

Dear SURF Readers,

Welcome to the February 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

March 11-13: DOE/SC LZ CD1/3a 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

LBNF announcement

This message from Fermilab Deputy Director Joe Lykken appeared in the January 27 edition of *Fermilab Today*:

“At approximately 6:15 p.m. CST on Jan. 22, 2015, the largest and most ambitious experimental collaboration for neutrino science was born.

It was inspired by a confluence of scientific mysteries and technological advances, engendered by the P5 report and the European Strategy update, and midwived by firm tugs from Fermilab, CERN and Brookhaven Lab. Going by the placeholder name ELBNF (Experiment at the Long Baseline Neutrino Facility), the newborn had the impressive heft of 145 institutions from 23 countries.

The new Institutional Board (IB), convened by interim chair Sergio Bertolucci, unanimously approved a Memorandum of Collaboration that launches the election of spokespeople and a process to develop bylaws. The IB also endorsed an international governance plan for oversight of ELBNF detector projects, in concert with the construction of the LBNF facility hosted by Fermilab.

The goal of this international collaboration is crystal clear: a 40-kiloton modular liquid-argon detector deep underground at the Sanford Underground Research Facility exposed to a megawatt-class neutrino beam from Fermilab with the first 10 kilotons in place by 2021. This goal will enable a comprehensive investigation of neutrino oscillations that can establish the presence of CP violation for leptons, unequivocally determine the neutrino mass ordering and strongly test our current neutrino paradigm. A high-resolution near detector on the Fermilab site will have its own rich physics program, and the underground far detector will open exciting windows on nucleon decay, atmospheric neutrinos and neutrino bursts from supernova detonations.



Figure 1: Physicists, engineers, and consultants visit SURF, future site of LBNF, in October 2014

Unlike most births, this one took place at an international meeting hosted by Fermilab; there was room for nearly all the friends and family of accelerator-based neutrino experiments. One of the critical items flagged at this meeting is to find a better name for the new collaboration. Here are a few of my unsolicited attempts:

nuLAND = neutrino **L**iquid **A**rgon **D**etector

GOLDEN = **G**iant **O**scillation **D**etector **E**xperiment for **N**eutrinos

Think you can do better? Go ahead. My older son, a high-priced management consultant, offered another one pro bono: **NE**utrino **R**esearch **D**etector**S**.

I am too young to have been in the room when ATLAS and CMS (or for that matter CDF and DZero) came into being, but last week I had the thrill of being part of something that had the solid vibe of history being made.”

(Editorial note: ELBNF is of special interest to SURF as it is the site currently selected to house its massive “far detector,” some 800 miles from the neutrino source at Fermilab in Illinois, the LBNF host laboratory and the ELBNF “near detector” site. See Figures 1-2.)



Figure 2: The Long Baseline Neutrino Facility would send neutrinos from Fermilab in Illinois through the earth to Lead, South Dakota. (No tunnel is needed for this 1300 km trip.) (Graphic: Courtesy of Fermilab)

Electron Beam Welding of Low Background Copper for the MAJORANA DEMONSTRATOR

The MAJORANA DEMONSTRATOR (MJD) collaboration takes extreme measures in producing copper parts of ultra-high purity for eventual use to build their neutrinoless double-beta decay experiment. Since 2011, most of the copper has been formed, machined, and assembled at SURF’s Davis Campus 4850 Level without ever traveling to the surface or outside of a cleanroom. However, there is one exception for welding.

Electron beam welding is performed on the thermosyphon and crossarm of the cryostat (see Figure 3). Electron beam welding is a technique that was developed commercially in the 1960s to service the aerospace industry. An electron beam is used instead of an arc. This produces a weld with a narrow bead, a challenge for copper parts. The welds are performed in a vacuum chamber to prevent beam spread, oxidation, and contaminants in the weld.

The time that MJD copper spends at the surface must be kept to a minimum to limit cosmic ray activation. When this service was needed, welders were evaluated based on value, experience, schedule flexibility, and proximity to SURF. *Electron Beam Welding Associates* (EBWA) in Indianapolis, Indiana was selected to complete the production

cryostat welds. In order to minimize surface exposure days and risk of contamination, collaboration members Matthew Busch, Project Engineer at Duke University/TUNL, and Kris Vorren, a graduate student at the University of North Carolina, delivered the materials round-trip and performed all of the material handling and setup at EBWA.



Figure 3: Cryo 1 thermosyphon tube just after welding at EBWA on January 31, 2014

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Pickup and delivery of the material at the Yates headframe and rest stops are scheduled in advance to minimize the time that the copper spends at high elevations. One of the reasons EBWA was selected is that the route’s elevation is low. When possible, hotels with underground parking were chosen to further reduce exposure overnight. As a result, the 2000+ mile round trips were completed with a total surface level exposure equivalent of 8-12 days, depending on weld complexity and weather.

Over the past one-and-a-half years, Matthew Busch and Kris Vorren have made the trip between Lead, South Dakota and Indianapolis four times. The final trip was completed December 10, 2014.

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

Fermilab Today: [Deep Science](#) (Joe Lykken, February 24)

[ELBNF is born](#) (Joe Lykken, January 27)

Wall Street Journal: [Scientists hunt for mystery particle under a mountain](#) (February 13)

Argus Leader: [\\$5M Sanford Lab visitor center to open by June](#) (Associated Press, January 28) (Also in [The Daily Republic-Mitchell](#))

Washington Times: [\\$5M Sanford lab visitor center in Lead set to open by June](#) (Associated Press, January 28)

KTIV.com: [\\$5M Sanford lab visitor center in Lead set to open by June](#) (January 27) (Also in [Aberdeen News](#), January 28)

Keloland TV: [\\$5M Sanford Lab Visitor Center in Lead Set to Open by June](#) (January 28)

SDSMT news: [Department of Energy Approves \\$1.1 Million to Fund Underground Physics Research at SD Mines](#) (February 3)

Newscenter1.tv: [Science + Arts: Sanford Lab & Homestake Opera House Theater Drama Reading of the Play "Background" with Reception and Speaker](#) (February 18)

Rapid City Journal: [\\$5M Sanford lab visitor center in Lead set to open by June](#) (January 28)

Black Hills Pioneer: [SD Mines gets \\$1.1 Million for underground physics research](#) (Staff, February 4) [Going with the flow](#) (Constance Walter, January 30)

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

Sanford Lab Homestake Visitor Center

On Tuesday, January 13, Steve Dangermond of *Dangermond Keane Architecture*, toured the Sanford Lab Homestake Visitor Center and was able to see the steel frame for the first time. He designed the new site nearly two years ago and has been following its progress since then. "It's exciting to see because it gives a sense of what it will become when it's finished," he said.

A cage once used in the Ross Shaft (see Figure 4) will be a focal point of the exhibit area. It was recently embedded into the concrete floor to make it handicapped accessible. When the building opens on June 1, audio and video inside the cage will give visitors an idea of what a cage ride to the underground is like.



Figure 4: A cage once used in the Ross Shaft will be a focal point of the exhibit area

Below a large viewing window overlooking the Open Cut (shown in Figure 5), a kick plate describes geological features of Lead's iconic landmark. The kick plate measures 16 feet long by 3 feet wide.



Figure 5: The Open Cut was used for surface gold mining by the old Homestake Mining Company

Ten panels, such as one pictured in Figure 6, line two walls of the new Visitor Center. Each 8-foot tall by 5-foot wide panel gives visitors a glimpse into the lives of the diverse peoples who lived and worked in Lead, the history of mining, and the science currently taking place at Sanford Lab. Photographic images surrounding the interior of the building depict life in Lead from the early days to the present.



Figure 6: Panels shown at upper portion of photo will give visitors a glimpse into the past

A time-lapse image by Randy Halvorson, taken at Sanford Lab near the Yates headframe in August 2014, will become a mural in the new Sanford Lab Homestake Visitor Center. This will illustrate the wonders of the universe in relation to the science taking place at SURF (see Figure 7).



Figure 7: Time-lapse image by Randy Halvorson from August 2014

Safety Matters

Since 2009, Steve Gabriel, a science teacher at Spearfish High School (about 20 miles north of Sanford Lab in Lead) has been monitoring air quality on the 4850 Level Davis Campus (see Figure 8). Airflow meters at the 4 Winze Wye, Governor’s Corner, and the 17 Ledge drift back the velocity of the air as it flows through the drifts. Several of Gabriel’s students work with him as part of their classroom assignment, and some go underground

with him to check on the experiment and retrieve data.

One mile belowground, heat, diesel exhaust, dust and radon must be managed through engineering controls.

SURF Radiation/Experiment Health and Safety Manager Chuck Lichtenwalner, who helps retrieve data for Gabriel, said ventilation is critical to the safety of personnel and the experiments. “Without a good system in place, we would have high radon levels and a very hot environment.”

Fresh air travels down the Ross and Yates shafts and is pulled through the drifts by the Oro Hondo and 5 Shaft fans—air doors ensure the air gets where it is needed (see Figure 9). Along with bringing much-needed air, the fans pull out dust, diesel exhaust and heat, and reduce radon levels.



Figure 8: Steve Gabriel and Madison Jilek, a senior at Spearfish High School, check out the weather station on the roof of the school



Figure 9: Industrial hygienist Jason Rosdahl regularly inspects airflow rates on the 4850 Level Davis Campus to ensure that dust and diesel particulate matters (DPM) are within acceptable limits

A recent test in which both fans were shut down for a period of time proved just how important the ventilation system is, Lichtenwalner said. After a

three-hour shutdown, airflows to the underground dropped significantly and radon levels increased by 80 percent in the Davis Campus. After four hours, radon levels at the Ross campus increased by 200 percent.

“Both LUX and MAJORANA want the lowest levels of radiation they can get,” Lichtenwalner said. “Our ventilation system is a key component in helping them achieve those levels.”

Bryce Pietzyk, SURF Senior Underground Operations Engineer, said Gabriel’s work is critical to another major project on the 4850 Level—the Long-Baseline Neutrino Facility (LBNF). “We will use Steve’s data to help verify that our ventilation model for LBNF is working correctly.”



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



Science Fairs

Winter is the season for local science fairs at many schools in South Dakota, leading up to regional fairs in March. The Sanford Lab Education and Outreach staff were joined by other Sanford Lab staff in volunteering to judge several science fairs this year. Students ranged in age from elementary through high school, all competing for a spot in the Intel International Science and Engineering Fair (ISEF). The Lab was or will be represented at four local fairs: Rapid City (North Middle School), Hill City (all grades), Newcastle, WY (Northeast Wyoming regional fair) and Spearfish (Spearfish Middle School). Participants in judging at one or more events included Tom Campbell, Julie Dahl, Peggy Norris, Bree Reynolds, Ben Saylor, Dave Taylor, and Jim Whitlock.

At the Wyoming Northeast Regional Fair, Tom Campbell, Peggy Norris, and Jim Whitlock judged the geology, physics, and environmental categories, respectively (see Figure 10). The six physics projects included a project on dark matter and two cosmic ray studies, demonstrating the impact the presence of Sanford Lab is having on area schools.



Figure 10: Tom Campbell judging student science projects at the Hill City Science Fair

Sanford Lab Engineer David Taylor sent a note after the Hill City fair that aptly describes the judging experience:

I had a good time at the science fair last night. I was on a team with two members of the US Air Force who were experts in weather. We collectively judged four students. Their topics were:

Student 1: the dangers of the XL pipeline

Student group 2: the recovery of sound energy for other use

Student 3: music that would be most soothing to an autistic person (the student was autistic)

Student 4: investigating the effect of temperature on the activity of tortoises

The three judges were impressed by the group of students on project 2, and the sophomore who investigated the behavior of tortoises when exposed to normal, high, and low temperatures.

The group of four students ended up generating voltage from piezo films and investigating different types of musical instruments and vehicle noises to see what produced the best response. They then did some scaling to find out the potential financial value of stringing the piezo films along US highways to convert road noise into volts.

The young lady who did the tortoise experiment had borrowed three tortoises from the Reptile Gardens in Rapid City. She found out about their normal living conditions, and then used different wattage incandescent bulbs to alter the tortoises' living environment. She monitored their behavior, catalogued it, and made sound conclusions on how the actual result differed from her hypothesis, along with possible reasons.

It was great fun.

STARBASE

Sanford Lab Cultural and Diversity Coordinator KC Russell represents Sanford Lab in many capacities across the state of South Dakota, including serving on a Governor's Commission, the SD EPSCoR Diversity Council, and several other state committees (for example, the selection committee for the state Hagen-Harvey Scholarship for tribal students). He is also on the Board of Directors of South Dakota STARBASE.

STARBASE is an outreach program funded by the Department of Defense. STARBASE focuses on elementary students, primarily fifth graders. The goal is to motivate them to explore Science, Technology, Engineering, and Math (STEM) as they continue their education. STARBASE academies serve students who are historically underrepresented in STEM. In his capacity as Board Member, KC assisted the organization in the procurement of a second mobile classroom to be used in outreach to tribal schools. In December 2014, almost 400 tribal students participated in STARBASE programs; in 2015, tribal schools in Cheyenne River, Yankton and Rosebud will be added.

ENVIRONMENT, HEALTH & SAFETY



Weather Safety

- Drive carefully in rainy and snowy road conditions. Stay tuned to your local weather forecast.
- Be prepared in case of emergency: carry a flashlight, shovel, bottles of water, blankets, or first aid kit. Keep your gas tank full.
- Keep pets indoors when the temperatures drop. They can easily become lost, or ingest salt,

antifreeze, or other toxic chemicals while licking their paws.

NEW PROFESSOR IN SOUTH DAKOTA



Frank Strieder has been hired as an Associate Professor of Physics at South Dakota School of Mines and Technology (SDSMT), where he will be Lead PI of the CASPAR project. He holds a PhD from the University of Bochum in Germany. The city of Bochum is located in the western part of Germany, with the university of about 35,000 students. He grew up in that same area, which is (or was) known for coal mining and steel production. Some members of Strieder's family have been coal miners, so this creates a perfect link to the Homestake mine, even though mining in his region stopped before he was born in 1969. He hadn't seen a shaft from the inside before coming to South Dakota.

Prior to coming to South Dakota, since about 1994, Strieder worked for the European underground accelerator project, called LUNA (Laboratory for Underground Nuclear Astrophysics), in the Gran Sasso Underground Laboratory in Italy. This project began in 1992 with a small homemade accelerator built by students and postdocs from his university; later, in 2000, it was extended to a larger commercially available machine. Working for CASPAR now is completely in line with Strieder's research interests and his considerable expertise. In general, his research interests concern the nuclear reactions that take place in stars and govern the energy production of stars as well as determine the nucleosynthesis of the chemical elements. He has a family with two kids, a daughter of 10 years and a son of 6 years. His wife, an English teacher, is still in Germany with the children, but he hopes they will join him in the near future. One of his favorite hobbies is day hiking, which makes the Black Hills an almost perfect location. He also loves the US National and State Parks.

UPCOMING CONFERENCES AND WORKSHOPS

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>

South Dakota Academy of Science 100th anniversary meeting, Cedar Shore Resort and Conference Center, Oacoma, SD, April 10-11, 2015. Symposium on 100 years of Physics in South Dakota. <http://sdaos.org>

APS April meeting, Baltimore, MD, April 11-14, 2015. Physicists and students in astrophysics, gravitational physics, nuclear physics, and particle physics will share new research and insights.

<http://www.aps.org/meetings/april/>

Conference on Science at the Sanford Underground Research Facility (CUSL), 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>

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>

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 pnnorris@sanfordlab.org.



JOBS

Postdoctoral position, Fermilab Center for Particle Astrophysics. Research on G2 Dark Matter experiment, including LZ, SuperCDMS or ADMX. Deadline: 2/28/15. <http://astro.fnal.gov>
http://fermi.hodesiq.com/job_detail.asp?JobID=4962188&user_id=

Research Associate, University College, London. Three-year post, research on Dark Matter, especially the LUX-ZEPLIN (LZ) experiment. Deadline: 3/25/15. Queries: Cham Ghag, c.ghag@ucl.ac.uk.
http://www.hep.ucl.ac.uk/positions/lz_ra_feb2015.shtml

Lecturer/Assistant Professor, Lancaster University (UK). Research in experimental particle physics, T2K collaboration, and the future ELBNF. Contact: Peter Ratoff, p.ratoff@lancaster.ac.uk
<http://hr-jobs.lancs.ac.uk/Vacancy.aspx?ref=A1169>

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

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

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 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>

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>

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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Contributors: Kevin Lesko; Connie Walter (Sanford Lab news); Joe Lykken, Fermilab (LBNF announcement); Matthew Busch (Electron Beam Welding of Low Background Copper for the MAJORANA DEMONSTRATOR) Ben Saylor, Peggy Norris (E&O)

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