Dear SURF Readers,

Welcome to the January 2014 Sanford Underground Research Facility (SURF) monthly newsletter. The newsletter is also 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

January 22-24: Environmental Health and Safety Oversight Committee review – Lead

January 23-26: MAJORANA DEMONSTRATOR review – Lead

March 6-9: LZ Collaboration meeting – College Park, MD

New South Dakota Ph.D. Program

August 20, 2013 marked the first day of the new doctoral physics program in South Dakota. Twelve students began studies: six at the South Dakota School of Mines and Technology (SDSMT) in Rapid City, and six at the University of South Dakota (USD) in Vermillion. They will focus on Sanford Lab research.

In this issue of the SURF monthly newsletter, Luke Corwin (shown in Figure 1), a faculty member in this program, shares his insights and experiences. Now Assistant Professor at SDSMT, Corwin received his Ph.D. in Physics from The Ohio State University in 2008. He then spent 4 1/2 years as a Postdoctoral Fellow with Indiana University in Bloomington, where he worked as a member of two neutrino experiment collaborations, MINOS and NOVA. For MINOS, he led a project that combined the results from beam and atmospheric neutrino data into a world-leading measurement. He continues his involvement with NOvA, pursuing analyses of neutrinos from the beam generated at Fermilab and from natural sources. He has joined LBNE, planned for SURF and Fermilab.

Figure 1: Luke Corwin, new Physics Assistant Professor at SDSMT in Rapid City

Luke Corwin writes:

At heart, we physicists are explorers. We want to know more about material reality than any human being has known before. To continue the exploration of our universe, we also need to train new physicists. That is the goal of the new physics Ph.D. program in South Dakota. As part of this new program, I was hired as an Assistant Professor at SDSMT in August 2013.

The main challenges that my colleagues and I face in starting this new program are obtaining funding, recruiting students, and the need for our students to devote their first year to coursework. With these challenges come opportunities to graduate the first student with a physics Ph.D. in the history of the state, to have great influence over the future of the program, to build it from obscurity to greatness, and to explore the universe through our research.

Since the Ph.D. physics program at SDSMT is new, we do not yet have a reputation among prospective graduate students. This is a challenge because we are competing with well-known physics programs around the country. The main recruiting tools in this environment are word-of-mouth and personal connections. As a member or former member of three international collaborations (MINOS, NOvA, and LBNE), I know many colleagues who can recommend undergraduates to me and recommend SDSMT to their promising undergraduates.

Most research in particle physics is funded by federal grants from the Department of Energy Office of Science and the National Science Foundation. As with most other federally funded programs, budgets are tightening and competition is increasing. Competing for funding in this environment is compounded by our nascent status, much like our recruiting efforts. However, we have no chance to be

funded unless we try. So, we are preparing as many good proposals as we can.

Most new professors need to learn important lessons about time management and delegation of responsibilities. As a new faculty member, I have responsibilities for committee service, teaching, applying for funding, administration, lab management, and others in addition to conducting research. In established programs, some of these responsibilities are delegated to graduate students and postdoctoral researchers. However, in a new program, we do not yet have postdocs, and our students are mostly busy taking their first-year classes, so I have little ability to delegate, yet.

Along with all of these challenges come great opportunities. Either SDSMT or USD will graduate the first student with a Ph.D. in physics in the history of South Dakota, which is a great accomplishment in its own right. We have the opportunity and responsibility to build a Ph.D. program from scratch without any pre-existing bureaucracy or traditions. We can learn from the mistakes and successes of other programs in building ours.

An additional and terrible unexpected challenge in this program is the suicide on November 21 of Dr. Alberto Lemut, one of our new professors. Life will go on without him, of course, but the questions and emotional shadow will hang over this department and the School for some time to come.

We have the opportunity to build our Ph.D. program from obscurity into something great. With our current funding from the state of South Dakota, we will demonstrate the abilities and talents of our students with small projects. These can, in turn, be used to show our funding agencies our potential and go a long way toward securing ongoing funding. We can do this by attracting good students via word-of-mouth and personal contacts and working closely with the Sanford Laboratory and all of the unique resources, attractions, and opportunities it provides

The experiments at SURF and on the SDSMT campus can be likened to ships sailing toward the horizon, bound for unknown shores, and our new graduate students are the newest crew members. We do not know what they will find, but we are confident that they will lead us and our successors to a deeper understanding of the material universe, and that is the greatest opportunity of all.

Reports/Papers Available

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

Paper: "The Large Underground Xenon (LUX) Experiment". *Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment,* Vol. 704, 11 March 2013, pp. 111–126.

Why the US Needs a Deep Domestic Research Facility. (Kevin Lesko, April 1, 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

Scientific American (**310**, *13):* *Cosmic Dragnet* (Clara Moskowitz, January 2014.

PBS Newshour: Scientists search for understanding of dark matter in deep underground lab (Miles O'Brien, January 20)

Yahoo!News: Dark Matter Near Earth Peaks Every March, New Study Suggests (Clara Moskowitz, January 6)

Deutschlandfunk (German public radio): *Experimente liefern widersprüchliche Resultate* (Frank Grotelüschen, January 6) – LUX results

Fermilab Today: Good FY14 budget news (Nigel Lockyer, January 21)

NOVA: Journey into the Dark Realm (Don Lincoln, January 22)

aps.org (American Physical Society): *Viewpoint: Ups and Downs in the Search for Dark Matter* (Rafael F. Lang, December 16; Physics 6, 136)

Symmetry: *Four things you might not know about dark matter* (Kathryn Jepsen, December 17)
US particle physicists look to space (Lori Ann White, December 6)

Space.com: Dark Matter Mystery Could be Solved in Next 10 Years (Katia Moskvitch, January 22)

Bloomberg.com: Astrophysicist Mac Low Explains the Invisible, WIMPS (Manuela Hoelterhoff, January 20)

News Daily: Sanford Lab begins $7M education center campaign (Associated Press, January 6)

KDLT news: Sanford Lab Begins $7M Education Center Campaign (AP, January 6)

The Daily Republic: Sanford Lab begins $7M education center campaign (AP, January 6)

Black Hills Fox News: *Sanford Lab to host more educational programs* (January 7)

Yankton Daily Press: Internships, Scholar Program Offered At Lab (December 29)

BHSU news: BHSU geology class takes first underground field trip at Sanford Lab (January 3)

Meade County Times-Tribune: BHSU geology class takes first underground field trip at Sanford Lab (January 6)

Aberdeen Times: Dark Matter: Artists explore the elusive substance (Jeff Bahr, January 9)

SDPB: Sanford Underground Lab Unhampered By Recent Cold Temps (Amy Varland, January 8)

Rapid City Journal: Fundraising campaign to build new Sanford Science Education Center (January 3)
Texas resident first to graduate with BHSU science communication emphasis (Staff, December 21)

Black Hills Pioneer: BHSU receives $117K research grant (Adam Hurlburt, January 10)
Lead upholds $30k commitment to Sanford Lab (Adam Hurlburt, January 8)
Texas resident first to graduate with BHSU science communication emphasis (December 27)

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

SURF Accomplishments in 2013

Sanford Lab Executive Director Mike Headley thanked the Sanford Lab staff and science researchers for their excellent work: a few highlights are summarized below.

The Large Underground Xenon (LUX) experiment completed its initial 85-day data run underground and announced its first physics results on October 30.

The MAJORANA DEMONSTRATOR (MJD) experiment collaboration continued copper electroforming and machining.

The Ross Shaft team rehabilitated over 1100 feet of shaft in an ongoing five-year project, and the Yates Shaft team provided great service transporting personnel and materials.

The Long-Baseline Neutrino Experiment (LBNE) is planning to construct a 34kT liquid argon detector on the 4850 Level. LBNE geotechnical work—rock core drilling and testing—will begin in early 2014 to support the facility design process.

The LUX-ZEPLIN (LZ) next generation dark matter experiment completed its concept designs and submitted its proposal to the Department of Energy and the National Science Foundation for construction funding. LZ will be located in the Davis Cavern.

Dark Matter Art Show

An art show, “Into the Dark” which debuted at the Lead-Deadwood Art Center in July 2013 has been on exhibit in other locations in South Dakota. It was taken to the Statewide Arts Conference in the state capital of Pierre, sponsored by the *South Dakota Arts Council* and *South Dakotans for the Arts*. In

December, the exhibit began touring the state, first stopping at the Aberdeen Recreation and Cultural Center. A reception was held on January 16 at the Center.

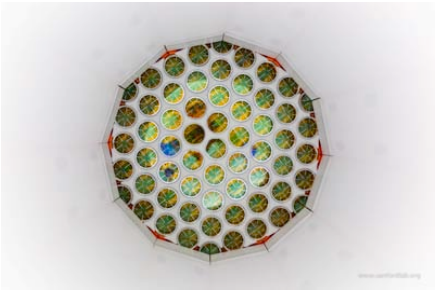

Figure 2: Inside the Large Underground Xenon (LUX) dark matter detector, with photomultiplier tubes (PMTs) at the top and bottom of the detector

Figure 3: Transition Cavern of Davis Campus 4850 Level, seen here during outfitting, excavated in 2010. Now home to the MAJORANA DEMONSTRATOR experiment

The "Deep Photography" part of the exhibit chronicles the transformation of the Homestake Mine into the Sanford Underground Research Facility, and is part of the exhibit. Photography (examples shown in Figures 2 and 3) is by Steve Babbitt, professor of photography at BHSU, and Matt Kapust, SURF multimedia specialist.

Safety at Sanford Lab

One of the many ways that Sanford Lab maintains safety is in the area of underground trained tour guides. "Safety is a core value at Sanford Lab," said Executive Director Mike Headley. "We do everything we can to provide a safety environment for our staff, science researchers, and visitors."

To that end, there are three categories of guides. A *Visitor Tour Guide* escorts visitors to areas that are maintained and considered safe. A *Science Guide* assists research personnel in areas where research is conducted. An *Underground Guide* is trained in ground control inspection, scaling, and ventilation in unmaintained and less-traveled areas of the underground.

"Guides are accountable for everyone underground," said Tom Regan, a consultant for SURF's Environment, Health, and Safety. Guides need to know escape routes, recognize hazards, and be familiar with emergency response procedures. Guides also must be aware of all communication systems, know how to use a hand-held gas tester, and be able to operate a locomotive.

Rachel Headley, Science, Technology, Engineering and Math (STEM) Liaison to Sanford Lab at Black Hills State University, coordinates trips for BHSU students to perform a variety of small-scale research projects. She is training to become a guide. On a recent trip underground (shown in Figure 4), she toured some unmaintained areas and walked the escape routes between the Ross and Yates Shaft.

Figure 4: Tom Regan shows Rachel Headley a map of the 4850 Level during a recent training trip underground

Sanford Lab's commitment to safety is also demonstrated by the distribution of safety reminders and reports to Sanford Lab staff. One of these reports dated December 27, outlines an injury where infrastructure technician pinched his hand during activities within the Ross shaft. The safety reminders provide information on: Why the incident occurred, Lessons Learned, and Recommendations, so that future mishaps can be avoided.

EDUCATION AND OUTREACH

Engaging K-12 students

SURF's Education and Outreach Department receives requests to help judge science fairs from numerous school districts each year. Many South Dakota middle and high schools, and some elementary schools, use science fairs as a means to

engage students in science and engineering projects outside of the school day. Top projects move on to regional fairs. For high school students, winning at the regional fair can be an opportunity to compete in the Intel International Science and Engineering Fair. 2013 Davis-Bahcall Scholar Karin Lee, of Aberdeen, now at University of Minnesota, attended the Intel Fair as a junior in high school. Her biggest thrill was attending a dinner with Nobel Prize winners.

On December 18, a Brown Bag lunch was held for Sanford Lab staff members and friends. The presentation and discussion, led by Julie Dahl (Science Education Specialist at SURF and BHSU), served as an orientation for staff interested in judging science fairs. The session covered what to expect when attending a fair as a judge, the kinds of things to look for, how to conduct a student interview, and other pertinent questions. On January 10, Julie, Ben Sayler (E&O Outreach Director), Peggy Norris (E&O Deputy Director), and Mining Consultant Jim Whitlock participated in North Middle School's (Rapid City) first ever science fair. Over 500 students in Grades 6-8 presented projects. Upcoming fairs looking for judges are Newcastle, WY (January 29), Spearfish, SD (February 7), and Hill City, SD (February 20).

Another vehicle that schools use to get students engaged in science and engineering is the research course. Lead-Deadwood High School is piloting one such course this spring, in partnership with Sanford Lab. Science teacher Robin Dirksen is leading the effort, with help from Julie Dahl. Students will engage in a project under the mentorship of a scientist or engineer. This month, students will be hearing from Sanford Lab staff who are able to mentor a student, and later in the month, the students will take a surface tour of the laboratory. Students from other schools occasionally request a mentor for a similar course; Mark Hanhardt (SURF Experiment Support Manager and LUX Operations Manager) is currently mentoring a student from his alma mater, Sturgis Brown High School.

Geology Class tours 300 Level

Twenty Black Hills State University students from Assistant Professor Abigail Domagall's geology class braved the cold and snow to walk the Sanford Lab underground on December 10 (shown in Figure 5). Domagall is also director of the BHSU's physical science program. The tour was arranged by Rachel Headley (BHSU), and led by SURF consultant Tom Regan, Science Liaison Director Jaret Heise, and Will Domagall.

Figure 5: Abigail Domagall (right) and geology student Jeff Murray examine a rock sample at the 300 Level

The class exercise aimed to study rock types and geologic processes at the 300 Level at the Kirk portal and study rock formations in the drift. Some of the activities included views of a large deposit of quartz, taking photographs of different rock formations, and colorations caused by manganese, iron and other minerals created by water running down the walls.

Once in the depths of the old mine, Domagall discussed the Precambrian period as well as schist, gold, metamorphic rock, folds, foliation, the direction of pressure and convergent boundaries (which form mountains), the history of the Black Hills, and how the rocks were formed.

The Black Hills are 1.7 to 2.6 billion years old, but the outer layers of rock are "only" 50-65 million years old. Some students also were able to hammer at the hard rock and take back a few chunks to observe in a classroom setting.

Internships at Sanford Lab

Sanford Lab offers several funded internships for young, aspiring scientists and engineers (see Figure 6). The Chris Bauer Engineering Internship was recently established by his family, following his death from cancer in July 2013. Bauer believed that students learned best through practical experience, and he was instrumental in assisting them in that process. Both of Bauer's daughters, Tessa and Emma, participated in internships during their college years, and later found good jobs in their fields. "When we lost Chris, Tessa and Emma asked about establishing an internship in Chris's memory,"

said his wife Julianne Bauer. “Given their wonderful experiences, their father’s pride in their accomplishments and in the lab, and his strong belief in the importance of applied education, It seemed the perfect way to honor him.”

Figure 6: Deputy Education Director Peggy Norris, 2013 science intern Conrad Farnsworth, and 2013 Davis-Bahcall Scholar Adrian DelGresso install cosmic ray detectors 4850 feet underground (Photo by 2013 Communications Intern Laura Howard)

Other internships include the Dave Bozied Internships open to students majoring in one of six areas: physics, chemistry, geology, engineering, science education or communication or related disciplines, and the 3M-sponsored Davis-Bahcall Scholar Program, which allows up to 12 students to participate in scientific research around the world. The Chris Bauer Internship will allow this program to expand to two additional students.

Community Lecture Series

On March 13, Ben Sayler will be the featured speaker at the PROMISE Community Lecture Series a free, monthly seminar hosted on the second Thursday of each month at the Sanford Center in Sioux Falls, South Dakota. Invited speakers are leaders in their respective fields of research representing academic institutions and industry in the South Dakota region.

ENVIRONMENT, HEALTH & SAFETY

Flu Prevention

- Take time to get a flu vaccine
- Practice good health habits. Get plenty of sleep and exercise, manage your stress, drink plenty of fluids, and eat healthy food.
- Cover your mouth and nose with a tissue when you cough or sneeze
- Wash your hands with soap and water or use alcohol-based hand sanitizers
- Avoid touching your eyes, nose and mouth
- Stay home from work or school when you become sick

UPCOMING CONFERENCES AND WORKSHOPS

Dark Matter 2014, UCLA’s 11th Symposium on Sources and Detection of Dark Matter and Dark Energy in the Universe, February 26-28, 2014. Northwest Auditorium, Covel Commons, UCLA.
https://hepconf.physics.ucla.edu/dm14/

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

Neutrino 2014, XXVI International Conference on Neutrino Physics and Astrophysics, Boston, MA, June 2-7, 2014.
http://neutrino2014.bu.edu/neutrino-2014/

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

JOBS

Chancellor’s Fellow in Experimental Nuclear Physics, University of Edinburgh, Scotland. Five-year position, research in Nuclear Physics group. Deadline: 2/7/14. Contact: Alex Murphy, a.s.murphy@ed.ac.uk
http://www2.ph.ed.ac.uk/nuclear/chancellor_pos/

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/ajo/jobs/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

Physics Postdoc, Los Alamos National Lab, New Mexico. Work with Weak Interactions team on MAJORANA double beta decay project. Contact: Steve Elliott, elliotts@lanl.gov. Job #: IRC31595.
http://www.lanl.gov/careers/career-options/jobs/index.php

Assistant Professor, Texas A&M University. Tenure-track position in experimental high energy physics or accelerator physics. Deadline: 1/31/14. facultysearch@physics.tamu.edu
http://inspirehep.net/record/1264576

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. Deadline: 1/15/14.
http://inspirehep.net/record/1260920
http://inspirehep.net/record/1260921

Assistant Professor, Dept. of Physics, Drexel University. Tenure-track faculty in experimental particle physics. Deadline: 2/1/14. Queries: Charles Lane. lane@duphy4.physics.drexel.edu
http://www.drexel.edu/physics/about/employment/

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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