

Dear Homestake Collaboration,

Welcome to the May 2010 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

June 1-2: Education and Outreach Community Meetings – Lead and Rapid City, South Dakota

June 16-17: LBNE Kick Off Meeting for LAr with Jacobs and ARUP – Berkeley, California

July 6-8: LCAB meeting - Lead, South Dakota



Figure 1: May 25-29, 2010 LBNE Collaboration meeting in Deadwood, South Dakota

LBNE Collaboration meeting

The Long Base Line Neutrino Experiment (LBNE) Collaboration held a four-day collaboration meeting at the Deadwood Lodge and Convention Center. About 120 people attended the meeting, which included nine Parallel and six Plenary sessions. The major focus of the meeting was to prepare for the Department of Energy CD1 review and Conceptual Design Report for LBNE, to be completed in Fall 2010. The final day included presentations from the

NSF, DOE, the LBNE project management and the spokesman of the Scientific Collaboration.



Focus on: Dark Matter at DUSEL

The collaborations interested in Dark Matter physics at DUSEL had an important meeting in Berkeley on Friday, 21 May and Saturday, 22 May. This meeting was devoted to making progress on a white paper, which will be the basis for the MREFC proposal in this area and on the convergence of the community. Significant exchanges also took place with the DUSEL facility on the needs, time scale, and cost of the program.

A broad range of observations, including inferences of the mass of astronomical objects from galaxies to superclusters, the anisotropies in the cosmic microwave background, the dimming of supernovae with distance, and the observation of light element abundances, tell us that our universe consists of 73% dark energy, 23% non-baryonic dark matter, and 4% of baryons (protons/neutrons). Among the many candidates suggested but as yet undetected, one of the most compelling possibilities is that the dark matter is comprised of Weakly Interacting Massive Particles, or WIMPs, that were produced moments after the Big Bang from collisions of ordinary matter. A direct detection of elastic scattering in the laboratory of dark matter particles from the galactic halo would be the most definitive way to demonstrate that WIMPs solve the dark matter problem.

The search for, discovery of, and detailed measurement of WIMPs will represent a flagship science program for the US DUSEL over the next 15 years. DUSEL presents the opportunity to fully explore the cross section range (quantifying the WIMP interaction probability) from current levels of 10^{-44} cm² to $\sim 10^{-48}$ cm² per nucleon (for so-called spin independent coupling at a WIMP mass of approximately ten times the mass of the proton). *Within our current theoretical framework, this is the most natural region to observe Weakly Interacting Massive Particles, and our goal should be to*

establish unambiguously that a signal in this range is due to dark matter. Following the recent Particle Astrophysics Scientific Assessment Group, it is useful to distinguish between three generations: "Generation 1" refers to the current round of experiments which should be able to reach a sensitivity of $10^{-45} \text{ cm}^2/\text{nucleon}$ over the next 3 years. "Generation 2" is defined as reaching at least 10^{-46} cm^2 per nucleon and "Generation 3" as reaching at least 10^{-47} cm^2 per nucleon. Solar and atmospheric neutrino backgrounds begin to contribute below WIMP cross-sections of $\sim 10^{-48} \text{ cm}^2$, limiting the ultimate reach of direct dark matter searches.

The increase by three or four orders of magnitude that DUSEL will enable is made possible by the improvement in detector technologies and background reduction techniques. The background requirement for such experiments is extremely challenging. The underground laboratory should provide not only the space for a powerful initial suite of experiments but also adequate depth and space needed to reach the ultimate cross-section goal of $\sim 10^{-48} \text{ cm}^2$ per nucleon, provide unambiguous confirmation of a signal, and rapidly deploy follow-up experiments (e.g. directional) or novel instrumentation.

DUSEL will also enable a coherent national approach to the dark matter problem, bringing together the broad range of US-led efforts taking place at labs both inside and outside the country under one roof and moving forward in a community-defined manner.

The US Dark Matter collaborations reaffirmed at the Berkeley meeting their consensus to focus the DUSEL initial Dark Matter program on two generation-3 WIMP searches. This important scientific goal, which is achievable with the strength of the US community, will capitalize on the current investments and assure continued US leadership in this preeminent area.

Some significant progress was made at the Berkeley meeting on the issues of convergence of the US dark matter community. It clearly shares a number of goals:

1) *Develop a common vision* for a powerful WIMP search/study program for the 2015–2025 timeframe, using several complementary targets and technologies.

2) *Design a compelling program for DUSEL* (at least two Generation-3 experiments, R&D, and

later on directional experiments), incorporating the lessons learned worldwide by the current generation and generation-2 experiments.

3) *Facilitate the international convergence* on complementary experiments across the various regions.

At the Berkeley meeting, there was a tentative agreement on the best strategy to achieve goal 2:

1) *Start studies on issues of common interest* (depth and neutron background, shield designs, radon) and identify common hardware (e.g. shields, photon sensors, electronics) and support functions that can be shared.

2) *Coordinate the competing generation 2 experiments* to explore as rapidly as possible the scientific frontier and provide complementary information on actual performance of technologies, as input for generation 3 decisions.

3) *Converge during the S4 process onto one design* for each of the four targets: Xenon, Argon, Germanium, and Fluorine. This will in effect lead to the merging of the S4 studies. The technological choice for the initial suite of experiments will then be made after DUSEL is approved and three years before beneficial occupancy of the laboratory.

This meeting was a watershed in our long-term goal for the unification of our collaborations and an important step toward constructing a world-leading scientific program at DUSEL.



Subsurface Microbiology Publications

The 7th International Symposium for Subsurface Microbiology was held in Shizuoka, Japan, from 16 - 20 November in 2008. Over 240 researchers from 22 countries attended and gave 200 presentations. A special issue of *Geomicrobiology Journal* vol. 27, 2010, is devoted to papers from this symposium, and many focus on the sub-seafloor biosphere. One paper of particular relevance to subsurface microbiology in underground laboratories is by Orcutt, Wheat and Edwards (DOI: 10.1080/01490450903456772). Their focus was on fractured basaltic oceanic crust, which is the largest contiguous, hydrologically-active subsurface environment on the Earth. They designed and implemented a new subsurface microbial observatory experiment called FLOCS (FLow-

HOMESTAKE DUSEL AND SANFORD LABORATORY NEWSLETTER

through Osmo Colonization Systems) and evaluated alternative casing materials (such as fiberglass-reinforced epoxy and plastic coated steel) and packers (inflatable and waterswellable polymers, used for sealing off different depth intervals within a borehole) in terms of their potential to release carbon, nitrogen and iron during long-term microbiology experiments. The FLOCS utilized an osmotic pump to slowly move fracture water through a cell containing sterile rock surfaces that were then colonized by the microorganisms in the fracture water. Such a device operates without power at the bottom of the seafloor and is collected at intervals. Fiberglass-reinforced epoxy seemed to represent the most promising casing material in terms of the leaching rates of organics and metals.



DUSEL IN THE NEWS

To read about DUSEL stories:

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

<http://www.duselwatch.com/>

Safety a core value at Sanford Lab – May 11
Governor to visit Gran Sasso Laboratory – May 27
International Scientists Advising DUSEL Team - May 27

Gov. Mike Rounds leading delegation to Switzerland for economic development mission – Argus Leader – May 12 - <http://www.argusleader.com>

An improved version of the archived April 28 videoconference from the 4850 Level is available at the Internet2 website: <http://bit.ly/lnt2DUSLdem>

DUSEL Research Association (DuRA) Election

The election is still underway for members of the Executive Committee of the DUSEL Research Association (DuRA). You may recall from the April DUSEL newsletter that the DEDC will morph into the DuRA Executive Committee and ultimately phase out. This Executive Committee will represent the full membership of the DUSEL underground science community involved in the general membership of DuRA. Statements from the nominees for the

Executive Committee of the DUSEL Research Association are available attached to the ballot at <http://dusel.org/DURA.html>

All members of the `dusel_all` listserv are entitled to vote. You may subscribe to this listserv by registering at:

http://dusel.org/mailman/listinfo/dusel_all

If you wish to vote and only joined the listserv after the first call for votes then complete the ballot available at: <http://dusel.org/DURA.html> and send it to the email address noted [dura.vote@gmail.com].

The vote will close at midnight [23:59 EST] on Friday June 11th.

In accordance with the DuRA charter, each of a younger member and a representative each of Physics and of BGE will be added to the Committee as part of the seven new members. Of the seven elected, three will begin immediately and four will begin Jan 1, 2011.

SANFORD UNDERGROUND LABORATORY AT HOMESTAKE

4850 Level Update

Excavation of the Transition Cavern which will house clean rooms for the LUX and Majorana experiments on the 4850 Level is near completion.



Figure 2: View from the entrance of the Transition Cavern



Figure 3: Mike Oates (left) operates jumbo drill at 4850 Level. Lighter colored rock in front of the jumbo is rhyolite.

Three extensometers will be installed in the Davis Cavern and four in the Transition Cavern. These permanently placed instruments will measure rock movements in the caverns. The extensometers, made by Geokon, Inc., are safety devices and will also provide data for engineers designing caverns for the DUSEL campus. Geokon instruments are used throughout the world, from China to Iceland. Geokon instruments measured movements of a glacier in northern Sweden for an NSF-funded experiment by Northern Iowa University.



Figure 4: Extensometer made by Geokon, Inc.

The Davis Cavern back (roof) has been raised eight feet to accommodate the LUX dark matter detector. The copper pieces mounted inside the black frame in Figure 5 were just returned from Lawrence Livermore National Laboratory, where they were cleaned using an acid-etch procedure. The cart in the middle provides an interface of cables and piping, etc. between the detector and the outside world.

During the week of May 9, Jeremy Chapman (Brown University, standing at left in Figure 6) and Michael Woods (University of California, Davis) assembled the LUX dark matter detector. The cables are coiled in the "breakout cart tree," a device that allows cables from the LUX detector itself to connect to the outside world. Cables coiled in the tree will be attached to photomultiplier tubes inside the detector and will run through the breakout cart to the data acquisition equipment.



Figure 5: LUX Surface Lab. Postdoc Researcher Peter Sorenson of LLNL (front)



Figure 6: Patrick Phelps of Case Western Reserve University inspects cables

CUBED Collaboration Meeting

On May 21-22, the CUBED Collaboration's second meeting was held at Sanford Underground Laboratory. About 50 researchers attended.

The Center for Ultra-Low Background Experiments at DUSEL (CUBED) was created in 2009 as part of the Governor's 2010 Initiative to promote economic development. CUBED has attracted 54 researchers from 11 institutions, including many students and groups from outside South Dakota.

Dr. Dongming Mei (University of South Dakota) is the CUBED Principal Investigator and Jaret Heise is the Sanford Laboratory Science Liaison Director.

One of CUBED's principal goals is to produce high-purity germanium crystals in an underground environment for the next generation of ultra-low background experiments at DUSEL. Crystal-pulling equipment used in the production of germanium crystals has been purchased. (This is the same kind of equipment used to manufacture electronics-grade silicon.) The equipment will be installed in surface laboratories at USD and SDSMT in June. Researchers there will master production techniques

before moving operations underground in a few years.

CUBED funding also provides support for the development of other low-background technologies for projects investigating dark matter, neutrinoless double-beta decay and the long-baseline neutrino experiment (LBNE).



Figure 7: CUBED Collaboration at the Yates Headframe

EDUCATION AND OUTREACH: Activities

Ask-an-expert community meetings on the future of the Sanford Underground Laboratory at Homestake

Why has the Sanford Underground Laboratory been called the future of physics in the United States? Why do geologists and biologists want to go deep underground too? What opportunities will be available for students, teachers and visitors at the Sanford Lab? How will engineers build caverns big enough to hold Mount Rushmore and do it a mile underground?

Get answers to these questions and more from scientists, engineers and educators during two informal, open house style meetings. Talk one-on-one with people working on plans to transform the Sanford Lab into the national Deep Underground Science and Engineering Laboratory (DUSEL). Learn firsthand how DUSEL could become the largest, most sophisticated laboratory of its kind in the world. Physicists, geologists, biologists, engineers and educators will be available to answer questions from community members. Refreshments will be served.

When and where:

Tuesday, June 1

6:30 p.m. to 8:30 p.m.

Golden Hills Resort
900 Miners Avenue
Lead, South Dakota

Wednesday, June 2

6:30 p.m. to 8:30 p.m.

Surbeck Center
South Dakota School of Mines and Technology
Rapid City, South Dakota

For more information:

- Call Bill Harlan or Peggy Norris at 605 722-8650
- E-mail bharlan@sanfordlab.org

ENVIRONMENT, HEALTH & SAFETY



The advent of Memorial Day signals the beginning of summer vacation. Whether you are taking a camping trip or traveling by airplane, travel safe.

- Pack right, mix and match so that your bags will not be too heavy.
- Bring plenty of sunscreen as UV rays increase in the summer sun.
- Drink plenty of water.
- Prepare for cooler weather: it can still rain in the summer.
- Don't overdo it. Relax, be safe, and have fun!

NEW STAFF



Bill Kalinowsky has joined the DUSEL team as a Systems Engineer with Stellar Solutions, Inc., to work with the Science Liaison team in Berkeley. Bill will develop the requirements

baseline and help establish interface control between experiments and the laboratory. Previously, Bill led a team responsible for defining internal vehicle interfaces at Lockheed Martin on NASA's Orion human spacecraft program. Before joining Stellar, Bill designed, built, tested, and operated space life science experiment hardware that flew aboard the Space Shuttle and International Space Station. Bill holds BS and MS degrees in Aerospace Engineering Sciences from the University of Colorado, Boulder, and is currently completing a master's degree in Engineering Management.

Bill tries to spend most of his free time outside and is an avid alpine skier and mountain biker. Being from Colorado, Bill looks forward to picking up surfing and wind surfing while in the Bay area. When he can't get outside, Bill plays the guitar and piano, and also loves to sing.



Josh Willhite joined DUSEL at the Lead office as Project Engineer for Underground Mechanical Design and Construction in early April. He is a native South Dakotan, growing up near Johnson Siding between Lead and Rapid City. After his career took him to Indiana (where he got married), and Wyoming (to get closer to home), he now lives in Hill City, a beautiful town near Mount Rushmore with his wife, Jodi, and two sons Chad (4) and Andrew (2).

Josh began his career working for Dacotah Cement during the summer months while attending the South Dakota School of Mines and Technology. After graduating in 1999 with a BSME, he was offered an engineering position for a cement plant in Greencastle, IN. This position provided the opportunity to be part of an \$85 million expansion project to build a cement manufacturing process unique to the U.S. After commissioning was complete on this project, Josh was offered a position with another company to move closer to home and work as the plant engineer for another cement plant in Laramie, Wyoming. About a year later, he was

given an opportunity to return to his original plant in Rapid City - now called GCC Dacotah. There he held various positions in the maintenance and engineering departments, finally settling in the production manager position. His wide variety of experience will be a great asset to the DUSEL project.

Josh enjoys working with his hands, whether it is remodeling a house, rebuilding a car, or playing Legos with his boys. As with most engineers, learning about science and technology is a part of his life and this project will certainly afford that opportunity!

Favorite Quote - A common mistake that people make when trying to design something completely foolproof is to underestimate the ingenuity of complete fools. – Douglas Adams

Upcoming Events and Announcements

Calling on DUSEL Science groups in the Washington, DC area: The Inaugural USA Science & Engineering Festival, the country's first national science festival, will descend on the Washington, D.C. area in October 2010. The Festival promises to be the ultimate multi-cultural, multi-generational and multi-disciplinary celebration of science in the United States. The culmination of the Festival will be a two-day Expo in the nation's capital that will give over 500 science & engineering organizations from all over the United States the opportunity to present themselves with a hands-on, fun science activity to inspire the next generation of scientists and engineers.

For more information: usasciencefestival.org

DUSEL/Sanford Lab will have a tent at the Expo in the Mall on Saturday and Sunday, October 23-24. We will have several hands-on activities set up, and need some enthusiastic and energetic volunteers. If you live close to the DC area, please consider sending some of your postdocs and graduate students to volunteer for a few hours in the DUSEL tent, or even participating yourself. Contact Peggy (pnorris@sanfordlab.org) for more details.

Be a Project Leader - Make a difference in science and math education at the Summer Math and Science Honors (SMASH) Academy.

Session 1: June 29-July 13

Session 2: July 15-July 29

HOMESTAKE DUSEL AND SANFORD LABORATORY NEWSLETTER

Since 2004, the Berkeley Experimental Cosmology group has partnered with the Level Playing Field Institute (LPFI) to support the Summer Math & Science Honors (SMASH) Academy, by presenting Topics in Current Science Research, a 5-week course for SMASH students who have just completed 9th grade.

For additional information:

cdms.berkeley.edu/UCBlabs/Main/SMASH
Miguel Daal * miguel@cosmology.berkeley.edu
Rachel Winheld * winheld@berkeley.edu

Neutrino 2010 (June 14-19)

The agenda for Neutrino 2010 is shaping up and the Greek Euro is a bargain! This could be the biggest neutrino meeting ever. For more info: <http://www.neutrino2010.gr>
<http://conferences.phys.uoa.gr/Neutrino2010/>

Fourth Pontecorvo School - The IV International Pontecorvo Neutrino Physics School," organized by JINR (Dubna) will be held 26 Sep - 06 Oct 2010 in Alushta (Crimea, Ukraine). For more info: <http://pontecorvosch.jinr.ru/>



JOBS

Two Postdoctoral positions at Case Western, in LUX dark matter experiment led by Professors Tom Shutt and Dan Akerib. Will participate in DUSEL-related R&D projects aimed at subsequent tonne and ten-tonne scale LXe experiments. Case Physics Department is home to the Center for Education and Research in Cosmology and Astrophysics- (<http://cerca.case.edu>). Prefer strong background in data analysis, detector operations, particle detectors, data acquisition and electronics, low-background techniques and purification methods, and/or Monte Carlo simulations. Physics Ph.D. or closely related field. Send application to: LUX_postdoc@phys.cwru.edu with CV and three letters of reference. Deadline: June 15, 2010.

Postdoctoral Position in Experimental Dark Matter Physics. Southern Methodist University. Contact Jodi Cooley, cooley@physics.smu.edu. For more details: http://www.physics.smu.edu/web/jobs/supercdms_postdoc.html

Postdoc Research position in neutrino physics, Physics Dept, Stanford. Contact Ms. Marcia Keating, Varian Physics, Stanford, CA 94305-4060; email: mkeating@stanford.edu.

Postdoctoral Research Position in experimental particle/nuclear physics, University of South Dakota. Apply online: <https://yourfuture.sdbor.edu>. Contact: Vincente Guiseppe, vincente.guiseppe@usd.edu

Newsletter Editor: Melissa Barclay

Contributors: Kevin Lesko, Bill Harlan, Derek Elsworth, Jaret Heise, Richard Kadel, Bill Kalinowsky, Dongming Mei, Tullis Onstott (Subsurface Microbiology Publications), Bernard Sadoulet (*Dark Matter at DUSEL*), and Joshua Willhite.

Photo Credits: Fig 1: Tom Russo using Richard Breedon's camera; Figs. 2,4,6,7: Bill Harlan; Fig. 3: Will McElroy; Fig. 5: Jaret Heise.

BERKELEY OFFICE

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

HOMESTAKE DUSEL 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/>

South Dakota Science and Technology Authority

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