

Dear SURF Readers,

Welcome to the July 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

August 12-13: LUX-ZEPLIN Director's Review - Berkeley, CA

August 15-16: LUX Collaboration meeting - Lead, South Dakota

LUX-ZEPLIN (LZ) Selected for Funding

The LUX-ZEPLIN (LZ) experiment has been selected by the Department of Energy and National Science Foundation as one of three experiments to be funded in the next-generation dark-matter search. LZ will be set up at SURF in the underground Davis Cavern at the 4850 Level.

"This is great news for dark matter," said Kevin Lesko, Senior Physicist with LZ and Berkeley Lab's Physics Division. "With our new detector at Sanford Lab, we plan on getting the experiment up and running in 2018. We'll continue searching for WIMPs with LUX in the interim."



Figure 1: LUX water tank at Davis Campus 4850 Level. Photographer Steve Babbitt of Black Hills State University used a tripod and long exposure to capture the light of his cap lamp as he walked quickly around the side of the tank.

Dark matter, so named because it does not emit or absorb light, leaves clues about its presence via gravity: it affects the orbital velocities of galaxies in clusters and distorts light emitted from background objects in a phenomenon known as gravitational lensing. However, finding convincing evidence of dark matter has so far been elusive.

Physicists speculate that dark matter could consist of difficult-to-see particles called Weakly interacting massive particles, or WIMPs, which usually pass through ordinary matter without leaving a trace. The current LUX experiment detector is located 4850 feet underground, shielded from cosmic rays.

Sanford Lab has been planning for the next-generation dark matter experiment for the past few years. Compared to the one-third ton of liquid xenon that currently fills the LUX detector, LZ will have a 7-ton liquid-xenon filled target inside the same 72,000-gallon tank of pure water shield used by LUX (see Figures 1 and 2).



Figure 2: LUX water tank at Davis Campus 4850 Level (Photo Courtesy of Roy Kaltschmidt, LBNL)

The international LZ collaboration includes scientists and engineers from England, Scotland, Russia, and Portugal, as well as more than a dozen universities and laboratories in the United States. LZ has combined collaborating researchers from LUX and ZEPLIN, a dark matter experiment located in the Boulby potash mine in northeast England. (ZEPLIN is an acronym derived from "zoned proportional scintillation in liquid noble gases.") LZ is managed by the DOE's Lawrence Berkeley National Lab and located at SURF in South Dakota.

LZ members will be meeting in Edinburgh, Scotland at the end of July. An LBNL Director's review of LZ is scheduled for August 12-13.

Visitor Center Groundbreaking

A public groundbreaking ceremony for the new Sanford Lab Homestake Visitor Center took place on June 30, hosted by SURF and the Lead Chamber of Commerce (CoC). Key figures involved in planning and construction include: James Benning (Ainsworth-Benning Construction), Joyce Carsten (Lead CoC President), Melissa Johnson (Lead CoC Executive Director), Jerry Apa (City of Lead), Ron Wheeler (Vice Chairperson, SDSTA), Josh Willhite (Sanford Lab Engineering Director), and Mike Headley (Executive Director, SDSTA) (shown in Figure 3).



Figure 3: Groundbreaking ceremony at the Open Cut in Lead, South Dakota on June 30

"Today represents the culmination of planning and facility design discussions that started in 2012," said Mike Headley. Headley thanked several dignitaries in the crowd of 70, especially T. Denny Sanford and South Dakota Governor Dennis Daugaard (not in attendance), for their ongoing support of Sanford Lab.

The new Visitor Center will play an important role in Sanford Lab's education and outreach efforts, providing streamlined access to information on the Lab's science and engineering endeavors. The 8000 square-foot Visitor Center will include a classroom, retail space, and Lead Chamber of Commerce offices. A 3000 square-foot exhibit will celebrate the history of Lead, presenting the discovery of gold, the ethnic groups who came to work for Homestake, and the transformation of the Homestake Gold Mine into an underground science research facility.



DBD14 workshop

An international workshop on "Double Beta Decay and Underground Science" (DBD2014) will be held

from October 5 to 7, 2014 on Hawaii's Big Island at Hilton Waikoloa Village. The workshop will provide a platform for open discussions on current and future directions in the study of double beta decay and other related topics in neutrino physics. Deadline for abstract submissions: July 31, 2014.

For more information or registration:
<http://dbd14.phys.sci.osaka-u.ac.jp/index.html>

Reports/Papers Available

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

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

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

The Economist: [*The ghosts and the machine*](#) (Staff, June 27)

Today at Berkeley Lab: [*Next-Generation Dark Matter Experiments Get the Green Light*](#) (Kate Greene, July 15); Also in [*Physics.org*](#) (July 16)
[*Nuclear Science, Physics, Help Celebrate Neutrino Day in South Dakota*](#) (July 21)

ScienceNews: [*Dark matter hunters may get three new experiments*](#) (Christopher Crockett, July 16)

Washington Times: [*Work begins on \\$5M Sanford Lab visitor center*](#) (Associated Press, July 2)

Ars Technica: [*The quiet search for dark matter deep underground*](#) (Matthew Francis, July 8)

Science 2.0: [*Is There A Future For Particle Physics In America?*](#) (Hank Campbell, June 23)

GEOkompakt: [Die Jagd Nach den Geister-Teilchen](#) (Christina Rietz, June 6)

ECN: [Physics panel to feds: Beam us up some neutrinos](#) (Seth Borenstein, May 27)

Symmetry: [Science inspires at Sanford Lab's Neutrino Day](#) (Kelen Tuttle, July 16)
[US reveals its next generation of dark matter experiments](#) (Kathryn Jepsen, July 11)

H+ magazine: [Neutrino Science: The Post Nuclear Age, Extra-terrestrial Contact and The Perfect Wave \(Part 1\)](#) (Peter Rothman, June 5)

Argus Leader: [Work begins on \\$5M Sanford Lab visitor center](#) (Associated Press, July 2) – Also in *News Daily.com*
[Connecting with the All About Science Festival](#) (Peter Harriman, June 14)

NBC News Center 1: [Davis-Bahcall Scholars Present at Sanford Lab](#) (June 20)
[Ground Breaking at Sanford Lab Visitor Center](#) (Jessica Nappi, June 30)

KOTA News: [Sanford Lab starts science education center](#) (Pat Dobbs, July 1)

KTIV news: [Work begins on Sanford Lab visitor center](#) (July 2)

KEVN Fox News: [Lead's New Visitor Center to Combine History, Science](#) (Darren Leeds, July 1)

KELOLand TV: [New Homestake Visitor Center to Mix Mining](#) (Kevin Woster, July 9)

SDSMT News: [Mines offers peek of science a mile underground at Sanford lab's Neutrino Day](#) (July 10)

SDPB: [Scientists Investigate Dark Matter in the Black Hills](#) (Cara Hetland, July 11)

Rapid City Journal: [DOE, NSF to fund next-generation experiment at Sanford Lab](#) (Tom Griffith, July 13)
[Neutrino Day expands young minds in Lead](#) (Eric Ginnard, July 12)
[Dive into science at Neutrino Day](#) (July 10)
[Neutrino Day events kick off Friday in Lead](#) (July 10)

[Sanford worker injured in accident, lab says](#) (Emily Niebrugge, July 4)

[Work begins on \\$5M Sanford Lab visitor center](#) (July 2)

[Sanford Lab, chamber break ground on new visitor center](#) (Tom Griffith, July 1)

Black Hills Pioneer: [Massive dark matter experiment receives funding](#) (Adam Hurlburt, July 15)

[Lab's seventh Neutrino Day bring the cosmos to the human level](#) (Adam Hurlburt, July 14)

[Ground breaks on \\$5M Sanford Lab Homestake Visitor Center](#) (Jaci Conrad Pearson, July 1)

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

Ross Shaft Refurbishment Update

On June 6, the Ross rehabilitation team marked an important milestone: the installation of the 100th set of new steel, reaching the 1550L station (see Figure 4).

This five-year project involves many steps: design, Standard Operating Procedure development, training, receiving the steel, staging, removal of old steel, and installation of new steel. The process of replacing the steel requires stripping out the old steel sets and then rock-bolting the shaft. The beams rest on six huge saddles anchored into the rock using 10, 8-foot resin bolts.



Figure 4: The Ross Shaft rehabilitation team installed the 100th set of new steel in early June

The Ross Shaft, sunk in the 1930, is supported by H beam sets installed every 6 feet throughout the 5000-foot shaft. The new sets consist of hollow

structural steel and are installed every 18 feet. Each new set replaces three old sets.

“A typical new set takes six shifts or three full days to complete,” said Ross Shaft Foreman George Vandine. Crews work 12-hour shifts on a seven-on, seven-off rotation. They have encountered some challenges with gadding, infrastructure configuration, and weather.

“When these challenges arise, we stop work, gather information, engage engineering, and then work together to solve problems,” said Will McElroy, Underground Access Director.

Yates Shaft Maintenance

At the Yates Shaft, which provides primary access to the Davis Campus 4850 Level, the Yates Shaft management team implemented a top-down maintenance plan that included inspection of all the timber that supports the shaft, as well as the condition of the rock behind the timber. Crews also inspected and replaced lacings: 2-inch slabs of wood that sit on top of the timber beams and protect the shaft interior. They removed muck and other debris that had accumulated behind the timber. Another accomplishment involved the refurbishment of the 2300 level station, with T3 condition bearing beams now supported by 6" x 8" timber posts (see Figures 5-6). Yates Shaft Foreman, Jack Stratton claims that the shaft is stronger today than when it was first installed.



Figure 5: Inside the Yates Shaft headframe



Figure 6: Framed-in new support for Station Gate at 2300 level



Info on Travel through Lead

The City of Lead will be working on roads from May 1 to October 1, 2014 and into 2015. The City of Deadwood project is expected to overlap during 2015 and will cause problems with access to SURF from Deadwood up Hwy 85 to Mill Street. It is recommended that all SURF traffic come through Central City, via Hwy 14.

In 2014, the Main Street utilities and grading project will move in 3-block intervals starting at the east end of Julius and Main Street and progress towards Blue Street. Main Street traffic will be detoured to Julius Street.

There will also be intermittent road closures due to joint and spall repair activities ongoing from Pluma to the top of Glover's Hill and Baltimore, where they join with Hwy 14.

EDUCATION AND OUTREACH

Neutrino Day

More than 800 people attended Sanford Lab's seventh annual Neutrino Day on July 12. The event featured a variety of exhibits and activities, geared toward all ages, both at Sanford Lab and in downtown Lead.

The Dakota Players (see Figure 7) and the Journey Museum's portable planetarium presented a *Space School Musical*. Visitors to Sanford Lab picked up brochures at information booths, spoke with

scientists underground, viewed science demonstrations, and toured the hoist room.



Figure 7: The Dakota Players present a "Space School Musical"

Nearly 400 people attended science lectures at the historic Lead Opera House. Keynote speakers Joel Primack, UC Santa Cruz Professor of Physics and Astrophysics, and Nancy Abrams, a science writer and visual artist, gave a presentation on the role of human beings in the universe (see Figure 8).



Figure 8: Keynote speakers Dr. Joel Primack and Nancy Abrams present at the Lead Opera House

Mary Kidd, Physics Professor at Tennessee Technological University, introduced the MAJORANA DEMONSTRATOR (see Figure 9):

"How do you detect a process so slow that its half-life is more than 100 million billion times the age of the universe? Moreover, if it happens so rarely, how important is it? So-called rare-event searches are pushing our limits of detection. One such search, the search for neutrinoless double beta decay, is the most promising method to establish the MAJORANA nature of the neutrino and probe for physics beyond the Standard Model.

The MAJORANA project is a tonne-scale experiment which seeks to push the limits of low-background measurements to detect the neutrinoless double-beta decay of ^{76}Ge . The initial stage, the MAJORANA DEMONSTRATOR (MJD), consists of 40 kg of ultra-clean P-type point-contact germanium detectors installed in two cryostats at the Sanford

Underground Research Facility with two goals: to demonstrate the background requirements of a tonne-scale experiment, and to test the recent claim of neutrinoless double beta decay observation."

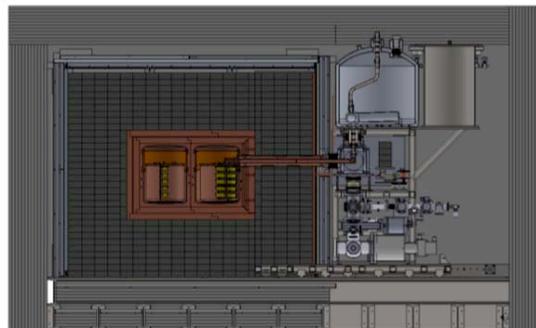


Figure 9: MJD detectors surrounded by layers of copper and lead shielding. This is then surrounded by an active muon veto, a radon exclusion box, and layers of poly shielding.

ENVIRONMENT, HEALTH & SAFETY



- Always swim with a buddy
- Have appropriate equipment, such as reaching or throwing equipment, a cell phone, life jackets, and a first aid kit.
- Protect your skin; wear sunscreen with a protection factor of at least 15.
- Drink plenty of water

STAFF NEWS



Noel Schroeder, the new SURF Environment Health and Safety Director began work on June 30. For the past 11 years, he has been Director of Safety Services with *Regional Health* in Rapid City. Prior to that time, he was employed as a Safety Officer with *Cortech Inc.* in Denver and also at the University of Iowa as a Research Assistant Lab Manager. He received his BA in Biology from Coe College (Iowa).

Noel has two college-age children: a daughter Bailey, a junior at Colorado University, Boulder studying Sociology/Law, and a son, Lane, an entering freshman at South Dakota School of Mines & Technology, studying Civil Engineering. Noel's hobbies include the outdoors, fly fishing, camping, hiking, and sports.

Noel is very excited to be back in a research environment again. He brings his enthusiasm for EHS to the SURF programs, along with his desire to continually learn and explore new areas, both in and out of his profession.

A special thanks to outgoing EHS Director Joe Gantos, who has served at SURF for the past two years. Gantos will continue involvement at LBNL's SURF Project Office providing critical EH&S oversight as well as assisting with the LZ project.

UC Berkeley Students at SURF

Several UC Berkeley students went to Lead this summer to work at SURF. Two of them share their experiences below. We will hear from the others in the SURF August newsletter.



Sophia Elia at Sanford Lab (Photo by Matt Kapust)

Sophia Elia returned to SURF for a second year, arriving on Memorial Day weekend and staying until mid-July. A former Davis-Bahcall scholar, Sophia will be a junior at UC Berkeley in the fall. Sophia shares her experience:

"This summer, I had the opportunity to travel to South Dakota and work as a shifter for LUX for three weeks. I was able to experience what it was like to be a dedicated member of the experiment. During my time underground, LUX was preparing for run four. This meant the day-to-day work was mainly repairs and testing. I helped fix and replace the

circulation pumps and learned how to bias the PMTs so that I could help with high voltage tests. During my last week underground, I acted as shift manager and prepared the daily reports of our activities. Additionally, I learned how to run many different types of software that LUX uses for interpreting data. In this way, the trip provided me with the foundation I need to continue working with LUX from Berkeley.

My favorite part about being underground, and about working in physics, is always the people. I am continually touched by the generosity that meets me. Even though the physics, especially during this phase of adjustment, was at some times incredibly complex, the other scientists were remarkably willing to share their knowledge with me and include me in their tasks. I also had a blast hanging out with them aboveground. We had great group dinners and went on gorgeous hikes through the Black Hills. Everything was unbelievably verdant (but still a bit treacherous because of winter storm debris.)

Now that I'm back in California, I'm spending the rest of the summer working with the MAJORANA DEMONSTRATOR group at LBNL. Most of my work focuses on fabrication and quality assurance testing of the front-end electronics for the experiment. I get to work both in the clean room and the laboratory.

I love being a part of the team. I have incredible mentors, and the work that I'm doing has a direct impact. It's satisfying to know that the electronics that I help to make and test are already making their way underground to be installed in the experiment. My favorite aspect of this job (besides the people I work with) is the problem solving that goes on. Critical thinking is the best part of experimental physics. It tests you on so many levels at once. The problem could be a complex physical issue that pulls on your scientific knowledge, or it could be something extremely simple that you're missing. I find the challenge of figuring out what's happening very fun.

It's been a great summer so far, and I can only expect it will continue to be one. I'm also taking a math course, which is both intensive and interesting. I'm extremely grateful for the opportunities that I've had, and would like to sincerely thank everyone who is making it possible for me to have such a rich undergraduate experience."

Michael Yen is a Physics graduate student who spent time at Sanford Lab from mid-June to July 4. He writes:

“Working at SURF this summer was like nothing I have ever done before. It was a unique experience waking up every morning to dress myself in coveralls, rubber steel-toed boots, a hardhat, a headlamp, and a self-rescuer. As a graduate student looking for a thesis topic, it was very important to me to be able to get to know what the day-to-day life of the LUX experiment would be like.

Every morning I would wake up at 6:00 a.m. so I would have enough time to get ready and walk to the Yates Shaft in order to catch the 7:30 a.m. “cage” down to the 4850. The first time taking the cage was awesome; it reminded me of the Tower of Terror in Disneyland. The ride from the surface to the 4850 Level took about 10 minutes, all of which was in the dark, standing shoulder to shoulder with other passengers, inside a rocking elevator. Upon arrival to the 4850, I entered the squeaky clean lab, complete with white walls and shiny floors.

The main reason for my trip to SURF was to become more familiar with the detector. As a data analyst, I understood how the detector “works”, but I had no idea of what the individual components were doing to make it work. The main system being worked on at the time was the high voltage grids. These grids are responsible for creating an electric field inside the detector, which can affect the rate at which you see events. I also helped install a new liquid nitrogen pipe, and diagnose a broken xenon circulation pump.

While these systems are only a small fraction of all the components of LUX, I now have a better appreciation for the effort it takes to keep the detector running smoothly. I also have a greater understanding of how important graduate students are to the operation of the experiment. The individual efforts of these students showed me that if I were to write my thesis on LUX, I would be making a real and effective change to the experiment. Being able to work with and learn from students from all over the world was by far the most rewarding experience, and I look forward to working with them in the future.”

UPCOMING CONFERENCES AND WORKSHOPS

42nd SLAC Summer Institute 2014, SLAC, Menlo Park, CA. Shining Light on Dark Matter, August 4-15, 2014. Focus on quest to identify Dark Matter. Morning lectures, afternoon topical conference talks, discussion sessions, tours, and social events. <http://www-conf.slac.stanford.edu/ssi/2014/>

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>

The 2nd Workshop on Germanium-Based Detectors and Technologies, University of South Dakota, September 14-17, 2014. To register, submit abstracts, apply for fellowships or more details, visit: <http://www.geworkshop.org/indico>

Perspectives of GPU Computing in Physics and Astrophysics, Rome, Italy, September 15-17, 2014. Companion workshop on GPU High Energy Physics, September 10-12 in Pisa. <http://www.roma1.infn.it/conference/GPU2014/>

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/index.html>

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. <https://www.npl.washington.edu/indico/conferenceDisplay.py?ovw=True&confId=5>



JOBS

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>

Postdoctoral fellowship, University of Alberta. Research in IceCube and PINGU. Review begins 7/2/14. Darren Grant, drg@ualberta.ca
<http://www.postdoc.ualberta.ca/en/Postdoc%20Opportunities.aspx>

Two Faculty positions, Carleton University, Ottawa, Canada. Research in particle physics, especially EXO. Review begins: 8/1/14. 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. Contact: Gregory Pawloski, pawloski@umn.edu
<http://inspirehep.net/record/1292955?ln=en>

Tenure-track faculty position, South Dakota School of Mines, Rapid City, SD. Assistant, Associate or Professor of Physics position (based upon qualifications) 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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