

Dear SURF Readers,

Welcome to the May 2012 Sanford Underground Research Facility (SURF) monthly newsletter. In the coming months, this newsletter will be posted online, but a pdf copy will be available. You will also receive an email reminder every month providing the link to the newsletter and SURF news updates. We will still be glad to 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

**May 30: Davis Campus 4850 Level
Opening ceremony – Lead, South Dakota**

**June 12-14: Shaft Rehabilitation Readiness
Review – Lead, South Dakota**

Long-Baseline Neutrino Experiment Phased Program Update

The Long-Baseline Neutrino Experiment (LBNE) is an experiment proposed for SURF that would explore neutrino physics and astrophysics while at the same time probing for new types of radioactive decay never before seen – Proton Decay. The project would take advantage of the deep depths available at the former Homestake gold mine, and near-optimal distance from Fermilab, the nation's large accelerator outside Chicago to pursue a world-leading science program. Such programs can be costly however, and in a March 19, 2012 letter to Fermilab Director Pier Oddone, Department of Energy (DOE) Office of Science Director Bill Brinkman cited the “current budget climate” and asked for the lab to “lead the development of an affordable and phase approach” to LBNE. The letter also goes on to say that “alternative configurations to LBNE should also be considered”.

The LBNE project and collaboration now face many questions such as the following: What is a “phased approach”? What are “alternative configurations”? These concepts have been pursued in two different ways: (1) partitioning LBNE into its component pieces (neutrino beam, near detector on the

Fermilab site, far detector at SURF) and phasing the development over time, or (2) considering alternative sites to the Sanford Lab in Lead, South Dakota site, and using an existing, shorter neutrino beam to Minnesota. The first alternative meets the scientific flexibility and ambitious goals of LBNE, and stretches out the project over time. The second alternative gives up the ultimate long baseline sensitivity (the distance to the Minnesota site is only about 60% of the distance to Sanford Lab in Lead) and seeks to move quickly to more limited science goals and saving on the development of a new and improved neutrino beamline.

As part of the decision-making process over what plan to propose to the DOE, the Fermilab Steering Group of prominent scientists has been meeting in recent weeks to examine the issues of concern, and generate a list of affordable options to Fermilab, taking issues of costs, science goals, and schedule into consideration. Fermilab will then work with the DOE Office of Science to develop a plan for LBNE. The expectation is that this will be completed by the end of Summer 2012.

MAJORANA DEMONSTRATOR (MJD) meeting

On May 8-9, over 50 members of the MJD collaboration met in Lead, South Dakota as part of their preparation for a major Department of Energy review in Germantown, Maryland, which took place later in May. MAJORANA Principal Investigator Steve Elliott (Los Alamos National Lab) reported the meeting a success. The review schedule also included an inspection of the 4850 Level Davis Campus.



*Figure 1:
MAJORANA DEMONSTRATOR collaboration in front of
Yates Shaft parking lot*

The MAJORANA team began moving equipment underground in March 2012, but finish work on floors and other final details must be completed before

additional equipment can be moved. Tools for the machine shop, which researchers will use to fashion precision parts from ultra-pure copper for electro-forming, top the list. Experiment Integration Manager Reyco Henning of University of North Carolina said that those machine tools are ready to be moved underground.

The review in Maryland is known as the CD-2 and CD-3 review. CD-0 already established the need for the project. CD-1 included a selection of the alternatives from the path forward, as well as approval of a cost range. The purpose of CD-2 is to establish performance baselines, and CD-3 concerns approval to start construction. MAJORANA combined the two reviews. CD-4 will involve the final phase: approval to begin operations.

SURF: Supplement Articles

The first in a series of SURF Newsletter Supplement articles explores some of the science basic to the Sanford Underground Research Facility, e.g. the LUX and MAJORANA DEMONSTRATOR experiments. “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>.



SURF IN THE NEWS

BBC News: [Searching for dark matter in the Homestake Gold Mine](#) (Matt Danzico, May 30) – Includes a BBC-produced video.

Washington Post: [New underground lab turns S. Dakota gold town into scientific hub in search for ‘dark matter’](#) (Associated Press, May 30)

--Additional reports on Sanford Lab’s May 30 Dedication ceremony will appear in the June newsletter.

Nature.com: [Neutrino project changes focus](#) (Nicola Jones, May 2)

LBNL News Center: [Lying in Wait for WIMPs](#) (Paul Preuss, May 23)

[Science Underground: Going to Great Depths](#) (Paul Preuss, May 16)

[MAJORANA, the Search for the Most Elusive Neutrino of All](#) (Paul Preuss, May 16)

Brown University: [Brown Scientists Help Search for Dark Matter](#) (David Orenstein, May 24)

KEVN TV: [Water level holding steady at the Sanford Lab at Homestake](#) (Jack Caudil, April 21)

LBNL News Center: [Four Berkeley Lab Researchers Named to National Academy of Sciences](#) (Jon Weiner May 1) - One of the new NAS associates is Dr. Bernard Sadoulet, UC Berkeley Physics Professor and LBNL Faculty Senior Scientist who is an internationally known leader in the search for direct detection of dark matter

Black Hills Pioneer: [Grant allows science programs to continue](#) (Wendy Pitlick, April 25)

[Plans continue for Sanford Center for Science Education programs](#) (Wendy Pitlick, April 24)

[Sanford Lab to hold water at 6,000 feet underground](#) (Wendy Pitlick, April 21)

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 at Sanford Lab

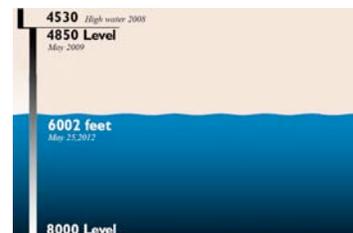


Figure 2: Dewatering graphic

The Figure 2 graphic indicates the dewatering progress made at Sanford Lab. As of mid-April, the water level was at 6005 feet, its lowest point ever. The high water mark, in August 2008, was at 4350 feet underground. Since 2008, pumping has continued steadily, pumping out a total of 1.9 billion gallons of water. On May 17, the water level reached 6000 feet.

A study was conducted to determine how much money might be saved by holding the watering level at 6000 feet rather than continuing to completely dewater the facility. Currently, the cost to pump water out of Sanford Lab is ~\$3 million per year. Much of this is electrical power to run the pumps, but \$350,000 in electricity costs will be saved under the new proposal. On April 19, Sanford Lab officials announced their decision to test the dewatering system to determine answers to these questions, and the Sanford Lab Communications Department sent out a press release.

A deep-water submersible pump, about 6500 feet underground feeds a series of sumps and pumps that lift water in 1200-foot steps to a water-treatment plant on the surface. SURF Operations Director Greg King said the rate of pumping will be slowed gradually during the next two or three months to maintain a steady flow of water to the treatment plant. Runoff flows into Homestake at an average year-round rate of nearly 700 gallons a minute, so pumping will continue even if the water level remains constant. Fluctuations in water level will depend on rain events and the time of year, so the level will continue to experience variances. May marks the second month of testing the water balance for holding water around the 6000-level mark. Laboratory Director Mike Headley said holding the water level at 6000 feet will provide a generous margin of safety for experiments at the Davis Campus. Even if the pumping system were turned off, Headley said, it would take a year for the water to rise more than a thousand feet to these experiments.

To read more on Sanford Lab dewatering, see Wendy Pitlick's *Black Hills Pioneer* article or the KEVN report mentioned in SURF In the News on page 2.

LUX Update

On May 4, the LUX team conducted two trial runs in anticipation of the process of moving the LUX dark-matter detector from the surface laboratory (where it was assembled) to its new underground home on the 4850 Level. The first trial run (shown in Figure 3) covered an 800-foot distance from the surface lab to the Yates Shaft headframe, and took about 45 minutes. *Donovan Construction* of Spearfish, South Dakota provided the forklift for this portion of the trip. Sanford Lab Facilities Technician Jake Quenzer, who constructed a transport cart for the LUX detector, used steel beams to assemble a 6000-pound stand-in for the detector for use during trial runs. Pat Wermers and Tanner Sealey of *Donovan* monitored two digital levels on the transport cart, which was raised by a forklift.



Figure 3: Tanner Sealey (left) uses hand signals to direct forklift operator Woody Burns in a simulated test run of the LUX dark matter detector from the surface lab to the Yates headframe

LUX Operations Manager David Taylor said that the goal was to keep the detector level “within plus or minus 1 degree”. Taylor also attached a pair of accelerometers to the mock detector to measure the acceleration forces or bumps that the real detector might encounter on this journey. According to Taylor, the rest of the trip is still in the planning stages. This includes loading the detector onto the Yates Shaft conveyance, slowly and carefully lowering the detector to the 4850 Level, and moving it by rail (and on Quenzer’s custom-built cart) to the Davis Cavern. The LUX team will test the entire route before the detector itself is moved early this summer.

LUX water tank passivation: Safety procedures are being followed for all aspects of operation at SURF. For example, to protect the LUX dark-matter detector from stray neutrons, the detector will be

submerged in a large stainless steel tank of deionized (DI) water. The DI water has already been purged of mineral impurities, including ions of sodium, calcium, and iron, but safety measures are in place to protect from possible contamination.

Confined-space rules were followed during the week of April 23, before inside surfaces of the LUX water tank were passivated so that they would be less affected by environmental factors. Before anyone entered the tank, clean HEPA-filtered fresh air was pumped in. Due to the hazardous atmosphere potential, a permit was required for personnel to enter the tank to test the air. Once they determined that continuous forced-air ventilation could control possible air hazards, LUX scientists received the go-ahead to work in the tank as long as the forced air system was running, and barring other safety issues.

Once inside, technicians from California-based contractor *Astro Pak* removed offending minerals, in particular trace amounts of iron, over three days of chemical cleaning. *Astro Pak* works regularly with pharmaceutical companies and organizations such as NASA and Proctor and Gamble. SURF Environmental Manager John Scheetz supervised the project.

Astro Pak technicians made their own deionized water to clean the tank. Twenty-thousand gallons were rinsed with hot DI water, using five high-powered nozzles, followed by an hour-long rinse with a dilute solution of sodium hydroxide. Once that basic solution was neutralized and removed, a four-hour rinse with a citric acid solution followed, which was also neutralized and removed. Finally, the tank was rinsed three more times with DI water.

Throughout the process, chemicals were added to the DI water through a pumping and filtration device. The latter also heated the cleaning solutions. The *Astro Pak* crew tested the water every half hour for mineral content (shown in Figure 4). Discharged water was pumped to the Yates Shaft sump, in accordance with a federal permit.



Figure 4: Ty Balmer of *Astro Pak* tests water during LUX water tank passivation

After the passivation, LUX scientist Dean White of UC Santa Barbara removed the last traces of DI rinse water from the tank (shown in Figure 5). LUX Operations Manager David Taylor said that the SURF Operations Department and Davis Campus outfitter *Ainsworth Benning Construction* provided support, including equipment delivery, and setting up electrical power and a water supply.



Figure 5: LUX scientist Dean White vacuums the remaining water from the experiment's water tank at the Davis Campus 4850 Level

Rope-Dog Safety System in Operation

The four-month installation of the rope-dog tower safety system in the Yates Shaft was completed by April 20. The Yates Shaft, the new primary underground access, was ready for general use as of mid-May. Test runs of the Yates service cage started on April 21, with Sanford Laboratory crews thoroughly inspecting all safety and maintenance issues (shown in Figure 6) before the shaft could be recommissioned.



Figure 6: Infrastructure

Tech Rick Tinnell inspects a dog rope

Ross Shaft progress

With the rope-dog system in place and the Yates Shaft in operation as primary underground access, engineers and technicians will soon begin the five-year project to replace steel supports in the Ross Shaft.

Preliminary work involved building a new scale model of the Ross Shaft which SURF Senior Project Manager Will McElroy says will help the steel-replacement team conceptualize the process and identify safety and other potential issues before the project starts. Technical Support Lead Jim Hanhardt (shown in Figure 7) and Infrastructure Technician Dan James built the 1-to-7 scale model using aluminum tubing and steel angle iron in a wood framework. The 8-foot tall model recreates 50 to 60 feet of shaft.

The Ross Shaft was originally commissioned in 1934, and reinforced with rectangular steel frames built in 6-foot sets. The new steel framework will be constructed in 18-foot sets, which will speed up installation and improve the structural integrity of the shaft. The Ross model also includes steel sets in the current configuration at the bottom with sets in the new configuration on top. Hanhardt will add models of jib cranes mounted on work decks, which infrastructure technicians will use to lower the new steel into position.



Figure 7: Jim Hanhardt points to the cage

compartment opening of the new model of the Ross Shaft

The Ross Shaft Risk Assessment Group met during the first week of May to plan the replacement of steel in the shaft. Members include: Project Controls Analyst Pam Hamilton, Engineering Project Manager Mike Johnson, Technical Support Specialist Jim Hanhardt, Shaft Consultant Bob Stevenson, Construction Manager Syd DeVries, Lab Director Mike Headley, Senior Project Manager Will McElroy, Construction Safety Specialist Tim Eggers, Technical Support Lead George Vandine, Project Engineer Bryce Pietzyk, Infrastructure Tech Jerry Hinker, Safety Consultant Tony Iannacchione, and Infrastructure Tech Pat Kinghorn.

EDUCATION AND OUTREACH

Recent Activities

Spring outreach: if the number of students served is one measure of success, Sanford Lab's Education and Outreach (E&O) Department has been quite successful this spring.

About a year and a half ago, the E&O Department embarked on a collaboration with other cultural institutions in the town of Lead (the Lead Educational Field Trip (LEFT) Committee) to market Lead as a destination for school field trips. With one phone call, teachers can request from a menu of choices, spending from a few hours to a full day in Lead. A few schools participated a year ago; this year, the program reached capacity, culminating in five different school groups during the last week of school in western South Dakota. School groups ranged from Grades 4 to 8, located as far away as Gillette, Wyoming, and with group sizes from four students (Black Hills Lutheran School) to 100 students (Rapid City Valley View Elementary). Most groups chose to add science to their agenda, through SURF programs offered either at Sanford Lab or at Lead's Homestake Visitor Center. In April and May 2012, the E&O Department served 378 K-12 students from 10 schools through the LEFT program, and an additional 157 students through six schools that contacted the department directly.

One popular program with students (particularly grades 4-6) utilizes data from the tiltmeters installed on the 2000 and 4850 Levels at Sanford Lab by Fermilab Physicist Jim Volk and his collaborators. Before leaving Sanford Lab in January 2012, Jason Van Beek analyzed some of the earthquake data

seen in the tiltmeters. Students start with a Slinky activity to learn about different kinds of seismic waves, and about properties of waves in general. The students are then shown tiltmeters identical to those installed underground, and have the chance to talk about how they work. At that point, students move to the computer to look at tiltmeter data. They can use the relative arrival time of the different kinds of seismic waves to determine how far away last year's large earthquake off of Japan occurred, and map it with Google Earth. They also may look at the effect of the Earth's tides on the tiltmeter data. In a popular addition, Jason took the waveform from one earthquake and converted it to a range of frequencies audible to the human ear. By 'listening' to the earthquake at different multiplication factors, students learn about the relationship between frequency and pitch.

With the increased emphasis on engineering practices in the national Education Framework, the E&O Department is also prototyping engineering design challenges with a SURF focus. On May 4, 48 Lead-Deadwood fifth graders visited the laboratory, having just finished a unit on levers and pulleys. While small groups toured the Hoist Room, the other students worked on their own hoist challenge: to design and construct a hoist to pull a load from a shaft (mailing tube), ring a bell when it got to the top, and hold it there. The students came up with an amazing range of innovative designs (see Figure 8).



Figure 8: Lead-Deadwood Fifth graders show off their hoist designs

Education programs: another measure of success might be the impact of SURF and its education programs on individual students in South Dakota. During this graduation season, the E&O Department has started to see that impact in the choices students make:

- As an undergraduate at Augustana, South Dakota, Hannah Rogers was one of the 2009 Davis-Bahcall Summer Scholars who visited Brookhaven. In 2010, she interned in the Physics Department at Augustana, and in 2011, at the National Radio Astronomy Observatory. This May, she graduated and will be attending graduate school at the University of Minnesota.
- In 2010, Adam Caldwell of Lead, did a high school senior project on cosmic rays under the mentorship of Sanford Lab's Deputy Director of Education and Outreach Peggy Norris. That same summer, he participated in the Davis-Bahcall Summer Scholars program visiting Fermilab. In 2011, as a SDSMT undergraduate in chemical engineering, he was a Dave Bozied Intern at Sanford Lab, and he is now working with Professor Cabot-Ann Christoferson (South Dakota School of Mines & Technology) on the MAJORANA DEMONSTRATOR (MJD) electroforming project.
- 2011 Davis-Bahcall Scholar Joel Krauss, of Mitchell, South Dakota was impressed when the group visited the NOvA site at Ash River, Minnesota last summer. As a freshman at University of Minnesota, he applied for and obtained an internship with the NOvA group.
- 2012 Davis-Bahcall Scholar Sophia Elia, of Rapid City, interned with the E&O Department at Sanford Lab last summer as a high school junior because she was fascinated by dark matter. She has chosen to study physics at the University of California, Berkeley, after being accepted to schools up and down the California coast.
- Graduating senior Tiarra Rose Little, of Red Cloud School in Pine Ridge, has visited the Sanford Lab twice in the past two years with the school science club. After the Red Cloud visit last October, Sanford Lab Science Liaison Connie Giroux began to mentor the girls in the club. She is very proud that Tiarra will be attending Stanford University this fall, where she will major in Native American Studies and Science. Tiarra also received a Gates Millennium Scholarship. Three other girls from the Red Cloud Science Club--Savannah Jensen, Genriel Ribitsch, and Gabriella (Gabby) Rodriguez--will be attending Georgetown University's Pathways to Success

Program this summer, a program that Tiarra attended last year.

SURF Tours

Beginning in May, the Homestake Visitor Center in Lead, South Dakota will run daily surface tours of the former Homestake Mining Operation. The tours will continue throughout the summer. The tour bus will drive on SURF property, going through the Yates Yard so tourists can visit the Yates Shaft hoist room, and then continue down nearby Ellison Hill. In addition to the daily trolley tour bus, the visitor center will also offer larger group bus tours. The one-hour guided tour will also pass through historic downtown Lead, explain the gold mining process to visitors, present some background on area geology, and offer a current view of the historic 1876 Open Cut mining area.

ENVIRONMENT, HEALTH & SAFETY



Electrical Safety

Outside

- Be sure to locate power lines before you begin outdoor chores, and keep ladders away from power lines.
- Do not fly kites or balloons, or toss objects around power lines. It can cause damage to the lines and result in electrocution or fire.

Inside

- Keep electrical appliances such as radios, phones, and hairdryers away from sinks and bathtubs.
- If there are children in the house, be sure that all electrical outlets have safety covers. A child (or pet paws) sticking any item into the socket can be seriously hurt.

Safety pages on Sanford Lab website:

www.sanfordlab.org - Use the left hand menu to open individual pages

STAFF NEWS

Joseph Gantos began his first day as SURF Environment, Health and Safety Director on May 21. More details will be provided in the June newsletter.

UPCOMING EVENTS & ANNOUNCEMENTS

Conferences and Workshops

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

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 Neutron Decay and Neutrino Detectors - October 4-6, 2012, Fermilab, Batavia, IL. <http://www-ppd.fnal.gov/conf-w/FermilabSponsoredConferences.htm>

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

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>

Postdoctoral researcher – Neutrino experimental group, University of Pittsburgh. Candidate will work on Minerva and MINOS+ at Fermilab and T2K in Tokai, Japan. Prof. Donna Naples; Dept. of Physics and Astronomy, Univ. of Pittsburgh, PA, 15260 or dnaples@pitt.edu.

Postdoctoral position – IRFU/SPP (CEA-Saclay), in close collaboration with CSNSM (Orsay University). Search for WIMPs with the EDELWEISS---III detectors. Eric Armengaud, IRFU/SPP, Bat 141, CEA Saclay 91191, Gif-sur-Yvette, France or eric.armengaud@cea.fr

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>

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