

Dear SURF Readers,

Welcome to the February 2014 Sanford Underground Research Facility (SURF) monthly newsletter. The newsletter is also posted online, and a pdf copy is available. You can read recent and archived newsletters at our website at 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 6-9: LZ Collaboration meeting – College Park, MD

March 15-16: MJD Workshop – Lead, SD

March 15-16: LUX collaboration meeting – Lead, SD

New South Dakota Ph.D. Program

August 20, 2013 marked the first day of the new doctoral physics program in South Dakota. Twelve students began studies: six at the South Dakota School of Mines and Technology (SDSMT) in Rapid City, and six at the University of South Dakota (USD) in Vermillion. They will focus on Sanford Lab research.

In this issue of the SURF monthly newsletter, Ryan Martin (shown in Figure 1), a faculty member in this program, shares his insights and experiences. Now Assistant Professor at USD, Martin received his Ph.D. in Physics from Queen's University, Canada in 2009, working on the SNO experiment. He was a Postdoctoral Fellow at Lawrence Berkeley National Lab from 2009-2013, where he continued to work with SNO and also joined in the MAJORANA DEMONSTRATOR (MJD) experiment. He continues to be a member of the MJD collaboration.

Ryan Martin writes:

With the recent start of the Physics Ph.D. program in South Dakota, the state government has sponsored several doctoral and faculty positions. This is a very

exciting direction that demonstrates a commitment toward developing an internationally recognized research program in physics, as well as training the next generation of scientists. The presence of SURF is, of course, a strong driver to develop this future in the state.



Figure 1: Ryan Martin, newly appointed Physics Assistant Professor at University of South Dakota in Vermillion

I was lucky enough to obtain a position at USD, where I started in September 2013. Indeed, I consider myself lucky, as faculty positions have become increasingly sparse and difficult to obtain.

I first started my research career working on the Sudbury Neutrino Observatory (SNO), an experiment designed to solve the “solar neutrino problem” first uncovered by Ray Davis’s pioneering experiment at the Homestake mine. It is fitting that I move to South Dakota, as I continue to work on understanding neutrinos by participating in the MJD experiment, currently under construction at SURF. The possibility to be involved on the ground floor of developing the new Physics Ph.D. program and the proximity of the world-class SURF facility have made a faculty position in South Dakota very attractive.

As advertised, the life of a new faculty member is very busy, with many responsibilities including: teaching, service to the University, supervising students, and conducting research.

I was fortunate to have the opportunity to develop a new course to add to the physics curriculum in South Dakota, and teach it during this Winter-Spring semester. This “Numerical Methods in Physics” course leverages my personal experience in computer programming, and aims to give students a strong base in programming that will be useful beyond a career in physics. Although it is extremely time-consuming to develop a new course, I have

found it to be a rewarding experience. It is satisfying to see students hand in complex assignments based on the material that you have taught to them. I find it stimulating to develop ways of integrating technology to my course as well as implementing findings from recent research that improve how physics is taught at universities.

USD and SDSMT share the teaching load for the physics curriculum together with South Dakota State University (SDSU), and occasionally with Black Hills State University (BHSU) and Dakota State University (DSU). This allows the relatively small departments to consolidate their faculty and offer a complete set of courses for physics majors. This is possible through the use of technologies such as the Digital Dakota Network (DDN), which allows for effective videoconferencing between the different sites. The DDN network even includes two sites at SURF (surface and underground), allowing faculty involved in research there to teach classes from underground, as I do when I am at SURF.

In addition to teaching, I am also developing my own research program. I currently advise two Ph.D. students funded by the state as well as an MS student and an undergraduate student. The proximity of SURF allows me to provide these students with the opportunity to participate in world-class research, as I simultaneously involve them in developing my own laboratory space at USD.

I have only just started my position at USD, but have already begun to experience the rewarding aspects of this job as well as begin to face some of its challenges. I am excited about the future and being a part of the development of science in South Dakota. I have found people in the state to be very welcoming as well as enthusiastic about the prospects of strengthening research and education in physics.

Prototype cryostat for LBNE

Scientists and engineers working on the design of the particle detector for the proposed Long-Baseline Neutrino Experiment (LBNE) celebrated a major success in January. For the first time, they operated the 35-ton prototype cryostat (shown in Figure 2) filled with some 5000 gallons of liquid argon; results met the stringent, less-than-200-parts-per-trillion (ppt) purity requirement on oxygen contamination in the liquid.

The purity of liquid argon is crucial for the LBNE detector. Oxygen and other electronegative impurities in the liquid can absorb ionization electrons produced by neutrino interaction products to prevent them from reaching the detector's signal-generating wires.



Figure 2: LBNE prototype cryogenic system

The test results were the outcome of the first phase of operating the LBNE prototype cryostat at Fermilab. On December 20, during a marathon 36-hour session, engineers cooled the cryostat -- slowly and smoothly -- to -262 degrees Fahrenheit and started to fill it with liquid argon from Fermilab's *Liquid-Argon Purity Demonstrator*. The membrane cryostat, based on industrial-type design and components, holds about 5,000 gallons of liquid argon. In January, the LBNE team announced that the systems for purifying, recirculating and recondensing the argon worked properly and consistently, achieving purity levels of about 100 ppt, significantly better than the minimum requirement of 200 ppt.

MAJORANA DEMONSTRATOR Annual Review

Professor John Wilkerson of the University of North Carolina, and Principal Investigator of the MJD project reports:

On January 23-24, an international review committee, along with program officers from the DOE Office of Nuclear Physics and NSF Particle Astrophysics program, visited SURF to carry out an Annual Review of the MAJORANA DEMONSTRATOR (MJD). As part of the review, the group visited the Davis campus, donning full clean garb in order to tour the MJD laboratories (see Figures 3-4). The comments on the underground tour were uniformly positive regarding both MJD and SURF.



Figure 3: Jaret Heise briefs the review committee and agency members on the Davis Campus laboratory



Figure 4: Review committee and agency members visit the MJD clean machine shop

The experience gave the visitors a first-hand understanding of the steps that the MAJORANA collaboration is taking to construct the DEMONSTRATOR under ultra-clean conditions. The collaboration expressed their appreciation to SURF and the SURF staff for their excellent assistance with what was a very positive and productive review.

The MJD project has been assembling natural germanium detectors into strings inside a clean room on the 4850 Level. These strings were installed and tested in a prototype cryostat (see Figure 5) nearly identical to the ultra-clean cryostats that will be used in the experiment.

The collaboration plans to start building strings with enriched ^{76}Ge detectors in April or May. If all goes as planned, they will begin collecting data later this year. "We're having fun, seeing the work of the last few years come to fruition," said Wilkerson.



Figure 5: A copper cryostat, as seen from above, will hold the extremely sensitive detector strings. This cryostat is a prototype of the ultra-pure copper that will be used in the actual module

Reports/Papers Available

[The Sanford Underground Research Facility at Homestake](#). (Jaret Heise, January 5, 2014, Cornell University Library, <http://arxiv.org/abs/1401.0861>)

YouTube video: October 30 LUX Science Seminar
<http://www.youtube.com/watch?v=SMzAuhRFNQ0&feature=youtu.be>

[Why the US Needs a Deep Domestic Research Facility](#). (Kevin Lesko, April 1, 2013, Cornell University Library, <http://arxiv.org/abs/1304.0402>)

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

BBC: [UK backs huge US neutrino plan](#) (Pallab Ghosh, February 14)

Phys.org: [Space science stories to watch in 2014](#) (David Dickinson, January 2)

Jeopardy TV show: [YouTube Video](#) (February 21 – Sanford Lab in category: Figuring out the Universe)

Universe Today: [Space science stories to watch in 2014](#) (David Dickinson, January 1)

Fermilab Today: [LBNE prototype cryostat exceeds goals](#) (Anne Heavey, January 21)

SDPB: [Keeping the Mine Clean](#) (Cara Hetland, February 6)

KOTA TV: [Fed funds Sanford Lab ops and experiment](#) (Constance Walter, January 27)

Keloland TV: [Art Exhibit Explores Dark Matter](#) (Sammi Bjelland, February 7)

Black Hills Woman Magazine: [Fabulous Women of the Black Hills](#) (January-February 2014) – includes Cabot-Ann Christofferson, Sanford Lab Deputy Director for the MJD project

Rapid City Journal: [BHSU geology class takes first underground field trip at Sanford Lab](#) (January 15)
[Students take trip under ground](#) (January 14)
[Lead 3](#) (January 7)
[Sanford Lab begins \\$7M education center program](#) (Associated Press, January 6)

Black Hills Pioneer (Adam Hurlburt): [Stars underground?](#) (January 28)
[Feds support underground neutrino experiment](#) (January 23)

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

Deep Well Pump Replacement

In January, when the pump that services the underground pool to Sanford Lab's Wastewater Treatment Plant (WWTP) began to fail, it took staff (shown in Figure 6) from several departments to replace it.

"This was a collaborative effort by operations, engineering, and the hazard mitigation crew," said Bryce Pietzyk, SURF Construction Engineer, who coordinated logistics and personnel. The project also required synchronizing pump operations with the

WWTP, which had to stockpile water in other underground reservoirs and sumps while the pump was installed.



Figure 6: Rope Technician Rick Tinnell and Infrastructure Technicians Jason Graves and Pat Urbaniak prep a 33-foot pump motor to be lowered down to the Yates Shaft

Water inflows collect in the depths of SURF, about 800 feet below the Davis Campus. These inflows are pumped from the underground pool to the WWTP, treated to ensure that the water meets government standards, and then released into the environment. The pump is an intricate system that includes more than 1500 feet of pipe, a 33-foot motor, and a 9-foot centrifugal pump, according to SURF Mechanical Engineer Mike Johnson, about 40,000 pounds total. All components were transported underground via the Yates Shaft.

Although the pump and other equipment fit into the cage, the motor does not. The crew had to sling it underneath the cage (see Figure 7). The long pipe is a motor for the deep well pump, attached to the bottom of the cage. A variable reach forklift was used to manipulate the motor into the shaft.



Figure 7: Equipment that is too large to fit in the cage must be slung underneath the cage

"Everyone did a great job completing this project safely," said Executive Director Mike Headley. "It was a real team effort."

Sanford Lab Sustainability Plan

One of the many ways that Sanford Lab encourages and maintains sustainable practices is by recycling. The list includes batteries, oil, cans, steel, aluminum, copper, plastics, and paper. Sanford Lab has been recycling since 2008. Recycling bins can be found in the Administration and Education and Outreach buildings, and at the Ross Dry.



Figure 8: Environmental Manager John Scheetz sorts Sanford Lab's recyclables

Environmental Manager John Scheetz (shown in Figure 8) is committed to reducing waste sent to landfills. "Landfill space is at a premium. Anytime you build a landfill it takes that land out of use for a long time," Scheetz says. Landfills sometimes have their own problems. Waste from landfills interacts with rainwater, and then runs off. This water is collected in pools, and has to be cleaned before being released into the water supply. Over time, Scheetz said, almost all landfills leak to some degree, which can create even greater problems.

Sanford Lab staff initiated a sustainability plan to help protect the environment and use fewer resources more efficiently. Sanford Lab also makes every effort to be energy efficient. The staff manages water and soil, and carpooling is encouraged, along with walking and bike riding.

Safety at Sanford Lab

As part of Sanford Lab's ongoing commitment to safety, the Emergency Response Team (ERT) recently did a safety walk-through at the Davis Campus 4850 Level (shown in Figure 9). Health and Safety Coordinator Chuck Lichtenwalner pointed out the air-handling system, primary and secondary egresses, and the sprinkler system. He also discussed chemicals and hazardous materials used by the experiments. For example, a Class D fire extinguisher would be used to put out metal fires.

"Our goal in any emergency situation is to save lives," says ERT Lead Woody Hover. "To do that we have to understand the specific challenges we might face anywhere underground."



Figure 9: Emergency Response Team members train in coveralls made of Nomex, a flame resistant material. Team members also wear red to help others identify them as emergency responders.

EDUCATION AND OUTREACH

Activities

Steve Gabriel, Spearfish High School teacher and Sanford Lab researcher, is the recipient of the 2014 Kelly Lane award given annually by the *South Dakota Space Grant Consortium*. The award will enable Steve to expand the instrumentation he has on the 4850 Level to monitor environmental conditions (air flow, temperature, etc.) and to install networking capability for remote access to the data. The experiment will be the first long-term underground experiment at Sanford Lab run by high school students.

Lead-Deadwood High School has started a pilot research course in partnership with Sanford Lab. Robin Dirksen is teaching the class, and Science Education Specialist Julie Dahl is working closely with her on its design and its connections with Sanford Lab. In January, students heard from SURF Education and Outreach Deputy Director Peggy Norris, Mining Consultant Jim Whitlock, Brianna Mount of BHSU, Cynthia Anderson from BHSU, and Rajesh Sani from SDSMT about their research. On their visit to the lab on January 29, they talked to SURF Experiment Support Manager and LUX Operations Manager Mark Hanhardt, SURF Multimedia Specialist Matt Kapust, and Lead-Deadwood alumnus Andrew Brosnahan via videoconference to the 4850 Level). In the coming weeks, they will be developing ideas for a research project and writing a proposal. Connie Walter, SURF

Communications Director, will be helping to critique their written proposals before they begin their research. As a culminating event, students will present their research findings onsite at Sanford Lab in May.

Connie Walter and Peggy Norris traveled to Aberdeen, SD on January 29-30 to give a presentation in conjunction with the *Into the Dark* art and photography show. They talked to art and science students from the Britton-Hecla and Aberdeen school districts. Several members of the general public attended as well. The *Into the Dark* show is now at Augustana College in Sioux Falls, where it will run through March 8.

Community Lecture Series

On March 13, Ben Sayler will be the featured speaker at the PROMISE Community Lecture Series a free, monthly seminar hosted on the second Thursday of each month at the Sanford Center in Sioux Falls, South Dakota. Invited speakers are leaders in their respective fields of research representing academic institutions and industry in the South Dakota region.

ENVIRONMENT, HEALTH & SAFETY

EHSOC meeting

EHSOC (Environment Health and Safety Oversight Committee) held its first 2014 review of Sanford Underground Research Facility (SURF) in Lead on January 22-24. The Committee reviewed EHS progress regarding construction projects and research experiments as well as other ongoing activities. SURF staff and collaboration researchers provided detailed presentations regarding current ongoing efforts highlighting progress and safety incidents and injuries. Members of the committee also received a tour of the underground campus (shown in Figure 10).

Overall, EHSOC acknowledged excellent progress but expressed concern about injury trends over the past three years. EHSOC recommendations were provided on a number of fronts to assist in reversing these trends.

SURF would like to welcome Ian Evans, of SLAC as the new Committee Chairperson as well as thank the entire committee for their time and effort.



Figure 10: Ian Evans (EHSOC Chair) with Evan Pease (LUX) and David Taylor, SURF Senior Project Engineer



Weather Safety

Slips, trips, and falls commonly take place on wet or icy surfaces, especially during rain and snow season.

- Slow down, so you can get ground traction
- Wear slip-resistant footwear
- Avoid carrying heavy loads that may throw you off balance
- Be aware of your surroundings – look ahead for ice, deep puddles, or uneven surfaces

UPCOMING CONFERENCES AND WORKSHOPS

Dark Matter 2014, UCLA's 11th Symposium on Sources and Detection of Dark Matter and Dark Energy in the Universe, February 26-28, 2014. Northwest Auditorium, Covel Commons, UCLA.
<https://hepconf.physics.ucla.edu/dm14/>

APS April meeting, Savannah, GA, April 5-8, 2014. Particle physicists, nuclear physicists, and astrophysicists will share new research and insights.
<http://www.aps.org/meetings/april/index.cfm>

Neutrino 2014, XXVI International Conference on Neutrino Physics and Astrophysics, Boston, MA, June 2-7, 2014.
<http://neutrino2014.bu.edu/neutrino-2014/>

Neutrino Day, Lead, South Dakota. July 12, 2014. Annual free science festival at SURF, Homestake Visitor Center, and downtown Lead. Science exhibits and talks, surface campus tours of SURF, and other activities. <http://sanfordlab.org/>

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=neutrino_s14



JOBS

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

Postdoctoral Research Assistant, University of Oxford. Research on the MicroBoONE and LBNE Experiments. Vacancy ID: 112001. Deadline: 3/21/14. r.guenette1@physics.ox.ac.uk. <https://www2.physics.ox.ac.uk/about-us/job-opportunities>

Postdoctoral Researcher, Louisiana State University. Work with experimental physics group on the T2K experiment. Thomas Kutter kutter@phys.lsu.edu. Deadline: March 2014. <http://inspirehep.net/record/1281988>

Postdoctoral Research Assistant, University of London. Research with DEAP/CLEAN group, experimental dark matter searches. Reference #: X0114/6551. Deadline: 2/24/14. Contact: Jocelyn Monroe, Jocelyn.Monroe@rhul.ac.uk <https://jobs.rhul.ac.uk/rhrl/pages/vacancy.jsf?latest=9>

Postdoctoral Fellowship, Physics, LBNL. Work on LUX dark matter, and possibly LUX-ZEPLIN next generation dark matter experiments. Deadline: 4/14/14. Dominga Estrada, estradadr@lbl.gov <https://academicjobsonline.org/ajo/jobs/3826>

Faculty positions, University of South Dakota. Tenure-track Professor and Assistant Professor in Earth Sciences and Physics. Posting numbers: 5811 and 5812. Apply: <https://yourfuture.sdbor.edu>

Tenure-track faculty positions, South Dakota School of Mines, Rapid City, SD. Junior and senior faculty openings in South Dakota's new physics doctoral program. Open until filled. <http://inspirehep.net/record/1260920>

<http://inspirehep.net/record/1260921>

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>

Newsletter Editor: Melissa Barclay

Contributors: Kevin Lesko; Connie Walter (Sanford Lab local news); Ryan Martin (New South Dakota Ph.D. Program); Kurt Riesselmann (Prototype cryostat for LBNE); John Wilkerson (MJD annual review); Peggy Norris, Ben Saylor (Education and Outreach); Joe Gantos (EHSOC)

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