling height)

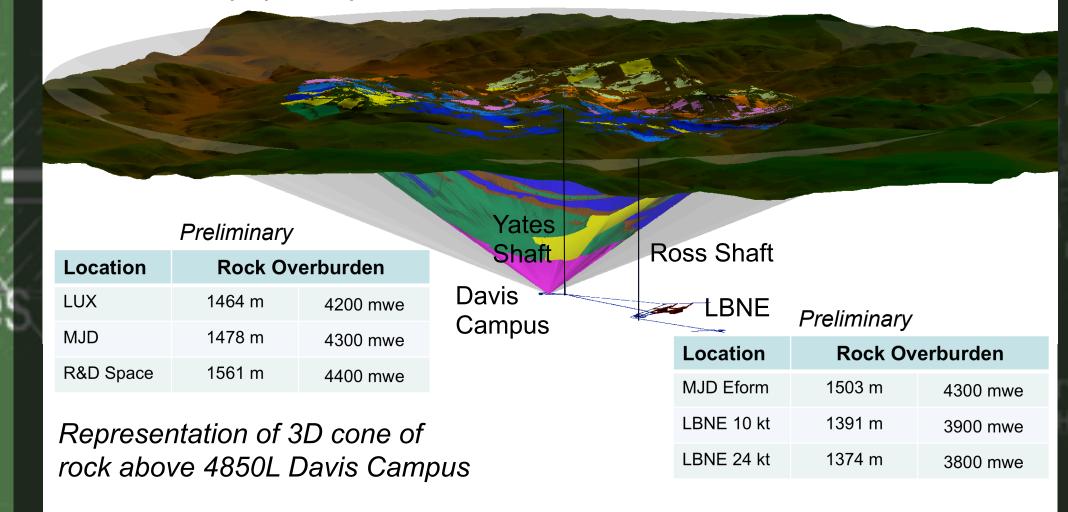


9. Science Support – Liquid Nitrogen



10. Science Support – Geology Model

- 3D model of seven main rock formations, detailed surface topology
- Compiling rock geo-chemistry and density data from variety of sources, paper expected mid-2014



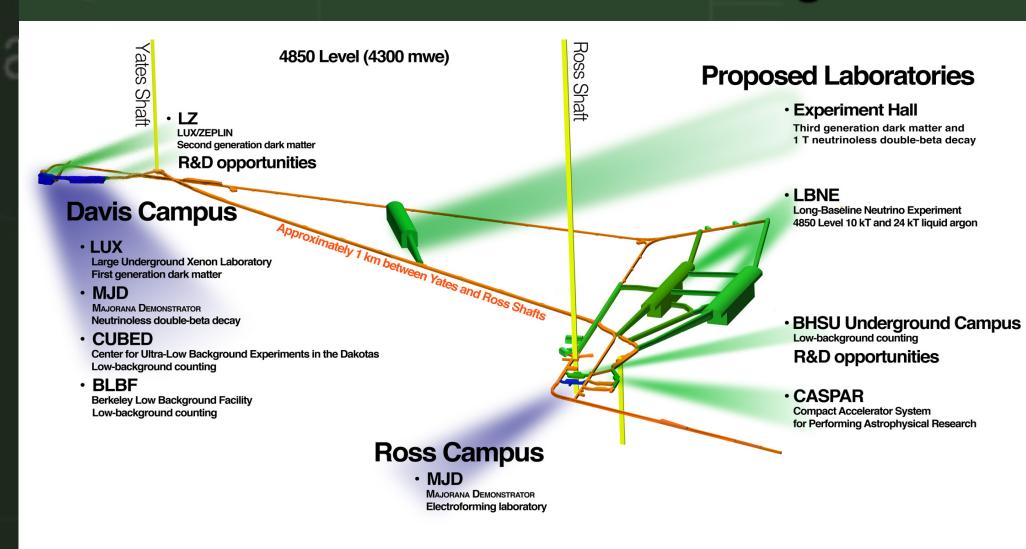
11. Future Physics Expts at the 4850L

Implementation Through the End of the Decade

- Dark Matter: G2 LUX-ZEPLIN (LZ) LXe (~10T total / 7T active / 6T fiducial)
- Using existing infrastructure (Davis Cavern water tank), improved veto (liquid scintillator) Start commissioning/operation ~2017
- **0νββ:** MJD
- Current generation through 2018/2019
- **Low-Background Counting:**
- CUBED, Oroville operational in 2014 Exploring additional capabilities
- **R&D Space:** Options available
- **CASPAR:**
 - Phase 1:Relocate small UND accelerator into existing UG space in 2014/2015 - Phase 2:Full scope (low/high E) in new excavation

Chamber LBC and CASPAR Phases at 4850L

12. Current & Future Science Program



15.4" (Sing LONG. 1" (25min) DIAMETER

Heise, arXiv:1401.0861v1 (2014) Lesko, Euro Phys J Plus **127**, 107 (2012)

