

Oak Ridge National Laboratory Neutron Sciences Progress Report June 2010

Neutron Highlights

At HFIR, Cycle 427 began February 19, 2010, and ended March 15, 2010. Cycle 428 began May 5, 2010, and ended May 29, 2010. Cycle 429 began June 16, 2010, and will end July 9, 2010.

At SNS, the current cycle of neutron production began February 22, 2010, and will extend through June 29, 2010. Reliability has averaged over 90% during the last 9 weeks.

Call for proposals deadline is **August 25, 2010**, for the December 2010–May 2011 period. See [details](#).

First submissions for the **User Partnership Program for Sample Environment Equipment** awards have been received. User ideas are needed for this collaborative activity.

Science Highlights

Armed with neutron imaging, a team led by Oak Ridge National Laboratory's (ORNL) Trent Nichols, a doctor of internal medicine who also holds a doctorate in physics, hopes to improve the odds for patients with cancer. The proposed work of a team that includes veterinarians and scientists from diverse disciplines could ultimately lead to less guesswork for surgeons and pathologists. "The prognosis and treatment plan after resection depends to a great extent on knowing whether the tumor is completely contained or extends beyond the block of resected tissue," Nichols said. With the aid of a low-energy neutron imaging system and boronated tissue stains, the difference between normal and malignant cells should become much clearer. Funding for the initial work is being provided through ORNL's seed money program. The team plans to submit a proposal to the National Institutes of Health for follow-on funding.

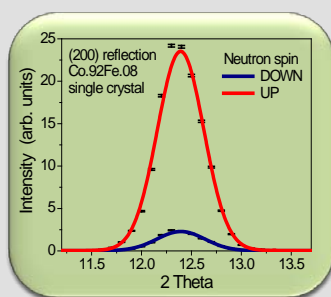


The **2010 SER-CAT Symposium** was held on March 19, 2010, at the Spallation Neutron Source at ORNL in Oak Ridge, Tennessee. More than 40 speakers and attendees shared their most recent significant structural and crystallographic research discoveries through a series of talks and a lively poster session. Several speakers are developing their projects to make use of neutrons, particularly the single crystal diffractometers (TOPAZ, IMAGINE, MaNDi), which are currently in commissioning or under construction at ORNL.

The structural and magnetic properties of the oxyarsenide NdCoAsO have been thoroughly explored by neutron diffraction using the HB2A powder diffractometer at HFIR. While the growing interest in the quaternary oxyarsenides is due to the superconducting state, investigating the underlying magnetic interactions also may further understanding of the fundamental mechanisms of superconductivity. The results of this study indicated a unique magnetic behavior with several phase transitions below room temperature. An itinerant ferromagnetic state established near approximately 69 K was found to be followed at lower temperatures by two spin reorientations into successive antiferromagnetically ordered states. Such behavior is the outcome of an intricate interplay between the two magnetic sublattices consisting of rare-earth (Nd) and transition-metal (Co) atoms. This work has been published in *Physical Review B* **81**, 104405 (2010) and is authored by M. A. McGuire, D. J. Gout, V. O. Garlea, A. S. Sefat, B. C. Sales, and D. Mandrus, all of ORNL.

Neutron spectroscopy measuring the phonon density-of-states in thermoelectrics is important in understanding how these materials may be able to more efficiently convert waste heat into useful electrical energy. The SNS instrument ARCS has been used to study the phonons in thermoelectrics, which determine the thermal conductivity and in turn the figure-of-merit. One recent example is a well-known family of compounds, $\text{La}_{3-x}\text{Te}_4$, which has its best performance at high temperatures (1300 K). It was seen that introducing vacancies as La atoms are removed disrupts the phonons in the material, particularly for high-energy excitations. Good agreement was found between the temperature dependence of the average phonon energy and a simple theory based on the quasiharmonic approximation. The study was conducted by a collaboration of O. Delaire, M. S. Lucas, M. B. Stone, D. L. Abernathy, M. A. McGuire, W. D. Porter, and A. F. May from ORNL; G. J. Snyder and V. A. May from Caltech; and V. A. Ravi and S. A. Firdosy at the Jet Propulsion Laboratory. "Phonon density of states and heat capacity of $\text{La}_{3-x}\text{Te}_4$," *Physical Review B* **80**, 184302.

New or Expanded Capabilities



Polarized neutron diffraction is one of the most powerful techniques in studying magnetism, since it allows researchers to reach high precision in measuring weak magnetic moments. Instrument scientists at HFIR's HB2A, in collaboration with other Neutron Sciences staff, have successfully installed and tested an ^3He polarizer cell that provides a unique capability to the powder diffractometer. This makes **HB2A the first powder diffractometer in the United States capable of performing polarized studies** for high sensitivity to weak ferromagnetism. Polarization efficiency has first been evaluated using a $\text{Co}_{0.92}\text{Fe}_{0.8}$ single crystal. The figure shows the intensity of (200) Bragg reflection measured with neutrons polarized UP or DOWN, perpendicular to the scattering plane. For more information about this instrument, contact [Ovi Garlea](#).

New sample environment capabilities are becoming available. An aerodynamic sample levitator with 3000°C laser heating capability arrived at the SNS in May. Offline testing and training are in progress. A NSF grant to develop a complementary electrostatic levitator system has recently been awarded. Several small-scale (but large-impact) development projects have yielded new devices such as high-current (50 amp) and high-voltage (2 kV) sample probes and a high-pressure (300 Bar) cell for reflectivity. A five year strategic plan for sample environment development is posted on our [web site](#). Comments and suggestions from the user community are encouraged.

A new complex of **laboratories** at the SNS will open this summer and provide a flexible, mobile environment in which users can work efficiently. The labs on the second floor of the Central Laboratory and Office Building are built with "green" operation in mind, as well as to optimize the available space for researchers' ever-changing scientific needs. "We surveyed more than 900 users on what they needed, and they gave us a wish list," said Chrissi Schnell, the lab's scientific laboratory coordinator. With overhead utilities and mobile furniture, the 13 labs in the complex will allow staff to easily reconfigure the layout of equipment and quickly change an experimental setup as needed. The lab suite has features such as a cold room, which will be kept at 8°C, and includes outlets and workbenches so researchers can run equipment for long periods of time. There is also a furnace closet for solid-state synthesis that has a wall with cable management to organize power and gas lines. The labs also contain standard American Disability Act-compliant fume hoods and safety showers, automatic sliding doors for hands-free access, and a combination of standard and non-standard power outlets suitable for different instrumentation. The Neutron Scattering Science Division has also been working with the Center for Nanophase Materials Sciences to set up a neighboring lab with various pieces of X-ray equipment. Lab staff will be on hand to provide services to the researchers such as chemical management and training. "We are here to meet the needs of the researchers and provide them with excellent customer service," Chrissi says.



The load frame has been installed on the **VULCAN Engineering Diffractometer** and commissioning is under way. The VULCAN team is looking forward to its availability for users in the next beam cycle.

Instruments and Users

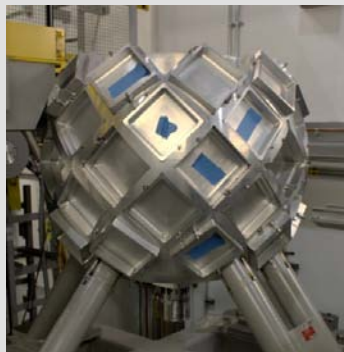
The recent call for proposals attracted more than 570 proposals for the experimental period June through November 2010. This is an increase from about 400 proposals in the previous call.

Three proposals have been submitted for the new [User Partnership Program for Sample Environment \(SE\) Equipment](#) that encourages collaborative development of SE equipment with users. Future projects will be awarded and started as budget allows. Contact [Lou Santodonato](#) if you want your SE project to be considered.

A new **Guest House** is under construction adjacent to the new Joint Institute for Neutron Sciences. Site preparation in the bottom right of the following image is for the Guest House; JINS is between it and the Central Lab and Office Building. JINS is expected to open this summer; the Guest House with 47 rooms will open early next year.



The **TOPAZ detector frame** with 14 detectors was recently installed (SNS BL-12, Single Crystal Diffractometer; see image below). It is beginning its commissioning.



New “End of Experiment” report requirement: Beginning with the current experimental cycle (December 2009–May 2010), the neutron scattering science program at ORNL is initiating an end of experiment (EoE) report requirement. For completed experiments, the Principal Investigator will receive an EoE notification e-mail with details for submitting the report directly via the proposal system (using the pen and pad icon on the dashboard). Contact the User Office at neutronusers@ornl.gov or 865-574-4600 for questions or additional information.

Publication citations are needed for reports to our sponsor. Please use the [acknowledgment](#) for HFIR or SNS experiments; complete the [form](#) or send the citation to neutronusers@ornl.gov.

Travel grants are available through the University of Tennessee for faculty and students from institutions in [EPSCoR states](#) to carry out approved experiments at HFIR or SNS and travel to discuss experiments before and after the measurements. Contact [Hope Moore-Webb](#) for details.

The **SNS schedule** in the coming months may be perturbed by the planned, but undetermined, end of life of the mercury target. This foreseen operational event will cause the shutdown of SNS for about two weeks while a new target is installed. Users will be notified as soon as possible and rescheduled to a future time. Our goal is to predict the target end of life and schedule future target replacements within normal maintenance periods.

Employment Opportunities

Positions in the Neutron Sciences Directorate or related to neutron scattering. Click on “View Open Positions” at <http://jobs.ornl.gov/> and view Position Category noted as “Science—Neutron Science.”

- Powder Diffraction Group Leader (NC50209258)
- Senior Scientist—Energy Materials (NC50209243)
- Senior Scientist—Environmental Geosciences (NC50209243)
- Senior Scientist—Nanostructured Materials (NC50209243)
- Senior Scientist—Biological Systems (NC50209243)
- Collaborative Research Visits Program, including Visiting Student Thesis Research, Visiting Postdoctoral Research, and Faculty Research Sabbaticals; see <http://neutrons.ornl.gov/crv/>.

Neutron Sciences Career Development Program (<http://www.ornl.gov/ornl/neutrons/>) was founded to nurture the creative development of neutron scattering science and instrumentation at ORNL. This initiative is viewed as a critical part of keeping the neutron scattering instruments at ORNL on the cutting edge of design and scientific functionality, keeping them competitive worldwide. It is designed to provide an environment in which early-career scientists and technicians can be a part of innovative concepts for neutron-related research and instrumentation while helping end users develop proposals, conduct experiments, and analyze data. See opportunities for Neutron Scattering Instrument Scientist, Neutron Scattering Instrument Associate, and Neutron Scattering Technician.

Fellowship Positions with ORNL through Oak Ridge Associated Universities. Descriptions are available at <http://www.ornl.gov/orise/edu/ornl/postneeds.htm>. Recently announced open positions are

- [Postgraduate Instrument Associate](#) (ORNL10-114-NSSD)
- [Postdoctoral Research Associate in Polarized Helium-3 Neutron Spin Filters](#) (ORNL 10-100-NFDD)
- [Postgraduate Instrument Associate-ToF Inelastic Group](#) (ORNL10-90-NSSD)
- [Postdoctoral Research Associate in Li-Based Battery Materials](#) (ORNL10-73-NSSD)
- [Data Acquisition Instrument Associate](#) (ORNL10-62-NSSD)
- [Postdoctoral Research Program in Neutron Scattering](#) (ORNL10-39-NSSD)
- [Postdoctoral Research Associate in Neutron Scattering](#) (ORNL10-34-NSSD)
- [Postdoctoral Research Associate in Neutron Scattering: thermoelectric materials](#) (ORNL10-21-NSSD)
- [Postdoctoral Research Associate for Developing the Spin-Echo Grazing Incidence Scattering \(SERGIS\)](#) (ORNL10-17-NFDD)
- [Postdoctoral Research Associates in SANS and Neutron Reflectometry Data Reduction and Analysis](#) (ORNL10-02-NSSD)

Educational and Research Experiences

ORNL has educational programs covering many scientific disciplines with an education continuum from pre-college through postgraduate, including teachers and faculty. The main link to all of these programs is <http://www.ornl.gov/orise/edu/ornl/>.

Applications are open now.

Meetings and Other Events of Interest to SNS and HFIR Users

June 12–26, 2010, National School on Neutron and X-Ray Scattering, Argonne and Oak Ridge. Registration is closed. Visit the [website](#) after the event for copies of the lectures and handouts.

June 13–18, 2010, [20th Annual VM Goldschmidt Conference](#), Knoxville, Tennessee, USA. This is the foremost meeting of the year for the worldwide geochemistry community.

June 26–30, 2010, [American Conference on Neutron Scattering](#), Ottawa, Ontario, Canada.

July 7–10, 2010, [Summer School in Biophysics at UT/ORNL: Computational and Experimental Challenges](#) Knoxville, Tennessee, USA.

July 24–29, 2010, [American Crystallographic Association](#), Chicago, Illinois, USA.

August 1–6, 2010, [Highly Frustrated Magnetism 2010](#), Johns Hopkins University, Baltimore, Maryland, USA

September 13–17, 2010, User Week, Oak Ridge, TN. Programs to be announced soon.

September 19–23, 2010, [IUCr Commission on High Pressure 2010](#), Gatlinburg, Tennessee, USA.

September 26–29, 2010, [Neutrons for Global Energy Solutions*](#), Bonn, Germany.

October 31–November 3, 2010, [Neutrons and Food*](#), Sydney, Australia. Scholarships are available for travel for early-career scientists from U.S. academic institutions. You will need to make a presentation and follow-on summary report. Contact Al Ekkebus, ekkebusae@ornl.gov, for more information.

*One potential outcome of these events is a book in the series *Neutron Scattering Applications and Techniques*. Volunteers are needed to develop additional topics in this series; support may be available. Contact Al Ekkebus, ekkebusae@ornl.gov, for more information.

Proposal Call Dates for HFIR and SNS

August 25, 2010, midnight, Wednesday: proposals for the period January–May 2011

March 2, 2011, midnight, Wednesday: proposals for the period June–November 2011

September 14, 2011, midnight, Wednesday: proposals for the period December 2011–May 2012

Neutron Science in the News

Recent articles about the “Jülich Neutron Spin Echo Instrument inaugurated” at the Spallation Neutron Source and the “Long-Pulse Neutron Instrumentation Workshop at Frascati” have appeared in [Notiziario Neutroni e Luce di Sincrotrone](#) (v.15, issue 1). See also *Neutron News*, v. 21(2) for the article “Inauguration of Jülich’s Neutron Spin Echo Spectrometer at SNS in Oak Ridge.”

[Study of animal tumors may bring more precision to cancer treatment](#) (WBIR 5/14). “Let’s look in your ears,” Dr. Amy LeBlanc said while examining a cat at the University of Tennessee (UT) Veterinary Clinic. “What a good boy. Yes.” Spider Monkey the cat certainly has a human personality. And his tissue is kind of like a human’s too—which is why tissue samples from UT Veterinary Clinic patients may soon help their two-legged friends. Once removed, tumors are sliced up and turned into slides, then dyed and read by pathologists. “You’re looking for disorder in the nuclei of the cells. Sometimes it’s very difficult to tell if cells are normal or abnormal,” said Oak Ridge National Laboratory research and development staff member Dr. Trent Nichols. Nichols practiced for two decades as a physician specializing in internal medicine and then recently completed a Ph.D. in theoretical physics. Now that he works at ORNL, he’s hoping to combine the two degrees, using the Spallation Neutron Source to better differentiate between healthy and cancerous tissue.

[Hendrick Construction Completes ORNL Expansion](#) (*BusinessNews* 5/5). Hendrick Construction, Inc., finished a 14,000 ft² expansion project at Oak Ridge National Laboratory, upgrading lab space at one of the world’s premier research facilities. The Tennessee project created 13 new labs to support scientific research conducted at the Spallation Neutron Source (SNS), the world’s most powerful pulsed source of neutrons for the study of materials. Scientific understanding of the molecular structure of materials is critical to the development of stronger, lighter, and cheaper compounds for a variety of commercial, industrial and other applications. “This was a tough project that was built to exacting specifications in order to provide a flexible research environment,” said Roger Hendrick, president of Hendrick Construction. “We’re excited to contribute to the growth of this important facility.” The project required the installation of various instruments and controls, as well as complex chemical storage, electrical, and ventilation systems. The labs will serve various needs, including X-ray, wet chemistry, magnetic materials characterization, protein crystallography, and neutron optics. The flexible space was constructed to adapt to new research needs without additional capital investment. The renovation project is surrounded by other operational space on the second floor of the SNS Central Lab and Office Building. The project required careful planning and coordination to avoid disruption of ongoing operations and to ensure the work was conducted safely. “The availability of these new labs will certainly enhance the ability of our neutron scattering user community to perform research at the SNS,” said Oak Ridge National Laboratory Neutron Sciences Director Ian Anderson.

[Boosting Batteries For Electric Cars](#) (*Forbes* 4/29). Gasoline beat out electricity as the prime power source for cars in the early 1900s. The problem was the battery. Electric cars are trying to make a comeback in the early 2000s. The problem is the battery. One excuse: “In energy storage, we have a much bigger problem,” says Claus Daniel, a research scientist and project director in the Materials Science and Technology Division at Oak Ridge National Laboratory. Oak Ridge happens to have a contraption that can see where others can’t. It’s the world’s brightest source of neutrons, called the Spallation Neutron Source. It speeds protons to 90% of the speed of light and smashes mercury atoms to break off neutrons. Beams of neutrons can then be directed at materials, including whole working batteries, where they penetrate deep into their targets. The way the neutrons bounce off atoms inside tells researchers what is going on in there. As they understand better, they may be able to tweak the chemistry to make the battery last longer. “It will give us totally new insight into what’s going on in the inside of a battery,” says Daniel. “The level of detail you can see is eye-opening.”

[Sleeping with neutrons \(Knoxville News Sentinel, 4/23\)](#) Thousands of scientists visit Oak Ridge National Laboratory every year, with many of them in town to do experiments at the Spallation Neutron Source or the nearby nanoscience lab known as the Center for Nanophase Materials Sciences. With a career-changing experiment in the balance, some researchers want to be nearby around

the clock. That's the reason for a new \$8.9 million mini-hotel that's under construction at ORNL just a few hundred yards from the world-class scientific facilities on Chestnut Ridge.

[Nuclear Security Push Bleeding Cryogenic Science Dry \(New Scientist 4/19\)](#). Helium-3 is invaluable for some scientific instruments. But supplies have been used up in making security systems to detect dangerous nuclear materials, and production can't be increased. On Thursday, a House subcommittee will try to pin down what went wrong and how to fix the problem. ... "There are labs in Germany and Japan that have half-built instruments and can't buy neutron detectors," says Ron Cooper of the Oak Ridge National Laboratory in Tennessee. Oak Ridge is planning a second large array of neutron detectors for its Spallation Neutron Source.

[Dr. Ian Anderson gets a charge out of batteries \(WBIR, 4/1\)](#)

Dr. Anderson explains the work done on batteries and the future the work holds for us all.

[Giant "microscope" will use neutrons to study glass transition \(Washington University Newsroom, 3/19\)](#). The National Science Foundation has awarded \$1.65 million to a project led by Washington University in St. Louis physicist Ken Kelton to build an electrostatic levitation chamber that will be installed at the Spallation Neutron Source in Oak Ridge National Laboratory. Using neutrons as a probe, the instrument will allow scientists to watch atoms in a suspended drop of liquid as the drop cools and solidifies. Kelton, Ph.D., the Arthur Holly Compton Professor in Arts and Sciences and chair of physics at Washington University, has many plans for the new instrument, but is particularly eager to see what it can tell him about a phase transition called the glass transition.

[Neutron scattering society honors Mook with Shull Prize \(Oak Ridge, 3/26\)](#). Herbert A. Mook, Jr., a UT-Battelle Senior Corporate Fellow at the Department of Energy's Oak Ridge National Laboratory, has been awarded the 2010 Clifford E. Shull Prize by the Neutron Scattering Society of America (NSSA). The NSSA recognized Mook with its top award for his "outstanding contributions to the study of magnetism, superconductivity, and quantum phenomena in matter with neutrons."

[U.S. Department of Energy Extends UT-Battelle Contract to Manage Oak Ridge National Laboratory \(UT, 3/24\)](#). The U.S. Department of Energy has extended the contract for the University of Tennessee and Battelle Memorial Institute to co-manage Oak Ridge National Laboratory for another five years, a decision that will significantly impact UT-Knoxville. UT-Battelle, a joint venture between the two institutions, first won the management contract for the lab on April 1, 2000. The contract was renewed in April 2005. DOE has consistently given top grades for UT-Battelle's management of the lab. ORNL was the only DOE lab to receive marks of "A" in all eight evaluation categories for the 2009 annual report card.

[PartTec to market SNS-developed neutron detector system \(Oak Ridge, 3/11\)](#). PartTec, an Indiana-based manufacturer of radiation detection equipment, has signed an agreement to manufacture and market an advanced neutron detector system developed at the Department of Energy's Oak Ridge National Laboratory. The Shifting Scintillator Neutron Detector system was developed for DOE's Spallation Neutron Source and High Flux Isotope Reactor complex, the world's most advanced neutron science facility. This system can determine the time and position of the neutron captured, enabling extremely accurate neutron time of flight measurements.

The most up-to-date news articles featuring neutron science performed at ORNL are available at **[Media Center—ORNL Neutron Sciences](#)**. You can sign up for an RSS feed **[here](#)** for ORNL Neutron Sciences. To receive ORNL news via twitter, use **<http://twitter.com/oakridgelabnews>**.