

Dear SURF Readers,

Welcome to the April 2014 Sanford Underground Research Facility (SURF) monthly newsletter. The newsletter is posted online, and a pdf copy is available. You can read recent and archived newsletters at our website at www.sanfordlab.org. We are 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 underground science.

Important Dates

May 8: INPA Dark Matter Workshop – LBNL, Berkeley, CA

May 9-10: LZ Data Processing Workshop – LBNL, Berkeley, CA

Sanford Lab Homestake Visitor Center

The Sanford Lab Homestake Visitor Center, in planning for about five years, will soon replace the existing Homestake Visitor Center on Main Street in Lead, South Dakota; it will be a larger, more dramatic facility (see Figures 1-2). Steve Dangermond of *Dangermond Keane Architecture* shares his vision:



Figure 1: Aerial graphic view of the new Sanford Lab Homestake Visitor Center against the background of the Open Cut (Courtesy of Dangermond Keane Architecture)

The new building will provide public outreach for the Sanford Underground Research Facility as well as interpretation of the history and cultural context of Lead and the Homestake Mine. Located on the edge of the Open Cut in Lead, it will be a prominent and exciting new attraction. The new facility will provide exhibit space, classroom space, and offices for the

Lead Chamber of Commerce, which will continue to own and operate the facility.

Exhibits inside will set the context for the Lab, giving an overview of the history of the City of Lead and the Homestake mine, including the cultural context of the Native Americans as well as the various ethnicities of the miners who came to work at Homestake. The exhibits will also interpret the laboratory and the past, present and future science taking place, answering the question “why here?” Care will be taken to not duplicate the stories being told in the local Mining Museum and other local interpretive centers.



Figure 2: Aerial graphic view of the new Sanford Lab Homestake Visitor Center (Courtesy of Dangermond Keane Architecture)

The interior of the building will echo the aesthetics of the underground lab, with a palette of high-tech materials and a white/gray neutral background that will allow graphics and media to pop. The exterior will continue this theme of relating to the science and the future. While the City of Lead is a National Historic Landmark, the site for the Visitor Center is sufficiently separated from the historic fabric of Lead to allow for this contrast without detracting. The new Visitor Center is intended to stand out as something visually exciting and different, attracting passing visitors.

The new building will be clad in stainless steel panels to give the building a contemporary look that resonates with the materials used in the underground experiments. The architects and planners wanted to avoid a pastiche of historic mining and “old west” motifs – this is a building decisively about the future, not the past. The architecture team also wanted to express that it is in the spirit of many of the major buildings at the Homestake mine that were purpose-built industrial facilities incredibly modern for their time. The U-shaped structure encloses an internal courtyard whose open side will have breathtaking views of the

Open Cut, and will be ideal for events. Inside, the ends of the U have large picture windows that will provide all-season viewing of the Open Cut.



Scientific Opportunities with LBNE

The P5 report to DOE, due in late May, will describe the Long-Baseline Neutrino Experiment (LBNE). The FNAL/Sanford Lab project, as a primary part of the US High Energy Physics Program in the next decade. An updated document that outlines the physics programs in some detail, is now available. The 286-page document includes descriptions of the beam, the ways to measure CP violation and the neutrino-mass hierarchy, atmospheric neutrinos, core-collapse supernovae, nucleon decay, and a range of other physics activities that can be done with a high neutrino flux in a near detector or in an underground far detector at Sanford Lab.

<http://lbne2-docdb.fnal.gov/cgi-bin/ShowDocument?docid=8087>

Reports/Papers Available

[Scientific Opportunities with the Long-Baseline Neutrino Experiment](http://arxiv.org/abs/1307.7335) (Cornell University Library, <http://arxiv.org/abs/1307.7335>)

[First Results from the LUX Dark Matter Experiment at the Sanford Underground Research Facility](http://arxiv.org/abs/1307.7335), *Physical Review Letters* **112**, 091303, March 4, 2014.

[The Sanford Underground Research Facility at Homestake](http://arxiv.org/abs/1401.0861). (Jaret Heise, January 5, 2014, Cornell University Library, <http://arxiv.org/abs/1401.0861>)

[Why the US Needs a Deep Domestic Research Facility](http://arxiv.org/abs/1304.0402). (Kevin Lesko, April 1, 2013, Cornell University Library, <http://arxiv.org/abs/1304.0402>)

For news, twitter updates, and other features see the SURF website: www.sanfordlab.org

Like SURF on Facebook:

<http://www.facebook.com/SURFAtHomestake>



SURF IN THE NEWS

BBC Today: [Dark Matter Hunt: US LUX experiment reaches critical phase](#) (Rebecca Morelle, April 8)
[Includes video version:](#) (Rebecca Morelle, April 7)
 Or <http://www.youtube.com/watch?v=u4VHFNwhdts>

Fermilab Today: [LBNE's core is at Sanford Lab](#) (Matt Kapust, April 3)

UCLA Newsroom: [Possible evidence for dark matter particle presented at UCLA physics symposium](#) (UCLA, March 10)

BHSU Media: [Sanford Lab And BHSU Team Up On Underground Campus](#) (Amy Varland, April 8)

Yale Daily News: [Nuclear physics lab undergoing renovation](#) (Jennifer Gersten, March 24)

Sky and Telescope: [Dark Matter Spotted in the Milky Way?](#) (Shannon Hall, March 25)

Capital Journal: [State university will have direct link to Sanford labs](#) (Bob Mercer, March 23)

Brown Daily Herald: [Research moves toward detection of dark matter](#) (Jason Nadboy, March 5)

Rapid City Journal: [Spearfish High School student awarded full ride Nelson Scholarship](#) (BHSU, April 16)

[Math, science education expanding](#) (Editorial, March 30)

[BHSU to expand its campus to Sanford Lab](#) (Bob Mercer, March 24)

[GOOD, BAD & UGLY: Lead visitor center more costly](#) (Staff, March 24)

Black Hills Pioneer: [SHS student awarded full ride Nelson Scholarship](#) (April 19)

[Another great year of accomplishments](#) (Steve Morford, April 17)

[New Lead visitor center to cost \\$1.5M more](#) (Bob Mercer, March 21)

DURA News

To comment on DURA, please contact chair Richard Gaitskell (Richard_Gaitskell@brown.edu). For Bio-Geo-Engineering matters, contact Bill Roggenthen (William.Roggenthen@sdsmt.edu). For further information on DURA, see: <http://sanfordlab.org/dura>

SANFORD UNDERGROUND LABORATORY NEWS

MAJORANA Engineering Update

Work continues on the construction of the MAJORANA DEMONSTRATOR (MJD) experiment's external shield. The layered shield will protect the experiment equipment from background sources. Vince Guiseppe, Assistant Professor of Physics at the University of South Carolina, is leading construction of the shield.

When completed, the shield will have six layers (see Figure 3), all designed to minimize cosmic and terrestrial radiation from contaminating the experiment. The outermost layer, a 12-inch thick panel of polyethylene, slows neutrons. The second layer, scintillating plastic veto panels, will detect muons, the most penetrating cosmic rays. Next, an aluminum radon enclosure will keep out room air, while the fourth layer of lead bricks set in a particular pattern, will block gamma rays.

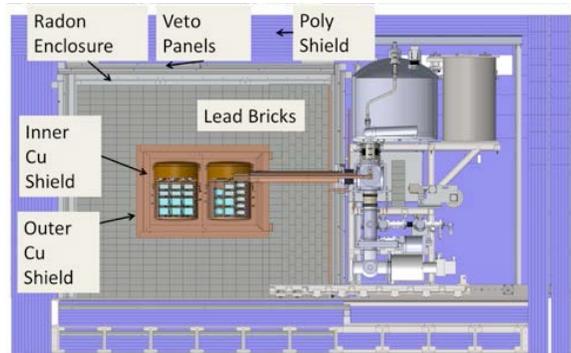


Figure 3: Six layers of the shield are designed to minimize cosmic and terrestrial radiation

Finally, a rectangular box of ultrapure copper will surround the 2-inch thick layer of electroformed copper. These two layers are designed to protect the experiment from the radioactivity of the shield.

The lead brick is the most complicated layer, consisting of three sections: a castle made of 3400

brick pieces, and two portable monoliths, each which will hold 570 bricks inside a copper frame. The monoliths will contain the germanium detector arrays and hardware. They are portable so that researchers will be able to move the detectors in and out of the shield, as needed.

Each section requires an intricate interweaving of bricks to ensure that every crack is covered (see Figure 4). Giuseppe and a mechanical designer created the patterns using computer models. For each layer of bricks, specific instructions must be followed precisely.

MJD experimenters plan to begin collecting data this summer, although the shield will not be complete.



Figure 4: An intricate interweaving brick design ensures that every crack is covered. Giuseppe and a mechanical engineer created the designs using computer models

LBNE Core Drilling

The LBNE (Long-Baseline Neutrino Experiment) has started its first construction project at Sanford Lab. A drilling crew is in the process of extracting rock core from the 4850 Level (see Figure 5). Core samples will be used to explore the rock mass that will house the LBNE liquid argon far detector. Tracy Lundin, Conventional Facilities Manager for LBNE, said that the drilling is an exploration program intended to characterize the rock mass.

“The rock is about 1.8 billion years old and contains some younger rhyolite about 30 million years old,” said David Vardiman, Geotechnical Design Engineer for Sanford Lab. Core samples will reveal the strength and geologic composition of the rock, and also the orientation of folds and other imperfections in the rock mass, all of which will influence the design of the excavation that will house the detector.



Figure 5: ARUP Rock Mechanics Engineer Reza Ghasemi and LBNE Project Manager Jim Strait examine a piece of core taken from the 4850 Level

Four exploration holds will be drilled, which will yield hundreds of feet of 3-inch diameter rock taken out in five-foot sections.

First Drilling, the drilling subcontractor, set up a Conner 208h core rig for the job. The rig uses a hollow diamond-tipped bit that cuts through the hard rock and leaves a solid core sample. Drill Supervisor, Mike Kukar, said that this setup was one of the most difficult he's ever done. The rig barely fit into the narrow drift on the 4850 Level. A generator behind the drill powers the rig, and it takes 8 to 12 gallons of water per minute to lubricate and flush out the borehole.

The drilling project is ahead of schedule. A more detailed report on the core drilling will be presented in a future SURF newsletter.



Safety at Sanford Lab

Ongoing safety exercises continue at Sanford Lab. Throughout the year, periodic training sessions are presented to the staff on various topics. In April, a general safety basic training was held on April 1, an Annual Refresher training took place over several days in April, and another training session on Blood-borne Pathogens and First Aid occurred on April 4.

An Emergency Response Team (ERT) mine rescue training took place on April 9. This is a monthly drill in which various emergency situations are simulated in order to determine emergency readiness and appropriate responses.

Other recent environment, health, and safety training sessions included the topics of:

- Stretching (a presentation on preventing musculoskeletal injuries) given by Will Domagall, SURF Infrastructure Technician and Certified Personal Trainer. The purpose of the program was to reduce injuries.

- Personal Protective Equipment (PPE), with a focus on hardhat inspection and protection.

EDUCATION AND OUTREACH

Activities

The Education and Outreach Department has been busy with spring field trips, onsite activities at the Yates Campus, offsite activities, and videoconferencing to the Davis Campus. Some groups who recently toured Sanford Lab include:

- The SDSMT (South Dakota School of Mines & Technology) student club affiliated with the *American Society of Heating, Refrigeration, and Air-Conditioning Engineers* (ASHRAE) toured the back rooms of the Davis Campus with student members and some of their professional mentors. Mike Johnson (SURF Engineering Project Manager) and Andrew Brosnahan (SURF Junior Facility Engineer) led the group.

- Aberdeen Central High School physics students toured the Hoist Room when they came to the Black Hills for a Quarknet Master Class at Black Hills State University (BHSU).

- Lead-Deadwood High School students toured the Hoist Room as part of annual government day activities.

- Two classrooms of fifth-graders from Vandenberg Elementary School in Douglas, South Dakota toured the Hoist Room and participated in a "Hoist 'Er Up" engineering challenge.



Offsite, the local Girl Scouts Council participated in *Earth Hour* on March 29. *Earth Hour* is a worldwide movement organized by the *World Wide Fund for Nature* (WWF), and is held annually to encourage communities, households, and businesses to turn off their non-essential lights for one hour. *Earth Hour* began at 8:30 pm, and organizers challenged everyone to turn off anything

requiring electricity. The Girl Scouts used it as an opportunity for an overnight sleepover. SURF's Education and Outreach team worked with the middle school students on the topics of air quality and pollution. Using an air monitor borrowed from Sanford Lab, typically used to monitoring particulates underground, students measured the particulates in various rooms of their Girl Scout facility in Rapid City. They discovered that the biggest source of particulate pollution turned out to be themselves. Thanks are due to Chuck Lichtenwalner (SURF EH&S Safety Manager) for suggesting the activities and lending the monitors.



Figure 6: LUX researchers Jim Dobson and Tom Davison of University of Edinburgh, with Jared Thompson, SDSMT Lab Technician for MJD, speak with students via videoconference

Virtual tours of the Davis Campus accomplished through the use of high-definition videoconferences took place for the following groups:

- A pilot project for middle school brought 50 sixth-graders from Lead-Deadwood Middle School to the Sanford Lab Yates Education building and almost 100 middle school students from Jamestown, North Dakota together in one videoconference to the LUX experiment. In preparation, students were introduced to dark matter and neutrinos in their separate schools by Peggy Norris (SURF Education and Outreach Deputy Director) and David Demuth (Valley City State University, North Dakota). David participates in the NOvA experiment in Minnesota and is a member of the Long-Baseline Neutrino Experiment. Jim Dobson and his colleagues from Edinburgh University in Scotland talked to the students from underground. The students had many questions for them. Jared Thompson (Research Technician, SDSMT) also talked to the students about constructing the MJD experiment, as the camera switched to the detector assembly room.

- Students from an advanced chemistry class from Newton High School in Newton, Kansas were treated to a talk and virtual tour of the MJD experiment by Cabot-Ann Christofferson (SDSMT Chemistry Instructor and Deputy Director of MJD Project at SURF). The class had just finished a unit on nuclear science. The students were amazed by the steps that are taken to make every component of the experiment as radiation-free as possible. The students also talked to Mark Hanhardt (SURF Experiment Support Scientist) about the LUX experiment (see Figure 7).



Figure 7: Rapid City High School students interested in STEM careers ask questions of Mark Hanhardt

- A second two-state technology pilot took place with high school students from Chamberlain and Timber Lake in South Dakota, and Valley City High School in North Dakota. In addition, members of the North Dakota STEM Network (a consortium of state government, universities, and industries within North Dakota) witnessed the experiment while attending a session at a Summit in Bismarck. The attendees had many questions for the scientists. Jim Dobson again represented the LUX experiment and Ryan Martin from University of South Dakota talked to the group about MJD.

Sanford Lab interns

The list of Davis-Bahcall Scholars appeared in the March SURF newsletter. In addition to those ten students, five others will have the opportunity to intern at Sanford Lab this summer. Three South Dakota School of Mines & Technology students received Dave Bozied internships. Dave Bozied, who passed away in 2009, was a longtime member of the South Dakota Science and Technology Board of Directors. Recipients have the opportunity to work in several fields. Interns for 2014 are Colter Dunagan and Rashyll Leonard, who will work in the SURF Science Department, and David Molash, who

will work in industrial hygiene in the EHS Department.

Two other students received Chris Bauer Engineering Internships, created in memory of Chris Bauer, a Sanford Lab electrical engineer who died in 2013. Recipients are Wade Vandine of South Dakota State University (engineering), and Dakotah Simpson, SDSM&T (operations). Dakota (shown in Figure 8) was a Davis-Bahcall scholar in 2013.



Figure 8: Dakotah Simpson helped install cosmic ray detectors on the Davis Campus 4850 Level as a Davis-Bahcall Scholar in 2013. He will return this year as a recipient of a Chris Bauer Engineering Internship

The Davis-Bahcall Scholars Program, which is sponsored by 3M, allows students to get involved with current ongoing research. The program is named for experimentalist Ray Davis and theoretician John Bahcall, who proposed the solar neutrino experiment in the former Homestake mine. Davis received a shared Nobel Prize in Physics in 2002, for his work in the field of underground physics.

“The goal is to encourage students to go on to graduate school, get involved in research, or become teachers,” Peggy Norris said. “We want them to become the future science, technology, engineering, and math (STEM) leaders of South Dakota.”

ENVIRONMENT, HEALTH & SAFETY



Spring Cleaning Safety

- Remove potential hazards from the yard and garage such as debris, stacks of paper, rubbish, or frayed appliance cords
- Properly store flammable liquids and chemicals: keep cleaning products in their original containers. Don't mix chemicals together, especially ammonia and bleach.

- Be kind to your back: get help when lifting very heavy objects, and stop to take breaks
- Petproof and childproof your garden - make sure all fertilizers and pesticides are locked up and out of reach

UPCOMING CONFERENCES AND WORKSHOPS

The Art of Experiment, Lawrence Berkeley National Lab, Berkeley, CA. May 2-3, 2014. A symposium to celebrate 40 years of advances, honoring Dave Nygren.

<http://nygrensymposium2014.lbl.gov/>

INPA Dark Matter Workshop, Lawrence Berkeley National Lab, Berkeley, CA. May 8, 2014. Presentations and discussions on Dark Matter experiments, theory, and related topics. Kevin Lesko, ktlesko@lbl.gov. To register by May 1: Melissa Barclay, mbarclay@berkeley.edu.

Neutrino 2014, XXVI International Conference on Neutrino Physics and Astrophysics, Boston, MA, June 2-7, 2014.

<http://neutrino2014.bu.edu/neutrino-2014/>

Neutrino Day, Lead, South Dakota. July 12, 2014. Annual free science festival at SURF, Homestake Visitor Center, and downtown Lead. Science exhibits and talks, surface campus tours of SURF, and other activities. <http://sanfordlab.org/>

Neutrino Summer School, St. Andrews, Scotland, August 10-22, 2014. An opportunity for students and postdocs to discuss neutrino physics.

<http://www.hep.anl.gov/ndk/hypertext/numeetings.html#ins14>

Present and Future Neutrino Physics, KITP, UC Santa Barbara, September 29-December 29, 2014. Topics include neutrino oscillations, nature of neutrino mass, absolute neutrino mass scale, and neutrino physics beyond the Standard Model.

<http://www.kitp.ucsb.edu/activities/dbdetails?acro=neutrinos14>



JOBS

Postdoctoral researcher positions (2), UC Berkeley. Work on neutrinoless double beta decay with CUORE and SNO+. Gabriel Orebi Gann

SURF MONTHLY NEWSLETTER

gabrielog@berkeley.edu, Yury Kolomensky,
yury@physics.berkeley.edu

Research Associate, Stanford-SLAC. One or more openings. Participate in LUX science running, launching LZ, and long-term R&D. Dan Akerib, akerib@slac.stanford.edu. Deadline: 6/1/14.
<https://academicjobsonline.org/ajo/jobs/4012>

Senior Scientist, DESY, Hamburg. Research in astroparticle physics, leading role in IceCube neutrino observatory. recruitment@desy.de, Job code: EM046/2014. Deadline: April 30, 2014.
<http://www.desy.de/v2/e/zeuthen.shtml>

Postdoctoral Researcher, Louisiana State University. Work with experimental physics group on the T2K experiment. Thomas Kutter kutter@phys.lsu.edu. Deadline: March 2014.
<http://inspirehep.net/record/1281988>

Postdoctoral Fellowship, Physics, LBNL. Work on LUX dark matter, and possibly LUX-ZEPLIN next generation dark matter experiments. Deadline: 4/14/14. Dominga Estrada, estradadr@lbl.gov
<https://academicjobsonline.org/ajo/jobs/3826>

Faculty positions, University of South Dakota. Tenure-track Professor and Assistant Professor in Earth Sciences and Physics. Posting numbers: 5811 and 5812. Apply: <https://yourfuture.sdbor.edu>

Tenure-track faculty positions, South Dakota School of Mines, Rapid City, SD. Junior and senior faculty openings in South Dakota's new physics doctoral program. Open until filled.
<http://inspirehep.net/record/1260920>
<http://inspirehep.net/record/1260921>

Postdoctoral position, University of North Carolina, Chapel Hill. Research in Experimental Nuclear and Particle Astrophysics. Work with MAJORANA and KATRIN. John Wilkerson. jfw@physics.unc.edu
<https://unc.peopleadmin.com/postings/31072>

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Contributors: Kevin Lesko; Connie Walter (Sanford Lab local news); Steve Dangermond (Sanford Lab Homestake Visitor Center); Maury Goodman (Scientific Opportunities with LBNE); Peggy Norris, Ben Saylor (Education and Outreach)

Photo Credits: Figs. 1-2: Dangermond Keane Architecture; Figs. 3-6: Matt Kapust; Fig. 7: Linda Storm, STEM Counselor at Stevens High School; Fig. 8: Laura Howard, Black Hills State University

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