

Dear SURF Readers,

Welcome to the March 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

April 23: LZ Hardware meeting – LBNL, Berkeley, CA

April 30: MJD workshop – Lead, SD

CUBED Research Activities

Dr. Dongming Mei (Physics Professor at the University of South Dakota) and other collaborators of the **C**enter for **U**ltra-low **B**ackground **E**xperiments in the **D**akotas (CUBED) have been installing equipment for the Low Background Counting facility (LBC) and the Isotope Separation and Ultra-Purification (ISUP) projects at the Davis Campus at SURF (see Figure 1). The LBC began in 2012, led by researchers at the University of South Dakota in collaboration with Black Hills State University and SURF. CUBED was created to be part of the State of South Dakota's 2010 Research Initiative to promote economic development within the state. A summary is given below.



Figure 1: (Left) Low Background Counting facility before full lead shield; (Right) Isotope Separation and Ultra-Purification at SURF

Low Background Counting facility: Experiments located a mile underground in order to escape cosmic radiation also demand low radiation counts of the materials from which they are constructed. Material assays, screening, and low background counting capabilities are critical to the success of the planned SURF experiments. CUBED has been working to install a low background counting n-type germanium detector in the Davis Campus at SURF. The initial data predict ~ 100 mBq per kg sensitivity to ²³²Th and ²³⁸U with 7-day long assays.

Shielding needed for this level of sensitivity extends beyond the mile of rock overburden (4300 m.w.e). The detector is shielded by 10-cm of OFHC copper inside a stainless steel nitrogen purge chamber (radon mitigation). A 15-cm lead shield further reduces environmental gammas. Lead corrosion inhibition was accomplished through low-activity silica blasting and borated paraffin coating, which slows thermal neutrons and guards against human contact.

Isotope Separation and Ultra-Purification: A new method for low-molarity gas isotope separation, designed at University of South Dakota, is poised for operation at Sanford Lab's surface. Initial tests are showing volume-by-volume enrichment of ¹³CO₂ at ~300% and throughput enrichment at ~233%/18grams/hour. Applications for germane and xenon gases are under investigation.



Figure 2: The LZ Collaboration met in College Park, Maryland March 6-9

LZ Collaboration meeting

The LUX-ZEPLIN (LZ) collaboration met at the University of Maryland on March 6-9 (see Figure 2). LZ has been proposed as a next-generation dark matter experiment to replace the LUX detector at the Davis Campus of SURF. The LZ detector would hold about 10 tonnes of liquid xenon, and could be one the world's most sensitive detector experiments for

direct dark matter detection by the end of the decade.

Some 60 members of the LZ collaboration from the United States, the United Kingdom, and Portugal met at the recently opened Physical Sciences Complex at the University of Maryland. This new building provided an excellent venue for detailed technical and scientific plenary and parallel meetings. All aspects of the LZ design were presented and discussed. The LZ collaboration is preparing a few-hundred page comprehensive design report; the progress to date was reviewed. Planning for advancement of the technical design, including detailed design reviews and prototypes, were described in detail. The next LZ collaboration meeting will be held at the end of July in Edinburgh, Scotland.



Figure 3: LUX collaboration met on a snowy weekend March 14-16

LUX workshop

The Large Underground Xenon (LUX) collaboration met at SURF on March 15-16 (see Figure 3). About 45 members of the collaboration from the United States, the United Kingdom, and Portugal met to discuss and review all aspects of the LUX experiment. The meeting focused on preparations for the next, yearlong run of the LUX experiment that will commence soon. Detailed plans for extensive calibrations, in addition to operation in WIMP-search mode, were presented. The LUX collaboration has pioneered unique calibration methods. A highlight of the meeting was a greater understanding of when the results of calibrations and other aspects of LUX performance could be published. A result of the extensive calibration program is an improved understanding of the LUX detector. The potential for this to allow improved sensitivity for dark matter detection was presented and evaluated. The LUX collaboration would like to express its appreciation

for the members of the SURF staff who supported this meeting.

MAJORANA Collaboration Workshop

On March 15, the MAJORANA Collaboration held a one-day workshop at Sanford Lab in Lead, South Dakota. At the meeting, task leaders responsible for different facets of the experiment had the opportunity to coordinate their activities and plan for upcoming months of work. Since construction on the MAJORANA DEMONSTRATOR is progressing quickly, integration between tasks is becoming more important. Groups working on different aspects of the DEMONSTRATOR hardware, such as those responsible for the cryostats, detectors, and shielding, must work together and also with those who are coordinating the analysis and commissioning tasks.



Figure 4: In March, the lead shield of the MAJORANA DEMONSTRATOR was completed. The shield has approximately the weight of a Boeing 737

Since the Department of Energy's annual review of MAJORANA's progress in January, a steady stream of data has begun to emerge from the commissioning of the prototype cryostat. For the first time, the DEMONSTRATOR is running with two fully operational strings of detectors. This important milestone has also given researchers early indications of how the experiment may perform when completed. The lead shielding (shown in Figure 4) that will enclose the cryostats has been completed, and work continues on the muon veto system that will limit the DEMONSTRATOR's background from high-energy cosmic rays.

Throughout March and April, commissioning will continue with three strings of detectors mounted in the cryostat. Following this, the Collaboration will begin construction of Module 1, the first of two cryostats to be built entirely of electroformed copper that will be operated in the DEMONSTRATOR. Over the

course of the summer, this cryostat will be loaded with strings of enriched detectors.

Germanium detector road trip

On March 3, an LBNL germanium detector that had been underground (beneath the Oroville Dam) for more than 10 years embarked on a 1500-mile journey from Berkeley to Lead, South Dakota. In a vehicle driven by Assistant Specialist Keenan Thomas (pictured in Figure 5) of UC Berkeley's Department of Nuclear Engineering. The LBNL Low Background Facility ceased counting at its remote facility on January 31 and began the transition from its longtime site in Oroville, CA.



Figure 5: Keenan Thomas arriving at Sanford Lab with the detector (pictured in wooden crate)

This winter marked the end of nearly 30 years of activities at the Hyatt Power Plant of the Oroville Dam (~ 530 m.w.e). Initially, the experiment site was established as the location of the UCSB/LBL neutrinoless double-beta decay experiment in the 1980s. Afterward, it was converted into a low background counting station to support other experiments. The LBNL LBF has a long history of low background counting that has serviced SNO, KamLAND, CDMS, CUORE, Daya Bay, LUX, MAJORANA, and many other experiments. The detector will service the next generation of science in its new home, the East Counting Room of the Davis Cavern on the 4850 Level. The remaining equipment will be shipped to SURF in late March 2014, with installation to take place soon after.

The Berkeley LBF group consists of Al Smith, Keenan Thomas, Yuen-Dat Chan, Kevin Lesko, and Eric Norman, all of UC Berkeley or LBNL.

Photo Contest

Carlos Faham, Berkeley Lab's Chamberlain postdoctoral fellow working on LUX, won first prize in

the Lab's February 2014 photo contest on the "Vintage" Theme.



An old fire truck at an abandoned building in Lead, SD

Reports/Papers Available

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

YouTube video: October 30 LUX Science Seminar
<http://www.youtube.com/watch?v=SMzAuhRFNQ0&feature=youtu.be>

[Why the US Needs a Deep Domestic Research Facility](#). (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

Nature: [Broaden the search for dark matter](#) (Mario Livio and Joe Silk, March 6)

CERN Courier: [LBNE prototype cryostat exceeds goals](#) (February 24)

Phys.org: [Possible evidence for dark matter particle presented](#) (Stuart Wolpert, March 11)

Fermilab: [LBNE Science Collaboration](#) (February 10) / [LBNE Beamline](#) (February 3)

Sioux Falls Business Journal: [Black Hills State University planning underground campus at Sanford facility](#) (Associated Press, February 28)

DOE Pulse: [Prototype cryostat for neutrino experiment exceeds purity goals](#) (Kurt Riesselmann, February 3)

ECN: [New calibration confirms LUX dark matter results](#) (Staff, February 21)

redOrbit: [Confirmation Of LUX Dark Matter Results](#) (John Millis, February 21)

Science 2.0: [LUX Confirms It Has Not Found Dark Matter](#) (Staff, February 20)

ppdnet.com: [LUX Dark Matter Results Confirmed](#) (Kevin Stacey, Brown University, February 21)

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

Argus Leader.com: [Dark matter as art](#) (Dorene Weinstein, February 21)

ABC6 News: [Program Takes Kingsland Students Deep Underground](#) (February 26)

Spring Valley Tribune: [Kingsland students to help with research in South Dakota mines without leaving school](#) (Gretchen Lovejoy, February 25)

KOTA TV: [Fed funds Sanford Lab ops and experiment](#) (Constance Walter, January 27)

Rapid City Journal: [BHSU will have underground campus at Sanford Lab](#) (March 5)
[Poverty strikes South Dakota doctorate degree students](#) (Associated Press, February 16)

Black Hills Pioneer: [Black Hills Mining Museum seeks state designation](#) (Jaci Conrad Pearson, March 3)

[BHSU to have Underground campus at Sanford Lab](#) (Staff, March 1)

[Majorana impresses annual review committee](#) (Adam Hurlburt, February 27)

[Black Hills State University faculty and staff transform lives](#) (Staff, February 22)

[What is the Sanford Lab, Alex?](#) (Staff, February 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 Update

Sanford Lab's engineering department is in the process of installing a dehumidifier in the ventilation drift on the 4850 Level. This is primarily to accommodate the MAJORANA DEMONSTRATOR (MJD) equipment, which is so sensitive to humidity that current systems are not providing the necessary humidity levels. The humidity level reaches nearly 100 percent, which creates problems for researchers and machinists working on the project. "The humidity affects the intricate machining tools, cables, and high-voltage electrical connectors used in the germanium detectors," said Jaret Heise, SURF Science Liaison Director.

To prepare for the new air-handling system, Project Engineer Bryce Pietzyk took laser scans to determine if any excavation needed to be done. "Laser scanning lets us see rock dimensions, existing ground support, or anything else we need to know about the infrastructure of the area," said Pietzyk.



Figure 6: A laser scan creates a digital file called a point cloud. The point cloud can be moved and rotated in 3D space or used in CAD software

Once the scans are completed, Mechanical Engineer Mike Johnson manipulates the data in point cloud, creating a 3D image (see Figure 6). This provides information on where the walls of the drift are located so engineers and technicians can see if

the equipment will fit and where rock removal may need to occur.

The new system is scheduled to be in place sometime in May.

Jeopardy! TV crew

On Friday, February 21, Sanford Lab was featured on the TV game show, *Jeopardy!* in the category, "Figuring out the Universe" delivered by Clue Crew member Sarah Whitcomb Foss (see Figure 7). In October 2013, the Clue Crew visited the Lab, where they filmed the clues at various locations at the 4850 Level.

Safety Specialist Woody Hover assisted the Clue Crew, and Multimedia Specialist Matt Kapust served as a guide and photographer for the crew. Foss suited up and entered the MJD experiment as part of the program. To view the segment: *Jeopardy TV show* [YouTube Video](http://www.youtube.com/watch?v=Lqah2zvXYnU#t=14m26s).

<http://www.youtube.com/watch?v=Lqah2zvXYnU#t=14m26s>



Figure 7: Jeopardy! Clue Crew member Sarah Whitcomb Foss reads clues for Sanford Lab in category, "Figuring Out the Universe" – Woody Hover drives the locomotive

Ross Shaft Rehabilitation

The Ross Shaft rehabilitation has just reached a major milestone at the 1250 Level, after eighteen months of a projected five-year steel replacement project. "We are on schedule and it's very gratifying," said Underground Access Director Will McElroy. "I'm really proud of the work the team has done."

The Ross Shaft was sunk in the 1930s and supported using H beams that were installed every six feet in "sets" throughout the 5000-foot shaft (see Figure 8). The new sets are made of hollow structural steel and installed every 18 feet. Each one replaces three old sets.



Figure 8: The 1250 Level station rehabilitation - Before and after (The yellow box is an emergency shelter).

The process requires stripping out the old steel sets, and then rock bolting the shaft. For every ten new sets, a bearing beam set is installed. The beams rest on six huge saddles, anchored into the rock using ten 8-foot resin bolts each. To date, 82 of 308 total sets have been completed.

"The upper 1250 feet of the shaft is safer than it has been since it was first built," McElroy said. "The steel is stronger, the rock has been re-supported and there are new utilities. It'll be that way all the way to the bottom by the time we finish." When the Ross Shaft is completed in 2017, rehabilitation will begin the Yates Shaft.

Watch a time-lapse video of the building of the 800-Level station: <http://vimeo.com/sanfordlab/800level>

Safety at Sanford Lab

On Monday, February 24, Sanford Lab received a new rock bolter in order to address noise level and vibrations safety concerns (shown in Figure 9). The new equipment will provide an alternative to the jackleg drill, which operates at 115 to 120 decibels, according to Industrial Hygienist Chuck Lichtenwalner, about the noise level of a rock concert. The jackleg drill is traditionally used to drill holes and insert rock bolts but the noise and vibrations make jackleg drilling physically and mentally demanding.



Figure 9: The new rock bolter located in the Yates Hoist room after arriving at Sanford Lab. It will be disassembled, lowered, and then reassembled underground

The new rock bolter is small enough to fit through the narrowest drift headings in the facility at 8x8 feet. It can be operated individually or with an assistant to

provide supplies. The machine will be disassembled, (in the water treatment plant space) in order to fit into the shaft. SURF Project Manager David Vardiman and his team have drafted a plan to divide the machine into three large pieces. They will cut spot-welded connections, disconnect 81 hoses in two separate places, and then piece it all back together once the equipment is underground. Vardiman says that the new rock bolter will reduce noise and vibration exposure, improve efficiency, and extend the professional life of the crew.



Figure 10: The Track-O will move lead shielding to and from the lower Davis Campus

Safety was also a consideration in the purchase of another piece of equipment: the *Track-O* lift (shown in Figure 10). This item is a motorized piece of equipment, which provides a safe and easy way to transport up to 1100 pounds on slopes up to 40 degrees. It will be used to move lead shielding to and from the lower Davis campus, as well as other project uses.

EDUCATION AND OUTREACH

Activities

SURF's Education and Outreach (E&O) Department is utilizing high-definition video with increasing frequency to deliver content to students in classrooms across the nation, with several sessions planned for this spring (see Figure 11). A 4850 Level videoconference was held on February 26 with several classrooms from Kingsland High School in Spring Valley, Minnesota. Kingsland is the first school in Minnesota to gain all three possible certifications in *Project Lead the Way*, a national engineering curriculum. SURF E&O Deputy Director Peggy Norris was on site at Kingsland to meet with teachers and provide an introduction to Sanford Lab. Experiment Support Specialist Mark Hanhardt was at the Davis Campus and gave a video tour of the LUX detector. A local news crew was on hand in

Minnesota to record the event, including interviews with students. The segment can be viewed at: http://www.youtube.com/watch?v=EBVG_U5tKXs&feature=youtu.be.



Figure 11: Chris Chiller (University of South Dakota) visits with research students at Lead-Deadwood High School to reproduce Galileo's inclined plane experiment

The videoconference was the first step in a collaboration between the Kingsland school district and Sanford Lab to explore ways to engage students through the introduction of real-world examples of the principles and techniques the students are learning in their science and engineering curriculum.

Davis-Bahcall Scholars

Ten students from South Dakota have been chosen to participate in the Davis-Bahcall Scholars program for 2014, which begins in June. The students will be onsite at Sanford Lab from June 8-20, then travel to several regional laboratories in the United States, and finally to *Laboratori Nazionali del Gran Sasso* (LNGS) in Italy, returning to the Sanford Lab on July 10-14. The students are:

Name	Hometown	School
SD Space Grant Consortium Davis-Bahcall Scholars (college freshmen)		
Rachel Williams	Spearfish	BHSU
Hannah Wisser	Oakland, OR	SDSMT
Davis-Bahcall Scholars (high school seniors)		
Pranammya Dey	Sioux Falls	Lincoln
Layne Droppers	Yankton	Yankton
Mattison Flakus	Aberdeen	Aberdeen Central
Madison Jilek	Spearfish	Spearfish
Jack Storm	Rapid City	Stevens
Kassia Symstad	Hot Springs	Hot Springs
Alison Van Horn	Plankinton	Plankinton
Noah Watkins	Sioux Falls	Roosevelt

ENVIRONMENT, HEALTH & SAFETY



Daylight Saving Time

When you change your clocks forward:

- Charge or replace batteries for smoke and carbon monoxide detectors, and emergency flashlights
- Rotate out your backup food and water supplies
- Check to see that your emergency contact numbers are updated
- Make sure that family members know what to do and where to meet in the event of an emergency

STAFF NEWS

New interns at Sanford Lab



Megan Leonard is the new science communications intern at Sanford Underground Research Facility. She is a senior Mass Communications student at Black Hills State University in Spearfish, S.D. Originally from northern New York, Leonard is an eight-year veteran of the U.S. Coast Guard. “The best thing about joining a seagoing service is the worldly experience,” Leonard said. “I’ve seen massive glaciers in Alaska and witnessed humpback whales breaching in Hawaiian waters.”

Leonard left the Coast Guard to pursue a Bachelor of Science degree in Science Communication. She says Sanford Lab offers the rare opportunity of being able to blend science and media, bringing exciting research and discoveries to the public on a whole new platform. When not in the classroom or office, Leonard prefers to spend her free time outdoors with her dog hiking, backcountry camping, or bike riding.



Maria del Pilar Melisa Revilla, a native of Lima, Peru, studied abroad during high school in the United States, Canada, and Japan. In college, she began studying medicine but soon discovered her goals were oriented more toward traveling, exploring, and documenting different habitats and cultures. She switched her major to Mass Communications. After studying for three years in Peru, Revilla decided to go on a new adventure and get her bachelor’s degree at Black Hills State University. “Being in a small town was a cultural shock at first,” she said. But she has adjusted well and is learning a lot from this new small-town environment.

Now a senior, Revilla took one year of business classes and is currently learning French, Russian, and Italian because she thinks they will be crucial to work in a globalized environment. As an intern at Sanford Underground Research Facility, Revilla is working on multimedia projects, including one that will be part of a Sanford Lab science exhibit at the Black Hills Mining Museum. “I love working in a place with people from so many backgrounds and who have been to some of the best colleges in the world.” Revilla’s plans include going to grad school, and then getting a job in the United States, perhaps working on documentaries.

UPCOMING CONFERENCES AND WORKSHOPS

APS April meeting, Savannah, GA, April 5-8, 2014. Particle physicists, nuclear physicists, and astrophysicists will share new research and insights. <http://www.aps.org/meetings/april/index.cfm>

INPA Dark Matter Workshop, Lawrence Berkeley National Lab, Berkeley, CA. May 8, 2014. Kevin Lesko, ktlesko@lbl.gov. To register by May 2: 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/>

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=neutrino_s14



JOB

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 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 Research Assistant, University of London. Research with DEAP/CLEAN group, experimental dark matter searches. Reference #: X0114/6551. Deadline: 4/7/14. Contact: Jocelyn Monroe, Jocelyn.Monroe@rhul.ac.uk <https://jobs.rhul.ac.uk/rhrl/pages/vacancy.jsf?latest=9>

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/ajojobs/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>

Newsletter Editor: Melissa Barclay

Contributors: Kevin Lesko; Connie Walter (Sanford Lab local news); Angela Chiller (CUBED research); M.G. Gilchriese (LZ collaboration meeting/LUX Workshop); Julieta Gruszko (MAJORANA Collaboration Workshop); Germanium detector road trip (Keenan Thomas); Peggy Norris, Ben Sayler (Education and Outreach)

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