Dear SURF Readers,

Welcome to the June 2013 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

June 24 – July 26: CETUP* Workshop – Lead, SD

June 25-26: LBNE site meetings - Lead and Rapid City (see Page 3 for more details)

July 13: Neutrino Day – Lead, SD

CUBED Low-Background Counting Facility

Dr. Dongming Mei (Physics Professor at the University of South Dakota) and other collaborators in the CUBED (**C**enter for **U**ltra-Low **B**ackground **E**xperiments in the Dakotas) collaboration have built a low-background counting (LBC) facility at the 4850 Level of the Davis Campus at SURF to screen experiment components and detector parts for activities produced by ^{232}Th and ^{238}U (and their progenies), ^{40}K and cosmic-ray induced isotopes. This facility, supported by NSF PHY-0758120, currently consists of a single commercial low-background high purity germanium (HPGe) detector with an optimal shield.

LBC began last year with collaboration from SURF Head of Operations and LBNL Senior Physicist Kevin Lesko and LBNL Physicist Yuen-Dat Chan. In addition, the team has been working with the AARM collaboration led by University of Minnesota Physics Professor Prisca Cushman to make the CUBED LBC part of a consortium network for low background counting.

The detector is deployed in an exceptionally well-shielded location at the 4850 Level to improve the sensitivity of the USD-1 detector (shown in Figure 2) by suppressing cosmic-ray backgrounds. The facility is located inside the Davis campus (near the LUX water tank) with a sufficiently clean environment for low-background counting, and is large enough to house four HPGe detectors with associated infrastructure. The space includes a class 10^5 cleanroom with ventilation, radon removal, power supply, and liquid-nitrogen supply.

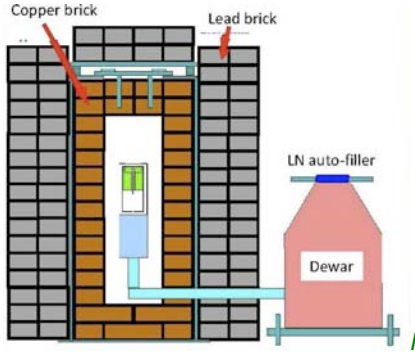


Figure 1: A diagram of the low-background γ-ray spectrometer. Each copper (orange) / lead (gray) brick has a dimension of 5x10x20 cm^3

Figure 2: Display of the USD-1 detector system without the lead shielding located inside the USD cleanroom

The USD-1 detector is a 1.2 kg *Ortec* n-type coaxial HPGe detector with a 254 cm^3 of active volume and a relative efficiency of 60%. It is mounted on a vertical cryostat, 30 cm directly on top of a nitrogen dewar with the crystal and its preamplifying electronics enclosed in a high-purity copper mount-cap. The whole structure is protected by a 95 mm diameter end-cap embedded in a window with a thickness of 0.8 mm. This end-cap is made from carbon fiber, a low z-material that allows for lower energy gamma-rays to penetrate. A detailed description of the U-type cryostat, which is made of ultra-low activity, oxygen-free copper, field-effect transistor (FET), and a pre-amplifier can be obtained from *Ortec*. The detector's liquid nitrogen (LN) dewar is attached to a LN auto-filler from *American Magnetics*, which is connected to a 180 liter LN

storage cylinder. The LN level in the detector dewar is frequently monitored by the auto-filler controller and this controller automatically fills the dewar when the LN level drops below 60%. The shield of the detector has been designed to provide a large sample capacity with ultra-low background and easy access to the germanium spectrometer itself. The sample chamber, with a dimension of 20×20×20 cm^3, is surrounded by a 10-cm thick, 99.9% pure oxygen-free high conductivity (OFHC) copper shield obtained from *Southern Copper* (shown in Figure 3). The contamination of ^{238}U and ^{232}Th in this material is less than 100 μBq/kg. The anticipated sensitivity for ^{232}Th and ^{238}U is about 0.1ppb.

Figure 3: Detector (upper left), copper shield (upper right), lid cover (lower left), and radon exclusion box (lower right)

The CUBED research center was created in 2009 as part of the State of South Dakota's research initiative to promote economic development within the state. Within CUBED, the LBC project has statewide participation involving the University of South Dakota (USD), Black Hills State University (BHSU), and SURF with USD serving as the lead institution and USD Physicist Jason Goon (a visiting Professor from Malaysia) as coordinator. Goon spent several weeks in May setting up the CUBED low-background counter with help from Sanford Lab Supervisor Dana Byram, a member of the CUBED collaboration when he was a grad student at USD (both shown in Figure 4). CUBED expects to accept samples in July 2013.

Figure 4: Jason Goon (left) and Dana Byram install the CUBED low-background counting device

LUX-ZEPLIN (LX) Meeting

On June 3-6, a LUX-ZEPLIN (LZ) collaboration meeting was held at Imperial College, London in the United Kingdom (shown in Figure 5). The LZ detector is a proposed successor to the LUX experiment that is now operating in the Davis Campus at SURF. The LZ experiment would contain up to about 9 tonnes of liquid xenon and would replace LUX in the large water tank located in the Sanford Lab Davis Cavern. All technical aspects of the LZ design were discussed at the London meeting. Members of LZ from the UK ably hosted the meeting, and everyone benefitted from unusually fine weather in London.

Figure 5: Members of the LZ collaboration in front of the Queen's Tower, Imperial College, London

ISOUPS 2013 meeting

The ISOUPS (International Symposium: Opportunities in Underground Physics for Snowmass) 2013 met at Asilomar, CA on May 24-27. UC Berkeley's INPAC (Institute for Nuclear and

Particle Astrophysics and Cosmology) was the major sponsor of the workshop, along with Argonne National Lab, Brookhaven National Lab, and additional support from the U.S. Department of Energy. The two main goals of the meeting were: (1) to provide a forum for physicists to exchange ideas on the scientific potential for a large underground particle detector at the Sanford Underground Research Facility as part of the U.S. scientific planning process (aka the "Snowmass Process"); and (2) to provide a venue for experimentalists from around the world to discuss how to form international collaborations to support large research projects such as the Long-Baseline Neutrino Experiment. Over 100 attendees came to the meeting, including official representatives from Japan, Europe, and major U.S. physics laboratories. The full agenda and posted talks have been posted at:
http://neutrino.physics.ucdavis.edu/indico/conferenceDisplay.py?confId=0

LBNE meetings

On June 25-26, two informational meetings will be held to discuss the future of the Long-Baseline Neutrino Experiment (LBNE). One proposed site is on the surface, in Kirk Canyon in Lead, while an alternate location would be underground at Sanford Lab. The sessions will include short presentations, posters, and Q&A sessions with representatives from the Department of Energy, Fermilab, and Sanford Lab. The first meeting on June 25 will take place (6:30-8:30 pm) at the Days Inn, Lead, and the second on June 26 (6:30-8:30 pm) will be held at Best Western Ramkota (Washington Room), Rapid City.

Environmental impact evaluations of both sites are underway, and a draft environmental assessment is expected to be released in early 2014. (More details to come in the July issue.)

Reports/Papers Available

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

Cornell University Library: *Why the US Needs a Deep Domestic Research Facility* (Kevin Lesko, April 1, arXiv: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

Smithsonian.com: Off the Road - How to Tour the World's Greatest Science Labs (Blog includes Sanford Lab - April 3)

ScienceDaily.com: Research Effort Deep Underground Could Sort out Cosmic-Scale Mysteries (May 24)

Science.com (Adrian Cho)*: Europe Opens Door to Global Approach on Megaprojects* (June 7) – Article on LBNE
Dark Matter Mystery Nears Its Moment of Truth (April 26)

Yahoo News (LiveScience.com): *Underground Experiment Asks Why We're Not Antimatter* (Clara Moskowitz, May 29)

LabManager.com: Research Effort Deep Underground Could Sort Out Cosmic-Scale Mysteries (Oak Ridge National Lab, May 28)'

Oak Ridge National Lab: Research effort deep underground could sort out cosmic-scale mysteries (May 23)

Tunnelling Journal: Sanford underground research facility selected for 20-year DIANA experiment (Amanda Foley, May 18)

Black Hills Knowledge Network: Sanford Lab Lands Third Experiment (Denise Ross, May 16)

Madville Times (South Dakota): *Homestake Sanford Lab Wins DIANA Project, Needs Federal Funding* (May 18)

Ktiv.com: SD lab selected for nuclear reaction experiment (Associated Press, May 21)

The Daily Republic: Sanford lab selected for nuclear reaction experiment (May 21)

KSOO: Sanford Lab in Lead Selected for Nuclear Reaction Experiment (Associated Press, May 21)

Keloland News: Sanford Underground Lab Selected For Experiment (Derek Olson, May 22)

Argus Leader.com: Public meetings planned on proposed lab near Lead (June 4)

Rapid City Journal: Flooding knocks out roads, closes Sanford Lab (Joe O'Sullivan, May 21)

Black Hills Pioneer: *Unicorns appear in Sanford Lab* (Wendy Pitlick, June 7)
Why the U.S. needs a deep domestic research facility (Kevin Lesko, June 4)
Sanford Lab officials outline LBNE plans (Wendy Pitlick, June 3)

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

Between May 17 and June 3, the Lead, South Dakota area received 14 inches of rain. The Sanford Lab Davis Campus on the 4850 Level experienced two closure periods--May 21-23 and June 3-6--due to heavy water inflow stemming from above-average rainfall. Frequent daily inspections by the SDSTA Hazard Mitigation Crew and other relevant SURF personnel continued throughout the period of the underground closures. Lab drainage systems continued to function normally, but ponding on the upper levels required that staff use caution in and around shafts. However, even if the deep pumps were turned off, it would take about a year to reach experiments on the 4850 Level.

Neutrino Day

Sanford Lab will host its Sixth Annual Neutrino Day on July 13. This is a free science festival, featuring a full day of science talks and hands-on activities, which will take place in downtown Lead. Some of the activities include an art show, a noon Science Café sponsored by *South Dakota Public Broadcasting (SDPB)* at Lead's Own Bumpin' Buffalo restaurant, science talks at the Historic Homestake Opera House, and science and engineering displays with activities for all ages at the Black Hills Mining Museum, the Hearst Library on Main Street in Lead, the Historic Homestake Opera House, the Lead Arts Council, and the Homestake Visitor Center. Steve Rokusek (shown in Figure 6), Education Specialist with SDPB, will present some kid-oriented science demonstrations.

Figure 6: Steve Rokusek of South Dakota Public Broadcasting assists young scientists during Neutrino Day 2012. Rokusek will return this year.

In addition, Emmy-nominated astronomer José Salgado of Chicago's Adler Planetarium will speak at the Historic Homestake Opera House. He is also an experimental photographer and filmmaker, who has photographed more than 30 scientific sites around the world, including Sanford Lab.

Visitors to Lead

The Homestake Visitor Center in Lead, South Dakota conducts visitor tours throughout the summer, including a surface tour of the Yates Complex, a stop at the Yates Hoist Room, and travel through the shops/yards area. The first tour of the season began Monday, May 13, and will end October 1.

EDUCATION AND OUTREACH

K-12 Outreach

During the last few weeks of school term, teachers and students visited Sanford Lab from elementary schools (Lead-Deadwood), middle schools (Belle Fourche, Sturgis) and high schools (Killdeer, ND).

Physics teacher Jeff West of Killdeer High School in North Dakota, a SDSMT graduate, brought nine physics students to Sanford Lab and SDSMT on May 10. Students participated in a videoconference to the 4850 Level, a Hoist Room tour, and other activities.

Belle Fourche Middle School brought four fifth-grade classes (85 students) over two mornings of May 13-14, to participate in the hoist engineering challenge and also tour the Hoist Room. Forty-nine Lead-Deadwood fifth-graders participated in hoist activities on May 23, after flooding of the Hoist Room and tunnel forced postponement of their scheduled visit earlier in the week.

Finally, Sturgis Middle School included Sanford Lab as one of their 'Discovery Day' activities on May 17. Students took part in activities related to magnets and motors and took a tour of the Hoist Room before spending the afternoon hiking the Mickelson Trail.

School members also participated in science activities off-site as part of the Lead Educational Field Trip (LEFT) program. These included New Underwood Elementary (Grades 2-3), Gillette Conestoga Elementary (Grade 4), Calvary Christian Academy (Grades 4-5), Valley View Elementary (Grade 4), and Gillette Middle School (Grade 6). In total, 231 students participated in activities ranging from magnets and motors to tiltmeters to seeing what is too small to see. Programs took place at the Historic Homestake Opera House or the Homestake Visitor Center.

Outreach to Educators

On June 10-14, 32 educators (shown in Figure 7) took part in a *Physics of Atomic Nuclei (PAN)* underground workshop at Sanford Laboratory. The educators--ranging from pre-service science teachers to experienced high school physics teachers--took part in lectures and hands-on activities exploring modern models of the atom, the nucleus and its components as well as the Standard Model. Educators learned about the MAJORANA DEMONSTRATOR (MJD) Project through discussions with Cabot-Ann Christofferson (SDSMT Chemistry Professor) and David Radford (ORNL Physics Division Researcher) from the 4850 Level, and about LUX through discussions with Richard Ott (UC Davis Postdoc) and Alastair Currie (Imperial College, London Researcher) on the surface (including a tour of the LUX experiment with help from LUX Operations Manager Mark Hanhardt underground, operating the camera). The educators developed lesson plans incorporating modern physics concepts into curriculum, and integrating content and best practices from the recently released *Next Generation Science Standards*.

Figure 7: South Dakota teachers at the Physics of Atomic Nuclei underground workshop held at Sanford Lab

Outreach to the General Public

SURF Director Ben Sayler and Science Education Specialist Julie Dahl, and Communications Director Bill Harlan, with help from intern Anna Hafele, took part in *It's All About Science*, a festival in Sioux Falls that attracted more than 5000 people. Approximately 800 adults and children visited the Sanford Lab booth, which featured an engineering construction activity for the children. An additional 200 people attended Bill Harlan's talk and videoconference to LUX underground.

Sanford Lab's Education and Communications Departments are partnering with the *Road Scholars* program during the 2013 tourist season, to provide educational programming for Black Hills tours taking place weekly during the summer. Up to 40 senior citizens from across the country are spending a half day in Lead, which will include a tour of the Historic Homestake Opera House, a talk on the history of the Homestake Mine and the story of its conversion to a science lab (provided by Sanford Lab) followed by a tour of the Hoist Room coordinated through the Homestake Visitors Center. At a recent talk, one of the participants from Syracuse, NY, brought a story about the Lab that he had clipped from his local paper.

ENVIRONMENT, HEALTH & SAFETY

Summer Bug Safety

- Don't use heavily-scented soaps or perfumes as it may attract insects such as wasps or bees.
- Try natural products that contain citronella, peppermint oil, or lemon eucalyptus as insect repellants, and wear protective clothing.
- Avoid infested areas such as stagnant water and tall fields of grass. Keep foods covered.

STAFF NEWS

Meet the Summer Interns

Sophia Elia will be pursuing an internship with the Science Department at SURF this summer. Sophia grew up in Rapid City and graduated from Stevens High School last spring. She and her family then moved to California where Sophia is pursuing a Bachelor's in Physics at the University of California, Berkeley. During high school, Sophia spent the summer after her junior year interning at Sanford Lab with Peggy Norris, SURF Education and Outreach Deputy Director. Sophia helped with various educational programs and worked with Sanford Lab's cosmic radiation detectors. She also helped with Neutrino Day, which she views as one of the most fun and rewarding experiences at SURF.

Last summer, Sophia had the privilege to take part in the Davis-Bahcall Scholarship Program with nine other science-oriented students from South Dakota. They spent two weeks at SURF learning a broad range of physics topics and attending in-depth lectures. This portion of the program culminated in a trip underground. They spent the next two weeks visiting different laboratories in the United States and Italy. One of the laboratories, Gran Sasso, was located in a part of Italy very close to where Sophia's family is from. She would like to take this opportunity to thank everyone who makes this astounding program possible, including *3M*, the *South Dakota Space Grant Consortium*, and of course all of the people the scholars interacted with along the way.

Sophia enjoyed her freshman year of college. She took courses in mathematics, physics, Italian, journalism, and psychology. Sophia worked as a photographer for Berkeley's student newspaper, was a chair of the service committee for the Women in Science and Engineering Program, and volunteered with the Challah for Hunger organization. During spring semester, Sophia joined professor Bob Jacobsen, graduate student Mia Ihm, and senior Alexandra Latshaw in their research for LUX. She learned the basics of data analysis and was thrilled to finally begin working on one of the experiments she had learned so much about.

This summer Sophia will be helping with all the experiments going on at Sanford Lab, but especially hopes to further her understanding of LUX. She will spend time both below- and aboveground. For Sophia, this internship offers a chance to explore her passion for science and return home to the beautiful Black Hills. Sophia has been hooked by the atmosphere of enthusiasm, discovery, and community at SURF, and she can't wait to be back for the summer.

Interns Brianna Schmidt, Brian Jones, and Laura Howard

Brian Jones is an Information Technology intern for the summer. He is majoring in English at Black Hills State University. Favorite quote: "Never confuse a single defeat with a final defeat." (F. Scott Fitzgerald)

Anna Hafele, the Education Department intern, is a biology major with physics interests at Black Hills State University. She works with BHSU Professor Andy Johnson on research into how students understand radiation. Hafele grew up in Newell, SD where her family raises cattle, sheep, and hay. Favorite quote: "Our imagination is stretched to the utmost, not, as in fiction, to imagine things which are not really there, but just to comprehend those things which are there." (Richard Feynman)

Laura Howard, Communications Department intern, is a junior in Photography and Graphic Design at Black Hills State University. She is originally from Utah, but moved to the Black Hills area with her husband, who works for the Black Hills National Forest. She enjoys drawing in charcoal and pencil. She will mainly work with SURF Multimedia Specialist Matt Kapust. Favorite quote: "Be yourself; everyone else is taken." (Oscar Wilde)

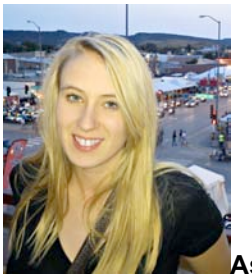
Bennett Prosser (right) snowmobiling with his dad, Dave

Bennett Prosser is from Sturgis, South Dakota, and will be a junior at South Dakota School of Mines and Technology in Rapid City in the fall. He is pursuing a double major in Mechanical and Electrical Engineering, with an anticipated graduation date of May 2016. His role at Sanford Lab is as a Surface Operations Engineer Intern, and he is working under the supervision of Dan Regan and Tim Baumgartner.

At school, Bennett is involved in a variety of different groups and activities which include playing horn in symphonic band, playing guitar in jazz band, and being the team lead for the school's Society of Automotive Engineers' electric snowmobile team. His hobbies and interests include snowmobiling, hunting, fishing, and anything to do with the outdoors. He currently lives at home in Sturgis with his parents, younger sister, and two golden retrievers.

Brianna Schmidt is an IT Department intern from Black Hills State University. She is majoring in elementary education. Favorite quote: "Be the change that you wish to see in the world." (Mahatma Gandhi)

Dakotah Simpson will work this summer with Environment, Healthy and Safety Manager Chuck Lichtenwalner. He will be a sophomore at South Dakota School of Mines and Technology this fall, where he is majoring in electrical engineering. Favorite quote: "If you're the smartest person in the room, you're in the wrong room."



Ashley Wingert is a SURF Science intern for Summer 2013 and she will be assisting with the MAJORANA DEMONSTRATOR (MJD) Project. Ashley was born in Madras, Oregon and grew up in Custer, South Dakota. She prefers it when the weather is sunny because it is perfect for hiking, swimming, and kayaking. She also loves to read in her free time, and one of her favorite novels is *To Kill A Mockingbird* by Harper Lee.

Ashley is currently enrolled at Black Hills State in Spearfish, SD. She is pursuing a major in chemistry with a minor in biology. Her expected graduation date is May 2014.

UPCOMING CONFERENCES AND WORKSHOPS

ARMA, 47th US Rock Mechanics/Geomechanics Symposium, Westin San Francisco Market Street, San Francisco, CA. June 23-26, 2013.
http://armasymposium.org/

CETUP* workshop, Lead/Deadwood Middle School, Lead, South Dakota. June 24-July 26, 2013. The CETUP* 2013 workshop will address questions in physics, astrophysics, geosciences, and geomicrobiology. Barbara.Szczerbinska@dsu.edu
http://www.dsu.edu/research/cetup/index.aspx

Community Summer Study 2013 (SNOWMASS on the Mississippi. Minneapolis, MN, July 29-August 6, 2013. Sessions on five particle physics frontiers: cosmic energy, facilities, instrumentation, and intensity.
http://www.snowmass2013.org

DPF 2013, APS Division of Particles and Fields Meeting, UCSC, Santa Cruz, CA. August 13-17, 2013.
http://www.aps.org/units/dpf/meetings/meeting.cfm?name=DPF13

EUROCK 2013, ISRM International Symposium, Congress Centre, Wroclaw University of Technology, Wroclaw, Poland. September 21-26, 2013. Rock Mechanics for resources, energy, and environment.
http://www.eurock2013.pwr.wroc.pl/index.php?id=0

JOBS

Reader/Senior Lecturer in Physics, University of Liverpool, U.K. Faculty of Science & Engineering, School of Physical Sciences. Deadline: 6/21/13. Prof. Christos Touramanis, c.touramanis@liv.ac.uk.
http://www.liv.ac.uk/working/job_vacancies/academic/a-583108/

Postdoc Fellowship, CEA Saclay, France. Research related to search for rare events with bolometric detectors. Experimental physics, LUMINEU project. Martin Loidl, martin.loidl@cea.fr.

Two Faculty positions, South Dakota School of Mines & Technology, Rapid City. Physics Dept. is establishing a new PhD program. Research in particle/astroparticle physics, nuclear physics, or nuclear astrophysics related to SURF experiments. Job # 0005390, 0005391. Review begins 5/10/13.
https://yourfuture.sdbor.edu/applicants/jsp/shared/frameset/Frameset.jsp?time=1359677906174

Postdoctoral Researcher, LLNL, Livermore. Research in Experimental Nuclear Physics (ENP) Group/Nuclear and High Energy Physics. Support of CUORE. Nicholas Scielzo (scielzo1@llnl.gov)
https://careers-prd.llnl.gov/psp/careers/EMPLOYEE/HRMS/c/HRS_HRAM.HRS_CE.GBL?Page=HRS_CE_JOB_DTL&Action=A&JobOpeningId=11017&SiteId=1&PostingSeq=1

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