

**Dear SURF Readers,**

Welcome to the January 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](http://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

**February 27-March 1: MJD Collaboration meeting – Lead, SD**

**March 11-13: LZ CD1 Review – Berkeley, CA**

**March 18-20: Low Radioactivity Techniques 2015 – University of Washington, Seattle**

**May 18-22: Conference on Underground Science at SURF - South Dakota School of Mines and Technology, Rapid City, SD**



## 2014: SURF in Review

*--A message from Mike Headley*

“2014 was another great year for SURF and for its current and future world-class science experiments,” said Mike Headley, Sanford Laboratory Director and SDSTA Executive Director. “I remain very excited and proud of the work we’re doing today and our future remains bright.”

Throughout 2014, Sanford Lab significantly raised the bar on safety. The implementation of new work-planning processes, widespread use of Job Hazard Analyses (JHAs), and increased management interaction in the field led to a 60 percent reduction in SDSTA recordable injuries compared to 2013. Science research and contractor work on-site had zero recordable injuries. SURF’s 2014 Safety Perception survey of staff and researchers saw a 10 percent improvement in Sanford Lab’s safety culture.

Current science activities advanced at a fast pace in the Davis Campus, 4850 Level. The MAJORANA DEMONSTRATOR (MJD) experiment continued assembling detector strings, production cryostat, and the shielding in preparation for science data collection in 2015. The Large Underground Xenon (LUX) experiment commenced its 300-day data collection run in October 2014.

Next-generation experiments made great strides as well. The LUX-ZEPLIN (LZ) Generation 2 dark matter experiment was selected by the Department of Energy (DOE) for future construction as a follow-on to LUX. The DOE review of LZ preliminary designs will take place in March in Berkeley.

Efforts to expand international participation and form a new collaboration for the Long-Baseline Neutrino Facility (LBNF) moved very quickly in 2014. LBNF is poised to have the new collaboration in place in early 2015; the first collaboration meeting occurred January 22-23 at Fermilab. Geotechnical studies on the 4850 Level—core drilling and sample testing—were also completed to support preliminary design work that kicked off in mid-January.

Facility space designs were completed for the Compact Accelerator System Performing Astrophysical Research (CASPAR) experiment and the Black Hills Underground Campus (BHUC). SDSTA crews completed the installation of ground support including rock bolts and mesh in 2014. In early 2015, a facility-outfitting contractor will transform these spaces into operational laboratories. These experiments are expected to be installed by mid-year.



*Figure 1: SURF underground: a “snow shed” on the 2000 Level Ross station was removed to promote safety*



*Figure 2: Installation of new ground support greatly improved safe access to SURF's underground 2000 Level*

Improvements to underground access remained a major focus. The Yates Shaft team continued to make strong progress with their “top down” maintenance efforts while supporting science and facility operations. The Yates team advanced maintenance efforts to the 2600 level in the skip compartment and down 1500 feet in the cage compartment. In 2014, Ross Shaft crews refurbished 820 feet of shaft, including the installation of 49 new steel sets, and are now below the 2000 level—40 percent of the entire shaft length (shown in Figures 1-2).

Finally, construction started in July on the new Sanford Lab Homestake Visitor Center. This 8000-square-foot facility with its high-quality exhibits will provide an excellent venue to tell the story of Lead’s rich history and the science at Sanford Lab. Opening is planned for June 2015.

**Search for Gravity Waves – Part II**

The Deep Underground Gravitational Laboratory (DUGL) is one of the experiments underway with the aim to test and prove Einstein’s Theory of Relativity. Vuk Mandic, Professor of Physics at the University of Minnesota, is the Principal Investigator for DUGL.

The experiment will deploy 25 state-of-the-art seismic instruments from the IRIS (Incorporated Research Institutions for Seismology) PASSCAL program, which is a major facilities program of the National Science Foundation. Four instruments will be located at SURF’s Davis Campus 4850 Level, four at the 4100-foot level, two at 2000 feet, four at 1700 feet, and one each at the 300 and 800-foot levels (16 total underground). Figure 3 shows one of the first of three underground stations installed in mid-November 2014. Nine surface stations are planned. Figure 4 (left) shows a photo of installation

of a typical surface instrument. Five of the full 25 instruments are currently operating (three in the underground and two at the surface). The remainder will be installed starting in January when the equipment arrives from IRIS. The data from the array are being recorded in real-time time by a data logging computer at the Sanford Lab administration building. Underground stations are using fiber optics connections for data communications and to transmit timing signals to individual data loggers. Surface sites use a GPS system for timing and six of the nine sites will use spread spectrum radios for data communication to the central recording site. The master radio for the surface sites has been installed on the Yates administration building (Figure 4, right), but the surface communication system is not currently functional due to interference from wireless networking equipment.



*Figure 3: Tanner Prestegard installing DUGL seismic instrument at 4850 Level. The seismometer is the green object viewed through the insulation box in which it was ultimately housed. Part of the data logger is shown at the back under the orange cables.*



*Figure 4: Left: Tom Regan assisting with installation of solar panel for surface seismic array station near Yates administration building; Right: Installation of wireless radio telemetry antenna for surface seismic stations at the Yates administration building*

The full underground array is planned for complete operation by the end of February. The surface array

schedule will depend upon South Dakota winter weather, so some instruments are unlikely to be installed before early spring. The array is expected to operate through December of 2016.

## 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](http://www.sanfordlab.org)

Like SURF on Facebook:

<http://www.facebook.com/SURFatHomestake>



## SURF IN THE NEWS

*National Geographic:* [A First Glimpse of the Hidden Cosmos](#) (Timothy Ferris, January 2)

*Phys.org:* [Is an understanding of dark matter around the corner? Experimentalists unsure](#) (Kavli Foundation, December 13)

*Today at Berkeley Lab:* [Berkeley Lab's 2014 Highlights](#) (January 1: Next-Generation Dark Matter Experiments Get the Green Light, July 15)

*Space.com:* [Will We Ever Find Dark Matter?](#) (Kelen Tuttle, December 11)

*Washington University in St. Louis:* [Hunting for dark matter in a gold mine](#) (Diana Lutz, December 8)

*R&D Magazine:* [Hunting for dark matter in a gold mine](#) (Staff, December 9)

*Rapid City Journal:* [Lawmakers applaud federal spending bill 'riders'](#) (Seth Tupper, December 27)

[Policymaking goes for ride with spending bill](#) (Seth Tupper, December 23)

[Science Authority updated on major projects](#) (Tom Griffith, December 20)

[Lawmakers say federal spending bill benefits SD](#) (Associated Press, December 10)

*Black Hills Pioneer:* [Sanford Lab visitor's center set for May 1 completion](#) (Adam Hurlburt, January 24)

[Computer Science 101 coming to Lead-Deadwood High School?](#) (Jaci Conrad Pearson, January 10)

[New shield design improves CUBED detector](#) (Staff, January 10)

[Water leak discovered in Lead on lab property](#) (Adam Hurlburt, December 30)

## DURA News

To comment on DURA, please contact its chair Richard Gaitskell ([Richard.Gaitskell@brown.edu](mailto:Richard.Gaitskell@brown.edu)).

For Bio-Geo-Engineering matters, contact Bill Roggenthen ([William.Roggenthen@sdsmt.edu](mailto:William.Roggenthen@sdsmt.edu)).

For further information on DURA, see:

<http://sanfordlab.org/dura>

## SANFORD UNDERGROUND LABORATORY NEWS

### New Labs at SURF in 2015

In 2015, SURF expects to house new science projects in the Davis Campus, 4850 Level space (see Figures 5-7).

To that end, SURF Project Engineer Bryce Pietzyk and the Hazard Mitigation crew have been busy outfitting the caverns that will house CASPAR (Compact Accelerator System Performing Astrophysical Research) and the Black Hills State University Underground Campus (BHUC). (More detailed reports on CASPAR and BHUC appeared in the October 2014 SURF monthly newsletter.) They have installed rock bolts and mesh in both caverns, and recently began applying a three-inch layer of shotcrete. "Shotcrete helps keep small rocks from falling and protects the ground support from corrosion," Pietzyk said. "It also makes the area safer for scientists and helps with cleanliness issues."



*Figure 5: This cavern will house the CASPAR experiment. The left side has had shotcrete applied and will soon cover the ribs on the right.*



Figure 6: Rock bolting in the Black Hills Underground Campus has been completed



Figure 7: Wayne Sartorius, W-D Masonry sprays shotcrete on the wall

So far, more than 3,000 rock bolts and 550 sheets of welded mesh have been installed. In the CASPAR cavern alone, 360 bags of shotcrete, weighing 1500 pounds each, have been applied. By the time the underground campus is completed, shotcrete will cover approximately 19,000 square feet. The shotcrete is mixed underground in a batch plant near the Ross Shaft. Once mixed, it is blown onto the ribs (walls) and back (ceiling) of the caverns using a concrete pump and nozzle. Only 70 percent of the shotcrete adheres; the remainder, called rebound, hits the ground and is removed as waste. “We spend about three hours of every shift cleaning that up so it doesn’t adhere to the floors,” Pietzyk said.

The crew of nine, which includes employees from Sanford Lab, *Ainsworth-Benning Construction*, and *W-D Masonry*, face unique challenges, Pietzyk said. First, there is the safety of the people applying the shotcrete. Crew members wear respirators while working and a mist system helps keep dust down. There is also the Temporary Clean Room or TCR, where MAJORANA electroforms copper, which requires stringent levels of cleanliness.

“We consciously designed the ventilation system to keep dust away from the TCR,” Pietzyk said. “When you have construction so close to a clean space you have to find a balance. I think the team is doing that

really well.” Pietzyk also gave credit to the Yates crew and the procurement office for their help in delivering and tracking supplies, and the safety team for its efforts to ensure the safety of the construction crew.

## Safety in 2014

The year-end December 2014 safety performance report (shown in Figure 8) shows SURF’s strong improvement over the past two years. SURF set a goal at the beginning of 2014 to reduce recordable injuries to no more than six, and succeeded with a 60 percent reduction in injuries compared to 2013. Also, SURF had zero researcher and contractor injuries again in 2014. For 2015, SURF has set a goal of no more than three recordable injuries.

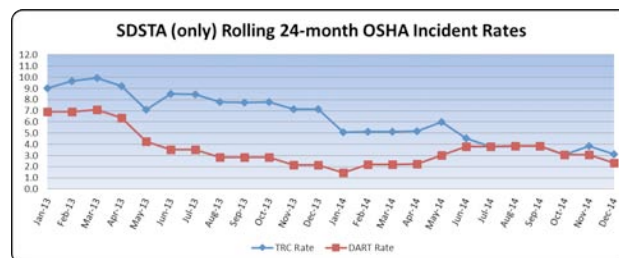


Figure 8: **TRC** = Total Recordable Case - more than first aid treatment was given.

**DART** = Days Away Restricted Transferred - more than first aid treatment was given AND restrictions were job limiting or the employee could not work.



## Info on Travel to Lead

Construction on Deadwood’s Highway 85 began in November with an anticipated completion date of September 2016. Expect closures and delays throughout this time period. You are encouraged to take the Central City route to and from Sanford Lab instead of Highway 85.

## EDUCATION AND OUTREACH

### Conferences for Undergraduate Women in Physics

What do you get when 140 undergraduate women get together for a weekend to talk physics? Lots of energy and excitement! Over Martin Luther King, Jr. weekend, approximately 1200 undergraduate women, mostly physics majors, converged on eight

campuses across the country for the 10<sup>th</sup> annual Conference for Undergraduate Women in Physics. They were joined by several hundred graduate students, postdoctoral fellows, and professional women in physics for plenary talks, workshops, panel discussions, and graduate school and career fairs.

The three-day conferences are organized by the American Physical Society with funding from the National Science Foundation and the Department of Energy, with the goal to help undergraduate women continue in physics by providing them with the opportunity to experience a professional conference, information about graduate school and professions in physics, and access to other women in physics of all ages with whom they can share experiences, advice, and ideas. The conferences have grown from one site in 2004 to eight this year and nine for 2016.

One of the sites chosen for the 2016 conference is the Black Hills of South Dakota. The South Dakota conference will be organized by a committee led by Dr. Brianna Mount (BHSU), Dr. Peggy Norris (SURF) and undergraduate Kristin Rath (BHSU). Friday and Saturday activities will be held at BHSU, and Sunday at Sanford Lab. Other members of the committee are students and faculty drawn from universities across the state.

This year, a group of BHSU students drove two days with Brianna Mount to attend the conference at Purdue University, the closest site to South Dakota. In addition, Peggy Norris attended the conference at Rutgers University, and represented Sanford Lab at their career fair, while two SDSMT students attended the conference at University of Texas Brownsville. All of these observations and experiences will be used to plan the best possible conference for next year. 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 next year's conference, please contact Peggy Norris at [pnorris@sanfordlab.org](mailto:pnorris@sanfordlab.org). The dates for the conference are January 15-17, 2016.

### STEM Research Course – Fall 2014 class

The Lead-Deadwood High School STEM Research Course is a partnership between the Lead-Deadwood School District and Sanford Underground Research Facility education staff. Science Teacher

Robin Dirksen and Sanford Lab Science Education Specialist Julie Dahl have taken the lead on this collaboration, which is now entering its third semester offering. Professors and scientists from Black Hills State University, South Dakota School of Mines & Technology and Sanford Lab work with the students. Dahl and Reynolds hope that this class will serve as a model for other school districts in South Dakota and elsewhere.



*Figure 9: Left to right: Robin Dirksen (Instructor), Clacy Percy, Julie Dahl (Co-instructor), Courtney Gould, Cobi Stokes, Danielle Brown, Angeliene Wisdom*

During this class, the Lead-Deadwood High School students (shown in Figure 9) gain valuable scientific experience by working closely with experts from Sanford Lab and other educational institutions in the region to conduct original research. In the fall, Clacy Percy who is being mentored by Bree Reynolds, a STEM Education Specialist with Sanford Lab's Education and Outreach Department (E&O), began collecting plants at the former Gilt Edge Mine, a federal Superfund cleanup site, in partnership with STEM and her high school course. Students start with a question, then do all the background research, design their project, conduct tests, and analyze and present their findings.

On December 18, students gave final presentations on their work in a session held at Sanford Lab. Mentors, school administrators and Sanford Lab staff attended. The presentations given are shown in the table on Page 6.

Dirksen is in her third semester of teaching the class. "What they learn is so powerful," she said. "The partnership with Sanford Lab creates unique experiences in science, but it also connects them to their heritage because many have grandparents or parents who worked at Homestake. It really helps them understand this transition to science."

<b>Student</b>	<b>Presentation Title</b>	<b>Mentor</b>
Cobi Stokes, Senior	Designing a Temperature-Controlled Heating Jacket for a CRDS* System	Brianna Mount (BHSU)
Danielle Brown, Senior	Bacterial Diversity of Whitewater Creek pre- and post-SURF water treatment	David Bergmann (BHSU)
Angeliese Wisdom, Sophomore	The Chemistry behind Coca-Cola and Dawn Dish Soap	Mike Zehfus (BHSU)
Clacy Percy, Senior	Investigating Plant Uptake of Metals due to the Mining Contamination in the Gilt Edge Mine	Bree Reynolds (E&O)
Courtney Gould, Senior	Toxicology of Tansy	Jim Whitlock (E&O)

- Cavity Ring Down Spectroscopy

### Summer Internships

Applications are being accepted for Dave Bozied and Chris Bauer Engineering Internships. Contact: Peggy Norris, SURF Deputy Director for Education and Outreach, [PNorris@sanfordlab.org](mailto:PNorris@sanfordlab.org), (605-722-5049). Deadline: January 31, 2015.

### ENVIRONMENT, HEALTH & SAFETY



#### Flu Season Safety

- Protect your immune system by eating healthy food and getting enough sleep
- Get a flu shot
- Try to avoid contact with sick people
- If you feel flu-like symptoms, stay home
- Wash your hands often with soap and water or hand sanitizer
- Cover your nose and mouth with a tissue when you cough or sneeze
- Take flu antiviral drugs if you do get the flu

### UPCOMING CONFERENCES AND WORKSHOPS

**2015 Physics Teacher Education Conference.** February 6-8, 2015, Seattle.

<http://www.aps.org/meetings/meeting.cfm?name=PTEC15>

**8<sup>th</sup> CERN Latin-American School of High Energy Physics,** Ecuador, March 4-7, 2015. Targeted particularly for students in experimental HEP who are in the final years of work toward their PhD.

<http://physicschool.web.cern.ch/PhysicSchool/CLASHEP/CLASHEP2015/default.html>

**Seventh International Conference on Quarks and Nuclear Physics,** Chile, March 2-6, 2015. Topics will include quarks and gluons content of nucleons and nuclei, hadron spectroscopy, effective field theories, nuclear matter under extreme conditions.

<http://indico.cern.ch/event/304663/>

**LRT Workshop V (Low Radioactivity Techniques)**

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>

**Conference on Science at the Sanford Underground Research Facility,** South Dakota School of Mines and Technology, Rapid City, May 18-22, 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>



#### JOBS

**Postdoctoral position, LLNL.** Work on the WATCHMAN experiment, a low energy neutrino project-reactor, supernova neutrinos, and nuclear non-proliferation in the Nuclear and Chemical Sciences Division. Job ID: 12836.

[https://careers-prd.llnl.gov/psp/careers/EMPLOYEE/HRMS/c/HRS\\_HRA\\_M.HRS\\_CE.GBL?Page=HRS\\_CE\\_JOB\\_DTL&Action=A&JobOpeningId=12836&SiteId=1&PostingSeq=1](https://careers-prd.llnl.gov/psp/careers/EMPLOYEE/HRMS/c/HRS_HRA_M.HRS_CE.GBL?Page=HRS_CE_JOB_DTL&Action=A&JobOpeningId=12836&SiteId=1&PostingSeq=1)

**Faculty positions, Queen's University.** Canada Research Chair in Theoretical Particle Astrophysics,

and Assistant Professor in Experimental Particle Astrophysics. Deadline: 2/15/15.

<http://www.queensu.ca/physics/canada-research-chair-theoretical-particle-astrophysics>

<http://www.queensu.ca/physics/tenure-track-position-experimental-particle-astrophysics>

**Postdoctoral Research Associate, Stony Brook University.** Openings in Nucleon decay and Neutrino group. Contact: Chang Kee Jung, [chang.jung@stonybrook.edu](mailto:chang.jung@stonybrook.edu), Clark McGrew, [clark.mcgrew@stonybrook.edu](mailto:clark.mcgrew@stonybrook.edu). Deadline: 1/15/15. Send CV, research statement, 3 letters of reference: Charise Kelly, [cckelly@sbhep.physics.sunysb.edu](mailto:cckelly@sbhep.physics.sunysb.edu)

**Tenure-track faculty positions, South Dakota School of Mines and Technology.** Undergraduate/graduate teaching and research in geophysics. Contact: Larry Stetler, [larry.stetler@sdsmt.edu](mailto:larry.stetler@sdsmt.edu)  
<http://www.sdsmt.edu/employment>

**Postdoctoral Researcher, SDSMT.** Work in Experimental Underground Physics as part of the Cryogenic Dark Matter Search (SuperCDMS), AARM, and LZ collaborations. Richard Schnee, [Richard.Schnee@sdsmt.edu](mailto:Richard.Schnee@sdsmt.edu)  
<https://inspirehep.net/record/1315388>

**Postdoctoral positions, University of Washington.** Work in Experimental Particle-Astrophysics with the ADMX experiment. Leslie Rosenberg, [ljrosenberg@phys.washington.edu](mailto:ljrosenberg@phys.washington.edu)  
<https://sharepoint.washington.edu/phys/admin/Pages/View-Position.aspx?pid=41>

**Postdoctoral Associate, Yale.** Research in short and long baseline oscillation experiments underway at Fermilab including MicroBooNE, LAr1-ND, LArIAT, and LBNE. Deadline: 1/28/15. Bonnie Fleming, [bonnie.fleming@yale.edu](mailto:bonnie.fleming@yale.edu)  
<https://academicjobsonline.org/ajo/jobs/4664>

**Postdoctoral position, Texas A&M University.** Work on SuperCDMS at SNOLab. Opportunities in detector development, cryogenic testing, data analysis, and research project management. [mahapatra@physics.tamu.edu](mailto: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](mailto:mszydagis@albany.edu)

<http://albany.interviewexchange.com/jobofferdetails.jsp;jsessionid=C639453CC99065905F7F634461A5BAAB?JOBID=51419>

**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](mailto:jfw@physics.unc.edu)  
<https://unc.peopleadmin.com/postings/31072>

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