

Dear SURF Readers,

Welcome to the October 2014 Sanford Underground Research Facility (SURF) monthly newsletter. The newsletter is posted online; a pdf copy is available as well. You can read recent and archived newsletters at our website -- www.sanfordlab.org. We are glad to receive your input on news, links to news articles, upcoming workshops, conference notices, scientific updates, information concerning SURF, employment opportunities, and other highlights relevant to underground science.

Important Dates

November 4-6: EHSOC review - Lead, SD

January 27-29: LZ CD1 review – Berkeley, CA

BHSU Underground Campus

The BHSU Underground Campus (BHUC) will be a research facility located at the Ross Campus of the 4850 Level at SURF. Available to the national and international scientific community as a facility in which to house research projects, space at the facility will be delegated according to the funding and sustainability of the requesting project, its benefits to student research, and its impact to the science community at large.

The enclosed clean room structure will be portioned into a class 10,000 clean room and a class 1,000 clean room (see Figures 1-2). The class 10,000 area will initially be used for sample preparation and microscope use for biology and geology research. The class 1,000 clean room will house several low background counting stations and possibly a microscope station for biology use.

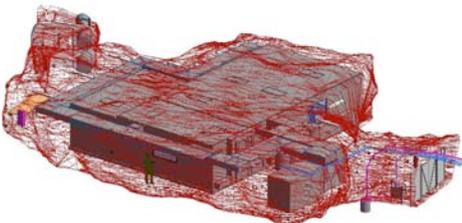


Figure 1: BHUC when complete. The red outline represents the walls of the cavern. The large grey structure will be the clean room, the outside open area laboratory, and staging area.

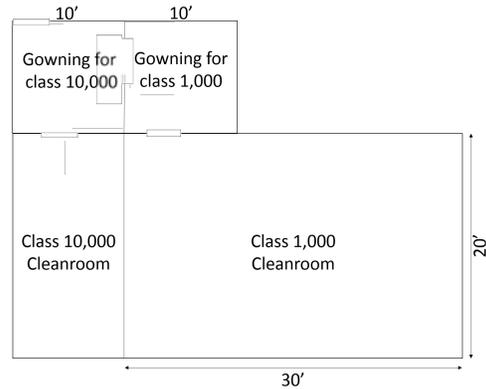


Figure 2: Schematic of the clean rooms in the BHUC

The open-air laboratory and staging area of the campus will be chiefly used by those who wish to collect samples in remote areas of the lab (mainly for biology and geology), conduct initial analysis that does not require a clean room, and as a meeting and preparation space for forays into the underground.

The BHUC will help satisfy critical underground physics community needs to screen and select materials for fabricating detector components by providing the infrastructure to house sensitive counting stations for assaying the radioactive content of materials. Three counting stations will be moved to the BHUC immediately. The Center for Ultra-low Background Experiments in the Dakotas (CUBED) collaboration currently operates a counting station underground that will be moved into the BHUC upon its completion. Similarly, two detectors operated by LBNL will also be moved immediately into the BHUC. The possibility exists to house up to 5 other counters in this space.

Life-science research proposed for the BHUC will focus on the identification and characterization of novel organisms living deep underground. The emphasis will be on discovery of genes that have applied applications in industry or medicine. Chemistry, geology, and environmental science research will include the analysis of groundwater chemistry and collection and analysis of rock samples throughout the mine.

The BHUC will be ready for occupancy in the summer of 2015.

CASPAR: Compact Accelerator System for Performing Accelerator Research

Researchers from University of Notre Dame (UND), South Dakota School of Mines and Technology (SDSMT), and Colorado School of Mines will soon collaborate on underground research, with CASPAR's low power accelerator allowing scientists to validate background radiation simulations. The expected energy range will be about 100keV – 1 MeV. Beam production will be in the range of 100 – 150 µA protons and alphas.

The SDSTA Board reviewed the CASPAR design and preliminary budget in early December 2014, approving funding for initial design and rehabilitation efforts. A collaboration of *Dean Kurtz Construction* in Rapid City, SD and *Leo A Daly* in Minneapolis, MN was selected for this scope of the project. The 100% deliverables for design, cost, and schedule were provided in late July. Some small changes were still necessary following this submittal, and the month of August 2014 was spent addressing these comments and working toward a firm construction proposal. This proposal was presented to the SDSTA board in September and approved. A contract modification will be finalized in early October to support the construction of the facility, to be located at the 4850 Level, Davis Campus at SURF (see Figure 3).



Figure 3: Former shop near the Ross Shaft, 4850 Level Davis Campus at SURF will soon become home to CASPAR

The rehabilitation of the space for CASPAR, including ground support and shotcrete, is being performed by the SDSTA hazard mitigation crew (see Figure 4). Rehabilitation of the CASPAR space was essentially completed in August, with focus shifting to the drifts between CASPAR and the BHSU Underground Campus in September.



Figure 4: Hazard mitigation crew member Mike Oates runs a bolter machine in the cavern that will become home to the CASPAR experiment

Further evaluation of the impact of adding shotcrete to the BHSU Underground Campus identified a significant conflict between outfitting the CASPAR space while shotcreting the BHSU Underground Campus. This conflict has resulted in a delay of outfitting the CASPAR project until both this space and the BHSU space can be finished in January 2015.

During the construction period, Assistant Professor Manoel Couder and Professor Daniel Robertson (both from UND) have been preparing equipment for CASPAR, including renovating the accelerator, which has already been in use aboveground for 10 years at UND. With installation of CASPAR by January 2015, the goal is to begin the first experiment sometime in the summer of 2015.

A safety review was conducted September 25-26, 2014 to validate that the design recognizes and controls the hazards associated with the experiment. This review focused on both the infrastructure being provided by the SDSTA and the experiment itself. The official results of this review will be provided later in October, but initial results were positive, and in fact cautioned against being overly conservative in some aspects.

**LYBE
LBNE SURF Berkeley Low Background Counting Facility: Part I**

In early 2014, the remote counting station of the Berkeley Low Background Facility (BLBF) was shut down for relocation from its home of 25-plus years in the powerhouse of the Oroville Dam in Oroville, CA to the Sanford Underground Research Facility (SURF) in Lead, South Dakota. The process took approximately 6 months, and as of July 2014, the BLBF staff began screening their first samples in the detector's new location underground.



Figure 5: BLBF equipment ready for shipment. (In rear, a viewing window in the wall reveals the bedrock in the cavern of the Hyatt Power Plant in Oroville.)

Overall, the relocation went very smoothly--though it was not trivial. Not only was the low background counting station moved, remnants of the former UCSB/LBL double beta decay experiment were also decommissioned (see Figure 5). The site has been returned to the Oroville Division of the California Department of Water Resources (DWR). The experiment and counting station were situated atop a mezzanine in the main bay of the hydroelectric power plant, which is nearly 600 feet underground in a bedrock cavern adjacent to the earth-fill dam. The counting site's neighbors consisted of six enormous hydro-generators (which fortunately never produced any electronic noise issues). There were many logistical challenges to removing nearly 20 tons of lead and numerous pieces of infrastructure including electronics, racks, storage, etc. from the power plant. Several planning trips were made to coordinate with DWR personnel regarding the challenges of removing items in a safe and timely manner. Following the shutdown of the counting operation, numerous items were retrieved back to LBNL, including a diverse library of samples from past projects.



Figure 6: The detector's arrival on-site, with Keenan Thomas

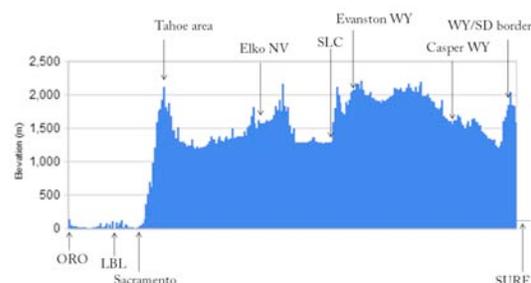


Figure 7: The elevation profile (and relative muon flux) experienced by the detector on its way to SURF

The current ORTEC HPGe detector used by the BLBF was removed from underground in late February 2014. In March, Keenan Thomas personally drove the detector and other delicate items to South Dakota over the course of one week to reduce cosmogenic activation in a detector that had been underground for over 10 years (see Figures 6-7). In terms of cosmic-ray muons, the main backgrounds the detector has been avoiding underground, it experienced a very “noisy” week while traveling from its relative solitude of 600 feet underground, to passing through elevations in excess of 7,000 feet (muon flux increases with elevation), followed by a sharp drop 4850 feet underground (an elevation similar to what it had started at), the detector is currently situated in a location with greater protection from muons with an overall overburden of 4300 m.w.e. The remaining equipment was shipped in late March to SURF, and other components not needed at SURF were returned to LBNL.

After a brief hiatus in April for some equipment upgrades, machining, and finishing touches for installation, the detector was installed and turned on for the first time again in May 2014 to begin taking background data. The detector and equipment safely survived the trip: no technical issues were encountered during installation. All detector support systems have proven to be reliable, including remote communications, liquid nitrogen autofilling/monitoring, and other electronics. After a few weeks of background testing and planning, the BLBF was given full “authorization to proceed” (ATP) in early July 2014 to begin sample counting operation. *(To be continued)*



DBD2014 and APS DNP Workshop

On October 5-7, the International Workshop on Double Beta Decay and Underground Science was held at Waikoloa Village in Hawaii. The event included three days of presentations and discussion on current and future directions in the study of double beta decay and other related topics in neutrino physics. The presentations can be found at: <http://dbd14.phys.sci.osaka-u.ac.jp>



Figure 8:

Susanne Mertens of LBNL speaks on "The Present and Future of the KATRIN experiment"



Figure 9: Group photo at DBD2014 meeting

The 4th Joint Meeting of the APS Division of Nuclear Physics and the Physical Society of Japan followed; it concluded on October 11. This event, held every five years, is designed to foster cooperation, collaboration, and exchange of ideas among nuclear scientists from Japan, the U.S., and other Pacific Rim countries.

Reports/Papers Available

[P5 report \(Print quality\)](#) The full Particle Physics Project Prioritization Panel report as accepted by the High Energy Physics Advisory Committee

For news, *twitter* updates, and other features see the SURF website: www.sanfordlab.org

Like SURF on Facebook:

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



SURF IN THE NEWS

Phys.org: [Detecting the flavors of neutrinos](#) (Brian Koberlein, October 7)

[How do neutrinos with "fuzzy" quantum mass solve the solar neutrino problem?](#) (Brian Koberlein, October 6)

Physics World: [Reducing cosmic rays to a trickle](#) (Michael Schirber, October 2014)

Fermilab Today: [Doing our part to make the P5 vision a reality](#) (August 19)

FACES: [Dave Snyder](#) (Summer 2014, Laura Tonkyn)

Interactions.org: [The mystery of dark matter](#) (September 30)

BHSU Communications: [BHSU receives \\$600,000 grant from National Science Foundation to develop sophisticated ICP-MS lab on Spearfish campus](#) (October 2)

Rapid City Journal: [\\$600,000 grant to aid scientific research at BHSU](#) (Meredith Colias, October 8)
[Grant will prepare teachers to use innovation](#) (September 30)

Black Hills Pioneer: [Stop 'N Gro partners with Sanford Lab](#) (Jaci Conrad Pearson, October 11)

[A study in subcultural anachronism](#) (Adam Hurlburt, October 6)

[Scientific works in progress](#) (Jaci Conrad Pearson, October 1) - also appeared in [Acuus.org](#) (Associated research Centers for the Urban Underground Space) and [Interactions.org](#)

[On a roll](#) (Jaci Conrad Pearson, September 24)

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

Visitor Center

The new Visitor Center construction continues (see Figure 10). As of mid-September, pier 16 of 22 had been drilled. SURF Engineering Director Josh Willhite reports that 900 yards of concrete will be poured in three sections to create the foundation, scheduled to be completed by the end of October. To watch crews from *Ainsworth-Benning Construction, Inc.* place piers for the new Visitor Center in Lead, South Dakota, check out this video: <https://vimeo.com/105167895>

Construction on the new Visitor Center began in July with the installation of piers to support a concrete foundation slab. Building construction is expected to be completed by May 1, 2015. The exhibits will include a 3-D model of the underground, the old Ross cage, wall panels, experiment artifacts, photographs, and video. The exhibits are expected to be installed before opening day on June 1, 2015.



Figure 10: Two cranes lift over 100 feet of steel rebar pillars used in construction at the new Sanford Lab Homestake Visitor Center

A 3-D model of the underground—from surface to the 8000 Level—will be among the featured items in the new Visitor Center exhibits. Brushed aluminum will be used to create the major drifts and shafts, with a 3-D printer used for the ramp system. The

1/1500-scale model will be suspended from the ceiling and have an overall bounding box of approximately 17 feet long, 12.5 feet wide, and 7 feet in height. Likenesses of the headframes and Visitor Center will sit on top of the model. (See Figure 11.)

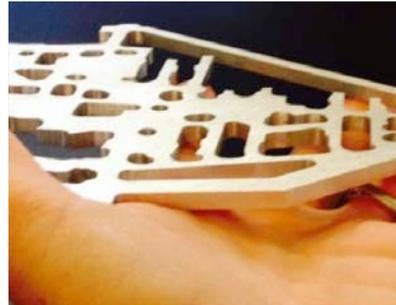


Figure 11: Proposed Visitor Center exhibit of 3-D model of the underground

Ross Shaft update

Ross Shaft crews have rehabbed the 1550, 1700 and 1850 stations, installed 23 sets of steel since June, and nine sets and 150 feet of steel in August.

Crews working on the Ross Shaft installed steel sets to 2069 feet. They are preparing for a cellular concrete pour, rehabbing the 2000 station, cleaning the Ross sump, and performing rope cuts and runner change outs. In preparation for filling the 2000 and 2600 skip pockets, staff are undergoing an internal readiness review.

Yates Shaft update

In top-down maintenance, crews working on the Yates Shaft recently added ground control in the cage compartment from set 181 to set 191 to address the majority of a seam in the rock face. They have also repaired or replaced 233 of 313 T3 panel pieces since the project began (T3 refers to the condition of the timber and is the most serious.)

Yates Shaft crews have removed 168 tons of debris from the shaft since January 2014 (42,000 pounds each month). Crews are also removing old lacing, legacy ladders and landings, and have completed skip side refurbishment down to set 360 (2460 feet).



Info on Travel to Lead

The City of Deadwood is carrying out excavation work that will cause some travel delays in Deadwood. The work may last until the beginning of 2015. Expect full closures between Charles and Cliff Streets between 9 a.m. and 3 p.m. You are encouraged to take the Central City route to and from Sanford Lab instead of Highway 85.

EDUCATION AND OUTREACH

Planning for the Sanford Science Education Center

On September 24-26, 2014, the Education and Outreach team hosted an expert conference to discuss areas of strength, challenges, and future direction of the Sanford Science Education Center. Funded by the National Science Foundation, the conference brought renowned experts in science education together with the core education and outreach staff. Key partners from Sanford Lab, Black Hills State University, and the Homestake Visitor Center also participated. Outside experts included:

- Marge Bardeen, Manager of Education, Fermilab
- Lisa Hunter, Director, Institute for Scientist and Engineer Educators and Director, Akamai Workforce Initiative, University of California Santa Cruz
- William Katzman, Program Leader, LIGO Science Education Center
- Brant Miller, Assistant Professor, Science Education and Learning Technologies, University of Idaho
- Marco Molinaro, Assistant Provost for Undergraduate Education, Innovation, and Research Analytics, University of California Davis
- Dennis Schatz, Senior Advisor, Pacific Science Center
- Greg Snow, Professor of Physics at University of Nebraska Lincoln and Director of Education for the Auger Observatory in Argentina

In addition to helping guide the development of the Sanford Science Education Center, the conference was structured to generate broader findings about the design and implementation of education and outreach efforts associated with complex scientific research experiments and large facilities. The external evaluation team for the NSF grant was on

hand to facilitate the discussions and document findings. An executive summary and more in-depth reports are being prepared and will be disseminated.

Education Programs

South Dakota's annual Indian Education Summit was held on September 28-30 in Pierre, SD. Cultural Diversity Coordinator KC Russell, Science Education Specialist Julie Dahl, and Science Education Specialist Tom Campbell staffed a Sanford Lab information table. STEM Education Specialist Bree Reynolds and E&O Deputy Director Peggy Norris gave presentations, including hands-on activities associated with the water treatment plant and environmental monitoring of the underground.

Julie Dahl and Bree Reynolds brought the water filtration activity to the sixth grade classes at Lead-Deadwood Middle School. The following week, the entire sixth grade (46 students) came to tour the Waste Water Treatment Plant (WWTP). It was all hands on deck for mining consultant Jim Whitlock, WWTP Foreman Ken Noren, Technician Duane Ennis, and Pat Hassen. Their willing help is very appreciated!

Peggy Norris and Bree Reynolds presented at a *Women in Science* conference for eighth grade girls from South Dakota and Nebraska, held at Mt. Marty College in Yankton, SD (see Figure 12). They adapted a nucleosynthesis game using magnetic nuclei (developed by the Joint Institute for Nuclear Astrophysics, University of Notre Dame, Michigan State University and University of Chicago) to help the girls think about nuclear fusion and beta decay, tying to Sanford Lab science by discussing the Ray Davis experiment.



Figure 12: Eighth grade girls from southeast South Dakota and Nebraska play a nucleosynthesis game at Women in Science Day in Yankton

Peggy Norris has recently been named to the management team of the *South Dakota Space Grant Consortium* for a two-year appointment. The organization works to expand opportunities in education, research, and public service in the fields of aerospace, earth science, and supporting STEM disciplines. SURF has been an associate member of the SDSGC since 2009.

ENVIRONMENT, HEALTH & SAFETY



Mental Health and Wellness

- Stay active – indoors and outdoors
- Eat healthy foods
- Manage stress with exercise, meditation, or other forms of relaxation
- Avoid overusing alcohol or prescription drugs
- Take time for yourself



UPCOMING CONFERENCES AND WORKSHOPS

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>

APS Conferences for Undergraduate Women in Physics (CuWiP). January 16-18, 2015. Three-day regional conferences held in various locations. <http://www.aps.org/programs/women/workshops/cuwip.cfm>

2015 Physics Teacher Education Conference. February 6-8, 2015, Seattle. <http://www.aps.org/meetings/meeting.cfm?name=PTEC15>

Low Radioactivity Techniques, Workshop V, University of Washington, Seattle, March 18-20, 2015. Topics include dark matter, solar neutrinos, double-beta decay, and long half-life phenomena. <http://lrt2015.npl.washington.edu>



JOBS

Postdoctoral Researcher, 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 <https://inspirehep.net/record/1315388>

Tenure-track Faculty positions, University of Washington. Undergraduate/graduate teaching; research in particle-astrophysics experiment or theory. facsrch@uw.edu. Deadline: 10/20/14. <https://academicjobsonline.org/ajo/jobs/4392>

Postdoctoral Associate, Yale. Research in short and long baseline oscillation experiments underway at Fermilab including MicroBooNE, LAr1-ND, LArIAT, and LBNE. Deadline: 12/31/14. Bonnie Fleming, bonnie.fleming@yale.edu <https://academicjobsonline.org/ajo/jobs/4664>

Wilson Fellowship, Fermilab. Self-directed research in experimental physics, Fermilab particle physics experiment of candidate's choice. Contact: Wilson_fellowship@fnal.gov. Deadline: 11/14/14. <https://academicjobsonline.org/ajo/jobs/4813>

Postdoctoral Fellow, University of Chicago. Conduct original research in experimental, observational, numerical or theoretical cosmology in an active interdisciplinary environment. Deadline: 10/31/14. centerfellow2015@kicp.uchicago.edu. <http://kicp-fellowship.uchicago.edu/>

Faculty position, UC Riverside. Work in observational astronomy/cosmology. Bahram Mobasher, mobasher@ucr.edu. Deadline: 12/1/14. <https://aprecruit.ucr.edu/apply/jpf00214>

Faculty position, Rice University. Teaching and research in Astroparticle Physics/Cosmology. Deadline: 1/12/15. Contact: umbe@rice.edu or M.

Baring, Dept. of Physics/ Astronomy, MS 108, Rice University, Houston, TX 77005
inspirehep.net/record/131942965

Assistant professor, New Mexico State University. Teaching and research in experimental high-energy neutrino physics. Deadline: 12/1/14. Vassili Papavassiliou, search@physics.nmsu.edu
<http://phi.nmsu.edu/~pvs/search/>

Professor, University of Münster. Experimental Neutrino Physics. Deadline: 9/30/14. Contact: Dean, Faculty of Physics, Westfälische Wilhelms-Universität Münster, Wilhelm-Klemm-Str. 9-48149 Münster. AND

Professor, University of Bayreuth. Experimental Physics. Deadline: 10/31/14. Contact: Walter Zimmermann, Dean, Faculty of Mathematics, Physics & Computer Science, Univ. Bayreuth, 95440 Bayreuth.
https://www.academics.de/wissenschaft/professur_physik_52256.html

Postdoctoral Researcher, UC Irvine. Work in experimental particle physics, with Neutrino Group in Super-Kamiokande, T2K and CAPTAIN liquid argon experiment. Deadline: October 31, 2014.
<https://recruit.ap.uci.edu/apply/JPF02506>

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

Postdoctoral researcher, University at Albany, SUNY. Research in direct WIMP detection, work on data analysis, travel to Lead, SD, gaining hands-on expertise on LUX/LZ. Deadline: 2/1/15. Matthew Szydagis mszydagis@albany.edu
<http://albany.interviewexchange.com/jobofferdetails.jsp;jsessionid=C639453CC99065905F7F634461A5BAAB?JOBID=51419>

Postdoctoral researcher positions (2), UC Berkeley. Work on neutrinoless double beta decay with CUORE and SNO+. Gabriel Orebi Gann gabrielog@berkeley.edu, Yury Kolomensky, yury@physics.berkeley.edu

Postdoctoral Research Associate, Wright Laboratory, Yale. Two openings in Weak Interactions Group. Contacts: Reina Maruyama,

reina.maruyama@yale.edu or Karsten Heeger, karsten.heeger@yale.edu
<http://wlab.yale.edu/opportunities>

Postdoctoral Research Associate, University of Minnesota. Work on NOvA and MINOS+ experiments. Deadline: 11/30/14. Contact: Gregory Pawloski, pawloski@umn.edu
<http://inspirehep.net/record/1292955?ln=en>

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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