

Dear SURF Readers,

Welcome to the November 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

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

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

LBNE SURF Berkeley Low Background Counting Facility: Part II

A brief timeline summarizing the key milestones of moving the ORTEC HPGe detector from Oroville, California to Lead, South Dakota is provided here:

- February 1, 2014: End of sample counting operations at Oroville Dam
- Early March 2014: Detector relocated to SURF
- Late March: Oroville Site decommissioned, shielding and equipment shipped to South Dakota
- May 2014: Detector and shielding installed underground at SURF
- June 2014: Background testing and equipment diagnostics
- July 2014: Counting station back online for receiving of samples

The HPGe detector, designated as MAEVE, is an 85% p-type detector that has resided underground at Oroville for over 10 years. It was manufactured by ORTEC, configured in an "HJ" low-background cryostat configuration with a remote preamplifier (external of lead shield). At SURF, the inner shielding is composed of 0.5 inches of OFHC copper (which has also been underground for 10-20 years, except for a few weeks during the moving process), surrounded by 8 inches on all sides by low

background Pb (sourced from Doe Run). The entire shield is enclosed within aluminized mylar, which creates an air barrier to allow for the shielding to be purged using N₂ gas. This prevents radon in the laboratory air from interfering with the measurement of samples (see Figures 1-2 for images of the detector setup underground, and Figure 3 for its nitrogen purge effectiveness).



Figure 1: BLBF counting room on SURF's 4850 Level: the fully installed and operational BLBF

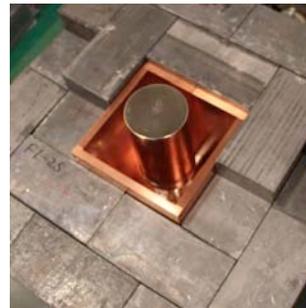


Figure 2: Image of detector during shield construction

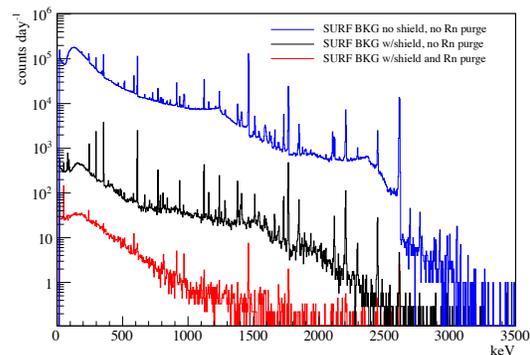


Figure 3: Detector backgrounds in BLBF East Counting Room of the Davis Cavern without shielding (top), with shielding (middle), and with a nitrogen radon purge running (bottom)

Upon reinstallation at SURF, due to minor improvements in the shielding configuration, the total integrated background in the detector (above 28 keV) was reduced by over 30% as compared to its previous life in Oroville. This was a welcome performance improvement in the re-establishment of the system. (See Figure 4 for a background comparison of the BLBF at SURF versus Oroville.)

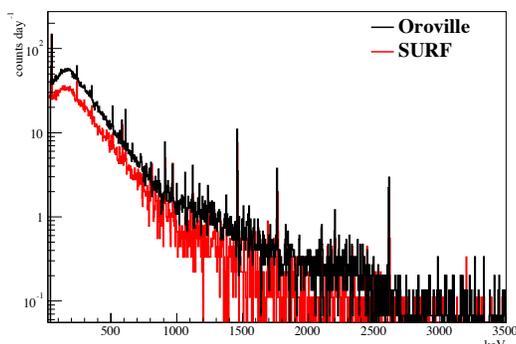


Figure 4: Comparison of shielded (N₂ purged) backgrounds at Oroville and SURF. The backgrounds at SURF are approximately 30% smaller than Oroville, due to some minor improvements made during reinstallation.

The first sample, a silver-based conductive epoxy under consideration for use in the MAJORANA DEMONSTRATOR (MJD), began counting in July. Although it was small in mass (which is the limiting factor in sensitivity), it was a great comparison sample for the BLBF 'MAEVE' detector, since it had previously screened a similar Ag-epoxy for MJD approximately one year ago when it was in Oroville. The results of the first screening at SURF were useful as they confirmed that the detector was operating normally. The results of the screening are shown in Figure 5. The samples were of the same make and brand, though produced in different batches (and possibly at different factories). The counting results at SURF provided a practical confirmation that the system is operating well, or even better than before.

Following the epoxy, a larger sample of titanium plate was counted for LUX-ZEPLIN, shown in Figure 6. This sample was much larger in mass than the epoxy, which resulted in a demonstration of how sensitive the counter is at quantifying small levels of radioactivity, including cosmogenically-produced isotopes.

| | | 2013 | 2014 |
|--------------------|--------|----------|-------|
| | | Oroville | SURF |
| mass | g | 62.1 | 56.5 |
| U | ppb | <1 | <0.8 |
| Th | ppb | <3 | <2.2 |
| K | ppm | <2 | <1.4 |
| ²³⁸ U | mBq/kg | <12 | <10 |
| ²³² Th | mBq/kg | <12 | <8.9 |
| ⁴⁰ K | mBq/kg | <62 | <43 |
| ^{108m} Ag | mBq/kg | 23(4) | 20(2) |
| ^{108m} Ag | mBq/kg | 15(3) | 17(3) |

Figure 5: A side-by-side comparison of the 2013 and 2014 Ag-epoxy samples counted by the LBF. The first sample was counted in 2013 at the Oroville installation; the second was the first sample counted after reinstallation at SURF.

| | | |
|------------------|----------|--------|
| U _e | 0.65(15) | ppb U |
| U _l | <0.01 | ppb U |
| Th | <0.03 | ppb Th |
| K | <20 | ppb K |
| ⁴⁶ Sc | 2.1(1) | mBq/kg |
| ⁴⁴ Ti | 0.09(3) | mBq/kg |

Figure 6: Results of low background counting of titanium plates for LZ. The improved backgrounds in the detector allowed for a modest improvement in sensitivity.

The BLBF detector at SURF will soon be reunited with its partner. The BLBF detector currently at SURF originally arrived at LBNL with an identical twin (another HPGE of same size and type) in the 1990s. MAEVE was converted into a low-background cryostat configuration for use underground in Oroville, while the other remained in a traditional cryostat for miscellaneous uses at LBNL. The process of converting this second detector to a low-background configuration is now in process. The second detector will soon be operating in parallel to MAEVE, doubling the counting capacity of the BLBF at SURF, with an expected sensitivity to be similar to its counterpart.

The BLBF had decades of experience in low-background gamma spectroscopy while located at LBNL. It currently provides and collaborates in a wide variety of services to projects, experiments, and individuals. These services include low background and passive counting of natural radioactivity of candidate construction materials to

be used in low-background experiments. Generally, these isotopes include the primordial decay chains of U, Th, and K, as well as common man-made isotopes ^{60}Co , ^{137}Cs , and cosmogenics. In terms of active counting, the BLBF routinely performs neutron activation analysis of U, Th, K, as well as other typically-stable trace elements. Other activities include a variety of gamma counting for neutron beam characterizations, environmental monitoring, and waste assay. More information, as well as info on requesting counting services, can be found at <http://lbf.lbl.gov>. The BLBF is available to all projects and experiments.

Special thanks to the Oroville Division of the California Department of Water Resources for hosting the former UCSB/LBL double beta experiment and the low-background counting for many years. Thanks also to those who helped facilitate the relocation: the Oroville DWR, Steve Dardin, Ken Wilson, and SURF staff.

Long-Baseline Neutrino Experiment

On October 8-10, a group of physicists and engineers from the Long-Baseline Neutrino Oscillation (LBNO) collaboration in Europe and the LBNE Project in the US visited the SURF site. They viewed presentations on the geotechnical characteristics of SURF, as well as the design and cost methodology used for the detector and facilities at SURF. Surface and underground site tours were also conducted for the group.

The move to form a new international collaboration for the LBNF (Long-Baseline Neutrino Facility) experiment hosted by Fermilab will continue with two open meetings to take place December 5 at CERN, and December 12 at Fermilab. All scientists who wish to join or contribute are encouraged to participate, either in person or by video. For the iIEB (interim International Executive Board website): <https://web.fnal.gov/project/iIEB/Pages/iIEB-home.aspx>

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

Kavli Foundation: [New Dark Matter Experiments Prepare to Hunt the Unknown](#) (Kelen Tuttle, Fall 2014)

Today at Berkeley Lab: [New Dark Matter Experiments Prepare to Hunt the Unknown](#) (November 10)

Broadway World Sioux Falls: [Washington Pavilion Receives SD Community Grant for 'Into the Dark' Exhibition](#) (BWW news desk, November 17)

Physics Review: [Synopsis: Discriminating Dark Matter from Neutrinos](#) (F. Ruppin et al., October 7)

Raw Science: [Descend 4850 ft under South Dakota: Search for Dark Matter and Neutrinos](#) (Alex Rotaru, October 15, video)

[Beyond the Higgs Boson: The Anti-Matter Imbalance](#) (Keri Kukral, October 8, video)

[FIAT LUX: The search for dark matter](#) (Keri Kukral, October 8, video)

Fermilab Today: [PU set to break new frontiers](#) (*India Times*, October 14)

Rapid City Journal: [Community invited to attend the inauguration of BHSU's 10th president](#) (November 12)

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 Update

Construction continues at the Sanford Lab Homestake Visitor Center site. On October 29, the first of three major concrete pours was completed, with the second and third to be completed in one-week increments. Structural steel placement will begin in early November, with the building expected to be completed by the end of December.

Exhibit design continues to progress with the focus on specific exhibit content. A review/kickoff meeting was held on October 30 with subject matter experts who will be providing exhibit content in various represented fields. The SURF Communications Department is also procuring and producing video content, which will be displayed throughout the completed building. One of the large artifact exhibits will include the old Ross Shaft cage, which was refurbished and delivered to the site in October. The cage is too large to be installed after the walls are in place, so it will be completed prior to steel installation. The other large display, a 3D model of the underground, is currently in the fabrication process and will be a centerpiece of the facility (see Figure 7).

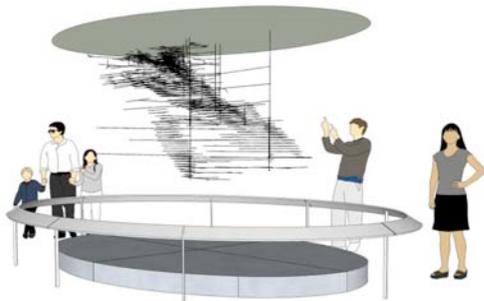


Figure 7: 3D model of the underground

Yates Shaft

The Yates Shaft attained its 75th anniversary this year. The Yates Shaft replaced the Ellison Shaft, and is named for Bruce Yates, general manager of Homestake Mine from 1918-1936.

According to Stephen Mitchell, access drifts were driven from the Ross or Ellison Shafts to the location for the Yates on the 800, 1100, 1700, 2300, 3050, 3650 and 4100 levels. “It was like going down a hallway in a big hotel to see where you need to put

the elevator,” Mitchell said. When the drifts reached their destination, pilot raises were driven upward (see Figure 8).

More details on the shaft’s construction can be found in Mitchell’s book, *NUGGETS TO NEUTRINOS: THE HOMESTAKE STORY*.



Figure 8: Deepening the Yates Shaft, 1954: When the pilot raise was completed, stripping crews slashed out the sides of the raise, bringing it to its full dimension of 15x27 feet, eight inches (Photo Courtesy of Homestake Mining Company and Stephen Mitchell)

Safety at Sanford Lab

Recent upgrades at Sanford Lab include additional painted crosswalks, new signs bearing the Sanford Lab logo, and banners to depict each headframe, the two major experiments, and the construction of the Davis Campus (see Figure 9).



Figure 9: Junior Facility Engineer Andrew Brosnahan inspects work at the Yates Ramp, which includes new signs with safety messages

In the Ross and Yates yards, work planning with *Pacific Steel* involves cleanup of scrap iron, and crews have installed large shipping containers for materials and storage equipment.

A new roof has been installed at the surface lab, and a new HVAC unit at the Admin Building. Other projects include mortar repairs and the addition of scupper extensions on both hoist rooms, securing the tin on both headframes, and replacing the Yates Shaft heater as a way to eliminate the potential for

ice buildup. New corrugated walls have been added in the Yates ramp to make it safer for visitors and personnel.

“All of the enhancements and additions certainly helped raise awareness of the importance of safety,” said SURF EHS Director Noel Schroeder.

With safety in mind, the EHS team also recently reviewed and revised Sanford Lab’s existing LOTO (lockout/tagout) policy. When an authorized person “locks out” an energy source, that person literally puts the lock on a disconnect switch, circuit breaker, valve handle, or other energy-isolating device in an off or closed position. A tagout or written warning is placed near the lockout area. The SURF EHS Department is developing equipment-specific lockout procedures that provide step-by-step instructions for de-energizing and restarting the equipment.

“We looked at our policies and developed, modified, and refined them so we can give staff the tools they need to do their job safely,” said Jamie Hopmeier, SURF EHS Occupational Health and Safety Manager.



Info on Travel to Lead

Construction on Deadwood’s Highway 85 will begin 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

Awards

Bree Reynolds (STEM Education Specialist for Sanford Lab and Black Hills State University) and Dana Gehring (Sinte Gleska University Biology faculty member) were awarded a NASA Tribal College Collaboration grant and a NASA travel grant focused on astrobiology. They will be developing connections between the extremophile research taking place at Sanford Lab to biology curriculum at SGU. With the travel grant, Bree and Dana will travel to NASA Ames and the National Institute for Astrobiology.

Activities

Every year, the SURF Education and Outreach (E&O) department introduces hundreds of students and teachers to science at Sanford Lab. The Lab partners with Black Hills State University to develop programs in STEM (Science, Technology, Engineering, and Math) for students of all ages. It also offers professional development for educators and provides after-school and summer enrichment programs.

The fall semester kicked off another busy season, with E&O hosting a group of students from Lead-Deadwood High School. Five students, part of a STEM research class, visited Sanford Lab to learn more about how the Waste Water Treatment Plant treats water from the underground before releasing it into Whitewood Creek (see Figure 10). Other hosted activities for K-12 students include projects in physical and life sciences, space exploration, engineering design, and data sharing.



Figure 10: Lead-Deadwood High School students tour the Waste Water Treatment Plant. Ken Noren, Plant Foreman, shows students a defuser (device used to spread water evenly through the filtration process)

The E&O staff is committed to engaging students from underrepresented groups. “The number of girls entering STEM careers is still significantly below parity in certain disciplines such as physics, engineering, and computer science,” said Peggy Norris, SURF E&O Deputy Director. Norris helped start *SciGirls of the Black Hills*, an after-school program, to bring about change. “SciGirls is based around a PBS TV series, with strategies and activities that engage girls and underrepresented groups,” Norris said.

Some other methods used include videoconferencing, virtual field trips, and augmented

reality programs, which allow access to Sanford Lab from anywhere in the world.

Sanford Lab also partners with the local Lead-Deadwood Elementary Stop 'N Grow. Bree Reynolds and Stop 'N Grow director Tera McGuire organized the monthly after-school program. Reynolds is creating modules that can be used in any after-school program. Each student keeps a science notebook to document their scientific observations; they will also complete two experiments.

Save the Date

A Public Science and Arts event will be held on December 4 at the Historic Homestake Opera House in Lead, South Dakota, at 6 p.m. presenting a staged reading of the play *Background* by award-winning playwright Lauren Gunderson. The play is based on the story of cosmologist Ralph Alpher, who predicted the cosmic microwave background (CMB) almost 20 years before it was discovered by Penzias and Wilson, but who was forgotten and unacknowledged for his work. The evening will include a reception with a talk by SURF Experiment Support Scientist Mark Hanhardt introducing the science and linking the CMB with dark matter.

ENVIRONMENT, HEALTH & SAFETY



Thanksgiving Safety

- Stay in the kitchen when you are cooking on the stovetop, and frequently check on your pies and turkey. Unattended cooking is the leading cause of Thanksgiving Day fires.
- Food that you love may be harmful for your pets: sage, onions, gravy, grapes or raisins, chocolate.
- If you plan to travel by car for Thanksgiving, remember to buckle up, watch your speed, and pay attention. An anticipated 43 million people will travel for the holiday; about 90% of them will be the road.

HAVE A HAPPY THANKSGIVING!

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>

GERDA-MAJORANA meeting, Max Planck Institute, Heidelberg, December 4-6, 2014.
<http://www.mpi-hd.mpg.de/personalhomes/lindner/gerda-majorana/>

INPAC-MRPI General Meeting, "At the threshold of a new era in Nuclear/Particle Astrophysics", Asilomar Conference Grounds, Pacific Grove, CA, December 5-7, 2014. Multi-campus discussion of Dark Matter, Dark Energy, and Neutrinos to Large Scale Structure and Cosmic Microwave Background.
<http://cosmology.berkeley.edu/inpac-mrpi/GeneralMeeting2014/Information>

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>

8th 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>



JOBS

Tenure-track faculty positions, South Dakota School of Mines and Technology. Undergraduate/graduate teaching and research in geophysics. Review begins 1/12/15. Contact: Larry Stetler, larry.stetler@sdsmt.edu
<http://www.sdsmt.edu/employment>

Project Scientist, LBNL. Physicist Software Developer for Particle Data Group, work on algorithms for evaluating particle physics data, producing the Review, development of new web applications. Deadline: 12/5/14.
<https://academicjobsonline.org/ajo/jobs/4977>

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>

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

Assistant Professor positions, University of Wisconsin-Madison. Teaching with research in experimental or theory. Deadline: 12/1/14. info@physics.wisc.edu
http://www.physics.wisc.edu/apply/pvl_80893/

Assistant Professor positions, UC San Diego. 1: Experimental particle physics (direct or indirect Dark Matter detection, Neutrino Physics, and experimental Cosmology); 2: open to all research areas in Physics. Deadline: 12/31/14.
<https://apol-recruit.ucsd.edu/apply/JPF00674>
<https://apol-recruit.ucsd.edu/apply/JPF00681>

Postdoctoral Researcher, LLNL. Work with HEAP and RED groups on the nEXO, PROSPECT, and fissionTPC experiments. Contact: Mike Heffner, mheffner@llnl.gov and Nathaniel Bowden, bowden20@llnl.gov.

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>

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/>

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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