Dear SURF Readers,

Welcome to the August 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 5-7: Double Beta Decay and Underground Science workshop – Waikoloa, Hawaii

MAJORANA DEMONSTRATOR milestone

In mid-July, the MAJORANA DEMONSTRATOR (MJD) collaboration reached a major milestone when researchers finished assembling the first string of detectors enriched in the isotope ^{76}Ge.

MJD is searching for the extremely rare neutrinoless double-beta radioactive decay. The collaboration hopes to determine whether the neutrino is its own antiparticle, or a Majorana particle. Its detection could help explain why matter—planets, stars, humans and everything else in the universe—exists.

During neutrinoless double-beta decay, two electrons are ejected in the germanium isotope. Those electrons deposit energy in the detector, which can be measured with special signal processing electronics. The experimental apparatus, built of ultra-clean materials, is located underground to avoid contaminants and cosmic rays that could also create similar electronic signals in the detectors.

For some time, MJD has been collecting data from natural-germanium detectors (i.e. not enriched in the precious ^{76}Ge isotope) installed and tested in a prototype cryostat nearly identical to the ultra-clean cryostats that will eventually be used. This allowed the team of scientists, engineers and machinists to understand different backgrounds, test for any problems, and make modifications where needed.

Figure 1: Ben Jasinski, Ph.D. student collaborator from University of South Dakota, assembles a detector string inside a glovebox

"We've learned a lot in terms of getting everything working the right way," said MJD PI John Wilkerson, John R. and Louise S. Parker Distinguished Professor of Physics and Astronomy at the University of North Carolina.

Ryan Martin, Assistant Professor of Physics at the University of South Dakota, oversees the assembly of the strings, making sure procedures are in place and everything is put together correctly. The assembly of the first string is the beginning of the production phase, and the end of the R&D period, Martin said.

Over the next few weeks, six more strings containing up to four detectors will be assembled and placed in the cryostat (see Figure 1) where they will be cooled to liquid nitrogen temperatures (-346°F). The cryostat will then be placed inside the shield and begin collecting data.

"It's taken many years to get here and a tremendous effort by everyone on the collaboration," Martin said. "We can see the light at the end of the tunnel and everyone is very excited."

LZ Director's Review

About 45 reviewers and collaborators gathered at Lawrence Berkeley National Laboratory for a review of the LUX-ZEPLIN (LZ) Project on August 12-13. This pre-CD-1 (Critical Decision) review was held to help prepare the LZ Project for a CD-1 review by the Department of Energy (DOE), anticipated to occur before the end of 2014.

The LZ Project was selected by the DOE and the National Science Foundation in early July 2014 as

part of a comprehensive Generation-2 dark matter program. The LZ detector will reside in the same water tank currently occupied by the LUX experiment at the SURF Davis Campus 4850 Level. The LZ Project prepared a comprehensive draft *Conceptual Design Report*, detailed presentations, and many other documents for the review committee, comprised of experienced members of the high energy physics community. The committee concluded that the LZ Project could be ready for the CD-1 review before the end of 2014.

Summit at Fermilab

A two-day summit took place at Fermilab on July 21-22. Fermilab Director N.N. Lockyer established the summit as a means to initiate the process of establishing the necessary international collaboration. Forty-eight leaders from the international neutrino community gathered to discuss the creation of a new international collaboration to fulfill the P5 goals for a long-baseline neutrino facility (LBNF). This process is the reformulation of LBNE. The next step is the creation of an *interim international Executive Board* (iiEB), which will establish some working groups to help define the process and form the collaboration. Rob Roser of Fermilab and Ken Long of Imperial College London are helping to guide the process. Participants agreed that the collaboration should present an LOI and further guide its *Conception Design Report* development. A second meeting will occur in the fall of this year.

One scenario for the future of LBNF includes Fermilab as the host laboratory and the site of LBNF's future beamline, with SURF as the site selected to house the massive far-detector. The neutrino beam would be constructed at Fermilab. The neutrinos would travel 1300 kilometers through the earth to a massive underground particle detector located at SURF.

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.

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

Kay Jorgensen receives award

Kay Jorgensen, who served in the South Dakota House of Representatives for 12 years, will be inducted into the South Dakota Hall of Fame in September. She will be honored for her contribution as a general and public service volunteer to the State. She serves on the board of the Sanford Lab Cultural Advisory Committee and provides critical input to integrating SURF and its research efforts into South Dakota.

Reports/Papers Available

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
Like SURF on Facebook:
http://www.facebook.com/SURFatHomestake

SURF IN THE NEWS

Phys.org: Hunt for dark matter takes physicists deep below earth's surface, where WIMPS can't hide (Margaret Allen, August 7)

Science Magazine: Two big dark matter experiments gain U.S. support (Adrian Cho, July 16)

Washington Times: South Dakota lab pays off as researchers dig deeper (Associated Press, Tom Griffith, July 27)

Al Jazeera: Scientists try to shine light on dark matter (Rob Reynolds, August 12)

Earth Sky: Three next-generation dark matter experiments get a green light (Staff, July 16)

ScienceBlog: *In Search of Elusive Dark Matter* (Staff, July 18)

The Daily Californian: *Berkeley Lab to manage dark matter project* (Sumaiya Mubarack, July 21)

Yale News: *It's go time for LUX-ZEPLIN experiment in dark matter* (Jim Shelton, July 17)

Imperial College London news: *New dark matter detector gets green light* (Gail Wilson, August 18)

Brown University news: *Brown physicists part of "second generation" dark matter experiments* (Kevin Stacey, July 17)

BHSU news: *BHSU receives $125,000 Grant for underground campus at Sanford Lab* (BHSU writers, August 12)

KEVN, Fox news (video): *Art Meets Science at the Dahl Arts Center* (July 27)

Rapid City Journal: *Underground tour of the Sanford Lab* (August 14)
Sanford Lab's new clean room will welcome student scientists (Meredith Colias, August 13)
'Into the Dark' exhibit sheds light on dark matter (Jackson Bolstad, July 24)
BHSU Professors discuss the connection between art and science (Staff, July 24)
5 questions with BHSU President Tom Jackson Jr. (Meredith Colias, July 23)
Homestake lab paying dividends (Staff, July 23)
Sanford Lab pays off for state as researchers dig deeper (Tom Griffith, July 20)

Black Hills Pioneer: *Funding Science* (August 13)
Restoring History (Jaci Conrad Pearson, August 12)
Majorana moves out of R&D, into production (Adam Hurlburt, August 4)
Professors discuss the connection between art and science (August 2)
Jackson looks to the future of BHSU (Mark Watson, July 25)

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

Safety at Sanford Lab

On July 10, more than 50 Sanford Lab staff participated in a routine evacuation drill developed by SURF's Environment, Health, and Safety department. These emergency simulations take place quarterly.

In this scenario, developed by Tim Eggers, SURF Construction Safety Specialist and Emergency Coordinator, the Yates Shaft was shut down due to water inflows, requiring personnel to exit through the Ross Shaft. The Ross Shaft is currently undergoing a five-year rehab construction and personnel are using work decks, so fall arrest (fall protection gear used in case of a vertical drop of 6 feet or more) was the primary focus of this exercise (see Figure 2).

"We wanted to evaluate the response to wearing fall arrest in order to come up to the surface," said Eggers.

Mark Hanhardt, SURF Science Coordinator, was the lead guide during the drill. At 9:30 a.m., he received an announcement to evacuate the space. Within minutes, guides directed people to the primary assembly point in the Common Corridor of the underground Davis Campus, at which time Hanhardt called the Yates hoist operator. The clean spaces were evacuated in 17 minutes. Teams met up with Woody Hover, Emergency Response Team Lead and Safety Specialist, who provided an explanation of fall arrest harnesses and lanyards, a rope or safety strap.

Figure 2: Researchers and Sanford Lab staff practice donning fall arrest gear during an evacuation scenario on the 4850 Level

The exercise included researchers working underground on LUX, MJD, and CUBED, as well as contractors, engineers, and interns.

"We were able to evacuate in a brief amount of time and get the information we needed to stay safe," Hanhardt concluded. He also commended the solid emergency planning on the part of Sanford Lab.

Sanford Lab receives award

Sanford Lab received the Patriot Award on July 24 from the South Dakota National Guard's *Employer Support of the Guard and Reserve*. The award recognizes employers that foster a culture of support for the military service of their employees, giving them the time they need to carry out their National Guard duties. SURF Infrastructure Tech and National Guard member Will Domagall nominated Sanford Lab for the award. Engineering Director Joshua Willhite accepted the award on behalf of SURF (see Figure 3).

Figure 3: Joshua Willhite with Jack Stratton and Will Domagall

Into the Dark Art Exhibit

On July 30, a panel discussion "When Art and Science Collide," took place at the Dahl Arts Center in Rapid City. The panel, consisting of SURF Multimedia Specialist Matt Kapust, Steve Babbitt, Photography Professor at Black Hills State University, visual artist and BHSU Professor of digital communication Gina Gibson, and SURF Experiment Support Specialist Dana Byram, focused on cutting-edge science at Sanford Lab and artistic interpretation of dark matter. Music was provided by guitarist Gordy Pratt.

The Dahl Arts Center has been hosting an exhibit, "Into the Dark: Artists Exploring Dark Matter" and "Deep Photography" from July 25 to August 30 (see Figure 4). The exhibit consists of paintings, digital design, photography, and other artistic media by 22 South Dakota artists. Photography from Matt Kapust and Steve Babbitt chronicles the transformation of SURF from the former Homestake gold mine into a world-class research facility. The exhibit, on tour since July 2013, has made stops in several cities in South Dakota.

Figure 4: 'Into the Dark' art exhibit at the Dahl Arts Center in Rapid City

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

K-12 Activities

The second of two teacher institutes on *Underground Science, Technology, Engineering and Mathematics (STEM)* was held for middle and high school educators on July 20-25, facilitated by SURF Education and Outreach Deputy Director Peggy Norris and SURF STEM Education Specialist Bree Reynolds of the Education and Outreach Department. Separate days were devoted to the

broad topics of earth science, physical science, life and environmental science, and engineering. Teachers toured the Waste Water Treatment Plant, the Yates Hoist Room, and the Black Hills Mining Museum. A videoconference to the SURF Davis Campus included a talk on the MAJORANA project by Professor Mary Kidd of Tennessee Tech University. South Dakota School of Mines and Technology (SDSMT) graduate student Mohit Bibra and undergraduate Kayla Morisette (both members of Professor Rajesh Sani's group in bioengineering) talked about their work using bacteria for biofuels and bioremediation. University of South Dakota (USD) graduate students Chris Chiller and Angela Chiller gave a talk about their work underground and in the Surface Laboratory, funded by the South Dakota Governor's Research Center CUBED (Center for Ultra-low Background Experiments at Dakota). SURF Geological Engineer Dave Vardiman gave a presentation on characterizing the rock mass for the caverns to be built for the LBNE experiment. In addition, teachers explored associated classroom activities developed by the Education and Outreach Department over the last several years, devising their own lesson plans around these activities and topics.

Two videoconferences were held in July for students attending STEM camps on separate sides of the state of South Dakota: The first, on July 10, was attended by 26 high school students in their final year of the summer GEAR UP program at SDSMT. They were in the last week of a six-week physics course. Students had already been introduced to the topics of dark matter and neutrinos the previous day by Luke Corwin, Physics Professor at SDSMT. On the day of the videoconference, SURF Cultural Diversity Coordinator KC Russell and Peggy Norris were on-site at SDSMT; underground at the Davis Campus were Sanford Lab intern David Molash, an SDSMT undergraduate in physics (who is also in the SDSMT Tiospaye in Science and Engineering Program), and Mark Hanhardt, Sanford Lab Science Coordinator (and SDSMT PhD student in physics). Carter Kerk, Industrial Engineering Professor and member of Sanford Lab's Cultural Committee, coordinated the event.

(GEAR UP, an acronym for *Gaining Early Awareness and Readiness for Undergraduates Program* is a US Department of Education program. The goals of the South Dakota GEAR UP program include increasing high school graduation rates among Native American students as well as encouraging them to attend post-secondary programs. South Dakota GEAR UP seeks to reach 6600 students per year in Grades 6-12 to increase the success of those students at the college and technical institute level.)

The second videoconference, held on July 17 in two sessions, was attended by 46 students (entering Grades 7-9) attending the Lawrence Brothers Science camp at USD. The theme of this year's camp was *Light and Vision*, and the topic of dark matter was connected to this theme through a discussion of the electromagnetic spectrum and telescopes. Bree Reynolds led the group in a hands-on activity remotely from the SURF Davis Campus 4850 Level, while Peggy Norris introduced the topic of dark matter. Mark Hanhardt then showed students the LUX experiment and answered questions.

Undergraduate Activities

The summer internship program at Sanford Lab has drawn to a close with the last students finishing up on August 15. The SURF internship program offers internships in the name of former SDSTA Board Member Dave Bozied for students in science, engineering, or related fields. In 2014, two additional internships in engineering were established by the Bauer family in the name of former Sanford Lab engineer Chris Bauer.

Two brown-bag lunches were scheduled for the students to present final talks about their experience for Sanford Lab staff and friends. Julie Bauer, widow of former staff engineer Chris Bauer, attended both events, and her daughters joined her for the second set of presentations on August 12 (see Figure 5).

Figure 5: (left) SDSMT Physics major David Molash, Julie Bauer, SDSMT Mechanical Engineering major Wade Vandine, Tessa Bauer, Emma Bauer

Summer 2014 Interns at Sanford Lab

Listed below are the SURF Summer 2014 interns, along with their university affiliation, major, and hometowns. All are from South Dakota.

Chris Bauer Engineering Interns: Dakotah Simpson (SDSMT, Electrical Engineering, Lead); Wade Vandine (SDSMT, Mechanical Engineering, Spearfish, SD)

Dave Bozied Interns: Colter Dunagan (SDSMT, Physics, Rapid City); Rashyll Leonard (SDSMT, Physics, Rapid City); David Molash (SDSMT, Physics, Rapid City)

Other Interns: Stephen Farghali (BHSU, Mass Communications, Spearfish); Rachel Williams (BHSU, Physical Science, Spearfish)

ENVIRONMENT, HEALTH & SAFETY

Campus Safety

- Avoid being alone on campus late at night. If you have to be out, walk with a friend or contact your safety escorts or police. Take a self-defense class.
- If you ride a bike, invest in a sturdy bicycle lock; always lock up your bike.
- Keep your dorm or apartment doors and windows locked. If you lose a key, contact your dorm manager or landlord.
- Be aware of your surroundings. Don't get distracted by cell phone calls, texting, or listening to music.

STAFF NEWS

UC Berkeley at SURF

Several UC Berkeley students worked at SURF this summer. Kelsey Oliver-Mallory, LBNL Research Assistant and UC Berkeley Physics graduate student (shown in Figure 6), shares her experience:

This summer I was fortunate to be given the opportunity to travel to SURF and work on the LUX experiment. Previously, during my undergraduate studies, I worked on the D3 (directional dark matter detector) that is in an early stage of development, so I was very excited to see a large, fully-commissioned dark matter TPC experiment. As a new graduate student exploring possible research projects, this gave me a better understanding of the different ways that underground experiments are probing the nature of dark matter, and provided some of the experience I need to become a better informed and fully active member of the astroparticle physics research community.

Figure 6: Kelsey Oliver-Mallory works with LBNL Staff Scientist Victor Gehman (Photo by Roy Kaltschmidt, Courtesy of LBNL)

While working in the underground lab, I was able to see the detector components I had previously only read about, and get a better understanding of how all of the subsystems function and interact. During the time I was there, LUX was in the process of preparation for Run 4. As part of these activities, I helped perform diagnostics on photomultiplier tubes, as well as the gas system, and learned to control certain elements of the detector through the slow control system. While on-site, I met many scientists, postdocs, and more senior graduate students from many institutions around the country. Everyone was extremely generous and very willing to guide me during my first foray into direct hardware work.

In addition to contributing to LUX and achieving numerous personal "firsts" in research, I was able to help with outreach activities and communicate science to the local population during Neutrino Day. This is an event that teaches members of the community about the scientific work being done at Sanford Lab. As cutting-edge research is performed in the Homestake mine, it is important to hold open events such as this, to inform people about the nature of the work and the motivations behind it. I am very happy that I was able to participate.

UPCOMING CONFERENCES AND WORKSHOPS

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

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/

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 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

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. 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

Newsletter Editor: Melissa Barclay
Contributors: Kevin Lesko; Connie Walter (Sanford Lab news); Alan Poon (MAJORANA DEMONSTRATOR); M. Gilchriese (LZ review); Ben Sayler, Peggy Morris (E&O); Stephen Farghali (Safety at Sanford Lab); Kelsey Oliver-Mallory (UC Berkeley at SURF)

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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