

Dear Homestake Collaboration,

Welcome to the September 2011 monthly newsletter for Homestake DUSEL 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 DUSEL, employment opportunities, and other highlights relevant to our shared goal.

Important Dates

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

PAC meeting: December 2011

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

Mike Headley named Director of Sanford Underground Laboratory



Mike Headley has been named laboratory director of the Sanford Underground Lab. He will report to South Dakota Science and Technology Authority (SDSTA) Executive Director Ron Wheeler. Headley has been at Sanford Lab since 2008 when he was appointed deputy lab director. He has also served as acting project director and facility project manager. He will act as a direct link between the SDSTA and funding agencies DOE and NSF, and participating institutions UC Berkeley and Lawrence Berkeley National Lab.

Before joining Sanford Lab, Headley was senior project manager for the Landsat Data Continuity Mission at the EROS Center in Sioux Falls. He is also a U.S. Air Force veteran. Headley received his bachelor's degree in computer science from South Dakota State University and holds a MBA from Loyola Marymount University. For links to media reports on Headley's appointment, see page 3.

James Siegrist appointed to Department of Energy post

On September 19, the Department of Energy announced that James Siegrist, current Physics Division Director and Associate Lab Director at Lawrence Berkeley National Laboratory, has been appointed as the new Associate Director of the Office of Science for the Office of High Energy Physics (HEP). His appointment will become effective on October 1, 2011. He will be responsible for strategic HEP program planning, budget formulation and execution, program integration with other Office of Science activities and with the DOE technology offices, and interagency integration.

In his position as LBNL Physics Division Director and also as an aide to UC Berkeley Vice Chancellor for Research Fleming, James Siegrist has been involved with and supportive of DUSEL Project concerns for several years. The Office of High Energy Physics supports important DUSEL science programs including LBNE, Dark Matter, and Neutrinoless Double Beta Decay.

Cosmogenic Backgrounds for Dark Matter Experiments: Part I

The Multiple Argon and Xenon (MAX) collaboration consists of over 20 institutions worldwide. The U.S. members include, among others, Princeton, MIT, UCLA, Columbia, and Fermilab. The MAX goal, funded in part by a NSF S4 research and development (R&D) grant, is to design 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 for DUSEL. A group at the University of Houston (UH), who are participating in the DAR development, has 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. Their work began by focusing on initial experiments to be mounted at the Italian underground facility at the Gran Sasso Laboratory (LNGS). Although the LNGS activity continues, the work is now beginning to be applied to the ton-scale experiments to be mounted at DUSEL. Some of these results were presented at the AARM (Assay and Acquisition of Radio-pure Materials) workshop in April 2011[1].

Modern Monte Carlo (MC) simulation codes are now sufficiently accurate to be useful in the study of elementary particle transport and production in materials. The three codes most used--FLUKA, GEANT, and MARS--accept complex detector geometries, and follow elementary particles as they interact, scatter, and deposit energy in materials along their trajectories. These codes can accurately follow each particle, including all the secondaries which are produced. They have been calibrated with, and benchmarked against experimental data taken at energies from keV to hundreds of GeV.

FLUKA and GEANT have been used to study neutron production in rock by cosmic muons. Muons are the only particles produced by cosmic rays with sufficient energy and penetration to reach detectors designed to search for extremely rare events deep underground. The deep rock overhead shields these detectors from cosmogenic backgrounds. However, even at DUSEL depths, backgrounds can mask the signals of interest, so detailed knowledge of all backgrounds is crucial for detector design and shielding. Thus, a simulation must input the geometry and geology of the overburden, as well as an accurate description of the detector and experimental cavern.

Results are available for a number of previous cosmogenic studies for the Gran Sasso facility using different MC simulations, and there are some experimental data on the cosmic muon flux and neutron backgrounds at this laboratory. However, consistency and understanding of the simulations, and the few data, of which all have incomplete descriptions of the experimental details, hamper the effort to calibrate and compare the codes. As an example, neutron-induced events present a particularly dangerous background. However, the absolute values of angular-dependent, energetic-neutron spectra are difficult to measure even at surface laboratories. The UH simulations using the latest FLUKA code (release 2011.2)[2,3] are compared to other simulations and experimental measurements at Gran Sasso. These simulations have been extended to predict cosmogenic backgrounds at the 4850 Level at Sanford Lab.

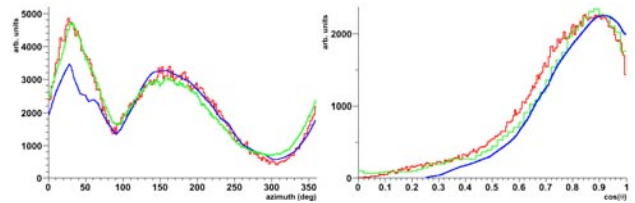


Figure 1: Left figure shows the azimuthal dependence of the cosmic muons at the walls of an experimental cavern at the Gran Sasso Laboratory (0=North). The FLUKA simulation is given by the red curve, compared to the MACRO[5] (blue, acceptance limited) and BOREXINO[6] (green) data. Right figure is the polar angle dependence of the muons.

To reproduce features in the experimental data collected by the LVD[4], MACRO[5], and BOREXINO[6] experiments at Gran Sasso, the UH researchers found that a detailed description of the overburden and the underground facility is required. This means that the detailed geometry and geology of the Gran Sasso Mountain is used to trace the angular- and energy-dependent cosmic muon flux from ground level to the detector cavern. As an example, Figure 1 shows a comparison of a FLUKA prediction to the data obtained by the MACRO and Borexino experiments. One sees a reasonable, if not perfect, representation of the muon flux at the walls of the experimental cavern. In these studies, researchers have also demonstrated that the simulations are more sensitive to the average muon kinetic energy than to the details of the differential energy spectrum. At the same time, measured values for the average muon kinetic energy are available, and simulating the shape of the spectrum becomes more reliable for deeper sites. The neutron kinetic energy spectrum induced by these muons compared to other simulations, is shown in Figure 2. The integrated neutron flux above various energy thresholds is given in Figure 3.

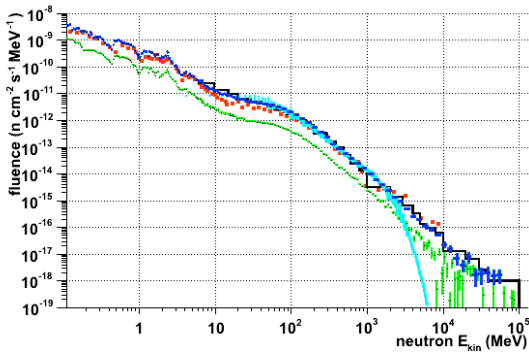


Figure 2: Indicates muon-induced neutron kinetic energy simulation compared to simulations by Wulandari (red) [7], Dementyev (blue) [8] and Mei (cyan) [9]. In green, University of Houston simulation for the 4850 Level at Sanford Lab

Flux 10^{-9} $\text{cm}^{-2}\text{s}^{-1}$	Threshold (MeV)				
	Total	≥ 0.1	≥ 1	≥ 10	≥ 100
Present Work	12.4	2.8	1.6	0.68	0.23
Ref [9]		2.7	0.81	0.73	0.20
Ref [7]			0.85		

Figure 3: The induced neutron flux above various thresholds

Part II will appear in the October 2011 newsletter

References

- [1] "Cosmogenic backgrounds in MAX", and "A look at physics in FLUKA relevant to cosmogenic backgrounds", Cosmogenic Activity and Backgrounds Workshop, Berkeley, April 2011.
- [2] "The FLUKA code: Description and benchmarking", G. Battistoni et al, Proceedings of the Hadronic Shower Simulation Workshop 2006, AIP Conference Proceeding 896, 31-49, (2007).
- [3] "FLUKA: a multi-particle transport code", A. Fasso et al, CERN-2005-10 (2005), INFN/TC_05/11, SLAC-R-773 <http://www.fluka.org>
- [4] "Single muon angular distribution observed in the LVD particle astrophysics experiment", Astroparticle Physics 2 (1994) 103-116.
- [5] "Muon astronomy with the MACRO detector", The Astrophysical Journal, 412:301-311, 1993 July 20.
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- [7] "Neutron Background Studies for the CRESST Dark Matter Experiment", H. Wulandari et al, arXiv:hep-ex/0401032 v1 21 Jan 2004.
- [8] "Production and Transport of Hadrons Generated in Nuclear Cascades Initiated by Muons in the Rock (Exclusive Approach)", A. Dementyev et al, 22 Sep 1997, Gran Sasso note: INFN/AE-97/50
- [9] "Muon-induced background study for underground laboratories", D.-M. Mei and A. Hime, Phys. Rev. D 73 (5), Mar 2006, arXiv:astro-ph/0512125 v2, 6 Dec 2005.



DUSEL IN THE NEWS

Black Hills Pioneer: *Why DUSEL?* (August 29), *Sanford Lab hires new director* (September 13), *Planning ahead* (September 15) (Wendy Pitlick)

Rapid City Journal: *Congressional delegates push for lab funding* (September 14), *SDSU grad named director of Sanford Underground Laboratory* (September 15)

KELO (Keloland.com): *Headley to Direct Sanford Underground Lab* (Derek Olson, September 13); KELO TV interviews Mike Headley - <http://t.co/e33n2G7>

The Republic (Columbus, Indiana): *Sanford Underground Laboratory hires Headley as its new lab director* (September 14)

Today at Berkeley Lab (today.lbl.gov): *ALD Jim Siegrist Takes Position with DOE Office of Science* (September 21)

Houston Chronicle: *SD senators seek funding for underground lab* (September 14, Chet Brokaw)

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>

SANFORD UNDERGROUND LABORATORY NEWS

Dewatering Levels



Figure 4: Progress of dewatering at Sanford Lab

The Figure 4 graphic indicates the dewatering progress made in the past three years at Sanford Lab. As of September 12, the water level was at 5600 feet. The high water mark was reached in August 2008 at 4350 feet underground. Routine maintenance and repairs at the water treatment plant will cause the water level to increase slightly over the next few months.

4850 Level News



Figure 5: Sanford Lab staff accompany the Homestake Mining Co. inspection team

On August 19, Homestake Closure Manager Todd Duex and five colleagues conducted a construction inspection of the Ross and Davis campuses at the 4850 Level. Other members included Environmental Manager Mark Tieszen, Operations Manager Les Erikson, and consultants Todd Hubbard of Sundance Engineering and Mark Zwaschka of JBR Environmental Consultants, Inc. They were joined by Sanford Lab Operations Director Greg King, Operations Safety Officer Tom Regan, and Sanford Lab Geologist Tom Trancynger.

This inspection was part of an earlier agreement after Homestake Mining Co. donated its underground gold mine to the South Dakota Science and Technology Authority for the purpose of converting the mine into an underground laboratory. The company wanted to satisfy its safety and environmental concerns. Sanford Lab has hired *Mine Safety and Health Administration* inspectors as consultants to inspect the lab regularly. The team was impressed as they viewed the MAJORANA DEMONSTRATOR project's temporary electroforming laboratory and construction underway at the Davis campus.

Davis Campus



Figure 6: Infrastructure Tech Mike Oates standing in the doorway (right) of one partially constructed "counting room," where radioactivity of experiment components will be tested

During the week of August 22, contractor Ainsworth-Benning poured the largest concrete floor at the Davis Campus in the space where the MAJORANA DEMONSTRATOR experiment will take place. Special concrete is required in two sensitive areas to further reduce background radiation. In the Davis Cavern, where the LUX dark-matter detector will be installed, this area is found in two "counting rooms" where experiment radiation levels will be measured. This mix is also used in the north end of the Transition Cavern where the MAJORANA DEMONSTRATOR experiment will be located. By mid-September, all the necessary special low-radiation concrete had been poured.

Concrete has also been poured for a mechanical room in the southwest corner of the Transition Cavern. Engineering Director Rick Labahn reported that masons have laid 20 to 25 percent of the concrete-block walls in the Davis campus.



Figure 7: (Left) Circular wooden form surrounds concrete ring which will hold the water tank used to protect the LUX dark-matter detector in Davis Cavern; (Right) Masons have laid 20 to 25 percent of the concrete-block walls at the Davis campus



Figure 8: Work progresses at Transition Cavern

Environmental Monitoring at Sanford Lab

GEI Consultants, an independent environmental monitoring firm from Denver, Colorado recently conducted tests at five stream sites near Sanford Lab. This marks the third year of biomonitoring. According to Sanford Lab Environmental Manager John Scheetz, the lab has discharged 1.9 billion gallons of mine water and 1.2 billion gallons of tailing water into Whitewood Creek since June 2008.

Tests were conducted at five stream sites: two on Gold Run Creek—one upstream from the lab's discharge point and one downstream. Three other sites are located on Whitewood Creek—one upstream from the confluence of Gold Run Creek and Whitewood Creek and two downstream of the confluence. *GEI* examined fish populations, aquatic insects, algae, habitat quality, and water chemistry. The team used an electrofishing device to temporarily stun fish so they could count, weigh and measure them. They found brook trout, brown trout, and long-nosed dace in approximately the same numbers in Whitewood Creek. (There are no fish in Gold Run Creek.)

GEI also measured and characterized algae for diversity, and insects such as stoneflies and mayflies, which are fish food.

"The overall health of the stream appears to be very good," Scheetz reported.



Figure 9: Don Conklin (left) and Moriah Crowder of *GEI Consultants* attempt to net a trout for testing

EDUCATION AND OUTREACH

Education and Outreach is busy planning its Fall and Winter activities. They offer plenty of opportunities for scientists and engineers—particularly graduate students—to speak to classrooms in the area or to help with a classroom visit to Sanford Lab. On your next visit to Sanford Lab, consider taking a few hours off to participate in an outreach event. If you are interested, please contact Peggy Norris at pnorris@sanfordlab.org

For girls in 5th-8th grade, a monthly science and engineering club is starting at Sanford Lab on Saturday, September 24. The club will be utilizing *SciGirls*® videos and activities developed for PBS. The *SciGirls* approach is rooted in research on how to engage girls in STEM. A quarter of a century of studies have converged on a set of common strategies that work, and these are the foundations of the *SciGirls* philosophy. The strategies are:

1. Girls benefit from collaboration, especially when they can participate and communicate fairly.
2. Girls are motivated by projects they find personally relevant and meaningful.
3. Girls enjoy hands-on, open-ended projects and investigations.
4. Girls are motivated when they can approach projects in their own way, applying their creativity, unique talents and preferred learning styles.
5. Girls' confidence and performance improves in response to specific, positive feedback on things they can control—such as effort, strategies and behaviors.
6. Girls gain confidence and trust in their own reasoning when encouraged to think critically.
7. Girls benefit from relationships with role models and mentors.

For additional information, see the book *SciGirls Seven: How to Engage Girls in STEM*, which includes tips for implementing the strategies, can be downloaded for free at:

<http://www.pbs.org/teachers/scigirls>.

ENVIRONMENT, HEALTH & SAFETY



Bicycle Safety

School has started and many kids will be riding bikes to school. Some safety tips for bicyclers and drivers:

- **Bicyclers:** Wear a bicycle helmet. Head injury is the leading cause of death in bicycle accidents.
- Follow the rules of the road: observe traffic signals and signs, and hand signal when making turns. Ride on the right side of the road with the flow of traffic.
- **Drivers:** Beware of young children darting out into the road or forgetting the bicycle rules. Slow down near school zones.
- Watch out for pets, darting out between parked cars or running behind bikes.

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

UPCOMING EVENTS AND ANNOUNCEMENTS

Conferences and Workshops

International Workshop on Double Beta Decay and Neutrinos (DBD11), Crystal Tower (near Osaka Castle), Osaka, Japan, November 15-17, 2011. 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 information:

http://dbd11.phys.sci.osakau.ac.jp/date_and_site.html

Underground Science Experiments & Research Seminars (USERS) will be held bi-weekly on Thursdays, 1:30-2:30 pm at 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 will open soon. 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 the Fermi National Accelerator Laboratory on January 19-20, 2012. Although normally held during the fall or end of the year, the meeting calendar became sufficiently crowded to warrant moving the meeting to January. 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, Beijing, China, Oct. 17-21, 2011.
<http://www.isrm2011.com/page.asp?id=100>

AGU Fall Meeting, 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

Postdoctoral Research Assistant, Royal Holloway, University of London, Physics Dept. Research on dark matter detection with liquid argon and DEAP/CLEAN experiment. For further details: <http://www.rhul.ac.uk/physics/research/particlephysics/experimentalparticlephysics/darkmattersearches.aspx>

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

Postdoctoral Research Affiliate at Stanford University, SuperCDMS (cryogenic dark matter search) group. Research will take place at Stanford and Soudan Lab, Minnesota. Deadline: October 15, 2011. Contact Marcia Keating, Physics Dept., Stanford University, Stanford, CA 94305 or mkeating@stanford.edu. For more info: <http://www.slac.stanford.edu/spires/jobs/ads/93637.shtml>

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=

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 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

Physicist position with the Double Chooz experiment, Division of Particle Physics at CEA/Irfu, France. Deadline: October 17. For more info contact: thierry.lasserre@cea.fr or see: http://irfu.cea.fr/Spp/en/Phoce/Vie_des_labos/Ast/ast_technique.php?id_ast=2260

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