Dear Homestake Collaboration,

Welcome to the October 2011 monthly newsletter for Homestake SURF and South Dakota's Sanford Laboratory. We gladly 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 our shared goal.

Important Dates

October 23-25: LUX Collaboration meeting and Readiness Review – Lead, So. Dakota

December 14-16, 2011: PAC meeting – Lead, So. Dakota

January 19-20, 2012: Annual DURA meeting – Fermilab, Batavia, Illinois

Cosmogenic Backgrounds for Dark Matter Experiments: Part II

Continued from September 2011

The Multiple Argon and Xenon (MAX), a collaboration of over 20 institutions worldwide, has been designing synergistic dual-phase TPCs, one with 5 tons of liquid depleted Argon (DAr), the other with 2.4 tons of liquid Xenon (LXe) as the active components of a dark-matter detection system. A group at the University of Houston (UH) has been participating in the DAr development. They have been attempting to reproduce by computer simulation, cosmogenic backgrounds created by muons as they penetrate through the rock mass overhead to the underground detector site.

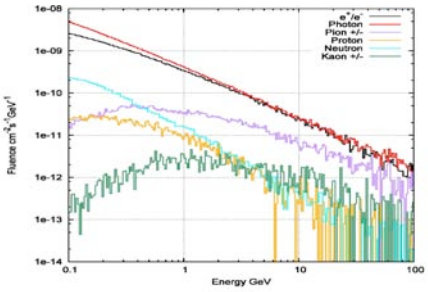

Figure 1: Various components of a muon shower at 3800 feet water equivalent

Particle	% in Shower per event
$\pi^{\pm}$	0.12
$K^{\pm}$	0.01
p	0.06
$e^{\pm}$	2.29
γ	84.47

Figure 2: The fraction of various particles in a muon shower

While neutrons are the most dangerous background, other particles are produced in muon-induced showers in the rock surrounding the cavern. The UH group has determined that a rock thickness of approximately 4m allows the shower to fully develop. Therefore, in their simulation they use the assumed angular-dependent muon spectrum at depth as previously determined, and then induce muon interactions in a 7m thick rock wall surrounding the detector cavern to produce the particle flux at the detector. Figure 1 shows that energetic gammas are the dominant particle in a shower, and this is tabulated in Figure 2. The simulated neutron multiplicities in the cavern are shown in Figure 3 as a function of neutron energy and tabulated in Figure 4. This simulation counts multiplicity of neutrons per muon shower, and allows neutrons to enter from all cavern walls. The muon that induced the shower may, but does not need to, enter the cavern.

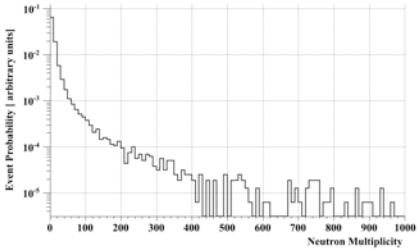

Figure 3: Neutron multiplicity as a function of neutron energy

Energy (MeV)	≥10^{-11}	≥1	≥10	≥100
Neutron Multiplicity	20	5	3	2

Figure 4: The neutron multiplicity above various thresholds

Finally, the UH group uses their FLUKA simulation to study cosmogenic backgrounds at the 4850 Level at Sanford Lab. In that simulation, they have applied a flat overburden and used the rock composition taken from the SURF website www.dusel.org (Poorman rock formation). They do not yet have an accurate description of the Homestake formation and use the

muon angular distribution as measured at the Kolar gold field[1]. The vertical muon intensity is adopted to be 0.46 x 10^{-8} muons/cm^{-2}/sec. and the average muon kinetic energy is set to 300 GeV, which were both measured during the Davis experiment[2] at the 4850 Level at Homestake. The neutron kinetic energy distribution obtained from this simulation is consistent with the expectation of a reduction in the flux by a factor of 6 from that at Gran Sasso Lab (LNGS) in Italy. Figure 5 shows a graphical illustration of the muon and neutron flux beginning at the water tank that shields the DAr detector. The result illustrated requires that at least one shower particle enter the water shield, and all events with a coincident muon (about 100/day) of E(kin) >1 GeV in the water tank be vetoed. The water shield is depicted as the largest rectangular shell within a 7m-rock enclosure; the detector is the innermost vessel. The number of simulated events was equivalent to 19 years of operation. The simulation results in 6.5 ± 2.1 events in the Ar sensitive volume and 1.7 ± 0.5 events in the Xe sensitive volume during this time frame.

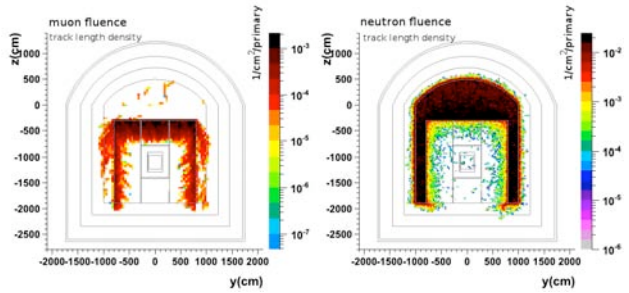

Figure 5: An illustration of the muon and neutron fluence in a Sanford Lab cavern at the 4850 Level showing the outer rock boundaries, the shielding water tank, and the detector. All particles of complete muon-induced events which reached the water shield were recorded and are simulated here starting at the tank.

In the future, the UH group intends to make careful comparisons of cosmogenic backgrounds at Sanford Underground Lab to other simulations in collaboration with the Acquisition and Assay of Radiopure Materials (AARM). They want to improve the geometric and geologic description of the Sanford Lab rock formation. In addition, they plan to include more details of the detectors, their shielding, and their response to background.

References

[1] "Neutron Background Studies for the CRESST Dark Matter Experiment", H. Wulandari et al, arXiv:hep-ex/0401032v1 21 Jan 2004

[2] "Muon intensities and angular distribution deep underground", Menon et al, 1967, Proc. Phys. Soc. 90, p649

SURF IN THE NEWS

Rapid City Journal: *European discovery may foreshadow Sanford lab potential* (October 2, Kevin Woster); *Editorial: Sanford Lab deserves full funding (October 13)*

Duselwatch.com: *Fighting for science* (September 16, Wendy Pitlick)

SpaceRef.com: *House Science, Space, and Technology Committee Examines Deep Underground Science* (September 28)

American Institute of Physics (aip.org/fyi/): *House Science Committee Roundtable Discusses Proposed Deep Underground Facility* (September 29)

Fermilab Today (http://www.fnal.gov/pub/today/): *New associate director of the Office of High Energy Physics* (September 26)

The Brookings Register (Brookings, South Dakota): *Brookings native to lead Sanford Underground Lab* (September 21)

For twitter updates see: www.sanfordlab.org

Report Available: The National Research Council report *An Assessment of the Deep Underground Science and Engineering Laboratory* can be ordered at: http://t.co/i3PAfPz

DURA NEWS

DURA meeting and DURA Election: This fall, Derek Elsworth and Hank Sobel will rotate off the DURA Executive committee. The committee is slated to have nine members total, so an election will be held to add one member to it for the coming year. Beginning in 2012, DURA will routinely replace three members. The higher number of current members is due to the evolution of the DEDC into DURA. This transition will be complete after this upcoming

election. Please think about those you may wish to nominate. The election will be held in November/December.

The DURA membership will also be asked to vote on a name change for the organization. It is now titled the DUSEL Research Association (DURA). Since DUSEL will no longer be used as a name for the underground facility, one proposed name change is Deep Underground Research Association (DURA). The idea is to keep the present acronym. A yes/no vote on this topic will be part of the election.

SANFORD UNDERGROUND LABORATORY NEWS

Dewatering Levels

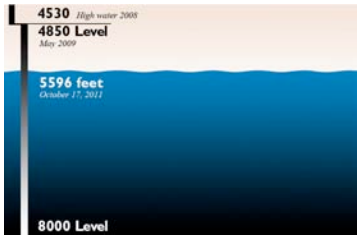

Figure 6: Progress of dewatering at Sanford Lab

The Figure 6 graphic indicates the dewatering progress made in the past three years at Sanford Lab. As of mid-October, the water level was at 5596 feet. The high water mark, in August 2008, was at 4350 feet underground.

Hydro Resources' deep-water pump, which had been pumping water from 7800 feet underground, failed on July 23. The cause of the pump failure is still to be determined. Hydro Resources, the contractor which owns the deep-water pumping system, was responsible for replacing the pump.

On September 30, contractor Hydro Resources pulled the deep-water pipes and pump from the Six Winze, so that a replacement pump could be installed in mid-October. The new pump, with a smaller 525 horsepower, will act as a temporary system until next year when the larger submersible pump will be re-installed. Dewatering continued during the installation.

Randy Badger was the Hydro Resources project manager. However, Sanford Lab Deputy Operations Director Will McElroy, coordinated the pump replacement. Sanford Lab staff provided support to the effort. Sanford Lab's crew leaders should be credited:

- Engineering Project Manager, Mike Johnson (Sanford Lab))
- Planner/Scheduler Kirby Denton (dewatering)
- Electrical Safety Engineer Chris Bauer
- Construction Site Safety Specialist Woody Hover
- Underground Ops Foreman Jack Stratton
- Technical Support Lead George Vandine (Shaft technical support)
- Rope Technician Rick Tinnell (underground site management and rigging)
- Surface Ops Foreman Dan Regan
- Facilities Technician Todd Stewart

Figure 7: Several members of the installation crew autographed the top cap of the deep-water pump column

Over the three-month repair period, the water level rose about 105 feet. Pumping from the deep pool resumed mid-October, and Sanford Lab's waterfall into Gold Run Creek also has returned to its normal flow of 1800 gallons per minute.

Construction Updates

As of September 20, all the concrete floors have been poured in the Transition Cavern. Contractors from Tessier's Inc. began hanging metal ducts from the Transition Cavern ceiling, a project that will take about three months.


Figure 8: Tessier's Inc. crew hangs ducts in the Transition Cavern

Ainsworth-Benning Construction (ABC) has begun installing the railroad track to the Transition Cavern

cart wash. Equipment will be delivered to the cart wash for thorough cleaning before admission to the clean areas of the MAJORANA DEMONSTRATOR (MJD) and LUX dark-matter experiments. ABC has also been prepping the last section of the mechanical room floor for a concrete pour.

On September 26, the Operations Department crew at Sanford Lab replaced the drum bushings in the Yates hoist. Facilities Tech Kevin Becker stated that the bushings are part of the complex drive trains on both Ross and Yates hoists, and allow the hoist's shaft to rotate freely. Each bushing weighs more than 500 pounds. The crew used an electric hoist to remove the old bushings and lower new ones into place, then used a 50-ton hydraulic ram to slide them into place.

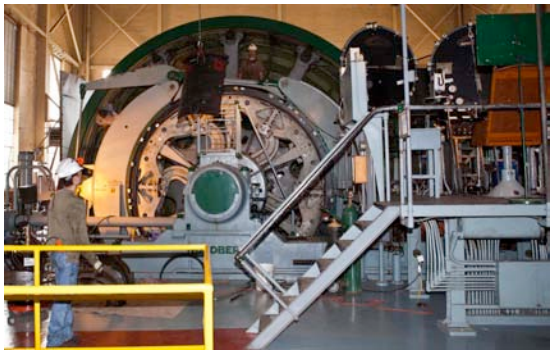

Figure 9: Facilities Tech Jeff Essink (in white hardhat) led the Yates hoist bushing change

On September 28, contractors installed a cryogenic tank at the surface laboratory, and filled it with 12,000 liters of liquid nitrogen. The liquid nitrogen will be used to cool the LUX dark-matter detector for a test run scheduled for mid-October.

Work that began on July 6 has just been completed: the removal of about 55,000 feet of old, unused power cable from the Ross Shaft. Over two dozen infrastructure techs, hoist operators, and electricians worked on the project. Safety procedures were followed and documented for the entire process.

Masons have constructed about 65 percent of the concrete block walls in the Transition Cavern, including walls for the MAJORANA laboratory.

Davis Campus

On Friday, September 16, Engineering Director Rick Labahn led scientists from the LUX and MAJORANA DEMONSTRATOR (MJD) collaborations on an inspection tour of the two main caverns at the Davis Campus. The LUX dark-matter detector is scheduled to be installed early in 2012, at which time the MJD neutrinoless double-beta detector will move into the Transition Cavern.

Figure 10: MAJORANA Construction Manager Reyco Henning said that construction reports were no substitute for an actual visit

Work continues to prepare the Davis Cavern for the LUX dark-matter detector. On October 10, dozens of 2-inch-thick steel plates arrived in the Davis Cavern, where they will be assembled to form the shielding to protect the LUX experiment from background radiation from the rock below.

Figure 11: Davis Cavern viewed from south end, from tunnel leading to Transition Cavern. The circular water tank will support the water tank for the LUX dark-matter detector

Figure 12: South Dakota School of Mines chemist Cabot-Ann Christofferson tends a copper electroforming bath in the MJD temporary cleanroom at Sanford Lab

EDUCATION AND OUTREACH

The Davis-Bahcall Mile Deep Muon Detector (MD^2): Three detector paddles have been donated to the Sanford Laboratory Education Department by Fermilab for use as an underground muon detector array. Each detector paddle is 0.91 x 0.47 meters (0.428 square-meters). As part of the Davis-Bahcall week at Sanford Lab in July, the paddles were tested and moved underground into the Materials Storage Area near the MAJORANA DEMONSTRATOR Temporary Cleanroom at the 4850 Level.

Figure 13: Detector paddle

The detector electronics were tuned up the first week of October, and the detector will be put online with remote access in the near future. A Fermilab-designed dta-acquisition (DAQ) board is being used to collect singles and coincidence data. In the future, it will be uploaded to the Quarknet Cosmic Ray E-lab server for education purposes. The same data can be made available for science groups as well. The DAQ board requires a timing signal from a GPS unit. The Education and Outreach team plans to obtain a slave board similar to what the DUGL uses for their seismic units, in order to interface between the GPS unit on the roof of the Sanford Lab Administration Building to the detector.

Other Outreach Activities: A successful inaugural meeting of *SciGirls of the Black Hills* took place in Rapid City on September 26 with 14 girls attending. The girls learned about electric circuits in a unique manner, using conductive thread and LEDs to make a fashion accessory. The club will continue in Rapid City and Lead (pending sufficient interest) in October with a program on light pollution. This new program is a partnership with the Journey Museum and South Dakota Starbase.

Figure 14: SciGirls met in Rapid City on September 26

Peggy Norris gave a surface tour of the Sanford Lab on October 1 to a group of 14 honors students and accompanying faculty members from Northern State University in Aberdeen, South Dakota. The group was in the area for a conference in Rapid City on international business. Thanks to Carlos Hernandez Faham from Brown University for the tour of the LUX Surface Lab.

Upcoming Activities: if you are in the area on the evening of Tuesday, November 1, the Education and Outreach Department is hosting Professor Brian Schwarz, of the City University of New York Graduate School. He will give a public lecture in Spearfish entitled, "Science as Performance: Communicating and Educating through Theater, Music, and Dance". More specifics will be announced in the next few days.

ENVIRONMENT, HEALTH & SAFETY

Halloween Safety *for a haunted house or yard*

- Keep large flashlights, smoke detectors, and fire extinguishers handy
- For younger children, provide a ghostly guide
- Set up more than one exit with exits clearly marked
- Avoid trip hazards with pumpkin or electric candle lights on the spooky pathways and stairs
- Keep pets inside, especially black cats

If you are visiting South Dakota, contact (605) 722-0002 for road closure and weather information or check Safe Travel USA.

Safety pages on Sanford Lab website: www.sanfordlab.org - Use the left hand menu to open individual pages

STAFF NEWS

Berkeley:
Dianna Jacobs has been promoted to a new level of responsibility within the SURF/Sanford Lab team. She will serve as the lead for all Project Controls scheduling efforts as SURF's "Schedule Integration Lead".

Nori Castillo has been reclassed at UC Berkeley from Analyst III to Analyst IV. Due to restructuring and reorganization at Berkeley, Nori has taken on some additional business responsibilities.

Lead, South Dakota:
To better integrate the SURF/Sanford Lab team, functions at Sanford Lab will be organized into two departments, *viz*

Finance/HR: **Nancy Geary,** Manager/ CFO with
Eileen Brosnahan, Human Resources Admin
Melanie Tollefson, Accountant

Business Services (new department): **Laurie Gehner,** Manager
- Deb Meyer, Senior Services Admin. The IT team includes Dave Turner, Content Management Applications Developer, and Leif Hage, Systems Software Specialist.
Laurie will also be Contracts Manager. The Contracts team includes Pam Millard, Procurement Specialist, and Lea Mathis, Contracts Specialist.

- Mandy Knight, User Support Office Manager. The USO team includes Jaye Conrad, Admin/Accounting Assistant, and Lindsey Hauck, Laboratory Receptionist. The reorganization will centralize administrative support functions under Mandy Knight. The USO will be responsible for administrative support needs in Lead for the SURF/Sanford Lab staff. This will include general clerical and receptionist activities, and conference, workshop, and meeting logistics and coordination. The USO will also provide editing and technical support for Sanford Lab's new Publications Review Committee (PRC) to track all formal publications and reviews through the PRC.

The changes represent new, expanded responsibilities for **Laurie Gehner** and **Mandy Knight.**

Congratulations to Dianna, Nori, Laurie, and Mandy!

Elizabeth Freer, a contractor with Oppenheim-Lewis (OLI), has been working with DUSEL/SURF on development of the DUSEL Preliminary Design Report (PDR) and the overall DUSEL Project for the past three years. She will be transitioning to a new contract between OLI and Fermilab-LBNE supporting LBNE's preparations for the upcoming DOE CD-1 Review. Her main responsibilities will focus on preparation of the LBNE Conceptual Design report and supporting documentation. Thanks to Elizabeth for all her hard work and effort.

Pat Kinghorn and **Tim Eggers** will be part of the EHS team at Sanford Lab. As of October 17, Pat will be a Site Safety Specialist working with the Operations team on the Yates and Ross Shafts. Starting October 24, Tim Eggers will be the Underground and Surface Construction Safety Specialist, backfilling Woody Hover, who has transitioned to the Site Safety Specialist and ERT Coordinator position.

Josh Willhite has been selected as Sanford Lab's new Director of Engineering. A new organization will combine SDSTA Engineering and SURF facilities into a single Engineering Department. The change will be effective November 12.

Additional details and photos on the new staff will appear in the November issue.

UPCOMING EVENTS AND ANNOUNCEMENTS

Conferences and Workshops

International Workshop on Double Beta Decay and Neutrinos (DBD11), Crystal Tower (near Osaka Castle), Osaka, Japan, November 14-17, 2011. The workshop will present an open discussion of current and future directions in the study of double beta decay and related neutrino physics. Registration fee: 10,000 JPY, Cash. For more info: http://dbd11.phys.sci.osakau.ac.jp/date_and_site.html

Fundamental Physics at the Intensity Frontier Workshop, Rockville, Maryland, November 30-December 2, 2011. This is an opportunity for Physics community input on this program and necessary facilities. A final report containing workshop results will be completed January 2012. For more info: http://www.intensityfrontier.org

Underground Science Experiments & Research Seminars (USERS) will be held bi-weekly on Thursdays, 1:30-2:30 PM. Alternate sessions will be held at LBNL and UC Berkeley, 325 Old LeConte Hall. If you are interested in attending these seminars please subscribe to this email list for future announcements:
http://dusel.org/mailman/listinfo/ugsseminars

2011 Fall Annual meeting of the APS Division of Nuclear Physics, Kellogg Center, Michigan State University, East Lansing, Michigan, October 26-29, 2011. Workshops, mini-symposia, and other activities.
For more info: http://meetings.nscl.msu.edu/dnp2011/

All-day Symposium in honor of Luis Alvarez (1911-1988) on the occasion of his 100th birthday, UC Berkeley, Stanley Hall, November 19, 2011. Registration for the Symposium has opened. For more information:
http://luis-alvarez-symposium.lbl.gov/home

Transcriptions of presentations made at the Meeting of the APS Division of Particles and Fields, August 9-13, 2011 have been posted at: http://www.hep.brown.edu/~DPF2011/

DURA Events

DURA Annual Meeting Scheduled for January 19-20, 2012

The annual meeting of the DUSEL Research Association (DURA) will be held at Fermilab National Accelerator Laboratory on January 19-20, 2012. The tentative agenda anticipates presentations on the future of the South Dakota laboratory, overviews of underground research around the world, and developments in underground research in the U.S. A final agenda will be posted as it becomes available closer to the meeting date.

Presentations at meetings of interest to DURA members are posted in the following:

12th International Congress on Rock Mechanics, with workshop WS-5 on networks of underground research laboratories for international disciplinary innovations. Three new ISRM Commissions have been proposed in which members of DURA will be participating and organizing: URL Networking, Coupled Processes, and Petroleum Geomechanics. Beijing, China, October 17-21, 2011. http://www.isrm2011.com/page.asp?id=100

AGU Fall Meeting, especially Sessions H13H: Fractures, Fracture Networks, and Fractured Media III: Field- and Fault-Scale Studies; NH51A, NH54A: Correlation and Coupling from Underground, Surface, to the Ionosphere. San Francisco, December 5-9, 2011. http://www.agu.org/meetings/

Please send information regarding upcoming meetings of interest or presentations from DuRA members, as well as other related events to Steve Elliott (elliotts@lanl.gov) or Duane Moser (Duane.Moser@dri.edu).

JOBS

Faculty positions in Physics Dept., UC Berkeley, in areas of Theoretical Condensed Matter, Experimental Astrophysics, Theoretical Biophysics, or Quantum Materials. Applications will be received until December 5, 2011. To apply or find more info: http://www.physics.berkeley.edu and click on "Faculty Job Listing" links at the right side bar.

Tenure-track faculty position in Dept. of Physics, Augustana College, Sioux Falls, South Dakota, beginning September 2012. Teach physics courses, conduct research involving undergraduates. More details:
http://www.augie.edu/admin/human_res/prospective/facultypositions.html - physics

Research Associate at Fermilab Center for Particle Astrophysics: research in dark matter (CDMS, COUPP, Darkside), dark energy (Dark Energy Survey) and spacetime physics (Holometer). Close date: 11/14/11. For more information:
https://fermi.hodesiq.com/job_detail.asp?JobID=2641629&user_id=

Faculty position in Nuclear and Particle Physics Division and Laboratory for Nuclear Science, MIT. Deadline: 11/21/11. Contact Professor Bolek Wyslouch, wyslouch@mit.edu or see:
http://web.mit.edu/physics/about/employment.html

Postdoctoral position at Gran Sasso Laboratory (LNGS) researching the development of scintillating

bolometers for the Lucifer experiment. For more info contact Stefano Pirro (Stefano.Pirro@mib.infn.it) or see announcement (in Italian): http://www.infn.it/job/dettagli_job.php?id=866

Postdoctoral Fellow in microbial ecology/geobiology at Desert Research Institute's Las Vegas campus. Involvement in deep subsurface microbiology studies at Nevada National Security site and other sites, including Sanford Lab. For questions on this position: contact Duane Moser, Chair, Postdoctoral Fellow-Microbial Ecology Search Committee (Phone: 702-862-5534 or duane@moser@dri.edu.

Postdoctoral position, Subatomic Physics Group, University of Michigan. Completion of upgrades to the calorimeter for neutron flux measurement and test phase at NIST. For more info, contact: Tim Chupp, chupp@umich.edu.

Postdoctoral position in experimental neutrino physics at the University of British Columbia to work on the T2K experiment. Contact: Profs. Scott Oser & HiroTanaka, UBC Dept. of Physics & Astronomy, oser@phas.ubc.ca or tanaka@phas.ubc.ca. For more info: http://www.phas.ubc.ca/~oser/postdoc_ad.txt

Newsletter Editor: Melissa Barclay
Contributors: Kevin Lesko; Bill Harlan (Sanford Lab); Edward Hungerford, Anton Empl, Riznia Jasim (Cosmogenic Backgrounds for Dark Matter Experiments); Steve Elliott, Derek Elsworth, Joe Wang (DURA News); Peggy Norris, Ben Sayler (Education and Outreach).

Photo Credits: Figs. 1-5: University of Houston Particle Physics Group; Figs. 6-11: Matt Kapust; Fig. 12: Steve Babbitt (BHSU); Figs. 13-14: Diane Melvin (Journey Museum).

SURF CONTACT INFORMATION

University of California at Berkeley
Kevin T. Lesko: 510-642-0147
KTLesko@berkeley.edu
Melissa Barclay: 510-642-2244
mbarclay@berkeley.edu
http://www.dusel.org/
SDSTA/Sanford Lab
Ron Wheeler, Executive Director
Mandy Knight, 605-722-8650, x222
MKnight@sanfordlab.org
http://www.sanfordlab.org/
South Dakota School of Mines and Technology
William Roggenthen: 605-394-2460
William.Roggenthen@sdsmt.edu

BERKELEY OFFICE

UC Berkeley
SURF Project Office
2440 Bancroft Way, Suite 303
MC 1295
Berkeley, CA 94720-1295
Fax: 510-642-2258