

Dear Homestake Collaboration,

Welcome to the January 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 the Collaboration, employment opportunities, and other highlights relevant to our shared goal.

Important Dates

January 24-25: Internal PDR Cost & Schedule Vetting – Berkeley

February 22-25 - Dry Run Reviews for PDR Defense – Berkeley



Figure 1: Kem Robinson on the left

I have asked Mike Headley to serve as the acting Project Director. Mike has graciously accepted and is now actively filling all the roles and overseeing the responsibilities of the DUSEL Project Director. We are very fortunate to have someone with Mike's skills, drive, and vision step in and so effectively take over this critical leadership position for the Project. I am sure we will all offer Mike our best wishes in this position and a hand when he might need it. Mike has requested that Josh Willhite step in and cover many of Mike's previous responsibilities as acting Facility Project Manager. Once again the DUSEL Project has shown itself to be adaptable, flexible, and robust.

Kevin Lesko
Principal Investigator

DUSEL Readers,

I would like to express my wishes for a happy 2011 to the entire DUSEL family. This year has already seen many significant changes. I'd like to update you on some of these today. As of January 3, Kem Robinson has returned to LBNL to reclaim his directorship of the LBNL's Engineering Division. Kem's history with DUSEL dates back to 2001 when I asked him to assist me as part of the Bahcall committee. He ably worked with the technical subcommittee assessing different locations. Then about 18 months ago, Kem once again answered a call to arms to help with our numerous proposals, technical reports, reviews and in general assembling the robust and competent DUSEL organization we enjoy today. He took a sabbatical from the Engineering Division and dove in head-first into DUSEL. The Project witnessed remarkable progress during this period. While there have been many memorable moments, perhaps my favorite was watching Kem extract a concession from one of our internal reviewers, that he, Kem, was actually correct and that the reviewer was *possibly* wrong. (See the cell phone image below.) Please join me in wishing Kem well in his new (old) position. He has not seen the last of DUSEL, but he will now be wearing a slightly different hat when he does.

LUCI: A facility at DUSEL for large-scale experimental study of geologic carbon sequestration

Geologic carbon sequestration is an important part of the portfolio of approaches that can be used to reduce atmospheric concentrations of greenhouse gases. Widespread adoption of this technology will occur only if the possibility and consequences of leakage are well understood. To test model predictions and critical hypotheses, CO₂ trapping and leakage processes must be studied at the pressures and long length scales operative in the context of geologic sequestration.

LUCI, the Laboratory for Underground CO₂ Investigations, is an experimental facility being planned for DUSEL. A partnership between Princeton and LBNL, it is being designed to study vertical flow of CO₂ in porous media over length scales representative of leakage scenarios in geologic carbon sequestration.

The plan for LUCI is a set of three vertical column pressure vessels, each ~500 m long and ~1 m in diameter. The vessels will be filled with brine and

sand or sedimentary rock. Each vessel will have an inner column to simulate a well for deployment of down-hole logging tools. The experiments are to be configured to simulate CO₂ leakage by releasing CO₂ into the bottoms of the columns. The scale of the LUCI facility will permit measurements to study CO₂ flow over pressure and temperature variations that span supercritical to subcritical gas conditions. It will enable observation or inference of a variety of relevant processes such as buoyancy-driven flow in porous media, Joule-Thomson cooling, thermal exchange, viscous fingering, residual trapping, and CO₂ dissolution. Experiments are also planned for reactive flow of CO₂ and acidified brines in caprock sediments and well cements, and for CO₂-enhanced methanogenesis in organic-rich shales. In partnership with Schlumberger Ltd, a comprehensive suite of geophysical logging instruments will be deployed to monitor experimental conditions as well as provide data to quantify vertical resolution of sensor technologies. The experimental observations from LUCI will generate fundamental new understanding of the processes governing CO₂ trapping and vertical migration, and will provide valuable data to calibrate and test large-scale model simulations.

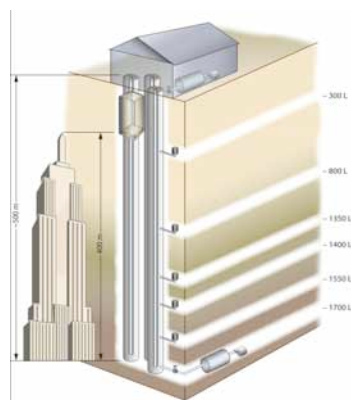


Figure 2: A graphical depiction (not to scale) of the LUCI facility, showing the three vertical columns, the surface building, and the access drifts. The Empire State Building is depicted to indicate LUCI's vertical extent

Nuclear Astrophysics: DIANA - Part I

Nuclear Astrophysics is a thriving and exciting field of research at the interface of nuclear physics, astrophysics, and particle physics. The field's key questions—the origin of the elements and the chemical evolution of the universe—are fundamental questions for our life on earth and the environment we live in. It provides the key for the understanding

of galactic chemical evolution from the Big Bang until the present time through multiple generations of stars slowly building the elements' abundance distribution – stellar nucleosynthesis – as we know it today. The field also identifies new observational signatures such as neutrinos from the sun and distant supernovae, and is closely interwoven with underground neutrino physics.

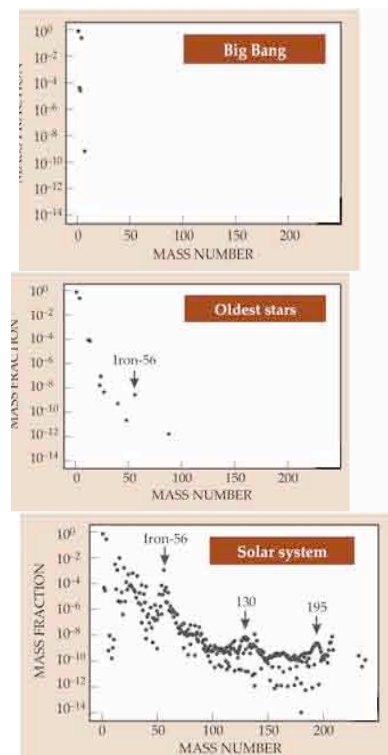


Figure 3: Three charts illustrate development of isotopic abundance distribution from the primordial distribution produced by the Big Bang, the distribution in the oldest observed stars, and the distribution in our solar system as observed today

The key reactions for stellar nucleosynthesis are light-ion capture reactions in hydrogen, helium, and carbon burning during the main sequence and red giant phase of stellar evolution. These reactions define the carbon oxygen ratio which is the basis of life on earth, they provide the neutron flux for building the heavy elements by slow neutron capture in Red Giant and Asymptotic Giant stars, and they set the seed material for subsequent explosive nucleosynthesis events in core-collapse supernovae shock-front nucleosynthesis and cataclysmic binary star explosions. The study of these reactions is challenging and difficult since low energy measurements of reactions at stellar temperature conditions are handicapped by low cross-sections

HOMESTAKE DUSEL AND SANFORD LABORATORY NEWSLETTER

and large radiation backgrounds in the laboratory environment. The utility of underground-based low-energy accelerators pioneered by the Laboratory for Underground Nuclear Astrophysics (LUNA) at the European Gran Sasso underground laboratory in Italy, has been demonstrated but at the same time revealed enormous deficiencies in our knowledge of low energy stellar reactions.

While LUNA was successful in the measurements of several hydrogen-burning reactions in the pp-chains and the CNO cycles, it also has demonstrated the need for a next generation underground facility to extend the energy range further down to lower energies and address new questions such as the origin of neutrons for synthesizing heavier elements in supernovae explosions. DUSEL offers a unique opportunity for the development of such a facility in the US to stay internationally competitive and become leaders in the field. A collaboration of the University of Notre Dame, Lawrence Berkeley National Laboratory, The University of North Carolina and Western Michigan University has developed a novel concept and design for a two-accelerator facility at DUSEL, Dakota Ion Accelerators for Nuclear Astrophysics - DIANA. Their goal is to address three long-standing fundamental problems in nuclear astrophysics: solar neutrino sources and the core metallicity of the sun, carbon-based nucleosynthesis, and neutron sources for the production of trans-Fe elements in stars.

(To be continued in February 2011 issue)

DuRA Survey and DuRA Charter

The DUSEL Research Association Executive Committee (DuREC) is conducting a survey among members of DUSEL.org by email to see if they wish to become voting members of the DUSEL Research Association (DuRA). (You may have already received your request.) Membership in DuRA is open by request; all are welcome. Given the research-specific focus of DuRA, emails regarding DuRA business may not be of interest to all and this underlies the upcoming membership request from DuRA. The request will come in the form of a brief survey. Responding to the survey will automatically establish membership. For more info on the DuRA survey:

<https://spreadsheets.google.com/viewform?formkey=dEZYUWhNQTJeb2RDMFFtdU15YTB0UHc6MQ>

DuRA Charter: http://www.dusel.org/PDFs/dura-docs/DuRA_charter_20101202.pdf



LZ Development Meeting

On January 6-7, a number of physicists, engineers, and others from UC Berkeley, LBNL, UC Davis, UC Santa Barbara, Case Western and TAMU took part in the LZ Development meeting. The group met at the Berkeley DUSEL office to discuss the LUX-ZEPLIN Multi-Tonne Dark Matter Experiment for DUSEL. Bob Jacobsen of UCB coordinated these efforts.

The discovery of dark matter is of fundamental importance to cosmology, astrophysics, and elementary particle physics. The LUX and ZEPLIN collaborations, building on their pioneering efforts in liquid xenon (LXe) dark-matter detectors and their broad expertise in low background techniques and rare-event searches, propose to pursue their combined research at DUSEL.



DUSEL IN THE NEWS

DUSEL stories:

Popular Science: *Deep Below South Dakota, a Mine Becomes a Physics Lab, and Miners Return to Work* (Brooke Borel) <http://www.popsoci.com/darkmining>

Rapid City Journal: *Hanks heads to D.C. for mayors meeting* (Kevin Woster, January 19); *Initiatives unveiled Tuesday by Gov. Dennis Daugaard* (January 8); *National Science Board seeks different management plan for DUSEL* (Kevin Woster, January 8)

Lawrence County Journal: *DUSEL eyeing year of milestones* (Tim Velder, January 17)

DUSELwatch.com and Black Hills Pioneer: *Lead scientist assures DUSEL community that project is alive, well* (Wendy Pitlick, January 11)

www.sanfordlab.org/ - Check out "Twitter updates" in lower left hand column

SANFORD UNDERGROUND LABORATORY AT HOMESTAKE

Davis Campus Progress

At the Davis Campus at the 4850L, the last major excavation blast was set off on December 23. During the first week of January, operations crews finished smaller rounds of drilling and blasting to deepen by two feet the floor of the 125-foot long chiller-cavity to complete excavation at the Davis Campus. During the weekend of January 8-9, the crew started lowering bags of shotcrete needed for shotcreting the walls of the Davis Campus.

The LUX dark-matter detector will be installed in the Davis Cavern later this year. LUX Principal Investigator Rick Gaitskell joined the group underground for a final inspection. "I want to thank everybody for the tremendous work that they've done in order to make this new scientific experiment possible," Gaitskell said.

Impressive statistics outlined by Construction Manager Will McElroy include:

- 17,000 tons of rock removed
- 33,672 work hours
- 0 injuries

The 4850L crew also excavated the **Chiller Cutout** (145 feet long, 26 feet wide and 12 feet high) for refrigeration and other equipment. The group included 11 miners, who also finished up odds and ends, including rock bolting, cleanup and decommissioning equipment.



Figure 4: In the new drift between the Transition and Davis Caverns on 4850L. From left: Ops Director Greg King, Will McElroy, Gov. Rounds, SDSTA Board Member Casey Peterson, DUSEL PI Kevin Lesko, Keith Bradley, SD Highway Patrol, and Kevin Forsch, Governor's Office

At the **surface lab**, the LUX detector has been assembled for testing. At the end of December the cryostat which holds the liquid xenon was slipped into place over the assembled set of internal electronics.

MAJORANA Cleanroom

In December, personnel from the MAJORANA collaboration and from Pacific Northwest National Laboratory did a preliminary cleaning of the "plenum"-a space near the ceiling of the cleanroom.



Figure 5: MAJORANA Demonstrator cleanroom at 4850 Level

Installation of the fire-suppression system should be completed sometime in January. Personnel from the Science, Engineering and Operations departments are working on this project with Western States Fire Protection and experts from Oak Ridge National Laboratory.

Following the fire-suppression equipment installation, a full-fledged cleaning is scheduled for later in January, which will take about two and a half weeks. After that time, the germanium detectors that were delivered to the 4850L in November will be moved into the cleanroom. Electroforming could begin in March.

EDUCATION AND OUTREACH

Early Programming

K-12 Education: Four sets of cosmic ray muon detectors (four paddles each) built in the summer of 2010 have been inspiring students at several high schools in South Dakota this fall and winter. The Quarknet Center at BHSU is in its second year of operation under the leadership of Physics faculty member Kara Keeter. Bob Peterson of the Fermilab Education Department visited BHSU in June 2010 to lead a professional development workshop in which several teachers built two sets of detectors. Bob also led a workshop at Fermilab in July for the South Dakota Summer Science Scholars to build two additional sets of detectors. This fall, the detectors have been operated at Aberdeen Central High School, Spearfish High School, Hill City High School, Washington High School in Sioux Falls, and Augustana College. In early January, a set was moved to Chamberlain High School. Peggy Norris presented an informal workshop on January 4 for Quarknet teacher John McEnelley and five of his science students (see Figure 6), at which students learned how to set up the detectors, calibrate them, and upload the data to the Fermilab-operated *Cosmic ELab* website. The students are now planning a research project using the detectors.



Figure 6: Members of the Chamberlain High School Quarknet Science Club – under the mentorship of teacher John McEnelley (second from left) came in on their holiday break to set up muon detectors in the school science lab.

Undergraduate Education: Science groups expecting to spend time at Sanford Laboratory this summer in engineering design, experiment set-up or data-collection should consider hiring a local undergraduate intern. We can help recruit, supervise, and provide enrichment activities for high

quality, highly motivated students. As a reminder, if you have an existing NSF grant, it is often possible to request an REU (Research Experience for Undergraduates) grant supplement to support one or two students. For more information, contact Peggy Norris, pnorris@sanfordlab.org or 605-722-5049.

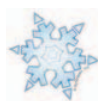
ENVIRONMENT, HEALTH & SAFETY

Winter Safety



Figure 7: Sanford Lab snowdrifts

This beautiful scenery of winter snow can be hazardous. Pedestrians at Sanford Lab should avoid walking on icy or snow-covered roadways. Be careful on sidewalks especially after winter storms. The safest route to the Yates Education Building is to take the stairs to the ground floor of the Admin Building. Snowdrifts can block views in the line of traffic between the Admin and Education Buildings (pictured in Figure 7).



Winter Safety

- Dress warmly, paying special attention to feet, hands, nose, and ears.
- Be careful when driving in snow or ice storms. If you must travel in bad weather, drive slowly. Let someone know what route you're taking and when you plan to arrive.
- The sun's rays can still cause sunburn in the winter, especially when they reflect off snow. Make sure to use sunscreen if you will be skiing or sledding.

HOMESTAKE DUSEL AND SANFORD LABORATORY NEWSLETTER



For info on Lead, South Dakota road and weather conditions: Call (605) 722-0002

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

STAFF CHANGES



Mike Headley at Governor's Corner 4850L

As Kem Robinson returns to LBNL to assume his role as the Director of Engineering in January, **Mike Headley** has been selected to serve as the Acting DUSEL Project Director until a search is completed for a permanent Project Director. Mike is a native of eastern South Dakota and after holding engineering and Project Management positions in the aerospace industry with the U.S. Air Force and U.S. Geological Survey, he joined the SDSTA/DUSEL team in August 2008 as the SDSTA Deputy Laboratory Director. In May 2009, Mike transitioned into the Facility Project Manager role with SDSM&T in support of DUSEL and led the Facility design development efforts for DUSEL during the Preliminary Design phase.

As Mike transitions into the Project Director role, **Josh Willhite** has been named as the Acting Facility Project Manager to backfill Mike during this interim period. Josh attended SDSM&T and has a mechanical engineering background. He came to the DUSEL team in April 2009 from the construction industry—specifically GCC Dacotah Cement in Rapid City. Josh has led the mechanical systems development for the DUSEL Underground Infrastructure and recently served as Deputy Underground Infrastructure Construction Manager. Please welcome Josh and Mike to their new roles in support of the SDSTA/DUSEL team.



Nori Michael Castillo joined DUSEL as a student in March 2010, and began working full-time after graduating from University of California Berkeley in May 2010, with a BA in Environmental Economics and a minor in Public Policy. As the DUSEL Sr. Financial Analyst, he has been managing the budgets and financial controls for all institutions from the Berkeley project office. Nori has over 20 years of experience in accounting and finance as a corporate controller and business manager in the private sector. Startup companies have been his specialty, with Wired Magazine being one of his greatest accomplishments. Recently accepted into the University of San Francisco Executive MBA program, Nori will begin his rigorous MBA courses in January with class meetings on the weekends. Nori is a native of northern California and resides in Berkeley.

UPCOMING EVENTS AND ANNOUNCEMENTS

Workshops

New Horizons for International Investigations into Carbon Cycling in the Deep Biosphere, at Univ. of the Free State, Bloemfontein, South Africa on January 18-23, 2011. This workshop will bring together scientists worldwide to explore new approaches for retrieving chemical, isotopic, metagenomic, transcriptomic, metabolomic and proteomic information from the deep biosphere where cell concentrations are low and metabolic rates slow. The Network of Inner Space Observatories (NISO), an international research network dedicated to the development of underground laboratories, deep boreholes and mines for microbial studies will also be inaugurated. Travel grants will be available for invited speakers and participating graduate students. For more info please contact: T.C. Onstott (tullis@princeton.edu), Esta vanHeerden (vheerde@ufs.ac.za), Tom Kieft (tkieft@nmt.edu) or B. Sherwood Lollar (bslollar@chem.utoronto.ca).

Third International Workshop on Baryon and Lepton Number Violation (BLV-2011) in Gatlinburg (Edgewater Hotel), Great Smoky Mountains, Tennessee, September 22-24, 2011. The Workshop

purpose is to discuss state of the art of B,L, and B-L violation search, stimulate experimental and theoretical developments in this area, and attract new and young researchers to this field. Other topics will include: proton decay, n-nbar transformations, Majorana neutrinos and their role in physics beyond the standard model and in Cosmology. For more info: <http://www.phys.utk.edu/blv2011/>

Fourth IUPAP International Conference on Women in Physics, Stellenbosch, South Africa, April 5-8, 2011. Conference goals: provide an opportunity to view and analyze current status of and progress in promoting women in physics in each country and internationally; provide an arena for women in physics to share their scientific accomplishments and create international scientific collaborations; and build capacity in each participating country to design and implement changes to improve the participation and advancement of women in physics. For more info: <http://www.uswip.org/>

DuRA Events

Presentations that may be of interest to DuRA members are scheduled in the following meetings:

2011 SME Annual Meeting & Exhibit, February 27–March 2, 2011, Denver. For more info: <http://www.smenet.org/public/Core/Events/eventdetails.aspx?iKey=AME2011&TemplateType=A>

2011 APS April Meeting, April 30–May 3, Anaheim. <http://www.aps.org/meetings/april/index.cfm>

45th U.S. Rock Mechanics/Geomechanics Symposium, including sessions on Geology and Geophysics, Mining Engineering, DUSEL Rock Mechanics, Civil Engineering, and underground construction. June 26-29, 2011, San Francisco. <http://www.armasymposium.org/>

2011 XXV International Union of Geodesy and Geophysics (IUGG) General Assembly, workshops and business meetings. June 28-July 8, 2011, Melbourne, Australia. <http://www.iugg2011.com/>

Some highlights will be presented by speakers in future monthly reports.

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

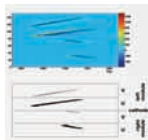
Visiting Assistant Professor Position in Dept. of Physics, Univ. of South Dakota. Candidate will participate in 2010 DUSEL Research Center (CUBED) activities and in the planned DUSEL experiments. Apply at: <https://yourfuture.sdbor.edu> or submit materials to Chair of Physics Search Committee, Dept. of Earth Science & Physics, University of South Dakota, 414 East Clark, Vermillion, SD 57069 or to physics@usd.edu.

Postdoctoral Position in Particle Detector Development, Dept. of Physics, UC Santa Barbara. Lead detector R&D program, building ultra-high-resolution particle detectors for future neutrino and dark matter detectors. Assist KATRIN neutrino experiment and at UCSB Nanofabrication Facility. Contact: bmonreal@physics.ucsb.edu, Professor Ben Monreal or <http://hep.ucsb.edu/>

Postdoctoral Position in Direct Dark Matter Detection at Syracuse University. Experimental particle astrophysics group working with Cryogenic Dark Matter Search (SuperCDMS), AARM, and DEAP/CLEAN. Further info: <http://cdms.syr.edu/> Apply: <https://www.sujobopps.com/> (Job # 026971)

Assistant Physicist with Electronic Detector Group (5900) in Physics Dept. at Brookhaven National Laboratory. Required Ph.D. in physics with emphasis on experimental particle or nuclear physics. Will participate in group activities including LBNE, DUSEL in South Dakota and Daya Bay reactor neutrino experiment in China. Appointment start date: March 1, 2011 under direction of S. Kettell. For more info: <http://www.bnl.gov/hr/careers/> - Job ID # 15570.

HOMESTAKE DUSEL AND SANFORD LABORATORY NEWSLETTER



Erratum for December 2010 Figure 4
Muon track in EXO-200: This track was recorded at
the Waste Isolation Pilot Plant (WIPP) near
Carlsbad, New Mexico.

Newsletter Editor: Melissa Barclay

Contributors: Kevin Lesko, Bill Harlan (Sanford Lab);
Catherine Peters (LUCI: A facility at DUSEL for large-
scale experimental study of geologic carbon
sequestration); Michael Wiescher (Nuclear Astrophysics:
DIANA-Part I); Steve Elliott, Derek Elsworth, Joe Wang
(DuRA News); Peggy Norris, Ben Sayler (Education and
Outreach).

Photo Credits: Fig. 1: Kevin Lesko; Fig. 2; Diana
Swantek; Fig. 3: Hendrik Schatz, Rare isotopes in the
cosmos, Phys. Today 61, November, 40 (2008); Figs. 4,7:
Matt Kapust; Fig. 5: Steve Babbitt, Black Hills State
University; Fig. 6: Nathan Iversen, Central Dakota Times

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