Dear Homestake Collaboration,

Welcome to the March 2012 monthly newsletter for Homestake SURF and South Dakota's Sanford Laboratory. We gladly receive your input on news, links to news articles, upcoming workshops, conference notices, scientific updates, information concerning SURF, employment opportunities, and other highlights relevant to our shared goal.

Important Dates

March 26-30: LBNE Director's Review – Fermilab

April 2: DOE Site Visit – Lead, South Dakota

SURF: Supplement Articles

As Sanford Lab prepares for research operations to be housed at the 4850 Level, a series of SURF Newsletter Supplement articles will explore some of the science basic to the Sanford Underground Research Facility, e.g. the LUX and MAJORANA DEMONSTRATOR experiments. The first paper, "The Construction of a Low-Background Underground Laboratory at the 4850 Level" is now available at: http://www.dusel.org/html/early-science-progress.html.

GEOX™ research: Measuring deformation in an intact rock mass on the 4100 Level of SURF

GEOX™ research at SURF has two main focuses: 1) Development of fiber-optic strain and temperature sensors for monitoring intact rock masses to increase the safety and longevity of underground openings; and 2) Examination of how the mechanical properties of rock vary over spatial scales.

The GEOX™ research group is composed of Herb Wang, Dante Fratta, and JoAnn Gage from the University of Wisconsin-Madison, Alan Turner from *Micron Optics Inc.,* Steve Gabriel from Spearfish High School, and Mary MacLaughlin from Montana Tech. Observers included Rich Barry, Chief Engineer on the *Crazy Horse Memorial project* near Custer, South Dakota, and Kevin Hachmeister from *Golder Associates*.

The GEOX™ team installed a dense array of 32 Fiber Bragg Grating (FBG) sensors and 600 meters of temperature sensing fiber-optic cable on the 4100 Level of SURF. The group has two main types of FBG sensors, an OS3600 gage which has a 0.25 or 1-m gage-length, and fiber-optically instrumented rock strain and temperature strips (FROSTS). They developed FROSTS to measure a detailed strain and temperature profile into the rock mass. Each FROST is 2-meters long and has six strain gages installed at 30-cm intervals along its length. The FROSTS are embedded into the rock mass.

To measure mechanical strain in their sensors, on January 19, 2012, the researchers did an active-loading experiment, using a 100-ton hydraulic cylinder and a specially manufactured steel post to apply a 100-ton point-source load to the rock mass near the fiber-optic sensors (shown in Figure 1).

Figure 1: GEOX™, SDSTA, and observers work together to position and assemble the hydraulic jacking system for 100-ton loading experiments. Standing from left: Rich Barry, Pat Kinghorn, and Luke Scott. Kevin Hachmeister, kneeling

The six strain gages of the FROSTS embedded in the ceiling of the alcove measured shortening strain that decreased in magnitude with depth into the rock mass (Figure 2). The team used the strain data from Figure 2 to determine that Young's modulus increased with depth into the rock mass.

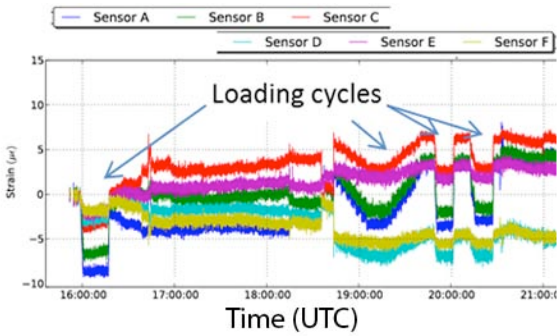

Figure 2: Strain data from active-loading experiments on January 19, 2012. Sensor A is closest to the surface; sensor F is deepest in the rock mass. Shortening is negative and elongation is positive. The box-shaped changes in stain are a result of the 100-ton load being applied to the rock mass. Note that strain magnitude decreases with depth.

Background Characterization for SURF Experiments

The Background Characterization Group consists of researchers from the University of South Dakota, Notre Dame University, and Regis University and covers a number of experiments. The group is monitoring and checking data underground, such as measuring background radiation levels (see Figure 3). They moved a sodium-iodide based detector from the 2000 Level to the 4850 Level to measure gamma radiation emitted from traces of uranium and thorium in the rock as well as cosmic ray-induced gamma radiation. This is important for underground experiments such as the LUX dark-matter search and the MAJORANA DEMONSTRATOR (MJD) neutrinoless double-beta decay search; they need to know background radiation levels so they can properly calibrate their detectors.

Figure 3: University of South Dakota Research Professor Chao Zhang explains a background radiation detector to Multimedia Specialist Matt Kapust. At the computer: USD Student Alyssa Day checks data

Characterization of the environmental background components (in particular neutrons, gamma-rays, muons, and radon contamination in the rock, in the air, and in the water) at the 4850 Level at SURF is an important first step in opening the facility to physics experiments, especially after the underground mine flooding in 2003. Existing information is being collected, coordinated, and analyzed. Subsequently, a campaign of new relevant measurements at the different levels has been undertaken with the aim of covering missing data, and resolving possible inconsistencies. This is particularly important for the neutron and gamma ray background components. Different techniques and detectors are being employed, and results are being compared. This will allow development of a consistent database of the relevant background components at different levels. Such a database is very important to the design of planned SURF experiments' shielding and, in the end, to interpret observed candidate events.

The measurements are being taken at the 4850 Level for the year 2011-2012. Chao Zhang, a research faculty member at University of South Dakota (USD), has undertaken implementation of the planned measurements/data analysis at the 4850 Level and database with a GEANT4 simulation package. He has dedicated his time to the interference package, which allows LUX, MAJORANA, and other planned SURF experiments to simulate their background correctly. With recent development in fixing GEANT4 problems for nuclear reactions including neutron inelastic scattering, cosmogenic production, and internal conversion, Zhang has developed significant expertise in the GEANT4 simulation under the direction of Dongming Mei, the Principal Investigator of this project.

The following team members (some of them shown in the Figure 4 photo) who have contributed significantly to the project include Fred Gray (Regis University), Keenan Thomas (USD), Chao Zhang (USD), Alyssa Day (USD), Jaret Heise (Sanford Lab), Dan Durben (BHSU), and Dongming Mei. Fred Gray and his students measured the muon fluxes at the 800-foot and 200-foot levels. Keenan Thomas, Chao Zhang, and Dongming Mei have been measuring gamma rays and muon-induced processes. Jaret and his team members have been monitoring radon levels. Alyssa is measuring muon-induced X-rays in lead bricks.

Figure 4: Background Characterization Group - left to right: Christopher Ruybal, Dongming Mei, Jonathan Totushek, Keenan Thomas, Chao Zhang, Fred Gray, Evan Keffeler, Tessa Jones, Katrina Knodel

During three years of current grant support, the group has published 11 papers and made 14 presentations at various conferences, having generated significant impact on low background experiments. These cover the measured muon fluxes, gamma-ray fluxes, and neutron fluxes at surface levels of 800 ft, 2000 ft, and 4550 ft. The radon concentrations are being measured for the surface levels at 800 ft, 1250 ft, 2000 ft, 4550 ft, and 4850 ft. The measured results are then given to the SURF design team and the planned SURF experiments for their consideration of the radon mitigation and the design of external shielding. The online database of (α, n) neutron yields and energy spectrum for different materials that are used to build detectors has been visited more than 1000 times internationally. All publications and presentations have generated significant impact on low background experiments. It is worth mentioning that several students and postdocs were involved in the publications, and that the majority of presentations were made by students and postdocs. Two sample papers: http://arxiv.org/abs/0912.0211 or http://arxiv.org/abs/1007.1921.

SURF IN THE NEWS

UC Berkeley News Center: *New discovery is key to understanding neutrino transformations* (Robert Sanders)

AIP.com: *OSTP Director John Holdren on FY 2013 S&T Budget Request* (Richard M. Jones)

Wired.com: *Strange Effects: The Mystifying History of Neutrino Experiments* (Adam Mann)

Rapid City Journal: *Editorial: Universities need to modernize*
School funding, SDPB cuts among budget proposals (David Montgomery)

Black Hills Pioneer: *'Nano' Days celebrates small science* (Jaci Conrad Pearson)
LUX prepares to move underground (Wendy Pitlick) – also on duselwatch.com

Water Well Journal: *Journey to the Center of the Earth* (Jill Ross)

For twitter updates see: www.sanfordlab.org

Reports Available: The National Research Council report – "An Assessment of the Deep Underground Science and Engineering Laboratory": http://www.nap.edu/catalog.php?record_id=13204

Marx-Reichanadter Committee report to DOE: http://science.energy.gov/~/media/np/pdf/Review_of_Underground_Science_Report_Final.pdf

SANFORD UNDERGROUND LABORATORY NEWS

Dewatering Levels

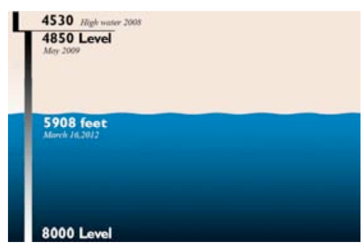

Figure 5: Progress of dewatering at Sanford Lab

The Figure 5 graphic indicates the dewatering progress made at Sanford Lab. As of March 16, the water level was at 5908 feet, its lowest point ever. The high water mark, in August 2008, was at 4350 feet underground.

Davis Campus

The LUX dark-matter detector will soon be installed in the Davis Cavern on the 4850 Level, where 2002 Nobel Prize for Physics winner Ray Davis once built his neutrino detector. LUX will also use Davis's nearby control room, pictured (then and now) in Figures 6 and 7. The smaller room will be used for storage of the liquid nitrogen needed to cool xenon for the LUX detector, as well as uninterrupted power supply (UPS) units to ensure a safe power supply to LUX.

Figure 6: Ray Davis prepares to enter the new control room for his neutrino detector (taken about 1965)

Figure 7: February 2012: masonry blocks being stored in the control room waiting installation for the new wall

The Davis campus is reported to be 80 percent completed. On the second floor of the cavern, the block walls of the LUX control room have been built (see Figure 8). A modular clean room for LUX, scheduled to arrive sometime in March, will be installed on the top floor. In the Transition area, where the MAJORANA DEMONSTRATOR experiment will be located, painters, electricians, masons, ductwork installers, and others continue to add finishing touches. Lead bricks that shield the MAJORANA detector from background radiation will be moved over the smooth floors by a compressed-air hover lift.

Figure 8: The new top floor of the Davis Cavern. Room at right will be the control room for the LUX dark-matter detector. Wide doorway in the center leads to the Transition Area where the MAJORANA DEMONSTRATOR experiment will be installed

Rope-Dog Tower Update

The rope-dog tower is scheduled for completion by late March. This 100-foot-high tower is being built inside the 150-foot-high Yates Shaft headframe. Figure 9 shows some of the difficulty involved in the construction process, as sheeting and windows must be removed at several locations so that cranes and other equipment can reach inside the Yates Shaft and position the tower's large structural beams.

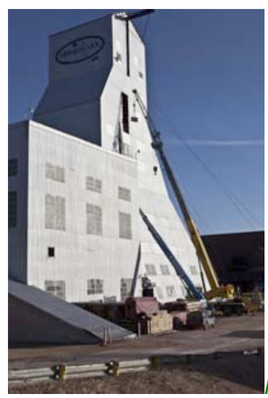

Figure 9: Heavy Constructors Inc. contractors open a window on the south side of the Yates Shaft headframe

Project Engineer Mike Johnson reported that as of March 5, five of the eight steel beams of the tower's vertical structure had been set in place. One beam remains to be installed on the headframe's south side, and two beams on the north side.

Once the vertical beams are in place, contractor *Heavy Constructors Inc.* will install a horizontal structure at the top of the tower that will include two 1100-pound rope glands. Glands are self-locking wedges that will secure the dog ropes to the tower. After the tower is completed, the Sanford Lab crew will hang the dog ropes which will run the entire length of the 5000-foot shaft. The ropes consist of braided steel wires; the “dogs” are clamps that serve as a safety feature, automatically gripping the ropes in the unlikely event of a hoist-rope failure.

In April, after the rope-dog system has been thoroughly tested, the Yates Shaft will serve as the main entry route to the underground.

EDUCATION AND OUTREACH

Recent Activities

Brian Schwartz from the Graduate Center of the City University of New York, who visited the Black Hills in November 2011 to talk to community members about his program, was awarded the American Institute of Physics Andrew W. Gemant Award in 2009. This award recognizes individuals who have made significant contributions to the cultural, artistic, or humanistic dimension of physics. Schwartz received the award "for ingenious creativity in engaging the public with the history and cultural aspects of physics and for inventing ways to celebrate physics through such varied vehicles as plays, musicals, exhibitions, street fairs, cabaret, posters, and opera." Following his visit in 2011, Dr. Schwartz generously donated a portion of his award as seed money for community and university events that connect science and the arts within the Black Hills and relating to SURF. (To read more about Brian Schwartz’s award, see: http://www.aip.org/aip/aipmatters/archive/2010/1_19_10.html.)

The first science and arts event in what is expected to become an ongoing series took place February 26-28 in Lead and Rapid City. The Repertory Dance Theater Company from Salt Lake City, Utah (http://www.rdtutah.org/), a modern dance troupe that features dances based on science themes, gave a public performance at the Homestake Historic Opera House on Sunday, February 26.The next day, it visited Lead-Deadwood Middle School and the Suze Cappa Dance Center in Rapid City (which works with disabled individuals) the next day. As part of the public event in Lead, Peggy Norris gave a pre-dance talk on *Dance through the Lens of Physics* together with a dessert reception, courtesy of the Black Hills State University Foundation.

Kara Keeter of BHSU organized a Quarknet Master Class for ten students on March 12 at Sanford Lab. In addition to participating in the Master Class through the videoconference system, the students toured the LUX surface lab and Hoist Room with Jaret Heise. A second class for an additional 16 students from four schools was given on March 21.

The second in a monthly series of Brown Bag Lunches for Sanford Lab staff took place on March 14. Peggy Norris presented a session on Radiation and Radioactivity. Participants built a cloud chamber, explored shielding requirements for various types of radioactivity, and learned about the low background needs of the physics experiments at the 4850 Level. Through hands-on activities, participants explored magnetism and the workings of motors, drawing connections to the hoist motors at Sanford Lab and the historic use of turbines to generate power. The seminar was repeated on Friday, March 23 for the benefit of staff who could not attend the first time, as well as some community partners.

The South Dakota Digital Dakota Network (DDN), which serves the educational needs of universities in the state for distance learning, installed equipment for a satellite classroom in the Yates Education Building. The installation allows students and faculty who are working onsite to take or teach a class at their home institution, whether inside or outside the state.

ENVIRONMENT, HEALTH & SAFETY

Spring Safety

Keep your kids safe: Make sure bikes and helmets are in good working order. Check your swing sets and other playground equipment for loose parts or sharp, rusty edges. Lawn mowers and yard chemicals should be stored properly. Monitor for allergies, sneezing, or skin irritations.

Keep your pets safe: More pets and wild animals will be outside. Have your pets microchipped. Keep dogs leashed or with you in a dog park. Don’t let cats roam too far, or keep them indoors. Install or check door and window screens.

If you are visiting South Dakota, contact (605) 722-0002 for road closure and weather information or check Safe Travel USA.

Safety pages on Sanford Lab website:
www.sanfordlab.org - Use the left hand menu to open individual pages

UPCOMING EVENTS & ANNOUNCEMENTS

Conferences and Workshops

APS April meeting – March 31-April 3, 2012. Hyatt Regency, Atlanta, GA. Held jointly with the Sherwood Fusion Theory Conference for Divisions of Astrophysics, Computational Physics, Nuclear Physics, Particles and Fields, Physics of Beams, and Plasma Physics.
http://www.aps.org/meetings/april/index.cfm

Underground Science Experiments & Research Seminars (USERS) continue bi-weekly on Thursdays, 1:30-2:30 PM. Alternate sessions will be held at LBNL and UC Berkeley, 325 Old LeConte Hall. If you are interested in attending these seminars please subscribe to this email list for future announcements:
http://dusel.org/mailman/listinfo/ugsseminars

DURA Events

IDUST2012 on Inter-Disciplinary Underground Science and Technology International Conference - May 9-11, 2012, Apt, France.
http://lsbb.oca.eu/spip.php?rubrique267

EUROCK2012, Rock Engineering & Technology for Sustainable Underground Construction International Symposium - May 28-30, 2012, Stockholm, Sweden. http://www.eurock2012.com/

46th U.S. Rock Mechanics Geomechanics Symposium - June 24-27, 2012, Chicago, IL. http://www.armasymposium.org/

AAPG: Fundamental Controls on Flow in Carbonates - July 8-13, 2012, Saint Cyr-Sur-Mer, Provence, France.
http://www.aapg.org/education/hedberg/france2012/

IWAA12: International Workshop on Accelerator Alignment - September 10-14, 2012, Fermilab, Batavia, IL.
https://indico.fnal.gov/confLogin.py?returnURL=https%3A%2F%2Findico.fnal.gov%2FconferenceDisplay.py%3FconfId%3D4712&confId=4712

NNN12: Next Generation Nucleon Decay and Neutrino Detectors - October 4-6, 2012, Fermilab, Batavia, IL.
http://www-ppd.fnal.gov/conf-w/FermilabSponsoredConferences.htm

NSF announcement of funding opportunities for underground experiments and development:
http://www.nsf.gov/publications/pub_summ.jsp?ods_key=nsf12043
The target date for submission is May 1, 2012. Applicants are requested to contact the relevant Program Director in PHY prior to submission.

Please send information regarding upcoming meetings of interest or presentations from DURA members, as well as other related events to Richard_Gaitskell@brown.edu or jswang@lbl.gov.

JOBS

Postdoctoral Fellow - Experimental Neutrino Physics, MAJORANA group, Lawrence Berkeley National Lab. Neutrinoless double-beta decay search in the MAJORANA experiment and direct kinematic measurement of the neutrino mass scale in the KATRIN experiment. Dr. Alan Poon (AWPoon@lbl.gov).
https://lbl.taleo.net/careersection/2/jobdetail.ftl?lang=en&job=73997

Physicist Postdoc Fellow - SNO+ Neutrino Experiment, Nuclear Science Division, Lawrence Berkeley National Lab. SNO+ will search for the neutrinoless double-beta decay of ^{150}Nd. Job #74020. Prof. Gabriel Orebi Gann, GOrebiGann@lbl.gov.
http://cjo.lbl.gov/positions.html?jobcode=abc&jobfield=10

Physicist Postdoctoral Fellow – Direct Dark Matter Search, Lawrence Berkeley National Lab. LUX dark matter search experiment. Amy

Pagsolingan, AVPagsolingan@lbl.gov.
https://academicjobsonline.org/ajo/jobs/1326

Postdoc position - Stanford University neutrino group. Activities may include data analysis on the EXO-200 double beta decay experiment, R&D for a multi-ton EXO detector, and R&D toward better technologies to test the behavior of gravity short scales. Prof. Giorgio Gratta, gratta@stanford.edu.

Postdoctoral Fellow - EXO Double Beta Decay Experiment, Physics Department, University of Illinois. Working on EXO-200 data analysis and R&D for full EXO. Prof. Liang Yang, liangyg@illinois.edu.
http://inspirehep.net/record/1091455

Postdoctoral Researcher position – Center for Neutrino Physics, Virginia Tech. Study of neutrino oscillations, working primarily on the Daya Bay Reactor Neutrino Experiment in China. Prof. Jonathan Link, jmlink@vt.edu, Virginia Tech Physics Dept., 317 Robeson Hall, M/C 0435, Blacksburg, VA 24061. Job #0121584. http://www.jobs.vt.edu

Postdoctoral position - Subatomic Physics Group, University of Michigan. Completion of upgrades to a calorimeter for neutron flux measurement and cold-beam neutron lifetime measurement at NIST. Prof. Tim Chupp, chupp@umich.edu.

Newsletter Editor: Melissa Barclay
Contributors: Kevin Lesko; Bill Harlan (Sanford Underground Lab News); JoAnn Gage and Herb Wang, University of Wisconsin-Madison, Department of Geoscience (Measuring deformation in an intact rock mass on the 4100 Level of SURF); Dongming Mei (Background Characterization for SURF Experiments); Rick Gaitskell, Duane Moser (DURA News); Peggy Norris, Ben Sayler (Education and Outreach).

Photo/Graphic Credits: Fig. 1: Herb Wang; Fig. 2: JoAnn Gage; Fig. 3: Steve Babbitt (BHSU); Fig. 4: Jaret Heise; Figs. 5,7-9: Matt Kapust; Fig. 6: Anna Davis

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