

Dear SURF Readers,

Welcome to the December 2013 Sanford Underground Research Facility (SURF) monthly newsletter. The newsletter is also posted online, and a pdf copy is available. You can read recent and archived newsletters at our website at www.sanfordlab.org. We are glad to receive your input on news, links to news articles, upcoming workshops, conference notices, scientific updates, information concerning SURF, employment opportunities, and other highlights relevant to underground science.

Important Dates

January 8-10: CASPAR Collaboration meeting – Lead

January 22-23: Environmental Health and Safety Oversight Committee review – Lead

January 23-24: MAJORANA DEMONSTRATOR review – Lead

Geotechnical Monitoring at Sanford Lab

For the past few years, a SURF team of engineers, geologists, and others has been working on SURF's excavation design and geotechnical monitoring. Members include current SURF Project Engineers David Vardiman and Bryce Pietzyk, School of Mines and Technology (SDSMT) Professor Emeritus Zbigniew Hladysz, former SURF engineer Wendy Zawada, consulting geologist Tom Trancynger, former SDSMT graduate student Jason Van Beek, and Kevin Hachmeister of *Golder Associates*. SDSMT Professor Emeritus and Consultant/Researcher William Roggenthen remains actively involved. At one point or another, all have had some involvement in the installation of the instruments. Project Engineer Vardiman reports:

The Davis Campus is one of the world's largest dimension underground laboratory cavern complexes available to scientists, at the significant depth of 1478 meters. The MAJORANA DEMONSTRATOR (MJD) cavern is 15.2 meters long, 42.7 meters wide, and 9.1 meters high. The requirements for excavation of the campus caverns during 2009 and 2010 mandated that the excavation and ground support design provide a long-term, 50-year life for facility stability with minimal

convergence of the wall rock. To help monitor compliance of this design and the overall stability of the cavern space, an array of geotechnical extensometers were installed to aid in the monitoring of the rock mass. Not only are managers of the facility interested in demonstrating that a stable science work environment exists, but the scientists themselves wish to be assured that they and their instruments are working in a stable setting, although perhaps an unfamiliar environment.

The long-term monitoring and reporting of the geotechnical stability of the wall rock conditions and ground support design performance for the Sanford Lab Davis Campus caverns are actively managed on a 24-hour basis. This is accomplished by the application of an array of ten separate Geokon™ vibrating wire extensometers (see Figure 1). These instruments provide daily collection of data sent to a set of data loggers stationed within the Davis Campus utility room. The data is then extracted by a surface-dedicated server via fiber optic cable, and processed for reporting through Vista Data Vision™ software. The instruments were installed between the conclusion of excavation activities in 2011 and the early stages of the installation of the Davis Campus infrastructure. These instruments come in two styles, a single-point anchor instrument with a depth of six feet from the instrument collar, and a multi-point instrument with five separate anchorages spaced on 1.8-meter intervals for a total coverage of nine meters in depth. Each instrument also contains a collar thermistor to record variations in instrument temperatures.

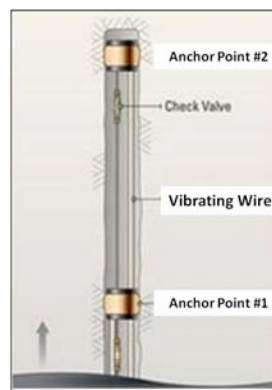


Figure 1: Multi-point Extensometer Instrument

Three single-point instruments were sited at the "Big X" intersection (so named because of its intersection of four tunnels) during the later stages of excavation to evaluate rock mass response due to excavation,

and one multi-point instrument was installed later to provide long-term monitoring of this large-span intersection. A configuration of four multi-point instruments monitor the MJD experiment cavern with rock conditions, with one in each wall and two instruments in the ceiling (see Figure 2). One single-point and one multi-point instrument monitors the LUX Experiment Davis Cavern.

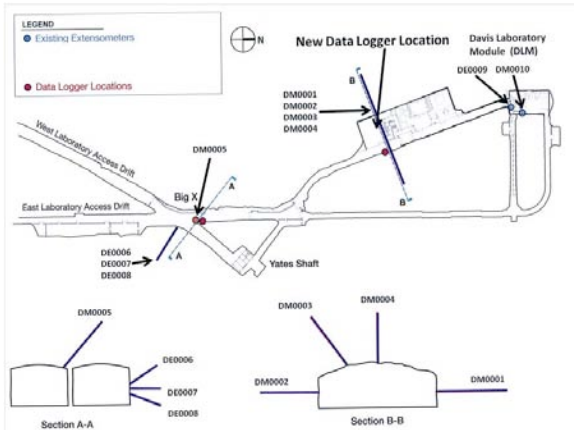


Figure 2: Davis Campus Extensometer Array

Data, which has been systematically collected for almost thirteen months, confirms very stable rock mass conditions. Two plots of data, one for instrument DM0004 of the MJD and one for instrument DM0010, are presented in Figures 3 and 4.

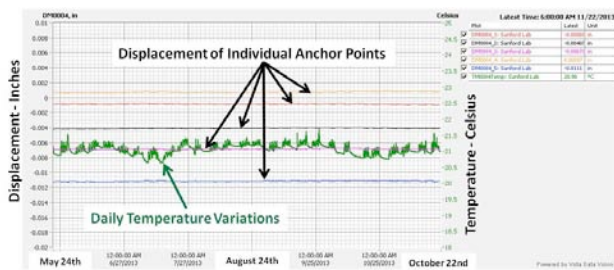


Figure 3: MJD cavern – DM0004, 6-month Data Plot

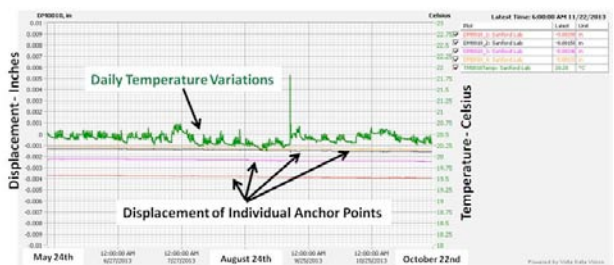


Figure 4: MJD cavern – DM0010, 6-month Data Plot

Active evaluation of these data reports may be conducted whenever required, but a monthly status report is nominally issued for each instrument at the end of each month. Alerts are issued via email if the instruments begin to record deviations from baseline in excess of 0.002 inches for any of the anchorage points.

To date, the data collected for the last thirteen months have indicated very minor variations in the cavern wall rock conditions with typically less than a total of 0.002 inches of deviation from the original baseline, as anticipated. As an additional benefit, charting of the concurrent temperature data collected shows not only daily temperature variations in the HVAC-treated portion of the campus due to shift-by-shift personnel occupancy, but the seasonal variations in temperature recorded on the "Big X" instruments.



LZ Technical Workshop

On December 12-14, nearly 40 members of the LUX-ZEPLIN (LZ) collaboration met at the Berkeley Lab to discuss planning for the next generation of dark matter experiments at SURF. Among the members who attended were scientists and engineers from the United States, the United Kingdom, Portugal, and Russia.

The LZ collaboration has proposed to construct the world's most sensitive dark matter detector to be placed in the water tank currently housing the LUX experiment in the Davis campus at the 4850 Level of SURF. The LZ detector would contain seven tonnes or more of liquid xenon and include a new liquid scintillator background veto system to achieve unprecedented sensitivity.

The technical meeting followed the submission of a proposal to the Office of High Energy Physics of the Department of Energy and to the National Science Foundation for support to design and construct the LZ detector. The technical status of the LZ detector was presented and discussed in detail. Plans for the first part of 2014 were also evaluated and will include a number of design reviews and other events to advance the readiness of the LZ design. The next LZ collaboration meeting will be held March 6-9, 2014 at the University of Maryland.

Reports/Papers Available

YouTube video: October 30 LUX Science Seminar
<http://www.youtube.com/watch?v=SMzAuhRFNQ0&feature=youtu.be>

Paper: [“The Large Underground Xenon \(LUX\) Experiment”](#). *Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment*, Vol. 704, 11 March 2013, pp. 111–126.

[Why the US Needs a Deep Domestic Research Facility](#). (Kevin Lesko, April 1, Cornell University Library, <http://arxiv.org/abs/1304.0402>)

For news, twitter updates, and other features see the SURF website: www.sanfordlab.org

Like SURF on Facebook:
<http://www.facebook.com/SURFatHomestake>



SURF IN THE NEWS

Nature: [365 Days: 2013 in Review](#) (Richard van Noorden, et al, December 18)

Physicsworld.com: [The world of physics in 2014](#) (Matin Durrani, December 19)

Washington Post: [Dark matter: What we know and why you should care](#) (Dominic Basulto, November 7)

Science Recorder: [LUX particle detector may shed some light on dark matter](#) (Rick Docksai, November 3)

Symmetry: [US particle physicists look to space](#) (Lori Ann White, December 6)

[Reading in the Higgs Era](#) (Mike Perricone, December 3)

BHSU Media.com: [Lead scientists experiment with dark matter detector](#) (Isaac Hanson, November 16)

The Courier: [Search for dark matter goes on](#) (November 11)

The Almagest (Alberta, Canada): [First results from dark matter](#) (December 2)

Space Reporter: [First results of groundbreaking dark matter experiment are in](#) (Andrew McDonald, November 18)

UCSD News Center: [\\$100 Million Gift Launches Sanford Stem Cell Clinical Center](#) (Scott LaFee, November 4)

Rapid City Journal: [Sanford lab evacuated after earthquake near Custer](#) (Claudia Lass, December 12)

[Earthquake near Custer; no damage reported](#) (Joe O’Sullivan, December 12)

[New Lead visitors center will add to education](#) (Editorial Board, December 10)

[Lead City Commission commits \\$30K to new visitor center](#) (Tom Griffith, December 3)

Black Hills Pioneer: [County contributes \\$30K to Lab projects](#) (Jaci Conrad Pearson, December 13)

[Lead commits \\$30k to lab and chamber visitor center](#) (Adam Hurlburt, December 5)

DURA News

To comment on DURA, please contact chair Richard Gaitskell (Richard_Gaitskell@brown.edu). For Bio-Geo-Engineering matters, contact Bill Roggenthen (William.Roggenthen@sdsmt.edu). For further information on DURA, see: <http://sanfordlab.org/dura>

SANFORD UNDERGROUND LABORATORY NEWS

Earthquake in South Dakota

On Thursday, December 12, Sanford Lab evacuated the Davis Campus underground research space after seismic activity was reported around 8:50 a.m. An earlier (~3 a.m.) earthquake near Custer, located 55 miles from Lead, registered 3.5 on the Richter scale. Seismic activity was detected at the Davis Campus, 5000 and 2000 Levels, and the Ross Dry buildings. Lab crews then went underground to inspect all areas for infrastructure integrity and stability. The Shaft was re-opened on Thursday evening, and Davis Campus resumed routine operations on Friday morning. Additional safety and structural inspections continued through December 18 to monitor the facility infrastructure and perform more detailed inspections.

Water inflow at Sanford Lab

Bryce Pietzyk, Evacuation and Construction Engineer at Sanford Lab, is leading the hazard mitigation crew in a new water inflow project to allow for more controlled water drainage.

The northern Black Hills area receives heavy amounts of annual snow and rainfall. This past spring, the area had record rainfalls, and already in October of this year, more than 60 inches of snow fell in Lead. When the snow melts, the water floods the streams and creeks, and also areas that connect to the old mine workings at the Lab. Pietzyk says, "We have to direct the water as safely as possible through the lab footprint while pumping as much as we can in the process." Heavy inflows of water interfere with underground operations, including research and experiments taking place on the Davis Campus.

In the first phase of the project (shown in Figures 5-6), the team worked with *Stu Blattner Inc.*, a company that designed a raise bore machine used to drill a 300-foot pilot hole from the 1700 Level to the 2000 Level underground. When the team reached the 2000 Level, they back reamed to the 1850 Level to create a water inflow raise. Completion of that phase is expected some time in December. Pietzyk and his team will then begin fusing 2000 feet of high-density polyethylene pipe as well as building additional infrastructure that will eventually take the water to the reservoir below the 5000-foot Level.



Figure 5: A crew from Stu Blattner Inc. changes a pipe on a drilling rig at the 1700 Level. The cylinder in the foreground is a button bit cutter. The reamer uses four of these cutters and is pulled up or back reamed to widen the pilot drill hole, creating a raise.



Figure 6: The team drills a bore hole 300 feet down and will back ream using the rig pictured here

The actual project was preceded by months of preparation. Before drilling began, ground support for the drill had to be installed, with safety in mind. The team blasted the area to accommodate the drilling rig, drained water from the area, and then installed rock bolts and mesh. Finally, they had to move the pipe and other equipment, including the 9000-pound raise bore machine, into the drilling area. The water inflow project will be completed in Spring 2014.

Safety at Sanford Lab

In mid-November, Sanford Lab's Emergency Response team took part in a quarterly exercise to test their emergency plans and procedures, and hone the skills of the Emergency Response Team (ERT).

A joint evacuation exercise was held with the South Dakota National Guard's 82nd Civil Support Team (CST) (see Figure 7) designed to test warning systems and rescue underground personnel in case of a crisis. Involving the Guard was an important aspect of the drill. SURF Executive Director Mike Headley stated, "Should there be a real emergency or a situation that requires a prolonged response, the Guard gives us an additional level of depth and expertise from which to draw."



Figure 7: Infrastructure Tech Dave Leatherman works with members of the South Dakota National Guard Response Team as they prepare to go underground for a simulated rescue mission

The rescue exercise focused on evaluating the effectiveness of the stench warning system, a process that involves dumping ethyl mercaptan, a colorless organic liquid with a strong odor, down the Ross and Yates Shafts. The stench warned anyone underground that there was a problem and they would need to evacuate to the surface. The exercise also determined how long it would take for the stench to permeate in different areas of the underground, and whether procedures in place were followed properly.



Figure 8: Self-contained breathing apparatus units are prepped for use by the Emergency Response Team

Emergency Response Coordinator Tim Eggers (also chief of the Lead Volunteer Fire Department) said, "The training is critical because an emergency is not the time to figure out what to do in an emergency."

Twenty-four hours after the evacuation exercise, safety team members met to discuss the process and lessons learned.

EDUCATION AND OUTREACH

ANNOUNCEMENT: Undergraduate Internships and Davis-Bahcall Scholars Program

Sanford Lab's commitment to education can be seen in the many outreach programs offered across the region, its efforts to advance science through world-class research, and its generous offering of summer internships. This summer, up to six students will receive internships, while up to 12 will be chosen for the prestigious Davis-Bahcall Scholars Program, sponsored by 3M.

Four *Dave Bozied Internships* are open to students majoring in physics, chemistry, geology, engineering (environmental, geological, mining, industrial, chemical or mechanical), science education, communications or related disciplines. Applicants must have a South Dakota address or be attending a university in the state.

Two engineering students will be selected to receive a *Chris Bauer Engineering Internship*. Created in memory of the late Chris Bauer, a former electrical engineer at Sanford Lab, the internships allow students to get hands-on experience. Preference for one position will be given to an electrical engineering major. For one position, South Dakota residency is NOT a requirement.

"We're thrilled to be expanding our summer internship program for 2014 including offering two internships to honor the memory of our friend Chris Bauer," said Sanford Lab Executive Director Mike Headley. "Through our program, students gain valuable experience while helping us meet the challenges of operating the deepest underground science laboratory in the United States."

Students receiving internships are paid \$10 an hour; additional compensation may be offered as partial offset of travel or living expenses. The deadline to apply is January 10, 2014. For more information, go to <http://www.sanfordlab.org/article/1644>.

The *Davis-Bahcall Scholars Program* allows students to delve into the world of modern scientific research. The program is named for experimentalist Ray Davis, and theoretician John Bahcall, who together proposed the solar neutrino experiment in the former Homestake mine. The experiment led to a Nobel Prize for Davis and opened the field of underground physics. Up to 12 students will spend five weeks learning from scientists at some of the world's leading universities and laboratories, including Sanford Lab. To participate, students must be at least 18 years old, South Dakota residents, and planning a career in science, engineering, technology or mathematics.

"A summer internship is all about the student experience," said Peggy Norris, Deputy Director of Sanford Lab's Education and Outreach Program. "Research opportunities, whether for graduate, undergraduate, or high school students, give participants a chance to experience science in practice."

The deadline to apply for the *Davis-Bahcall Scholars Program* is Jan. 15, 2014. Applications can be found at <http://doe.sd.gov/secretary/scholarships.aspx>. For more information on this program or internships at Sanford Lab, contact Peggy Norris at 605-722-5049

or pnorris@sanfordlab.org.

Planning for the Sanford Science Education Center

A strategic planning process for the Sanford Science Education Center began with a meeting on November 15 on the Black Hills State University (BHSU) campus. Leaders from the three partner institutions--Sanford Lab, BHSU, and the Lead Area Chamber of Commerce--came together for a one-day meeting to refine the mission, vision, core values, and goals of the Center. The group also considered the current education programs and possible areas to expand. On December 11, the planning team reconvened to prioritize the ideas that were generated and to develop action steps.

The architectural firm, *Williams and Associates of Spearfish*, together with its partner firm *Treanor Architects* of Lawrence, Kansas, has been advancing plans for renovation of the Jonas Science Building and the creation of the Sanford Science Education Center at BHSU. On October 31-November 1, they led a two-day conceptual design workshop that involved BHSU administrators and faculty members from science, mathematics, and education. Ben Saylor is representing Sanford Lab's Education and Outreach department throughout the design process. The project's architectural program is being finalized now, and construction is anticipated to begin this coming summer.

Design efforts are also on track to transform the Homestake Visitor Center into the Sanford Lab Homestake Visitor Center. Construction on that project is due to begin this spring with an anticipated completion date of June 2015.

The old Homestake Visitors Center (shown in Figure 9) will be demolished to make way for the new Sanford Lab-Homestake Visitors Center, an 8000 square-foot building (see Figure 10).



Figure 9: Current Homestake Visitors Center



Figure 10: Architectural rendering of the Sanford Lab Homestake Visitors Center at the open cut

The current center sits at the edge of the historic 1876 open cut mining area that measures 1000 feet wide by 900 feet deep (now inactive). More than 40,000 visitors come to the center annually. The new building will be equipped to narrate the story of a western mining town and its transformation into a center for scientific research.

SURF Executive Director Mike Headley said, "This facility will advance our partnership with the Lead Chamber of Commerce and Visitors Center and expand our education and outreach programs. We're excited to support the Visitors Center in telling the story of Lead's history and the science of Sanford Lab to the general public, educators, and students."

The partnership of many local groups is responsible for bringing this to fruition: Sanford Lab, the Lead Chamber of Commerce/Homestake Visitors Center, and Black Hills State University.

The new Visitors Center will include 3000 square feet of exhibit space in which to tell Lead's story of the discovery of gold and the history of mining, Barrick-Homestake's stewardship of the land, the ethnic groups who worked in the mine, the effect of the gold rush on Native peoples, and Sanford Lab's groundbreaking science.

The structure will also include offices for the Visitors Lead Chamber, flexible classroom space, and retail and exhibit areas. The design is by architect Steve Dangermond of *Dangermond/Keane Architecture (DKA)* in Portland, Oregon.

E&O Picture of the month

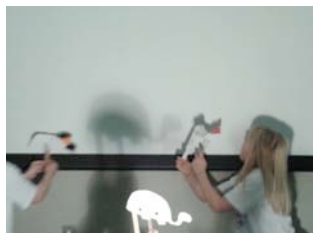


Figure 11: At a 'Girls and Gadgets' event, Bismarck, ND, Girl Scouts explored mechanical linkages by making shadow puppets with moving parts



Julie Dahl, Science Education Specialist, has recently been appointed to the South Dakota Standards Workgroup, consisting of K-5 teachers, MS teachers and high school teachers, a school board member, administrators and curriculum leaders, postsecondary, business and industry representatives. Some parents are also providing feedback to the group. This group of teachers and science leaders will study the issue of science standards. Julie divides her time between the Center for the Advancement of Math and Science Education at Black Hills State University, and Education and Outreach at Sanford Lab.

Books for the scientist on your gift list

(from *Reading in the Higgs Era*, *Symmetry Magazine*)

- *My Brief History* – Stephen Hawking
- *An Appetite for Wonder* – Richard Dawkins
- *The Cosmic Tourist* – Brian May, et al
- *Robert Oppenheimer: His Life and Mind* – Ray Monk
- *The Universe in the Rearview Mirror* – David Goldberg
- *An Astronaut's Guide to Life on Earth* – Col. Chris Hadfield
- *Brilliant Blunders: From Darwin to Einstein* – Mario Livio
- *Hubble's Universe: Greatest Discoveries and Latest Images* - Terence Dickinson

ENVIRONMENT, HEALTH & SAFETY

EHSOC meeting

On January 22-24, 2014, SURF will be hosting the Environmental Health and Safety Oversight Committee (EHSOC). The agenda will focus on 2013 EHS performance, science experimental status, and updates on the Ross Shaft refurbishment and the Yates Shaft maintenance program. The EHSOC will be chaired by Ian Evans of SLAC, who recently replaced Craig Ferguson. We appreciate Craig's contributions to SURF and welcome Ian to the SURF team.



Holiday Safety

The holiday season can be a difficult time. If you are feeling depression, stress, or anxiety, please take care of yourself:

- Reach out to family, friends, and colleagues
- Seek the counsel of a priest, rabbi, or minister
- Do not be afraid to contact a therapist or mental health professional

Have a safe holiday season and a Happy New Year!

UPCOMING CONFERENCES AND WORKSHOPS

APS Conferences for Undergraduate Women in Physics, January 17-19, 2014. Information and resources to support women undergraduate students as they pursue a career in physics. Contact: women@aps.org
<http://www.aps.org/programs/women/workshops/cuwipapp.cfm>

Dark Matter 2014, UCLA's 11th Symposium on Sources and Detection of Dark Matter and Dark Energy in the Universe, February 26-28, 2014. Northwest Auditorium, Covel Commons, UCLA.
<https://hepconf.physics.ucla.edu/dm14/>

APS April meeting, Savannah, GA, April 5-8, 2014. Particle physicists, nuclear physicists, and astrophysicists will share new research and insights.
<http://www.aps.org/meetings/april/index.cfm>

Neutrino 2014, XXVI International Conference on Neutrino Physics and Astrophysics, Boston, MA, June 2-7, 2014.

<http://neutrino2014.bu.edu/neutrino-2014/>

Present and Future Neutrino Physics, KITP, UC Santa Barbara, September 29-December 29, 2014. Topics include neutrino oscillations, nature of neutrino mass, absolute neutrino mass scale, and neutrino physics beyond the Standard Model.

<http://www.kitp.ucsb.edu/activities/dbdetails?acro=neutrinos14>



JOBS

Staff Scientist, Lawrence Berkeley National Lab, Physics Division. Work with Particle Data Group. Deadline: 1/3/14. Juerg Beringer, jberinger@lbl.gov.

<https://academicjobsonline.org/ajo/jobs/3458>

Faculty positions, University of South Dakota. Tenure-track Professor and Assistant Professor in Earth Sciences and Physics. Posting numbers: 5811 and 5812. Deadline 12/15/13. Apply:

<https://yourfuture.sdbor.edu>

Assistant Professor, Texas A&M University. Tenure-track position in experimental high energy physics or accelerator physics. Deadline: 1/1/14.

Walker, facultysearch@physics.tamu.edu

<http://inspirehep.net/record/1264576>

Postdoctoral Fellow, Lawrence Berkeley National Lab, Nuclear Science Division. Work on neutrinoless double-beta decay search in the MAJORANA Experiment. Alan Poon.

awpoon@lbl.gov

<https://lbl.taleo.net/careersection/2/jobdetail.ftl?lang=en&job=76244>

Tenure-track faculty positions, South Dakota School of Mines, Rapid City, SD. Junior and senior faculty openings in South Dakota's new physics doctoral program. Deadline: 1/15/14.

<http://inspirehep.net/record/1260920>

<http://inspirehep.net/record/1260921>

Assistant Professor, Dept. of Physics, Drexel University. Tenure-track faculty in experimental particle physics. Queries: Charles Lane.

lane@duphy4.physics.drexel.edu

<http://www.drexel.edu/physics/about/employment/>

Lecturer, University of North Carolina, Chapel Hill, Dept. of Physics & Astronomy. Redesign and teach undergraduate physics/astronomy courses. Laurie McNeil, mcneil@physics.unc.edu. Deadline: 1/15/14.

<https://unc.peopleadmin.com/postings/33408>

Postdoctoral position, University of Zurich. Research on XENON dark matter project. Deadline: 1/15/14. Send applications to: Carmelina Genovese, Physics Institute, Univ. of Zurich, Winterhurerstr. 190, CH-8057, Zurich, Switzerland.

Carmelina.genovese@physik.uzh.ch;

Queries: Laura Baudis, lbaudis@physik.uzh.ch

Postdoctoral position, University of North Carolina, Chapel Hill. Research in Experimental Nuclear and Particle Astrophysics. Work with MAJORANA and KATRIN. John Wilkerson. jfw@physics.unc.edu

<https://unc.peopleadmin.com/postings/31072>

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