

Dear SURF Readers,

Welcome to the September 2014 Sanford Underground Research Facility (SURF) monthly newsletter. The newsletter is posted online; a pdf copy is available as well. You can read recent and archived newsletters at our website -- 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

October 8-10: LBNE/LBNO Geotechnical review - Lead, SD

Geologic Model and Density Variations at SURF

The physics laboratories located in the underground at the Sanford Underground Research Facility (SURF) laboratories are shielded by the overlying rock from the effects of cosmic radiation. The efficiency of the shielding typically is evaluated in terms of water-equivalent depth, which is the thickness and density of rock that would represent the equivalent depth of water. This equivalent depth is dependent upon the angle from vertical of the incoming radiation, the density of the rock encountered along that path, and the topographic elevation throughout the area. Although the use of an average density of the rock may be sufficient in many instances, this study examined the sensitivity of the water-equivalent depth due to variations in the density of the subsurface.

In order to provide a basis for evaluation of the effects of the shielding rock, a geologic model was developed that used available mapping from the underground, surface mapping, and information derived from the Sanford core archive. Figure 1 shows the portion of this geologic model that is encompassed by a 45° cone centered over the Davis Campus. The formations included in the geologic model consist of all the units that occur in the Sanford underground workings, plus other formations that are only accessible through surface mapping and core from the Sanford core archive. Although published values of rock density were

available for those formations that are present in the underground workings, additional measurements on core from the Northwestern, Flagrock, and Grizzly Formations were made as part of this study.

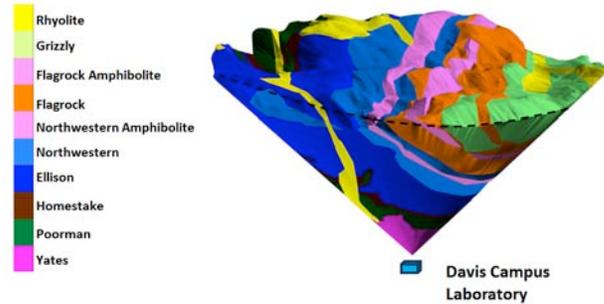


Figure 1: The portion of the SURF geologic model that occurs within a 45° cone centered on the Davis Campus is shown above. The figure shows both the topography and the three-dimensional distribution of the rock units mapped as part of this study.

In addition to the angle of the incoming radiation, the most important effect on shielding depth is due to variations in topography. Although variations in rock density affect the depths, particularly in the western area of the site, the effects are secondary. The influence of stopes or mined-out areas is not significant, most of the voids having been backfilled, and mined volumes generally being small relative to the much larger volume of the geologic cone of analysis.

Results of the study will be published in the forthcoming 2014 issue of *Proceedings of the South Dakota Academy of Science (Topographic, geologic, and density distribution modeling in support of physics experiments at the Sanford Underground Research Facility (SURF))*, K. Hart, T. C. Trancynger, W. Roggenthen, and J. Heise).

Berkeley Low Background Counting Facility

The Berkeley Low Background Counting Facility (BLBF) relocated to the SURF 4850 Level Davis Campus in May 2014 (see Figure 2). The Facility is overseen by staff from the Low Background Facility at LBNL, assisted by members of the SURF Science Department.



Figure 2: The recently installed BLBF HPGe spectrometer and associated equipment at SURF

Recently, ten samples were taken from the wall rock and concrete floor at the BLBF cavern to help determine the background radiogenic properties of the facility; they are now awaiting analysis (see Figure 3). Among the pieces collected is a sample of ironstone from a drift outside the cavern--Precambrian rock containing iron minerals. Another sample came from the rhyolite aggregate below sections of the concrete floor, which is usually higher in radiogenic background than the surrounding rock and concrete.

The analyses could take a month or more to complete, with the final outcome determining what products will be used to apply a surface coating to the ceiling and cavern walls. During this phase, engineers and scientists will work together to make decisions to determine the cavern design, the type of environment that will best suit their needs, and how to bring this about in a cost-effective manner.



Figure 3: SURF Engineering Technician Kip Johnson uses a 3-inch core drill to extract a rock sample

The team will follow three steps in this process. First, they will define the isotope backgrounds of naturally occurring uranium, thorium, and potassium that emit radiation from the wall rock and concrete floor. Next, they will define the experiment's limit, and finally, a

trade study will be performed to help determine which option will be the most economical. (More on the BLBF in future issues of the SURF newsletter!)

Reports/Papers Available

[P5 report \(Print quality\)](#) The full Particle Physics Project Prioritization Panel report as accepted by the High Energy Physics Advisory Committee

Watch crews from *Ainsworth-Benning Construction, Inc.* place piers for the new Visitor Center in Lead, South Dakota. <https://vimeo.com/105167895>

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

Scientific American: [Strange Neutrinos from the Sun Detected for the First Time](#) (Clara Moskowitz, August 27)

Phys.org: [Tiny particles have big potential in debate over nuclear proliferation](#) (Elle Calderone, September 1)

Fermilab Today: [What is a WIMP?](#) (Don Lincoln, August 15)

[LBNE collaboration expands to more than 500 members](#) (Maury Goodman, August 7)

Science Magazine: [Chinese team is catching up in hunt for dark matter](#) (Adrian Cho, August 26)

R&D Magazine: [Univ. of Washington project becomes focal point in hunt for dark matter](#) (Vince Stricherz, August 21)

Tuscaloosa News: [Three University of Alabama physicists get funding to participate in international dark matter experiment](#) (Molly Olmstead, August 30)

Plain Talk: [Workshop held to give better Germanium view](#) (Dylan Geuther, September 19)

Rapid City Journal: [FORUM: Proposed K-12 science standards deserve our support](#) (Ben Saylor, September 20)

[Board of Education hosting hearing in Rapid City](#) (Associated Press, September 14)

[The opportunity of a lifetime](#) (Curt Nettinga, September 2)

Black Hills Pioneer: [Lead/Sanford Lab visitor center construction on track](#) (Adam Hurlburt, August 13)

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



Figure 4: Rebar is tied together as a long cylinder

New Visitor Center

The first 22 piers of the Sanford Lab Homestake Visitor Center were completed on August 4. The piers, which run 90-100 feet belowground, will provide support for an 8000 square foot foundational slab (see Figure 4). Each pier takes a day to a day-and-a-half to install. Crews will then begin to pour the foundation. The goal is to have the structure enclosed before the snow season begins in South Dakota. (South Dakota already saw its first snowfall on September 11 – see Figure 5.) “We’ve got the right team working on this to make it happen,” said Josh Willhite, SURF Engineering Director. Hopefully, the weather will cooperate with construction plans.



Figure 5: Panoramic morning view of summer snow at Sanford Lab

Environment and Safety at Sanford Lab

The Waste Water Treatment Plant (WWTP) recently received a new tank for processing waste water (see Figure 6). Since 2008, more than 4.5 billion gallons of water has been treated at Sanford Lab, over half of it coming from underground, and the rest from nearby Grizzly Gulch tailings. Once treated, the water is released into Gold Run Creek, which then joins Whitewood Creek.



Figure 6: The new tank is lowered through the roof of the influent building

The water from the old mine contains suspended solids (mostly iron) reported WWTP Foreman Ken Noren. To remove the iron, the water is pumped into a sludge removal tank. A coagulant neutralizes the charge of the particles, and a flocculent or clarifying agent is added to the tank, and mixed with the water for 15 minutes. The process causes the particles to form into clumps, which can then be removed (see Figure 7). Flocculants, also known as flocking agents, are commonly used in water such as swimming pools to aid removal of microscopic particles, which would otherwise cause the water to be cloudy, and which would be difficult or impossible to remove by filtration alone.



Figure 7: Flocculant is added to the iron-rich water pumped from underground

Previously, the process took place in the “green tank” inside the influent building. Noren indicated that they had problems with the line freezing every winter. Other issues included clearing out all of the iron from the flat tank, and the inability to bring back the water to the plant so it had to be processed and released by the city.

Since the new tank is cone-shaped, it is easier to clean and also allows for better “flocking” results because there are no temperature changes. Money is also saved because less water is flowing to the sanitary sewer.



Figure 8: Don Conklin, ecological consultant, readies his net to catch a trout for environmental testing at Whitewood Creek

Environmental health at Whitewood Creek is monitored quarterly. In September, Don Conklin, ecological consultant, along with two other consultants from *GEI Consultants Inc.* waded through Whitewood Creek to monitor the fish population (see Figure 8). Each fish is stunned by a low-voltage wand, put into a bucket and holding net, then counted, measured, and weighed before releasing back into the stream. Three sections of the creek were tested and compared—two downstream, and one upstream. Monitoring the fish is one way to assess the overall biological health of the streams.

This is a required assessment. Other requirements include looking at macroinvertebrates populations (insects, crustaceans, molluscs, arachnids, and annelids) that live in the water, as well as algae. This test determines whether certain sensitive organisms that are put into the stream can survive and reproduce. Additional lab tests are carried out to assess possible chemical impacts. SURF Environmental Manager John Scheetz reports that since 2008, tests consistently have shown very little impact from Sanford Lab’s discharge into the creek. “Biological indicators show us this is a very healthy stream,” he said. “The trout are happy, the sensitive insects are healthy, and algae all seem to be very much the same up and down the stream.”

JHAs (Job Hazard Analyses) write-ups have been on the increase with the arrival of new EHS Director Noel Schroeder, who is promoting a renewed focus on job safety. He reports that crews are using JHAs as a way to document the work process for the next crew, so this creates an atmosphere of safety for their co-workers as well. The JHA allows Sanford Lab staff to assess each step of a project and identify potential hazards. The next step, says Construction Safety Specialist Tim Eggers, is to find ways to mitigate those hazards. “That might include changing a step in the process, developing an engineering or administrative control, or including additional personal protective equipment.”

Once the JHA is written, it passes through an approval process, Schroeder said. “The project manager has to review it and give the authorization to move forward.” EHS assists workers in developing the process, and reviews each JHA before it is put in place.

The JHA is just one component of safety at Sanford Lab. The Lab also employs Standard Operating Procedures (SOP), which establish strict guidelines for carrying out routine operations. Keeping the workplace safe is also a requirement for outside contractors. “Contractors do an overall JHA for a project,” said Eggers.



A recent incident on September 11 highlighted the effectiveness of the

safety system in place at Sanford Lab. On the night shift, the Yates hoist operator heard a popping noise and rattling in the Yates cage overwind drum. Assessment indicated that a bolt on the cage hoist clutch system had broken. Even though the clutch system could handle the weight, to ensure maximum safety, the Yates hoist was placed out-of-service until additional inspections and maintenance could be performed. All personnel underground were instructed to use the Ross Shaft as a secondary exit. The direct cause of the breakage is still unknown but the likely reason seems to be age and wear on the bolt. Bolts on all critical hoist systems are inspected on a 7- and 30-day routine preventive maintenance schedule. An information sheet of Lessons Learned and Recommendations was compiled and sent out as an "Incident Flash Report" to all Sanford Lab staff.

Ongoing workshops and seminars at Sanford Lab include: General Safety Basic Training, Annual Refresher Training, ERT/Mine Rescue, and periodic safety reviews.



Info on Travel to Lead

The City of Deadwood is starting some excavation work that will affect traffic and cause some travel delays in Deadwood, starting at the end of September. The work may last until the beginning of 2015. Expect full closures between Charles and Cliff Streets between 9 a.m. and 3 p.m. although one lane of traffic may be open at various times. If you normally take Hwy 85 through Deadwood, you are encouraged to take the Central City route to and from Sanford Lab to avoid delays.

EDUCATION AND OUTREACH

K-12 Activities

Lead-Deadwood High School has recruited its second cohort of young scientists for their new semester-long research course. The course is taught by Lead-Deadwood's Robin Dirksen. Julie Dahl is the primary liaison from Sanford Lab--linking the students with mentors at SURF, SDSMT, and BHSU. Research projects will be conducted in November and presented in December. Meanwhile, the students will be touring the Sanford Lab facilities. Thanks to everyone who has been willing to talk to

the students during the first few weeks of the semester.

Other Activities

Education and Outreach Director Ben Saylor and E&O Science Education Specialist Julie Dahl testified at the Rapid City Board of Education public hearings on K-12 curriculum standards.

SURF Communications Director Connie Walter gave presentations on Sanford Lab as part of the *Road Scholar Program*, and also hosted the Lead High School Class of '49, in association with Lead's Historic Homestake Opera House.

Cultural Diversity Coordinator KC Russell attended a STARBASE board meeting, in his role as voting board member. STARBASE is a South Dakota educational program that focuses on at-risk fifth graders, with a primary goal to motivate them to explore Science, Technology, Engineering and Math (STEM). The target group includes students who live in inner cities or rural locations, are socio-economically disadvantaged, low in academic performance, or have a disability.

ENVIRONMENT, HEALTH & SAFETY



Earthquake Safety

- Plan ahead and decide how you will communicate in case of emergency. Identify potential hazards and take steps to remedy them.
- Prepare an emergency kit containing first aid supplies, bottled water, canned/dried food, batteries, flashlights, etc. Store in a convenient place.
- When the quake strikes, drop, cover, and hold on to a sturdy desk or table. Stay there until the quaking stops. Stay away from windows.



STAFF NEWS



Tom Campbell has recently joined SURF's Education and Outreach Department. His expertise is in geology, with a strong interest in astronomy as well. Tom is no stranger to the SURF community; he worked for Homestake in the past, and was involved with early DUSEL efforts before leaving the area for the Hemlo Gold Camp in Ontario, and subsequently *Cliffs Natural Resources* in Minnesota and Michigan. He was associated with NASA's *South Dakota Space Grant Consortium* at South Dakota School of Mines and Technology, where he developed working relationships with NASA Centers and scientists, promoted collaborations with Space Grant affiliates and tribal high schools and colleges across South Dakota, initiated Earth and Space camps for middle school students and teachers with his wife, Melissa, in the Rapid City school system. Tom also taught undergraduate astronomy and geology courses at SDSMT and developed curriculum for an Advanced Observational Astronomy course that he co-taught with Ron Dyvig of Badlands Observatory. His hobbies include collecting minerals and Native American art, astronomy, fishing, photography, and railroad history. Tom is shown in the photo on the left with his dog, Rocky.

UPCOMING CONFERENCES AND WORKSHOPS

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>

DBD2014, International Workshop on Double Beta Decay and Underground Science, Waikoloa Village, Hawaii. October 5-7, 2014. Open discussions on current and future directions in the study of double beta decay and other related topics in neutrino physics.
<http://dbd14.phys.sci.osaka-u.ac.jp/>

4th Joint Meeting of the APS Division of Nuclear Physics and the Physical Society of Japan, Waikoloa, Hawaii, October 7-11, 2014. An event to foster cooperation, collaboration, and the exchange of ideas among nuclear scientists from Japan, the U.S., and other Pacific Rim countries.
<http://web.mit.edu/lns/hawaii14/>

Workshop on Low Energy Particle Physics with Liquid Xenon Detectors, MEPHI, Moscow, October 23-25, 2014.
<http://enpl.mephi.ru/dle/workshops/>

APS Conferences for Undergraduate Women in Physics (CuWiP). January 16-18, 2015. Three-day regional conferences held in various locations.
<http://www.aps.org/programs/women/workshops/cuwip.cfm>

2015 Physics Teacher Education Conference. February 6-8, 2015, Seattle.
<http://www.aps.org/meetings/meeting.cfm?name=PTEC15>

Low Radioactivity Techniques, Workshop V, University of Washington, Seattle, March 18-20, 2015. Topics include dark matter, solar neutrinos, double-beta decay, and long half-life phenomena.
<http://lrt2015.npl.washington.edu>



JOBS

Postdoctoral Fellow, Lawrence Berkeley National Lab. Work in Experimental Neutrino Physics, research neutrinoless double-beta decay carried out by the CUORE experiment. Contact: Brian Fujikawa, bkfujikawa@lbl.gov.
<https://inspirehep.net/record/1313554>

Postdoctoral Researcher, SDSMT. Work in Experimental Underground Physics as part of the Cryogenic Dark Matter Search (SuperCDMS), AARM, and LZ collaborations. Richard Schnee, Richard.Schnee@sdsmt.edu
<https://inspirehep.net/record/1315388>

Postdoctoral Researcher, UC Irvine. Work in experimental particle physics, with Neutrino Group in Super-Kamiokande, T2K and CAPTAIN liquid argon experiment. Deadline: October 31, 2014.
<https://recruit.ap.uci.edu/apply/JPF02506>

Professor, University of Münster. Experimental Neutrino Physics. Deadline: 9/30/14. Contact: Dean, Faculty of Physics, Westfälische Wilhelms-Universität Münster, Wilhelm-Klemm-Str. 9-48149 Münster. AND

Professor, University of Bayreuth. Experimental Physics. Deadline: 10/31/14. Contact: Walter Zimmermann, Dean, Faculty of Mathematics, Physics & Computer Science, Univ. Bayreuth, 95440 Bayreuth.

https://www.academics.de/wissenschaft/professur_physik_52256.html

Postdoctoral position, Texas A&M University. Work on SuperCDMS at SNOLab. Opportunities in detector development, cryogenic testing, data analysis, and research project management. Deadline: 9/30/14. mahapatra@physics.tamu.edu
<https://physics.tamu.edu/about/openpositions.shtml>

Postdoctoral researcher, University at Albany, SUNY. Research in direct WIMP detection, work on data analysis, travel to Lead, SD, gaining hands-on expertise on LUX/LZ. Deadline: 2/1/15. Matthew Szydagis mszydagis@albany.edu
<http://albany.interviewexchange.com/jobofferdetails.jsp;jsessionid=C639453CC99065905F7F634461A5BAAB?JOBID=51419>

Postdoctoral researcher positions (2), UC Berkeley. Work on neutrinoless double beta decay with CUORE and SNO+. Gabriel Orebi Gann gabrielog@berkeley.edu, Yury Kolomensky, yury@physics.berkeley.edu

Postdoctoral Research Associate, Wright Laboratory, Yale University. Two openings in Weak Interactions Group. Contact: Profs. Reina Maruyama, reina.maruyama@yale.edu or Karsten Heeger, karsten.heeger@yale.edu
<http://wlab.yale.edu/opportunities>

Two Faculty positions, Carleton University, Ottawa, Canada. Department of Physics, research in particle physics, especially EXO. Gerald Oakham, physchair@physics.carleton.ca or Joanne Martin, jmartin@physics.carleton.ca
<http://physics.carleton.ca/news/14/assistant-professor-particle-physics-2015>
<http://physics.carleton.ca/news/14/crc-tier-i-tenured-professor-particle-physics-2015>

Postdoctoral Research Associate, University of Minnesota. Work on NOvA and MINOS+

experiments. Deadline: 11/30/14. Contact: Gregory Pawloski, pawloski@umn.edu
<http://inspirehep.net/record/1292955?ln=en>

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>

Newsletter Editor: Melissa Barclay

Contributors: Kevin Lesko; Connie Walter (Sanford Lab news); William Roggenthen, Kathy Hart, Jaret Heise, C. Trancynger (Geologic Model and Density Variations at SURF); Stephen Farghali (BLBF); Ben Sayler, Peggy Norris (E&O)

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Lawrence Berkeley National Lab

Kevin T. Lesko: 510-486-7731
KTLesko@lbl.gov

Melissa Barclay: 510-486-5237
mbarclay@berkeley.edu

SDSTA/Sanford Lab

Mike Headley, Executive Director
Mandy Knight, 605-722-8650, x222
MKnight@sanfordlab.org
<http://www.sanfordlab.org/>

BERKELEY OFFICE

SURF Project Office
Lawrence Berkeley National Lab (LBNL)
One Cyclotron Road
MS 50B-5239
Berkeley, CA 94720