Neutron Sciences Progress at Oak Ridge National Laboratory
December 2008

Summary

- HFIR Cycle 418 began November 12, 2008, and ended December 5, 2008. Cycle 419 began January 7, 2009.
- SNS neutron production cycle ended January 3, 2009. Neutron production will next begin March 12, 2009, and will continue through July 11, 2009.
- The U.S. Department of Energy has given its initial approval to begin plans for a second target station for the SNS. The Critical Decision Zero (CD-0) status is the first step in an approximately $1 billion construction project. The Second Target Station (STS) will be optimized for nanoscale and biological sciences with an emphasis on novel materials for energy production, storage and use. It will add up to 24 instruments utilizing long pulses of "cold" neutrons. See the press release at http://www.ornl.gov/info/press_releases/get_press_release.cfm?ReleaseNumber=mr20090116-00.
- The 2009 National School on Neutron and X-ray Scattering will be held May 30-June 13, 2009, at Oak Ridge and Argonne National Laboratories. Details and registration information are at http://www.dep.anl.gov/nx/.

Instruments and Users

- The Magnetism Reflectometer (SNS, BL-4A) now has an active and thriving user program. A broad variety of scientific problems in magnetism, nanoscience, and new magnetic materials was addressed by experiment teams, including those from Argonne, University of Alabama, and Ohio State University. These includes studies of interface-induced ferromagnetism in epitaxial metal-oxide films and organic ferromagnetic semiconductor films, understanding of switching behavior of trilayers for magnetic random access memory applications, phase transitions and magnetization profiles of complex oxide films, conformational switching of organic ligand molecules based on tethering them to magnetic nanoparticles. At the beginning of July 2008, the world's first in situ ^{3}He neutron analyzer with on-line pump-up polarization on a reflectometer was successfully installed and tests were made with a magnetic multilayer film showing a strong off-specular spin-flip scattering.
- The Extended Q-Range Small Angle Neutron Scattering (EQ-SANS, SNS BL-6) received its first neutrons in late December 2008; commissioning is now under way. Initial data indicate that EQ-SANS will meet or exceed its design goals of achieving high intensity, wide Q-range, high precision, and low background. EQ-SANS is designed to study noncrystalline, nanoscale materials. The unique capabilities of the instrument will open new opportunities for studies in life science, materials research, and earth and environmental science. Everyday applications include improved polymers; better detergents, soaps, and similar materials; more effective drugs from protein studies, and improved materials for the oil industry. EQ-SANS will participate in General User Program in October 2009. A photo of the beginning of commissioning is below left.

- The HFIR Powder Diffractometer (HFIR HB-2A) received its first neutrons in November 2008 and commissioning is now under way with users expected early this spring. Instrument scientist Ovi Garlea is pictured above right with this instrument. The HB-2A Neutron Powder Diffractometer is a world-class constant-wavelength diffractometer designed to provide an optimum balance between the high flux and high resolution. This will be a workhorse instrument to perform crystal and magnetic structural studies of

powdered and ceramic samples, particularly as a function of intensive conditions such as temperature, pressure, and magnetic field. Technologically important materials amenable to study by neutron powder diffraction include (but are not limited to) catalysts, ionic conductors, superconductors, alloys, intermetallic compounds, ceramics, cements, colossal magnetoresistance perovskites, magnets, minerals, waste forms, H-storage, thermoelectrics, zeolites, and pharmaceuticals. The HFIR Powder Diffractometer will participate in the General User Program in May 2009.

- The POWGEN Powder Diffractometer (SNS BL-11A) also opened its shutter in late December 2008; it is now beginning its commissioning. POWGEN will be an extremely versatile general purpose diffractometer useful for a wide range of structural studies. It can cover atomic spacings from ~0.15 Å or less to well over 10 Å in a single measurement. POWGEN is capable of collecting typical Rietveld statistics in less than 20 minutes from a 0.6 cm^3 sample with a <0.1% resolution at ~.5 Å and <1% resolution for nearly all other wavelengths to 10 Å. Alternatively, much of this resolution can be traded for intensity, making it possible to make measurements in much less than 20 minutes with still quite good resolution. The adjustable bandwidth-limiting choppers allow large variations in the incident wavelengths and pulse repetition rate. Users will also have the ability to trade resolution for intensity at the analysis stage allowing great latitude to optimize the data range, resolution, and statistical precision for each particular experiment. With the addition of POWGEN at SNS and Powder Diffractometer at HFIR, the resources available to the North American research community are greatly expanded. POWGEN will participate in the General User Program in October 2009.
- Since being published on June 12, 2008, the article ["Magnetic order close to superconductivity in the iron-based layered LaO1-xFxFeAs systems", *Nature*, v.453 (2008) 899-902] on iron-based high temperature superconductors has received over 110 citations. This is an impressive feat considering both the short duration of the time since publication and length of time needed to write, review, and publish articles that cite this research. On a worldwide basis, this paper is the third most cited paper on superconductivity in 2008. The research team included authors from ORNL, the University of Tennessee and the National Institute of Standards and Technology; Clarina de la Cruz, a joint UT/ORNL post doctoral fellow was the lead author. Other local authors include ORNL's Herb Mook and UT/ORNL joint faculty member Pengcheng Dai. Research was performed in part on ORNL's HFIR HB-1A triple-axis spectrometer.
- The first annual report of ORNL's Neutron Sciences Directorate "Neutron Sciences Annual Report 2007", highlights of HFIR and SNS activities, is posted at http://neutrons.ornl.gov/nscd_2007_annual_rpt.pdf.
- Over 290 General User proposals were submitted for review during the recent call for proposals at HFIR and SNS. This call was for experiments to run from March through September 2009.
- New members of the SNS-HFIR User Group Executive Committee are: Seung-Hun Lee (University of Virginia), Cora Lind (University of Toledo), Ursula Perez-Salas (Argonne), Matthew Stone (Oak Ridge), Patrick Woodward (Ohio State University), and Stephen Wilson (University of California – Berkeley, Postdoc member). The new EC Chair is Michael Crawford (DuPont). These terms begin in January 2009.

Operations

- HFIR Cycle 418 began on November 12, 2008, and ended December 5, 2008. The reactor remained shutdown for the remainder of December for planned maintenance and refueling. In addition to supporting neutron scattering experiments, Cycle 418 supported 71 in-vessel irradiation capsules. Cycle 418 accumulated 409.1 MW-Days in December and ended with a total of 1994.8 MW-Days. At the end of December, HFIR had produced a total of 3,464 MW-Days in fiscal year 2009; well above the goal of 2,805 MW-Days. The FY2009 goals for the High Flux Isotope Reactor are operation for 6 cycles with >90% predictability. Cycle 419 began January 7, 2009.
- The SNS accelerator Run 2009-1 ended January 3, 2009. In December 2008, the SNS delivered 340.5 MW-Hrs of beam to target. The beam to target time scheduled in December was 632.5 hours and 524.0 hours were delivered for a total operating efficiency of 82.8%. A new peak power record of 700 kW was also established. The next SNS cycle will begin in March 2009; neutron production will next begin March 12, 2009, and continue through July 11, 2009.

Employment Opportunities

Positions in the Neutron Sciences Directorate or related to neutron scattering are available for browsing. Click on "View Open Positions" at http://jobs.ornl.gov/.

- **Neutron Scattering Postdoctoral Fellowship Positions with ORNL through Oak Ridge Associated Universities** [description available at http://www.orau.gov/orise/edu/ornl/postneeds.htm. Recently announced open positions are listed below.
  - Postdoctoral Research Associate for Neutron Scattering Research on the Backscattering Spectrometer (BASIS) [ORNL09-23-NSSD]
  - Postdoctoral Research Associate in Molecular Biology [ORNL09-22-SNS]
  - Postdoctoral Research Associate in Polarized Neutron Diffraction Studies on Protein Crystals [ORNL09-15-RAD]
- **Educational and Research Experiences**: ORNL has educational programs covering many scientific disciplines with the education continuum from pre-college through postgraduate including teachers and faculty. The main link to all of these programs is http://www.orau.gov/orise/edu/ornl/

Meetings of interest to SNS and HFIR users

- Physics Diversity Summit and the Joint Annual Conference of the National Society of Black Physicists and National Society of Hispanic Physicists, February 11-15, 2009, Nashville, TN. http://www.nsbp.org/conference/
- The Minerals, Metals, and Materials Society (TMS), February 15-19, 2009, San Francisco, CA. Symposium on "Emerging Applications of Neutron Scattering in Materials Science and Engineering," http://cmsplus.tms.org/CMS/CMSPlus.nsf/layout2?OpenFrameSet&Frame=main&Src=%2FCMS%2FCMSPlus.nsf%2FWeb%2520Views%2FUpcomingConferences%2F91ebf2c3c9c57919852572730050bb89%3FOpenDocument%26AutoFramed. Contact Xun-Li Wang, wangxl@ornl.gov, for details.
- Workshop on a National Materials Irradiation Sciences User Facility, April 14-16, 2009, Oak Ridge, TN. http://neutrons.ornl.gov/conf/mi2009/index.shtml.
- International Conference on Neutron Scattering, May 3-7, 2009, Knoxville, TN. http://neutrons.ornl.gov/conf/icns2009/index.shtml.
- National School on Neutron and X-ray Scattering, scheduled for May 30-June 13, 2009, Argonne and Oak Ridge National Laboratories. http://www.dep.anl.gov/nx/.
- 20th Annual VM Goldschmidt Conference, June 13-18, 2010, Knoxville, TN. http://www.goldschmidt2010.org.