

**Dear SURF Readers,**

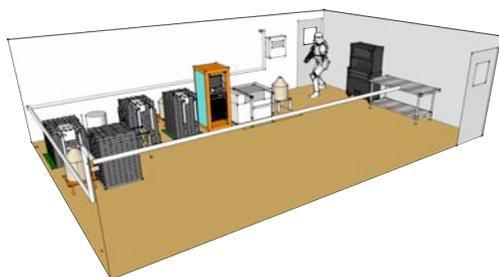
Welcome to the April 2016 Sanford Underground Research Facility (SURF) monthly newsletter. The newsletter is posted online; a pdf copy is available as well. You can read recent and archived newsletters at our website -- [www.sanfordlab.org](http://www.sanfordlab.org). We are glad to receive your input 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 19-22: DUNE Collaboration meeting – SDSMT, Rapid City**

### Low-Background Counting

The Black Hills State University (BHSU) Underground Campus (BHUC) at SURF has just welcomed its third detector: the Soudan Low Background Gamma Counting Facility (SOLO). Operated by the LUX-ZEPLIN (LZ) collaboration, the detector's crystal and lead components were recently moved from the Soudan Underground Lab in Minnesota (Figure 1). Researchers from Brown University, LBNL and UC Berkeley, and BHSU--its designers--finished the construction of the newly revamped shield and opening mechanism in mid-April (Figure 2). The detector is currently operating to determine background levels in its new location and configuration.



*Figure 1: BHUC layout with current and near-term counting stations*

The Campus has a class-1,000 cleanroom housing ultra-sensitive low background counters that assay materials for sensitive physics experiments.

Currently, two counters from UC Berkeley are in operation, and several more germanium-counting stations are expected to be installed before the end of the year. The newly-overhauled CUBED detector, scheduled for installation soon, probably will be the next one installed. (An update on CUBED will be featured in a future SURF newsletter.) In collaboration, the Berkeley Low Background Facility, BHSU, and UC Santa Barbara will install the dual-crystal "Twins" detector. A counting station dedicated mainly for the nEXO experiment and two detectors for MAJORANA are "in the works" as well.

The facility's ultimate goal is to house 10 counters from different collaborators. Most of the counters look for gamma rays, while others will be sensitive to surface alpha particles. One instrument proposed by the SDSMT will look for beta contamination.

"Low background materials are vital to nearly all underground physics experiments," said Dr. Brianna Mount, a Research Assistant Professor at BHSU and Underground Campus Lab Director (Figure 3). "Assaying the backgrounds of different materials also helps model the background of the detectors, while offering students the opportunity to work with experts on gamma ray spectroscopy."



*Figure 2: Keenan Thomas (BLBF), Will Taylor, Casey Rhyne, and Dongqing Huang (from Brown) with SOLO detector while constructing its shield*

BHSU manages the Campus, but it is open to students across the State of South Dakota and across disciplines. "Biology students can study microbes *in situ* and geology students can study the unique rock formations," Mount said. "We're very excited that students have access to Sanford Lab and the unique environment of the 4850 Level."

The experience is not confined to the university level. K-12 students can also participate. For example, a pilot program paired 16 middle-school students with BHSU students to create robots for an underground competition, which first took place in

March. The college students took the robots through an underground obstacle course where the robots completed a mission. Middle-school students were able to watch via videoconferencing. Other videos and games about the science taking place at Sanford Lab are offered on the BHSU website: [www.bhsu.edu/underground](http://www.bhsu.edu/underground).



*Figure 3: Brianna Mount and BHSU undergrads Rachel Williams and Madison Jilek hold lead bricks used to shield low-background counters in the BHSU Underground campus cleanroom*

The demand for the BHUC Counting Room has almost exceeded its footprint. The BHUC is currently seeking funding to upgrade the current 200 sq. ft. gowning rooms into another class-1,000 cleanroom. In addition to low background counting stations, the BHUC is used by biologists, and is also the home for many education and outreach opportunities.

## REPORTS/PAPERS AVAILABLE

*Low energy neutron background in deep underground laboratories*, Andreas Best et al. (University of Notre Dame authors present neutron background measurements gathered from a number of SURF locations. (<http://arxiv.org/abs/1509.00770>).

*Forward Momentum 2025*, a 5-year strategic plan based on a 10-year vision for SURF: [www.sanfordlab.org/sites/sanfordlab.org/files/.../Forward\\_Momentum.pdf](http://www.sanfordlab.org/sites/sanfordlab.org/files/.../Forward_Momentum.pdf)

All four volumes of the Deep Underground Neutrino Experiment (DUNE) for Conceptual Design Report DUNE/LBNF are now available on arXiv: Vol. 1. Overview 1601.05471. Vol. 2. Physics 1512.06148, Vol. 3. LBNF 1601.05823, Vol. 4. DUNE detector 1601.02984. <http://arxiv.org/>

[The Sanford Underground Research Facility at Homestake \(SURF\)](#). (K.T. Lesko, Phys.Procedia 61 (2015) 542-551.)

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

For news, *twitter* updates, and other features, see the SURF website: [www.sanfordlab.org](http://www.sanfordlab.org)  
Like Sanford Lab Visitor Center on Facebook: <https://www.facebook.com/sanfordlabhomestake/>



## SURF IN THE NEWS

*Symmetry*: [Belle II and the matter of antimatter](#) (Matthew Francis, April 1)

*YouTube*: [Small Particles, Big Science: The International LBNF/DUNE Project](#) (Fermilab, March 28)

*Gizmodo Australia*: [Scientists At Fermilab Are About To Start Shooting Neutrinos Through The Earth](#) (Bryan Menegus, April 1)

*University of Notre Dame*: [Unearthing the Secrets of a Star](#) (Andy Fuller and Bill Gilroy, April 4)

*AIP Bulletin of Science Policy News*: [House Passes Bill to Inspire Girls and Women to Enter STEM Fields](#) (Michael S. Henry, March 25)  
[Flurry of Fusion & Facilities Questions at House Science Hearing on DOE Budget](#) (Mitch Ambrose, March 24)

*Daily Star Albany*: [Sophisticated Instrument in South Dakota trying to detect dark matter](#) (Staff, April 4)

*Black Hills Knowledge Network*: [In History: Manuel Brothers Discover Gold Outcropping at Lead](#) (Staff, April 4)

*KOTA TV*: [Sanford Lab seeking city approval to move rock](#) (Kirk Stevens, April 13)

*Rapid City Journal*: [DUNE project is complex, but not unlike a game of catch](#) (Tom Griffith, April 24)  
[DUNE – by the numbers](#) (Tom Griffith, April 24)  
[Neutrino project could bring elevated conveyor over downtown Lead](#) (Tom Griffith, April 24)  
[Science group wants Lead's OK for conveyor over Main Street](#) (AP, April 13)

*Black Hills Pioneer*: [Science group wants Lead's OK for conveyor over Main Street](#) (Associated Press, April 13)

## DURA

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

## SANFORD UNDERGROUND LABORATORY NEWS

### Historic Preservation at SURF

SURF is located on a site with historic significance in South Dakota. Not only is it situated in the old Homestake Mine, which operated for about 125 years as a gold mine, but it is also within or near the City of Lead Historic District (Figure 4). Because it receives funding from the Department of Energy, Sanford Lab must follow the National Historic Preservation Act, which focuses on preserving historic and cultural resources.



Figure 4: Map of the SURF property boundary, outlined in gray, intersects with the Lead Historic District, indicated by the yellow overlay

The development of future experiments at SURF will require the rehabilitation or demolition of some buildings, further excavation underground, and the removal of equipment and artifacts. To ensure that historical preservation requirements are met, John Scheetz (SURF Environmental Manager) and KC Russell (SURF Cultural Diversity Liaison) are working with the South Dakota State Historic Preservation Office (SHPO), guided by Section 106 of the Historic Preservation Act.



Cultural preservation requires more than just saving old buildings and artifacts that might be found, Scheetz said. He and Russell recently attended a Section 106 training, which will be used

to help Sanford Lab employees, contractors, and scientists.

Cultural preservation focuses on “the importance and sacredness of the land. We are working hard to ensure everything we do is done thoughtfully and with respect,” said Mike Headley, Executive Director of the SDSTA.

“Although there is some concern about new surface disturbances among tribal members, they don’t want to stop progress,” said Russell, who is a member of the Lower Brule Sioux. “But they do want to preserve the sacredness of the land. They want the land treated respectfully. And I believe the people who live here understand what the land means to the tribes.” The fact that excavated rock will be brought to the surface and placed in the Open Cut, an existing disturbance, helps mitigate tribal concerns.

Paige Olson, review and compliance officer with the State Historic Preservation Office, said all cultural resources are taken into consideration. “Artifacts, equipment, buildings, or even human remains,” Olson said. “If someone finds something that appears to be prehistoric or discovers human remains, work stops and a buffer zone is established until the historic value is determined.”

Russell wants to make sure that all cultural history is preserved. “Tribes from Montana, Wyoming, Colorado, South Dakota, North Dakota and Nebraska have ties to *He Sapa* (the Black Hills),” he said. “But mining is an important South Dakota heritage and it’s important to make sure we preserve that as well.”

### Top Down Maintenance

At night, when most of the population is asleep, crews of Infrastructure technicians are on the job at SURF. In fact, their most challenging work takes place in the dark hours. This includes something called top-down maintenance (TDM), which involves inspecting the shaft, replacing timber, removing debris, and installing new ground support.

The old Homestake Mine began “raising” the Yates Shaft in 1939, which meant that crews mined vertically starting at the 4100 Level, said Jack Stratton, Yates Foreman. The shaft was built with fir timber blocked to the rock walls using 10- by 20-inch

10-foot long fir blocks. The interior of the shaft was secured using a combination of vertical and horizontal fir slabs, called lacing. This shaft has been in use for 75 years.



*Figure 5: Infrastructure Techs Ashama Baumberger (left) and Charlie Roth at the recently bolted 3200 Level of the Yates Shaft*

In 2013, Sanford Lab implemented a TDM approach to inspect every piece of timber for safety. Each piece is rated, and it is then determined what needs to be replaced. If a piece of timber is rated T-1, it is in good condition and has a life expectancy of more than five years. A T-2 rating means the timber is in fair condition and has a life expectancy of at least five years. If a piece of timber is rated T-3, it needs attention sooner than later. Since 2013, nearly 4,000 components have been addressed. TDM also involves removing the lacing one slab at a time to remove any debris behind it, Stratton said. "On average, we remove about 25 tons of debris every month. It's done with shovels, pelican picks, and 5-gallon buckets."

TDM began at the 1100 level. A recent milestone was reached when they completed work on the 3200 Level station (Figure 5).

Safety is always a top priority during these operations. If any questions come up regarding procedure, the crew slows down or stops work to re-evaluate, says Pat Urbaniak, Team Lead. He also ensures that science personnel have continued access to their experiments.

### EDUCATION AND OUTREACH

#### Field Trips

This year, the Education and Outreach Department (E&O) instituted an online process for schools who wish to sign up for field trips to Sanford Lab,

designating specific dates, times, and activities to choose from. This was necessary due to the amount of travel that E&O staff and helpers have been doing to present programs across the State of South Dakota.

The new system was wildly successful, with all available dates for April and May filling up by mid-March. E&O hosted a capacity of 90 students in a day (doing three parallel activities) and one middle school scheduled three full days so that 270 students could tour Sanford Lab.



*Figure 6: Students examine the Davis Memorial ring after learning about his seminal experiment*



*Figure 7: Future geologists examine Homestake ore looking for evidence of gold*

The majority of the field trips requested this year are for grades 4-8. The most popular choice for middle schools this spring is to rotate students through a hoist room tour, an activity on magnets and motors (connecting to the Fermilab accelerators for the DUNE experiment), and a tour of the Sanford Lab Homestake Visitors Center (SLHVC) combined with a geology activity. For upper elementary (Grades 4-5) the popular choice is to combine the hoist room tour with the engineering challenge of designing a hoist.

The spring season officially opened on April 11 when Sanford Lab hosted 47 students from Hermosa Middle School. Figures 6-7 represent the SLHVC/geology portion of the program.

## Davis-Bahcall Scholars

This year, eight students from across the state were accepted into the prestigious Davis-Bahcall Scholars Program at SURF. The Scholars Program gives students unique opportunities to work with scientists on research experiments at Sanford Lab, Fermilab and Argonne National laboratories in Illinois, and Gran Sasso and Frascati National Laboratories in Italy. This year, the program is sponsored by *First Premier Bank*, the *South Dakota Space Grant Consortium (SDSGC)*, Black Hills State University, and Sanford Lab. The SDSGC has sponsored the Davis-Bahcall program for several years as part of its mission to instill the spirit of exploration and discovery in students, educators, and in the general public.

This year's scholars are:

- James Mayclin, Plankinton, South Dakota (SD), senior, Plankinton High School.
- Trey Waldrop, St. Lawrence, SD, senior, Miller High School.
- Sowmya Yamini Ragothaman, Vermillion, SD, senior, Vermillion High School.
- Hadassah Meyer, Madison, SD, senior, Madison High School.
- Theodore Savinov, Sioux Falls, SD, senior, Lincoln High School.
- Gina Selig, Rapid City, SD, senior, Rapid City Stevens High School.
- Alexandra Wiley, Mesa, Arizona, freshman, Black Hills State University.
- Lucas Sternhagen, Groton, SD, graduated from Groton High School; currently a freshman at University of South Dakota

Students will be on-site at Sanford lab during the period June 6-17.

## Upcoming: DUNE Public Outreach Event

Sanford Lab (Communications and E&O), South Dakota School of Mines and Technology (SDSMT), and the DUNE Collaboration are working together to organize a public reception and talk to take place at SDSMT on May 18, the eve of the DUNE collaboration meeting at SDSMT. The reception,

which begins at 5:30 PM in the Surbeck Center Ballroom, will include activities designed to engage community members and students with visiting DUNE scientists.



## Deep Talks

On April 14, a Deep Talks event took place at the Sanford Lab Homestake Visitor Center in Lead with Markus Horn, Research Scientist at Sanford Lab, speaking on "LUX: Hunting for [Dark Matter] Unicorns in the Black Hills." A reception preceded the talk, with sample craft brews from Crow Peak Brewery and light refreshments from The Lodge. To view the talk: <https://vimeo.com/162999848>

## ENVIRONMENT, HEALTH & SAFETY



## Bicycle Safety

- Use designated bicycle lanes and share the road. Follow the traffic laws.
- Wear a properly fitted bicycle helmet. Maintain bicycle readiness: check that tires, saddle, lights, and brakes are in top shape.
- Observe and use hand signals to communicate turns.

## UPCOMING CONFERENCES AND WORKSHOPS

**The Cold Universe, April 25-July 15, UC Santa Barbara.** Program will present the role of molecules, heavy elements and dust for star formation. <https://www.kitp.ucsb.edu/activities/colduniv16>

**PhysStat2016 workshop, Kavli IPMU University of Tokyo, May 30-June 1.** A second workshop will follow at Fermilab, September 19-21. <http://indico.ipmu.jp/indico/conferenceDisplay.py?confId=82>

**Neutrino 2016, London, England, July 4-9.** Programs on neutrino physics, the impact of neutrino physics on astronomy and cosmology, and future development. <http://neutrino2016.iopconfs.org/home>

**Geoneutrino summer school, Gran Sasso, Italy, July 11-21.** Bring together nuclear/particle physicists and geologists, with the aim to contribute and build up a new geoscience community. <https://agenda.infn.it/conferenceDisplay.py?confId=10519>

**ICHEP 2016 Chicago: 38<sup>th</sup> International Conference on High Energy Physics**, August 3-10, Chicago. Physicists will share latest advancements in particle physics, astroparticle physics, cosmology, and accelerator science.  
<http://ichep2016.org/>

**NuFACT 2016, Quy Nhon, Vietnam**, August 21-27. Workshop on neutrino physics beyond the PMNS matrix.  
<http://vietnam.in2p3.fr/2016/nufact/>



**JOBS**

**Postdoctoral Fellow (Nuclear Science), LBNL.** Work on experiments to search for lepton number violation and to probe the absolute neutrino mass scale. Contact: Alan Poon, [awpoon@lbl.gov](mailto:awpoon@lbl.gov). Closing: 3/30/16.  
<https://lbl.taleo.net/careersection/2/jobdetail.ftl?lang=en&job=82113>

**Postdoctoral research scientist, South Dakota School of Mines & Technology, Rapid City.** Research in experimental underground physics, direct dark matter searches. Closing: 4/15/16. Richard Schnee, [Richard.Schnee@sdsmt.edu](mailto:Richard.Schnee@sdsmt.edu); Juergen.Reichenbacher@sdsmt.edu  
<http://inspirehep.net/record/1430055>

**Postdoctoral researcher, LLNL.** Research on fission TPC project in Nuclear and Particle Physics Group. Contact: Lucas Snyder ([snyder35@llnl.gov](mailto:snyder35@llnl.gov)) or Samuele Sangiorgio ([sangiorgio1@llnl.gov](mailto:sangiorgio1@llnl.gov)). Job ID: 100894.  
<http://careers-ext.llnl.gov/jobs/search?q=100894>

**Postdoctoral Associate, Dark Matter and Neutrino Physics, Northwestern University.** Join group of Prof. Enectali Figueroa-Feliciano. Research SuperCDMS and other experiments. Closing: 7/31/16. Contact: [enectali@northwestern.edu](mailto:enectali@northwestern.edu)  
<http://inspirehep.net/record/1430991>

**Lab tech positions, South Dakota School of Mines & Technology, Rapid City.** Work with construction of systems including LZ dark matter experiment at SURF.  
<https://www.higheredjobs.com/details.cfm?JobCode=176244745>

**Postdoctoral position, Univ. of Michigan.** Research with neutrino group. Opportunities to work on JSNS2 experiment in Japan, SBND, and MicroBooNE experiments at Fermilab. Contact: Joshua Spitz, [spitzj@umich.edu](mailto:spitzj@umich.edu). Closing: 7/15/16.  
<http://inspirehep.net/record/1423248>

**Postdoctoral Research Fellow, Queen's University.** Research with PICO Dark Matter experiment at SNOLAB. Contact: Tony Noble, [potato@snolab.ca](mailto:potato@snolab.ca). Review begins: 3/1/16.  
<https://www.sanolab.ca/employment/2016-02-02-post-doc-position-queens-university>

**Postdoctoral Position, Brown University.** Research on LUX-ZEPLIN (LZ) in Astroparticle Physics group led by Rick Gaitskell. Review begins: 2/6/16. Contact: [richard\\_gaitskell@brown.edu](mailto:richard_gaitskell@brown.edu)  
<https://academicjobsonline.org/ajo/jobs/6834>

**Newsletter Editor:** Melissa Barclay  
**Contributors:** Kevin Lesko; Constance Walter (Sanford Lab news); Brianna Mount, Keenan Thomas, Constance Walter (Low-Background Counting); June Apaza, Peggy Norris (Education & Outreach)

**Photo Credits:** Fig. 1: Keenan Thomas; Fig. 2: Brianna Mount; Figs. 3,5: Matt Kapust; Figs. 6,7: Lynn Arnold

**Lawrence Berkeley National Lab**  
 Kevin T. Lesko: 510-486-7731  
[KTLesko@lbl.gov](mailto:KTLesko@lbl.gov)  
 Melissa Barclay: 510-486-5237  
[mbarclay@berkeley.edu](mailto:mbarclay@berkeley.edu)  
**SDSTA/Sanford Lab**  
 Mike Headley, Executive Director  
 Mandy Knight, 605-722-4022  
[MKnight@sanfordlab.org](mailto: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