

Dear SURF Readers,

Welcome to the May 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

June 27-28: CUBED collaboration meeting – Lead, South Dakota

July 12: Neutrino Day - Lead, South Dakota



P5 Draft Report

On May 22, a new report released from the particle-physics community advises that there be strong support for the sciences in place at the Sanford Underground Research Facility (SURF). The report, developed by the Particle Physics Project Prioritization Panel (P5), presents a strategic plan for high-energy physics in the United States. In September 2013, the Department of Energy (DOE) Office of Science and the National Science Foundation (NSF) charged the 25-member panel to “develop an updated plan for U.S. high energy physics that can be executed over a 10-year timescale, in the context of a 20-year global vision for the field”. UC Santa Cruz Physics Professor Steven Ritz chaired the P5 panel.

The panel recommends a U.S. particle physics program that includes research into neutrinos and dark matter, both of which are basic components of the program at Sanford Lab. Research related to the Higgs boson, dark energy, and cosmic inflation as well as yet-to-be-discovered particles, interactions, and physical principles are also covered among the recommendations.

“It’s clear the particle physics community is making a strong commitment to these programs, and we’re

expecting the report will play a key role in the federal government funding process for years to come,” said Mike Headley, Executive Director of Sanford Lab.

The P5 recommendations include:

- Proceed immediately with a broad Gen2 (Generation 2) dark matter program at significantly increased funding levels than previously proposed
- Pursue Gen3 (Generation 3) dark matter experiments as part of an international program with the United States hosting at least one of the G3 experiments
- The Long-Baseline Neutrino Experiment (LBNE) should be re-organized as a broader international effort led by Fermilab, and renamed the Long-Baseline Neutrino Facility (LBNF).

While noting that “LBNF is the highest priority large project in its timeframe,” the panel concluded that “to address even the minimum requirements specified (above), the expertise and resources of the international neutrino community are needed. A change in approach is therefore required. The activity should be reformulated under the auspices of a new international collaboration, as an internationally coordinated and internationally funded program, with Fermilab as host.”



Figure 1: Illustration of what the Long-Baseline Neutrino Experiment Facility underground detector complex might look like at Sanford Laboratory

The facility would use a neutrino beam from Fermilab, upgraded through the proposed project Proton Improvement Plan II, “to produce higher intensity beams”. Current plans are for a massive liquid-argon neutrino detector to be placed underground (most likely located at SURF--see Figure 1), with a smaller detector nearer to the source of the beam. LBNF projected construction

and operation phasing, outlined in a timeline featured in the report, depends strongly on resolving various funding scenarios. In rough terms, construction would take place from 2015-2030, with operation to follow.

The panel recommended moving forward on other large projects: the Mu2e experiment at Brookhaven National Lab, Muon g-2 at Fermilab, upgrades to the Large Hadron Collider at CERN and to its experiments. P5 remarks, “The LHC upgrades constitute our highest-priority near-term large project”.

The United States would continue to be a leader in particle physics, playing a major role at the Large Hadron Collider at CERN, hosting a world-leading neutrino program, and participating in the development of a proposed international linear collider, which may be built in Japan. These efforts, focusing on international collaboration and scientific cooperation, would be aided by specific investments from the DOE’s Office of Science and the NSF Directorate for Mathematical and Physical Sciences.



Figure 2: The LUX dark matter detector, inside its water tank

Planning for Gen2 dark matter experiments at Sanford Lab is already underway. The Large Underground Xenon (LUX), a Gen1 experiment, consists of a detector filled with one-third of a ton of liquid xenon inside a 72,000-gallon tank of ultra-pure water (see Figure 2). One possible G2 experiment, the LUX-ZEPLIN (LZ), would consist of 10 tons of xenon inside the same tank used by LUX. LZ currently is seeking funding from the US DOE and the NSF.

Another recommendation also suggested increased funding for the particle physics components of

cosmic surveys, including completing the Large Synoptic Sky Survey (LSST), and if possible, building the Dark Energy Spectroscopic Instrument (DESI). Other projects mentioned were the Cosmic Microwave Background (CMB) experiments, and small projects that include short-baseline neutrino experiments. Overall, the plan addressed a wide range of larger as well as smaller planned or ongoing scientific projects in the United States.

“Overall, the report is great news for Sanford Lab’s science programs,” said Kevin Lesko, SURF Operations Head at Lawrence Berkeley National Lab. “These programs all need the facilities the Lab has made available to the science community—a dedicated, deep underground facility.”

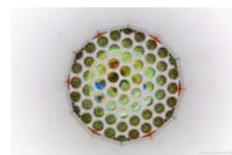
Several prospective budget plans were presented in the Charge to P5 as context for considering its recommendations. Two would have DOE’s particle physics budget level for three years, one followed with 1.5 percent per year increases, the second by 2 percent per year. The third would be without limits. Budgetary considerations also concern R&D funds, and funds toward the Japanese-hosted International Linear Collider (ILC). Clearly, there are still some financial details to be worked out before implementation, but this recommendation marks a major milestone in the life of the LBNF and science underground.

A summary of the report has been posted at:

<http://usparticlephysics.org/p5/>

To read the full 78-page report, see:

<http://science.energy.gov/hep/hepap/reports/>



Dark Matter Workshops

Lawrence Berkeley Lab hosted two dark-matter workshops during the month of May.

On May 8, Kevin Lesko, LBNL Senior Scientist and Head of SURF Operations, hosted the Institute for Nuclear and Particle Astrophysics (INPA) Dark Matter Workshop, held in the Lab’s Building 50 Auditorium. More than 70 scientists from UC Berkeley, LBNL, UC Davis, UC Santa Barbara, Lawrence Livermore Lab, Yale, Case Western, and other institutes in the United States gathered to hear

featured speakers. The speakers included Uros Seljak (UC Berkeley/LBNL), Surjeet Rajendran (Stanford), George Fuller (UC San Diego), Ian Hinchliffe (LBNL), Wick Haxton (UC Berkeley/LBNL), Michael Witherell (UC Santa Barbara), Spencer Klein LBNL, and Matthew Pyle (UC Berkeley) presenting on various current topics of dark matter.

On May 9-10, Carlos Faham, Chamberlain Postdoctoral Fellow at Lawrence Berkeley Lab, organized the two-day workshop for the LUX collaboration which 26 scientists attended (see Figure 3). The LUX collaboration is preparing for a new run of the Large Underground Xenon detector this year; the workshop focused on data processing and analysis.



Figure 3: Members of the LUX collaboration gather outside LBNL's Building 50C

Reports/Papers Available

[Scientific Opportunities with the Long-Baseline Neutrino Experiment](http://arxiv.org/abs/1307.7335) (Cornell University Library, <http://arxiv.org/abs/1307.7335>)

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

[Why the US Needs a Deep Domestic Research Facility](http://arxiv.org/abs/1304.0402). (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

Symmetry Magazine: [Proposed plan for the future of US particle physics](#) (Kathryn Jepsen, May 22)

Physics World: [US particle-physics panel presents plan for the future](#) (Tushna Commissariat, May 23)

LA Times: [Report champions \\$1-billion effort to make U.S. a neutrino science hub](#) (Amina Khan, May 22) / Also in *Chicago Tribune*

New Scientist: [Neutrinos top list of targets for US particle physics](#) (Jessica Orwig, May 22)

CBS (Washington, DC): [Physics Panel: US Should Build Billion-Dollar Project To Beam Ghostlike Subatomic Particles Underground](#) (Associated Press, May 22)

Nature World News: [\\$1 billion Plan to Make US Particle Physics Hub](#) (Jenna Iacurci, May 23)

Fermilab Today: [A New Plan for U.S. Particle Physics](#) (Nigel Lockyer, May 23)

Science Mag.org: [New Plan for U.S. Particle Physics: Go International](#) (Adrian Cho, May 22)

Today at Berkeley Lab: [A 10-Year Plan for Particle Physics](#) (May 23)
[Lab Hosts Dark Matter Workshops](#) (May 19)
[Low Background Counting Facility Moves to Sanford Underground Research Facility](#) (April 25)

Ars technica: [US particle physics roadmap: Build facilities for neutrinos and muons](#) (John Timmer, May 23)

Daily Herald: [Physics panel to feds: Let Fermilab beam neutrinos](#) (Associated Press, May 22)

NBC News: [Neutrinos Take Center Stage in America's Plan for Future Physics](#) (Alan Boyle, May 21)

Prairie Business Journal: [Research & Technology: World-class Sanford Lab supports local education, economy](#) (Constance Walter, April 25)

Black Hills Fox News: [Residents See Sanford Underground Lab](#) (May 1)

Watertown Public Opinion: [Sanford lab shows off wares](#) (Rachelle Klemme, April 12)

Capital Journal: [‘Exciting’ new science center is ready for construction at BHSU](#) (Bob Mercer, April 28)

[Homestake mine continues legacy of physics research](#) (David Rookhuyzen, April 6)

Rapid City Journal: [BHSU music student and faculty member use Sanford Underground Lab as inspiration for compositions](#) (BHSU, May 21)

[New \\$4.5M Lead visitor center on track for June construction](#) (Tom Griffith, April 28)

Black Hills Pioneer: [New science center readies for construction at BHSU](#) (Bob Mercer, April 30)

[Lead to receive historic cultural neighborhood signs](#) (Jaci Conrad Pearson, April 26)

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

MAJORANA Copperforming Update

The MAJORANA DEMONSTRATOR (MJD) experiment continues to grow pure electroformed copper, which is then machined into various copper parts and pieces to be used in the experiment. Over the past few years, MJD experimenters have machined thousands of pieces of copper, including cryostats, copper shields, and connectors (see Figure 4). Each piece is machined underground to minimize exposure to cosmic rays and radioactive materials. The shop is filled with computer-controlled machine tools. An arbor press pushes pins into a plastic known as Vespel. The lathe machines the outer layer of the copper while it's still in the mandrel, a slitting saw cuts the copper cylinders in half, and a 70-ton press flattens the copper pieces. A laser engraver traces serial numbers into each piece of

copper, allowing scientists to track the copper to its origins. An electron beam welder (e-beam) is used to two quality welds on each cryostat. The electrical discharge machine or EDM vaporizes copper as it cuts hundreds of tiny parts that are identical to within two ten-thousandths of an inch.



Figure 4: Tiny parts made in the MAJORANA machine shop. These small pins will hold the conductive wire in the copper clip at the right. (Pen is shown for scale.)

The variety of complex machines and parts can create challenges. For example, machinist Randy Hughes was faced with gold-plated brass pins, each thinner than a single hair strand, which did not quite fit. His goal was to come up with an optimal drill size to give the holes the ideal fit for the pin.

Matthew Busch, R&D Engineer at Duke University/Triangle Universities Nuclear Laboratories says, “We have to modify the tool or the design. We have to determine how we can make what we need with the tools we have.”

Currently, MJD experiments are collecting data with a prototype that is not made with ultra-pure copper. Their ultimate goal is to work only with ultra-pure copper, but meanwhile, they are using the experience to learn and make necessary changes by the time they begin data collection.

“The whole idea is to test everything we do before we begin the ultra-pure experiment,” said John Wilkerson, Principal Investigator on the project, and Physics and Astronomy Professor at the University of North Carolina.

Science, Construction, and Customer Service

The simultaneous activity of ongoing experiments and continuing construction for future experiments at Sanford Lab is a major topic of concern. One of these construction projects is the Ross Shaft rehabilitation that stirs up dust and other debris,

which is then carried to the underground shaft as construction moves forward.

"It's impeding the objectives of some of the experiments," said SURF Underground Access Director Will McElroy. "We take that very seriously."

One area of challenge concerns the lab where copper is electroformed for the MJD experiment. Filters trap particles as they enter the area, and the electroforming lab was not designed to handle the high level of construction currently underway.

When particle counts are too high, activity in the clean room stops, reported Cabot-Ann Christofferson, Liaison to Sanford Lab for the MJD project. "If it's too dirty, we can't open the electroforming baths and that puts us behind schedule."

Project Engineer Bryce Pietzyk and Mechanical Engineer Mike Johnson came up with a solution. Technicians set up a new filter system designed to match the airflows between the Ross Shaft and the clean room. Sanford Lab's hazard mitigation and engineering crews worked with *Ainsworth-Benning Construction*, placing a fan and filter in the drift. They then designed a structure around it that includes Kennedy panels and a drive-through door (see Figure 5). Sealant was placed around the foundation to minimize leakage and force air through the fan.



Figure 5: Terry Garcia of Ainsworth-Benning Construction in the newly-constructed Kennedy drive-through structure (right). The filter system (left) is designed to keep the air in the copper electroforming lab clean. Fan is on the back of the filter wall.

"We need to find solutions that work for science," said Pietzyk. "So we can continue to improve the facility for future experiments."

Christofferson was pleased with the result. The increased construction activity has also increased

demands on the cages, which go down into the shaft. SURF Operations has added a 6:30 a.m. time to accommodate construction crews, lab personnel, and scientists.

"Infrastructure technicians wear two hats: customer service and construction," said McElroy. "We strive to be professionals at both."



New Info on Travel to Lead

Road construction will take place in The City of Lead from May 1 to October 1, 2014 and into 2015, with the starting and ending dates subject to weather conditions. The City of Deadwood project is expected to overlap during 2015 and will cause problems with access to SURF from Deadwood up Hwy 85 to Mill Street. It is recommended that all SURF traffic come through Central City, via Hwy 14.

In 2014, the Main Street utilities and grading project will move in 3-block intervals starting at the east end of Julius and Main Street and progress towards Blue Street. Main Street traffic will be detoured to Julius Street.

In 2015, the project will continue from Blue Street to Blatt Street. In 2014, beyond the main construction effort, there will be intermittent road closures due to joint and spall repair activities ongoing from Pluma to the top of Glover's Hill and Baltimore, where they join with Hwy 14.

Due to the complete closure of Main Street and the tight radius turns from Main Street onto any street which connect to the detour street of Julius Street, it is recommended that SURF institute a system of escorting deliveries, especially long or wide loads via West Summit Street.

EDUCATION AND OUTREACH

Activities

Across South Dakota, at high schools too small to offer their own Physics courses, students are able to take Physics long-distance through the State's E-Learning Center. Headquartered at Northern State University, the E-Learning center recently utilized the *Dakota Digital Network (DDN)* for a

videoconference session connecting their physics students with scientists at the Sanford Underground Research Facility. Approximately 30 students participating from ten rural schools at Canistota, Frederick, Montrose, Deubrook, Armour, Corsica, Plankinton, Hamlin, Herreid, and Jones County. Mary Cundy, Principal of the E-Learning Center, sent a Thank-You Note:

Yesterday, Jacki Omland hosted an outstanding educational experience for her physics students by arranging for them to visit with you and to enter the research environment at the Sanford Underground Lab via DDN connection. I am so grateful to you for hosting this visit! You let students see something that is not readily available in South Dakota: scientists at work.

I was particularly impressed by the two graduate researchers; their enthusiasm and energy was infectious! What a remarkable opportunity for Jacki's students to glimpse a career that they may know very little about.



Figure 6: Peyton, daughter of Infrastructure Tech Fritz Reller signs the board at the cage

On the Sanford Lab surface, a busy season of school field trips is winding down with the beginning of summer. Almost every day during the last month, a new group visited Sanford Lab or the Homestake Visitor Center for science activities. Groups ranged in size from 12 to 112 and included all ages from elementary students through undergraduates. The following schools were served since mid-April:

Elementary Schools:

South Dakota: Knollwood (Rapid City), Lead-Deadwood, Rapid Valley (Rapid City), Vandenberg (Douglas), Black Hills Catholic Home School Association

North Dakota: Amidon, Marmot (Mandan)
Wyoming: Prairie Wind (Gillette)

Middle Schools:

South Dakota: Spearfish, Red Shirt (Pine Ridge), Wall, Black Hills Catholic Home School Association

High Schools:

South Dakota: Lead-Deadwood, Wall, Black Hills Catholic Home School Association

North Dakota: Killdeer

College: Iowa: Upper Iowa University

ENVIRONMENT, HEALTH & SAFETY



Barbecue Safety

- Do not wear loose clothing while cooking.
- Be careful when using lighter fluid. Do not add fluid to an already lit fire. Keep lighter fluids away from children and pets.
- Dispose of hot coals properly: douse them with plenty of water and never place them in plastic, paper, or wooden containers.

UPCOMING CONFERENCES AND WORKSHOPS

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/>

42nd SLAC Summer Institute 2014, SLAC, Menlo Park, CA. Shining Light on Dark Matter, August 4-15, 2014. Focus on quest to identify Dark Matter. Morning lectures, afternoon topical conference talks, discussion sessions, tours, and social events. <http://www-conf.slac.stanford.edu/ssi/2014/>

Neutrino Summer School, St. Andrews, Scotland, August 10-22, 2014. An opportunity for students and postdocs to discuss neutrino physics.

<http://www.hep.anl.gov/ndk/hypertext/numeetings.html#ins14>

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=neutrino14>



JOBS

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

Research Associate, Stanford-SLAC. One or more openings. Participate in LUX science running, launching LZ, and long-term R&D. Dan Akerib, akerib@slac.stanford.edu. Deadline: 6/1/14. <https://academicjobsonline.org/ajo/jobs/4012>

Postdoctoral Research Associate, Wright Laboratory, Yale University. Two openings in Weak Interactions Group. Contact: Profs. 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. Contact: Gregory Pawloski, pawloski@umn.edu https://employment.umn.edu/applicants/jsp/shared/search/Search_css.jsp

Postdoctoral Fellowship, Physics, LBNL. Work on LUX dark matter, and possibly LUX-ZEPLIN next generation dark matter experiments. Deadline: 7/22/14. 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 Inews); Peggy Norris, Ben Saylor (Education and Outreach)

Photo Credits: Fig. 1: Courtesy of Fermilab; Figs. 2,3,6: Matt Kapust; Fig. 3: Carlos Faham; Fig. 5: Cabot-Ann Christofferson

Lawrence Berkeley National Lab

Kevin T. Lesko: 510-486-7731

KTLesko@lbl.gov

Melissa Barclay: 510-486-5237

mbarclay@berkeley.edu

SDSTA/Sanford Lab

Mike Headley, Executive Director

Mandy Knight, 605-722-8650, x222

MKnight@sanfordlab.org

<http://www.sanfordlab.org/>

BERKELEY OFFICE

SURF Project Office

Lawrence Berkeley National Lab (LBNL)

One Cyclotron Road

MS 50B-5239

Berkeley, CA 94720