

Dear SURF Readers,

Welcome to the April 2015 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

May 18-20: Conference on Underground Science at SURF - South Dakota School of Mines and Technology, Rapid City, SD

June 8-9: Berkeley Workshop on Dark Matter Detection – LBNL, Berkeley, CA – To register or for more details, see page 6

June 9-11: EHSOC meeting, Sanford Lab, Lead

June 17-19: LUX Collaboration meeting, Sanford Lab, Lead

CASPAR Milestones

The *Compact Accelerator System Performing Astrophysical Research* (CASPAR) project is a collaboration between the University of Notre Dame (UND), the South Dakota School of Mines and Technology (SDSMT), and the Colorado School of Mines. CASPAR will use a low power particle accelerator, which has already been used aboveground at UND for several years, at SURF's 4850 Level, Davis Campus (see Figures 1-2).

"This project could help complete our picture about the mechanisms that generate energies in stars and how the elements in our universe are built," said SDSMT Physics Professor Frank Strieder, Principal Investigator for the project. The accelerator will help researchers mimic nuclear fusion in stars.

"We need to have a better understanding of what happens in stars." That means going deep underground, Professor Strieder said, and Sanford Lab is the perfect place to conduct this research. "The infrastructure is in place and we escape cosmic radiation."

With ground support complete, construction crews are ready to begin installing the utilities needed to operate the experiment—electrical service, heating, and air conditioning.



Figure 1: With the ground supporting shotcrete in place, the CASPAR cavern on the 4850 Level is ready for outfitting

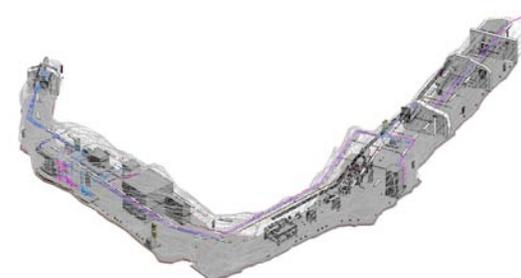


Figure 2: Three-dimensional drawing of the CASPAR experiment (Leo A. Daley Company)

Although experiments are located underground to escape cosmic radiation, there still remains some level of radioactivity, including from the rock and the materials used in construction. CASPAR is further protected from radiation with a unique design: walls at the entrance and exit to the experiment site are two feet thick, and the doors are lined with lead to mitigate any stray neutrons from traveling outside the site.

"We want CASPAR researchers to have the right space in which to operate their experiment," said Professor Strieder.

It is expected that the construction will be completed in August. In the meantime, members of the CASPAR team are preparing the equipment and renovating the accelerator at Notre Dame. When construction is complete, CASPAR researchers will begin moving into the cavern. Professor Strieder said the experiment will be operational by January 2016, and researchers hope to begin collecting data next year.

South Dakota Connection

Seventy-five years ago, Ernest Orlando Lawrence, a Physics Professor at UC Berkeley from 1928-1958 (Figure 3), received the Nobel Prize in Physics for his invention of the cyclotron, the world's first basic resonance particle accelerator. Lawrence grew up in Canton, South Dakota, where his father served as superintendent of schools. After graduating from high school, Lawrence attended college at St. Olaf's in Northfield, Minnesota but returned to his native state one year later to finish his bachelor's degree at the University of South Dakota in Vermillion. He then went on to receive a Ph.D. from Yale in 1925. Lawrence Berkeley National Laboratory (LBNL) and Lawrence Livermore National Laboratory (LLNL) are named for him, and both institutions are connected to the Large Underground Xenon (LUX) experiment now at SURF. Lawrence was the first at UC Berkeley and the first South Dakotan to become a Nobel Laureate.



Figure 3: Ernest Lawrence in front of the old Radiation Laboratory, UC Berkeley campus (c. 1930) (Courtesy of LBNL)

Reports/Papers Available

The Sanford Underground Research Facility at Homestake. (Jaret Heise, January 16, 2015, Cornell University Library, <http://arxiv.org/abs/1503.01112>.)

USGS: Surface and Subsurface Microgravity Data in the Vicinity of Sanford Underground Research Facility, Lead, South Dakota (J.R. Kennedy, K. Koth, R.L. Carruth, March 19)

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

Physics Today: [South Dakota begins to reap benefits of underground lab](#) (Toni Feder, April 2015)

Harper's Magazine: [The Quietest Place in the Universe](#) (Kent Meyers, April 20)

CERN Courier: [Long-distance neutrinos](#) (Ken Long and Rob Roser, April 9)

Symmetry: [The dawn of DUNE](#) (Jennifer Huber, Kathryn Jepsen, March 25)

Fermilab Today: [Welcome, DUNE](#) (Nigel Lockyer, March 31)

Quantum Diaries: [The dawn of DUNE](#) (link to *Symmetry*, March 25)

[Vote LUX, and give an underdog a chance](#) (Sally Shaw, March 25)

BHSU Communications: [Meyers writes cover story about Sanford Lab](#) (April 17)

[BHSU science student, inspired by heritage, receives Sanford Lab internship](#) (April 14)

[Sanford Lab inspires unique learning experiences for BHSU students](#) (March 6)

SDPB Radio: [BHSU Student Lands Internship at Sanford Lab Underground Research Facility in Lead](#) (Amy Varland, April 15)

Innovation: [Dr. Michael Cherry](#) (Cara Hetland, April 9)

Prairie Business Magazine: [TECHNOLOGY: The future of the Sanford Underground Research Facility](#) (Gov. Dennis Daugaard, March 27)

Rapid City Journal: [Lawmakers deserve our thanks](#) (Gov. Dennis Daugaard, March 23)

Newswise: [SD Mines to Host International 'Conference on Science at the Sanford Underground Research Facility'](#) (April 17)

Black Hills Pioneer: [Lead greenlights comprehensive park rehaul](#) (Adam Hurlburt, March 19)

DURA News

To comment on DURA, please contact its chair Richard Gaitskell (Richard.Gaitskell@brown.edu). For Bio-Geo-Engineering matters, contact Bill Roggenthen (William.Roggenthen@sdsmt.edu). For further information on DURA, see: <http://sanfordlab.org/dura>

SANFORD UNDERGROUND LABORATORY NEWS

MAJORANA Update

For several months, the MAJORANA DEMONSTRATOR (MJD) EXPERIMENT has been collecting data with a prototype. “This is a test bed for the actual experience,” said Steven Elliot, spokesperson for the MJD collaboration and physicist at Los Alamos National Laboratory. “We’ve vetted designs of certain components and debugged some of the electronics. By the time the new module is ready to go, we’ll be confident in its performance.” With most of the strings of germanium detectors complete, Elliott hopes the new module will be ready to begin collecting data by early summer.



Figure 4: MAJORANA researcher Matthew Green test fits a copper cryostat loaded with seven strings of germanium detectors

In its search for neutrinoless double-beta decay, MJD researchers use detectors made from enriched, specially engineered crystals of germanium with enhanced levels of the rare Ge-76 isotope. The crystals are tied together as “strings” in frames (Figure 4) or made of ultra-pure copper that is electroformed deep underground to avoid cosmic radiation contamination. To prepare the crystals for use in the detectors, the germanium is trimmed, and then undergoes a chemical processing that leaves a sludge containing enriched germanium previously unusable, said Elliott. Germanium being costly, MJD

researchers asked a team of chemists to develop a recycling plan. They expect to glean close to an additional five kilograms of enriched germanium detectors as a result of recycling.

Ross and Yates Shaft progress

On April 6, the Ross Shaft construction crew completed steel installation of Set 152B in the ongoing five-year project. They reached the 2548.7’ level in the Davis Campus underground, which is the halfway point.

The five-year project to replace steel supports in the 5000-foot Ross Shaft began in 2012 (see Figure 5). The shaft, constructed in the early 1930s, is supported by steel I-beam frames, or sets, every six feet. The new tubular steel is assembled in 18-foot sets.

In March, another milestone was reached in the Yates Shaft with Top Down Maintenance, as the project reached the 2750 Level within the skip compartment.

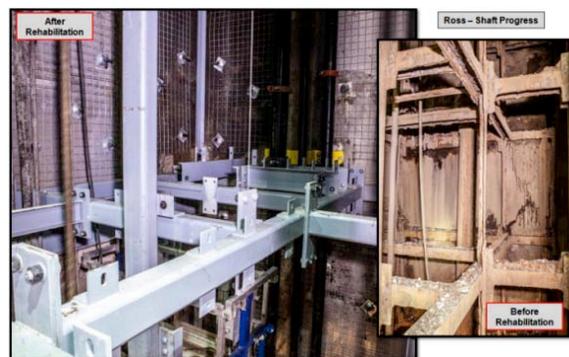


Figure 5: Ross Shaft – before and after steel removal

Safety Matters

To facilitate safety awareness and knowledge, members of the student mine rescue team at South Dakota School of Mines and Technology (SDSMT) participate in simulated rescues (see Figures 6-7). During their training, they work with certified professionals with decades of safety experience. This group includes members of the Sanford Lab Emergency Response Team as well as safety experts and industry leaders from other parts of the country such as staff from *Peabody Energy* (St. Louis) and *Essroc Italcementi Group* (Pennsylvania). Glenn Kellow, president and CEO of *Peabody*, is an expert in mine safety.

Sanford Lab has provided a primary learning environment for the student team from SDSMT. Woody Hover, SURF Emergency Response Team Lead and Safety Specialist, has worked with the students on a number of occasions. "For as short a time as the student team has been in existence, and for as young as they are, they are doing phenomenally well," said Hover.



Figure 6: Simulated rescue scenario, an important part of student training at SDSMT



Figure 7: SDSMT student mine rescue team

Hover, who has been active in mine rescue for 20 years, said that although the students have their own collection of face masks, breathing apparatus, gas meters, headlamps, safety-grade helmets, and other equipment, when they train at Sanford Lab, they use Sanford Lab gear.

Kathleen Tew, a senior majoring in mining engineering, had a chance to work with her father Terry, the safety manager for *Essroc Italcementi Group's* U.S. plants. As vice president of the student Mine Rescue team, she welcomed the opportunity. "It has made a huge impact for our training to have someone in the industry talk about their experiences and explain the roles each person has on the team and to give advice," she said. She hopes to someday design underground mines.

Ongoing rescue scenarios with experts like Hover, Kellow, and Tew give students valuable life-saving skills, and prepare them for emergency situations.

This is essential experience for those planning to work in the mining industry.



Info on Travel to Lead

The second section of Main Street in Lead will be under construction, and detours will be in place as of May 4, 2015. Please follow this link to see the map of Main Street and to locate the detours for traveling to and from Sanford Lab:

<http://www.highway85lead.com/traffic>

EDUCATION AND OUTREACH

Sinte Gleska University Outreach

In recent months, two partnerships in SURF's Education and Education Department have been evolving with Sinte Gleska University (SGU) located in Mission, South Dakota on the Rosebud Indian Reservation. SGU offers two- and four-year degrees in the Arts and Sciences, as well as two Master's programs, with an emphasis on the preservation and teaching of tribal culture, history, and language.

In 2013, Peggy Norris participated in a program with *QuarkNet* outreach staff at Fermilab to work with SGU faculty members and students to construct a cosmic ray detector for use in both university science classes and in outreach to local schools. This project hit a *speed bump* in 2014 when the two faculty members involved moved to other institutions. Contact has recently been re-established with new faculty members in the Chemistry and Environmental Science Departments. On March 31, Dr. Norris visited the campus and gave workshops for undergraduate classes in both disciplines. Four faculty members and 11 students participated. Discussions are ongoing for continued activities for the fall semester.

During her visit in Mission, Peggy also took the cosmic ray detector, along with a cloud chamber and Geiger counters, to the Todd County Middle School, where she spoke with six eighth-grade classes about cosmic rays, radiation, and the Sanford Underground Research Facility. Plans are ongoing for a data project with these students.

In mid-March, Bree Oatman, STEM Education Specialist at Black Hills State University (BHSU),

accompanied a group of students and faculty from SGU to California.

The group visited the Jet Propulsion Lab (JPL) at California Technology Institute (Caltech), the University of Southern California (USC) and the NASA Ames Research Facility (Figure 8). The trip was funded through a grant from NASA EPSCoR (Experimental Program to Stimulate Competitive Research).



Figure 8: Sinte Gleska University students Karen Moore and Dakota Young and their instructor Dana Gehring visit with Dr. Annie Rowe in the Microbiology Lab at the University of Southern California

“We wanted the students and teachers to meet some of the scientists who are involved in the underground experiments taking place at Sanford Lab and expose them to a variety of disciplines in science and engineering,” Oatman said. “They had a chance to meet people and get a better understanding of the research being done at Sanford Lab.”

Students toured JPL’s facilities, including clean rooms where scientists build experiments and test new technologies. They learned the history of JPL, which can be traced to the mid-1930s when a few Caltech students and amateur rocket enthusiasts started tinkering with rockets, and talked with scientists about space exploration.

EPSCoR focuses on establishing partnerships with government, higher education, and industry to improve and enhance research. The program also targets underserved populations through Capacity Building, which is designed to develop research in rural areas.

“A lot of tribal colleges have limited resources and equipment,” Oatman said. She applied for and received a Capacity Building Grant from NASA,

which will allow SGU to buy basic equipment to help faculty teach simple biotech activities in the classroom. “As we walked through USC’s laboratories, we were thinking about the Sinte Gleska environment and what it could become.”

The students, Oatman added, were thinking about their summer research projects. “They’re trying to figure out which topics they want to explore.” The Capacity Building Grant includes stipends for summer research, which can be done on the Rosebud Reservation where SGU is located.

The next step, Oatman said, is to find out exactly what SGU needs to upgrade its facilities. “There is great potential for future collaborations. It’s really what Capacity Building is all about.

Michael Cherry Presentation

Following a \$6 all-you-can-eat Chili Feed fundraiser for the Lead-Deadwood Community Fund, on the evening of April 16, Michael Cherry, the Roy P. Daniels Professor of Physics and Chair of the Physics and Astronomy Department at LSU, gave a public presentation, “Early Science at Homestake” at the Deadwood Gulch Convention Center. He spoke on his experiments and experiences at the Homestake Mine (now SURF). The event was sponsored by Sanford Lab and the Lead and Deadwood Chambers of Commerce.

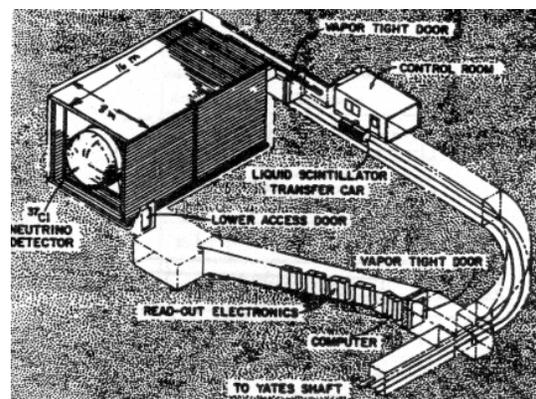


Figure 9: The Large Area Scintillation Detector (LASD) consisted of 200 one-foot square plastic pipes welded together and stacked around Davis’s tank. Each box contained ultra-pure mineral oil (about 6,000 gallons total) and had sensitive light detectors on each end. (Image courtesy of Dr. Davis Kieda, dissertation 1989)

While Research Assistant Professor at the University of Pennsylvania (1980-88), Cherry worked on

Physics Nobel Prize-winning Ray Davis's solar neutrino experiment at the 4850 Level of the Homestake Mine. His focus, however, was more on the study of cosmic rays using the Large Area Scintillation Detector (LASD) there (Figure 9). He has continued to actively pursue astrophysical research, now far aboveground, working on the CALET project (CALorimetric Electron Telescope) which will collect data from the International Space Station.

While in South Dakota, Dr. Cherry also took a tour of the Sanford Lab underground (which was much changed since the days when he conducted his research in the 1980s). He also participated in interviews for the Homestake Visitors Center video archive.

ENVIRONMENT, HEALTH & SAFETY



Water Conservation

- Check for leaks in pipes, hoses, or faucets
- Install water-saving shower heads and low-flow faucet aerators
- Take shorter showers
- Turn off the water after you wet your toothbrush
- Use your dishwasher and washing machine for full loads only
- When washing dishes by hand or cleaning food, don't leave the water running
- Plant drought-resistant lawns, shrubs and plants
- Don't run the hose while washing your car

Underground Lab Space Available

For use by Summer 2015 at the Waste Isolation Pilot Plant (WIPP). Formerly used by LANL researchers, space with four air-conditioned storage/office conexas (over 475 sq. ft. total) and one cleanroom (over 400 sq. ft.) is available (see insert photo). The cleanroom is plumbed for liquid nitrogen and has routinely operated as class 1000. Located in the northwestern part of WIPP, 667m below the surface, the cavity is mined in Halite.



More information about doing science at WIPP and radiologic characteristics is available at:

http://www.wipp.energy.gov/science/UG_Lab/UG_LabNew.html.

For inquiries, please contact Roger Nelson at the DOE Carlsbad Field Office (575-234-7213) (roger.nelson@wipp.ws).

UPCOMING CONFERENCES AND WORKSHOPS

Conference on Science at the Sanford Underground Research Facility (CUSSL), South Dakota School of Mines and Technology, Rapid City, May 18-20, 2015. Topics will include science carried out at Sanford Laboratory: Neutrino Physics, Proton Decay, Nuclear Astrophysics, Dark Matter, Neutrinoless Double Beta Decay, Materials Science for Nuclear and Particle Physics, Geology, and Biology.

<http://meetings.undergroundphysics.org/indico/conferenceDisplay.py?confId=0>

12th Conference on the Intersections of Particle and Nuclear Physics (CIPANP 2015), Vail Marriott Mountain Resort, Colorado, May 19-24, 2015. Focus on elementary particle physics, nuclear physics, astrophysics, particle astrophysics, nuclear astrophysics, and cosmology. Bonnie Fleming, cipanp2015_questions@yale.edu
<http://cipanp2015.yale.edu>

Neutrinos and Dark Matter in Nuclear Physics (NDM15), Jyväskylä, Finland, June 1-5, 2015. Gathering of scientists in fields of neutrino physics, astrophysics, and dark matter physics.

<https://www.jyu.fi/en/congress/ndm15>

Berkeley Workshop on Dark Matter Detection, LBNL, June 8-9, 2015. Sponsored by LBNL's Institute for Nuclear and Particle Astrophysics (INPA) and UC Berkeley's BEPP Center (Berkeley Experimental Particle Physics). Theme for the 2015 workshop will be Dark Matter detection beyond G2-new ideas and directions. For contributions for presentations on new ideas, please contact: Kevin Lesko KTLesko@lbl.gov, Kathryn Zurek,

KMZurek@lbl.gov, or Peter Sorensen
pfsorensen@lbl.gov

To register: Melissa Barclay, mbarclay@berkeley.edu
 Website:
<https://indico.physics.lbl.gov/indico/conferenceDisplay.py?confid=191>

Weak Interactions and Neutrinos Workshop (WIN2015), MPIK, Heidelberg, Germany, June 8-13, 2015. Examine crucial issues in neutrino physics and related fields.

<http://www.mpi-hd.mpg.de/WIN2015/>

Conferences for Undergraduate Women in Physics, Rapid City, South Dakota area, January 15-17, 2016. If you are associated with any of the physics experiments taking place at Sanford Lab or planned for the future, and wish to be involved in the planning process for the 2016 conference, please contact Peggy Norris at pnorris@sanfordlab.org.



JOBS

Postdoctoral position, Imperial College, London. Work with High Energy Physics Group on development of the next-generation LUX-ZEPLIN (LZ) dark matter experiment. Contact: H. Araujo, h.araujo@imperial.ac.uk. Deadline: 5/18/15.
<http://www.jobs.ac.uk/job/AKY328/research-assistant-associate-in-high-energy-physics/>

Postdoctoral position, University of British Columbia. Research in experimental dark matter with SuperCDMS experiment. Applications: Prof. Scott Oser, UBC Dept. of Physics & Astronomy, oser@phas.ub.ca. Deadline: 4/30/15.

Associate Professor, Kamioka Observatory, ICRR, University of Tokyo. Conduct research at Super-Kamiokande and other future projects. Deadline: 4/27/15. Queries: Prof. Masayuki Nakahata, nakahata@icrr.u-tokyo.ac.jp
 Applications: application@icrr.u-tokyo.ac.jp

Postdoctoral position, Texas A&M University. Work on SuperCDMS at SNOLab. Opportunities in detector development, cryogenic testing, data analysis, research project management. Position will remain open till filled. mahapatra@physics.tamu.edu
<https://physics.tamu.edu/about/openpositions.shtml>

Newsletter Editor: Melissa Barclay

Contributors: Kevin Lesko; Constance Walter (Sanford Lab news, CASPAR, NASA SGU trip); SDSMT Communications Manager Fran LaFort, excerpt from Winter 2015 *Hardrock Magazine* (Safety Matters); Ben Saylor, Peggy Norris, (E&O)

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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