

**Dear SURF Readers,**

Welcome to the September 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](http://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**

**October 13-14: LZ EHS Review, Lead, SD**  
**October 15: LZ Infrastructure Review, Lead, SD**

**October 27-29: LBNF CD-3a Directors Review, Lead, SD**

**Prepping for LZ**

The LUX-ZEPLIN (LZ) experiment is a Generation 2 (G2) dark matter experiment approved by the U.S. Department of Energy. As a G2 experiment, it is a huge scale-up from previous detectors, e.g., the LUX G1 experiment currently operating at SURF. LUX uses approximately 380 kg of liquid Xenon to search for dark matter; LZ will use 10 metric tons of Xenon.

The Figure 1 CAD rendering--the 1.8 m (6-ft) tall mannequin establishes scale--shows a comparison of the LUX and LZ inner cryostat vessels. The LZ vessel diameter and height both are seen to be significantly larger than LUX's.

Years ago, when the Davis Campus was being designed, a future G2 experiment was envisioned to be incorporated. For example, the 265m<sup>3</sup> (70,000 gal) neutron-shield water tank for either detector has a 2.6m (102-inch) diameter center flange of sufficient size for LZ installation. Further, the Davis Campus has power and cooling capability installed that well exceeds the current demands of LUX and the MAJORANA DEMONSTRATOR.

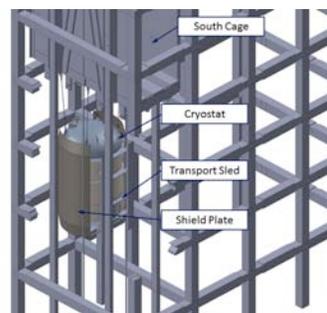
To achieve the maximum detector sensitivity, the cryostat vessels--inner and outer--sizes have been based on SURF engineering inputs for the maximum

size that can be transported within SURF infrastructure. Lightweight mockups were carried through the Davis Campus LN (Liquid Nitrogen) storage drift and entrance corridor in 2013 to verify that the inner cryostat could be transported to the Davis Cavern.

As the design of the cryostat has matured, the vessel has grown in diameter from what was originally conceived in 2012. The growth has been primarily a result of the need to reduce peak electric fields around the high voltage cathode near the bottom. The diameter of the current design is 1.7m (67-inches).



*Figure 1: Comparison between the current LUX dark matter detector and the larger LZ detector*



*Figure 2: CAD simulation of detector slung below Yates south cage*

SURF Mechanical Engineer Mike Johnson has been developing designs and methods for transport of the inner cryostat vessel from the Surface Assembly Lab to the Davis Campus via the Yates Shaft. A key part of that transport is rotating the cryostat from a horizontal to a vertical orientation while it is slung under the south cage in the Yates Shaft. The design shown in Figure 2 incorporates a thin sheet metal shield that can be attached to the cryostat to protect its exterior from bumps or scrapes that may happen as the cryostat descends to the 4850 Level.

Both titanium vessels are being supplied by the United Kingdom members of the LZ collaboration. They are long-lead fabrication items. Design for the vessels is nearing completion, and procurement

documents are in final preparation to start the bid process. To assure that the slightly larger vessel along with protective shield will be able to traverse the Yates Shaft (Figure 3), in June the project did a mock run of the load in the Yates Shaft, assisted by SURF Operations. Figure 4 shows the mock load being slung under the cage.



*Figure 3: From left: Infrastructure Tech Jarred Burluson, Rope Tech Rick Tinnell, and Infrastructure Techs Ricky Alan, Kirby Cleland, and Mike Harvey prepare to lower a scale model of the LZ dark matter detector down the Yates Shaft*



*Figure 4: Loading the mock load with slings attached to Yates south cage*

After a visual check of clearances, the load was lowered to the 4850 Level accompanied by several infrastructure technicians who were able to monitor progress visually through an opening in the floor. The transport was also recorded with a Go-Pro TV camera for review. Transport time down was approximately 45-minutes as opposed to the 12-minute typical trip. The slower speed was chosen to reduce swaying of the load. Even so, some swaying resulted in the shield rubbing on the wooden guides or the “rope dog” cables. This was anticipated in the design of the shield. The real detector will be lowered yet more slowly to reduce swaying further.

The mock-run experience taught, most important, that the as-designed inner cryostat will fit in the Yates Shaft. Another conclusion is that there should be mock runs of a load closer to the final

configuration’s size and weight to allow for more practice of the most difficult loading and unloading sequences. Those tasks require close communication between crews that have tension lines attached to the bottom of the cryostat while the hoist operator moves the cage in concert while relying on radio communications. These activities planned for the future.

### **Visit to Boulby Underground Lab**

On Wednesday, August 12, Kevin Lesko (LBNL), Keenan Thomas (LBNL & UCB), Chamkaur Ghag (University College London), Alex Murphy (University of Edinburgh), Roy Preece (Rutherford Appleton Laboratory), and Henrique Araujo (Imperial College) visited the Boulby Underground Laboratory on the northeast coast of England (Figures 5-6). The lab, housing the ZEPLIN-III dark matter detector and other scientific projects, is located 1100 meters belowground in a potash mine. Current studies at Boulby include the search for Dark Matter, studies of cosmic rays and climate, astrobiology and life in extreme environments, development of techniques for deep 3D geological monitoring, and studies of radioactivity in the environment.



*Figure 5: Alex Murphy, Chamkaur Ghag, Keenan Thomas, Kevin Lesko, Henrique Araujo, and Roy Preece inspect one of the Low Background HPGe detectors*

Chamkaur Ghag and Kevin Lesko are Principal Investigators on a Royal Society Grant promoting technological advancements in low background assay and collaboration among their institutions. At Boulby, Kevin, Keenan, Chamkaur, Jim, Alex, and Henrique visited the existing low background assay devices and discussed their plans and schedule for creating a new facility at Boulby supporting low background assay. The group was hosted by Sean Paling, the Boulby Laboratory Director.

The assay of the detector components for trace quantities of Uranium, Thorium, Cobalt, Potassium,

and other radio-nuclei is critical for the success of experiments such as LUX-ZEPLIN (LZ) located at SURF. The low background detectors at SURF are also moving to a new location at the 4850 Level, the Black Hills Underground Campus over the coming several months.



*Figure 6: Group visits site of the new low background assay facility in Boulby*

The visit was timely and very useful in exchanging techniques, designs, and methods of reducing assay backgrounds. Keenan and Kevin were then hosted at UCL, where Chamkaur is installing a state-of-the-art ICMPS (inductively coupled plasma mass spectrometry) instrument used to perform trace metal analysis. The Berkeley Low Background Counting Group and the Boulby Low Background Facility will continue collaborating as their facilities continue to enhance sensitivities and sample throughput.

To read more about the Boulby Underground Lab: <http://www.boulby.stfc.ac.uk/Boulby/>

## REPORTS/PAPERS AVAILABLE

[The Sanford Underground Research Facility at Homestake \(SURF\)](#). (K.T. Lesko, Phys.Procedia 61 (2015) 542-551.)

For supplemental information on the kISMET/ SubTER article (August SURF monthly newsletter): [http://science.energy.gov/~media/bes/pdf/reports/2015/BES\\_CSFFF\\_rtp.pdf](http://science.energy.gov/~media/bes/pdf/reports/2015/BES_CSFFF_rtp.pdf)

[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](http://www.sanfordlab.org)  
**Like SURF on Facebook:** <http://www.facebook.com/SURFAtHomestake>



## SURF IN THE NEWS

*Symmetry:* [The birth of a black hole](#) (Laura Biron, September 9)

*Scientists below the surface* (Laura Biron, September 3)

*Cosmos:* [Ghost traps: the hunt for dark matter](#) (Robin McKie, September 21)

*The Washington Times:* [New sculpture in Lead honors Nobel Prize recipient](#) (Jaci Conrad Pearson, Associated Press, September 6)

*India Post:* [Memorable visit to Mount Rushmore Black Hills](#) (Lina Shah, September 15)

*Radiolab.org:* [Elements](#) (podcast with Damiano Marchetti, Andy Mills)

*Kane County Chronicle:* [Fermilab planning to study neutrinos to understand more about universe](#) (Eric Schelkopf, August 31)

*Philanthropy News Digest:* [Community Foundation Update](#) (Staff, September 19)

*KEVN news:* [SDSTA receives \\$2,000,000 investment](#) (Staff, September 17)

*KOTA news:* [New Visitor Center - The Sanford Lab Homestake in Lead](#) (Priscilla Borrego, September 7)

*Rapid City Journal:* [SD Community Foundation investing \\$2 million in Sanford Lab](#) (Jim Holland, September 18)

[Governor visits BHSU during Spearfish Capital for a Day](#) (BHSU Staff, September 14)

[Another researcher named to SDSTA](#) (Bob Mercer, September 1)

*Black Hills Pioneer:* [\\$2M awarded to upcoming Sanford Lab project](#) (Staff, September 20)

## DURA News

To comment on DURA, please contact its chair Richard Gaitskell ([Richard.Gaitskell@brown.edu](mailto:Richard.Gaitskell@brown.edu)). For Bio-Geo-Engineering matters, contact Bill Roggenthen ([William.Roggenthen@sdsmt.edu](mailto:William.Roggenthen@sdsmt.edu)).

For further information on DURA, see: <http://sanfordlab.org/dura>

## SANFORD UNDERGROUND LABORATORY NEWS

### Sculpture Dedication

On August 26, the Raymond Davis Jr. Memorial sculpture was dedicated in a ceremony held at the new Sanford Lab Homestake Visitor Center with nearly 100 in attendance. Speakers included Mike Headley (Executive Director of the South Dakota Science and Technology Authority), John Wilkerson (Principal Investigator of the MAJORANA DEMONSTRATOR (MJD) Project and a former colleague of Davis), Roger Davis (son of Ray Davis), and David Kieda (Dean of the Graduate School, University of Utah), who formerly worked with Davis at Homestake as a graduate student. Their talks highlighted the 2002 Nobel Prize winner, who built his solar neutrino experiment on the 4850 Level of the former Homestake Mine in the 1960s, as a scientist and a person.



*Figure 7: Dedication of Raymond Davis Jr. Memorial sculpture with Mike Headley speaking to the crowd*

A primary element of the sculpture, designed by South Dakota Artist Laureate Dale Lamphere, includes a tank support from the Davis experiment (Figure 7). A secondary element features a gigantic stainless steel ring that floats off the interior of the tank support. The sculpture also has a light feature. Lamphere also designed a tribute to the Homestake miners, located in a downtown Lead park.

### MAJORANA DEMONSTRATOR Milestones

In July, Postdoctoral Researcher with Oak Ridge National Lab (ORNL) Brandon White made the last of 11 trips between ORNL and Sanford Lab to pick up seven of 35 detectors (Figure 8). This travel, starting in February 2013, has been in aid of the

MAJORANA DEMONSTRATOR (MJD) Project, which uses enriched germanium detectors in its search for a rare form of radioactive decay. The detectors are manufactured in Oakridge, Tennessee, and then stored at the back of the Historic Cherokee Caverns in special safes to protect them from cosmic rays. Before transport, each detector was mounted securely inside a cryostat and packed into wooden crates lined with thick foam padding. White had a limited time frame of 36 hours to reach SURF.

“Cosmic rays can change the germanium material into other radioactive isotopes. Spending less time at higher elevations or increasing the amount of shielding around the detectors could reduce the rate of production of these isotopes,” said Alan Poon, MJD Group Leader at Berkeley Lab.



*Figure 8: From left: Brandon White, Elisa Romero, Ryan Martin, Yuen-Dat Chan, Susanne Mertens, and Alfredo Galindo-Uribarri take enriched germanium detectors to the Davis Campus 4850 Level*

Once packed, White and another MJD collaborator would begin the 1464-mile trip with a single stop in Omaha, staying in a very tall concrete hotel with a room on the lower level, where the other rooms and the concrete served as shielding. White would monitor the detectors throughout the journey.

Once at SURF, safely underground, the detectors were cooled to liquid nitrogen temperatures, and then run through a series of tests and calibrations to ensure that they met experiment standards. All seven detectors have been tested and will be used in Module 2, which is expected to be operational in 2016.



### Info on Travel to Lead

Check for detour routes through Deadwood and Lead: <http://www.highway85lead.com/traffic>

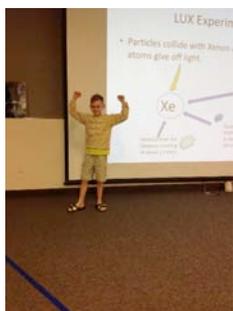
## EDUCATION AND OUTREACH

### 2015-16 School Visit Programs

The Sanford Lab Education and Outreach Department has developed four school visit programs for the 2015-2016 school year. The programs are designed to take 30-50 minutes and will engage students in Science, Technology, Engineering and Math (STEM) by introducing them to science and engineering topics related to Sanford Lab. Sanford Lab staff and members of the science collaborations who may be interested in visiting classrooms in the region are invited to contact E&O about making use of their PowerPoint presentations and other material.

#### Elementary (Grades K-5)

*A Day in the Life of a Scientist:* Working a mile underground is unique. How do the scientists who work at Sanford Lab every day get underground? What do they wear and what do they do? This engaging presentation will have students playing scientist in an underground research laboratory.



*Figure 9: Sanford Lab staff members were invited to be students as the assembly programs were tested. SURF Project Manager Pam Hamilton's youngest son, Coy, became a WIMP*

*Nerds Searching for WIMPS:* Students are introduced to dark matter - a mystery particle that is much more abundant than anything in the universe, but has not (yet) been detected – and to the experiment, LUX, that is searching for it at Sanford Lab. Students will participate in a tag game that simulates the components and interactions within the LUX detector (Figure 9). Recommended for grades 3-5.

#### Middle School (Grades 6-8)

*Discover Exciting Career Possibilities:* Students will learn about the current work at Sanford Lab and discover potential careers in STEM fields. Operating a research facility nearly a mile underground requires personnel with a wide range of skills. This is

a great opportunity for students to learn about the scientists, engineers, and other professionals that build and design the spaces, develop the tools, collect the data, support the work, and research the questions that are behind the cutting-edge experiments.

#### High School (Grades 9-12)

*Neutrinos – Matter or Not?:* Students will learn about an experiment that will transform our understanding of one of the universe's most abundant but most mysterious particles, neutrinos. The Deep Underground Neutrino Experiment at Sanford Lab will study neutrinos as they oscillate their way through Earth to South Dakota from an accelerator 800 miles away at Fermilab outside of Chicago. Construction will start in a few years, and experiments in this new facility at Sanford Lab will last decades.

#### Recent books about South Dakota or by South Dakota authors

Chris Browne, *The Monster Who Ate the State:* Hagar the Horrible cartoonist has written a children's book with Soozy the dinosaur, born in the Sanford Lab! (South Dakota Historical Society-SDHS-Press)

Elizabeth Cook-Lynn, *That Guy Wolf Dancing*

H. Alan Day, *The Horse Lover*

Richard Etulain, *The Life and Legends of Calamity Jane* (Univ Oklahoma Press)

Jerome A. Greene, *American Carnage: Wounded Knee, 1890* (Univ Oklahoma Press)

Mary Woster Haug, *Daughters of the Grasslands: A Memoir*

John D. McDermott, *Red Cloud: Oglala Legend* (SDHS Press)

Meredith Redlin, Christine Stewart and Julie Barst, *Action, Influence and Voice: Contemporary South Dakota Women*

Arthur Rusch, *County Capitols: The Courthouses of South Dakota* (SDHS Press)

**Tom Campbell**, Science Education Specialist with E&O, will be leaving SURF to pursue other interests. Campbell first worked for *Homestake Mining Co.*, was involved with early DUSEL efforts, and then pursued other career interests before returning to South Dakota in 2014. Best wishes to Tom Campbell on this new phase of his career.

## ENVIRONMENT, HEALTH & SAFETY



### Office Exercise

- To stimulate creativity and improve your thought processes, it is a good idea to leave your chair and take a walk at least once an hour, even if only to the water cooler or coffee machine.
- Avoid hunched posture and staring too closely at your computer screen. Get up and take a stretch.
- Partner with a co-worker to take a walk during the lunch hour.
- Use a phone headset instead of cradling the phone between your neck and ear.

## UPCOMING CONFERENCES AND WORKSHOPS

**APS Division of Nuclear Physics Annual Fall Meeting**, Santa Fe, New Mexico, October 28-31. Travel and lodging awards granted to selected qualified students.

<http://www.lanl.gov/conferences/dnp-2015/>

**NNN15**, International workshop on Next Generation Nucleon Decay and Neutrino Detectors and Unification Day 2 Workshop (UD2), Stony Brook, New York, October 28-31. Funds available for grad students and postdocs.

<https://www.bnl.gov/nnn2015/index.php>

**NuINT 2015**, workshop on Neutrino-Nucleus Interactions in the Few-GeV Region, Osaka, Japan, November 16-21.

<http://indico.ipmu.jp/indico/conferenceDisplay.py?ow=True&confid=46>

**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 [pnorris@sanfordlab.org](mailto:pnorris@sanfordlab.org).

**Lake Louise Winter Institute**, Chateau Lake Louise, February 7-13, 2016. Explore recent trends in particle physics in an informal setting.

<https://uofa.ualberta.ca/physics/research/lake-louise-winter-institute>

**UCLA Dark Matter Symposium**, UCLA Northwest Auditorium, February 17-19, 2016. Sources and

Detection of Dark Matter and Dark Energy in the Universe. Followed by special session on David Cline, February 20.

<https://conferences.pa.ucla.edu/dm16/about.html>



### JOBS

**Chamberlain Postdoctoral Fellows (2016), Lawrence Berkeley National Lab.** Multiple openings in experimental particle physics and cosmology. Deadline: 10/15/15. Contact: Sapana Kanakia, [skanakia@lbl.gov](mailto:skanakia@lbl.gov).

<https://academicjobsonline.org/ajo/jobs/5816>

**Postdoctoral Research Associate, University of Wisconsin-Madison.** Research on both LZ and LUX experiments. Initially situated at SLAC. Contact: Kimberly Palladino, [kpalladino@wisc.edu](mailto:kpalladino@wisc.edu).

**Research Associate, University College London.** Work on the SuperNEMO neutrinoless double-beta decay experiment. Ref: 1492069. Deadline: 10/16/15. Contact: Ms. Khadija Bouzgan, [k.bouzgan@ucl.ac.uk](mailto:k.bouzgan@ucl.ac.uk) or Prof. David Waters, [d.waters@ucl.ac.uk](mailto:d.waters@ucl.ac.uk) / <https://goo.gl/wHKoal>

**Tenure-track Assistant Professor, University of Alabama.** Research in experimental particle physics, focus in neutrinos or dark matter. Deadline: 11/15/15. Contact: Ion Stancu, [ion.stancu@ua.edu](mailto:ion.stancu@ua.edu)  
<https://facultyjobs.ua.edu/postings/37555>

**Assistant Professor, Dept. of Physics, Yale.** Research cutting-edge questions in astrophysics, weak interactions, fundamental symmetries, or physics beyond the Standard Model. Contact: Witold Skiba, [witold.skiba@yale.edu](mailto:witold.skiba@yale.edu) or Paul Tipton, [paul.tipton@yale.edu](mailto:paul.tipton@yale.edu), Deadline: 11/1/15.  
<http://apply.interfolio.com/30535>

**Tenure-track Assistant Professor, Dept. of Physics, Virginia Tech.** Research in experimental particle and nuclear physics. Deadline: 12/1/15. Contact: [hepsearch2015@phys.vt.edu](mailto:hepsearch2015@phys.vt.edu).  
<https://listings.jobs.vt.edu/postings/58844>

**Tenure-track Assistant Professor rank positions, University of South Dakota, Physics.** Ph.D. in physics and postdoctoral experience required. Candidates must have backgrounds/research interests in areas such as dark matter searches,

neutrino experiments, phenomenology or materials science focused on development of detectors utilized in an underground environment such as that found at SURF. Preference for one position will be given to candidates who are currently members of the MAJORANA collaboration. Anticipated start date: 8/22/16, although USD will consider start date of 1/4/16. Job #: 0007467. Queries: [physics@usd.edu](mailto:physics@usd.edu). Apply online: <https://yourfuture.sdbor.edu>

**Assistant Professor Position, Dept. of Physics & Astronomy, UCLA.** Research in experimental nuclear and particle physics. Job #: JPF01535. Deadline: 11/1/15.  
<https://recruit.apo.ucla.edu/apply/jpf01535>

**Lecturer in Experimental Astroparticle Physics, Imperial College, London.** Candidate will also conduct research in Dark Matter, strengthen LZ experiment effort. Job ref: NS2015148PE. Deadline: 9/31/15. Queries: Paul Dauncey, [p.dauncey@imperial.ac.uk](mailto:p.dauncey@imperial.ac.uk), Paula Brown, [paula.brown@imperial.ac.uk](mailto:paula.brown@imperial.ac.uk)  
<http://www3.imperial.ac.uk/highenergyphysics/about/jobs>

**Research Associate, SLAC.** Work with nEXO Collaboration, Neutrinoless Double Beta Decay. Contact: P.C. Rowson, [rowson@slac.stanford.edu](mailto:rowson@slac.stanford.edu), G. Gratta, [gratta@stanford.edu](mailto:gratta@stanford.edu). Deadline: 9/30/15.  
<https://academicjobsonline.org/ajob/jobs/5710>

**State Department Fellowship, American Institute of Physics.** Explore intersection of science, policy, and international affairs. Deadline: 11/1/15. Contact: Jennifer Greenamoyer, [jgreenamoyer@aip.org](mailto:jgreenamoyer@aip.org).  
<https://www.aip.org/policy/fellowships/sdf>

**Nuclear Physics Postdoc, LANL.** Research with Weak Interactions/ Astrophysics Team. Vacancy #: IRC41796. Contact: Steve Elliott, [elliotts@lanl.gov](mailto:elliotts@lanl.gov) / Keith Rielage, [rielagek@lanl.gov](mailto:rielagek@lanl.gov).  
<https://jobs.lanl.gov>

**Postdoctoral Researcher, LLNL.** Work with team to develop and execute nuclear data focused fission-TCP experiment. Job ID: 100107. Contact: Brandon Seilhan, [seilhan3@llnl.gov](mailto:seilhan3@llnl.gov).  
<https://careers.llnl.gov/>

**High Energy and Nuclear Physics Consultant, NERSC, LBNL.** Will consider candidates at Computer Systems Engineer 3 or 4 levels. Job # 81045.

<https://lbl.taleo.net/careersection/2/jobdetail.ftl?lang=en&job=81045>

**Postdoctoral position, Northwestern University.** Research in Dark Matter and Neutrino Physics in group led by Prof. Enectali Figueroa-Feliciano. SuperCDMS second-generation experiment/search for dark matter in the form of WIMPs. Submit to: [postdoc@figueroagroup.nu](mailto:postdoc@figueroagroup.nu)  
<https://inspirehep.net/record/1365222>

**Postdoctoral position, Northwestern University.** Dark Matter Search with Micro-X Rocket, to join the group of Prof. Enectali Figueroa-Feliciano. Deadline: 12/31/15. Submit to: [postdoc@figueroagroup.nu](mailto:postdoc@figueroagroup.nu)  
<https://inspirehep.net/record/1365224>

**Newsletter Editor:** Melissa Barclay  
**Contributors:** Kevin Lesko; Constance Walter (Sanford Lab news); David Taylor (Prepping for LZ); Peggy Norris, June Apaza (Education & Outreach)

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**Lawrence Berkeley National Lab**  
Kevin T. Lesko: 510-486-7731  
[KTLesko@lbl.gov](mailto:KTLesko@lbl.gov)  
Melissa Barclay: 510-486-5237  
[mbarclay@berkeley.edu](mailto:mbarclay@berkeley.edu)

**SDSTA/Sanford Lab**  
Mike Headley, Executive Director  
Mandy Knight, 605-722-4022  
[MKnight@sanfordlab.org](mailto: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**