The SING Project

The SNS Instruments – Next Generation (SING) Project is a set of 5 neutron scattering instruments that are being managed as one Major Item of Equipment (MIE) Project funded through the Department of Energy's Office of Science. Kristin Bennett is the DOE-Office of Science Program Manager and Larry Radcliffe is the DOE-Oak Ridge Office Project Director for the SING MIE Project.

The instrument concepts were developed by Instrument Development Teams (IDTs) in consultation with the scientific community through a series of workshops, conferences, and focused review committees. These concepts and associated instrument conceptual designs were endorsed by the SNS Experimental Facilities Advisory Committee (EFAC), an international team comprised of senior neutron scattering scientists, and awarded funding by DOE in late 2003.

The project's Critical Decision-0 (CD-0), which signifies approval of the mission need, was granted in May 2003, and Critical Decision-2 (CD-2), which approves the cost range for the project was granted in April 2004. The remaining critical decisions will be staggered for each instrument based on the phased execution and completion of the five instruments. The first SING instrument becomes operational in March 2008 and the final SING instrument is scheduled for completion in September 2011.

The technical objective of the SING MIE Project is to design, build, and install at SNS a suite of five best-in-class neutron instruments that supplement the instruments included in the SNS construction project. A team of staff members from the SNS Experimental Facilities Division is responsible for executing this project.

The five instruments, lead instrument scientist, and capabilities are described as follows:

1. High-Pressure Diffractometer (SNAP) - Instrument Scientist: Chris Tulk

The SING MIE Project will develop a high-pressure instrument dedicated to expanding the knowledge base of high-pressure neutron science. Capitalizing on a number of recent developments in studies of materials under pressure, this unique instrument will use the high neutron flux of the SNS together with state-of-the-art high-pressure devices. It will advance the current pressure range of neutron studies well beyond present limits (tens of Giga Pascals or GPa), making entirely new classes of experiments possible. Materials behavior spanning many orders of magnitude will be examined—for the first time into the megabar range (>100 GPa)—with unprecedented resolution, accuracy, and sensitivity at all conditions. With the dramatic advances in techniques for preparing and investigating single crystals, studies of more complex materials become tractable. This instrument will advance the frontier of high-pressure science in the United States and will set a new standard for the world neutron research community.

2. High-Resolution Chopper Spectrometer (SEQUOIA) – Instrument Scientist: Garrett Granroth

This instrument is a direct geometry time-of-flight chopper spectrometer, with fine energy (E) and wave-vector (Q) resolution. It will be used to conduct forefront research on dynamic processes in materials. In particular, this instrument will enable unprecedented high-resolution inelastic neutron-scattering studies of magnetic excitations and fluctuations and lattice vibrations. The impact on condensed matter and materials science will span a wide cross-section of important research areas. Today these would include strongly correlated electron systems; high-temperature superconductors; colossal magneto resistive materials; quantum and molecular magnetism; itinerant magnets and multilayers; alloys; ferroelectric, piezoelectric, and thermoelectric materials; and soft condensed matter. This spectrometer complements the capabilities of A high-Resolution, direct-geometry, time-of-flight Chopper Spectrometer (ARCS) currently under construction at the SNS facility.

3. Single-Crystal Diffractometer (SCD) – Instrument Scientist: Christina Hoffmann

The single-crystal diffractometer is optimized for the rapid measurement of Bragg intensities on materials with moderate-sized unit cells (up to ~50 Å) and provides the capability to study small 0.1-mm3 samples, approaching the size that is routinely used in a broad range of laboratories for single-crystal X-ray investigations. To maximize the scientific impact, the instrument design will include functionality for magnetic-scattering experiments using polarized neutron beams, and for diffuse scattering measurements. By greatly expanding the range of materials that can be explored, this instrument will revolutionize single-crystal neutron diffraction, especially from the viewpoint of the practicing synthetic chemist. Great advances are also expected in the study of critical structural problems in biology, earth science, materials science and engineering, and solid-state physics.

4. Disordered Materials Diffractometer (NOMAD) – Instrument Scientist: Jörg Neuefeind

This diffractometer is designed for investigation of systems with no long-range order, where interatomic and intermolecular interactions can be probed only through detailed investigation of short-range order. The ability to synthesize and use novel nanoscale systems, including crystalline materials, can be enhanced through accurate determination of structural features of materials from interatomic to nanometer length scales. The structural characterization of new materials provides critical feedback for further improvements in synthesis and in tuning of desired properties. This diffractometer is designed to effectively and efficiently use the high flux at SNS for studies of atomic-level and nanoscale structure to provide the basis for continuing advances in understanding and exploiting the fundamental interactions that control the properties of materials.

5. Hybrid Polarized Beam Spectrometer (HYSPEC) – Instrument Scientist: Mark Hagen

The hybrid spectrometer will be a world-class inelastic-scattering instrument with neutron polarization analysis capabilities. The polarization feature makes it a unique instrument among those to be installed at SNS and essential in any detailed study of the magnetic properties of condensed matter systems. Such studies extend from the determination of the magnetic form factor to a detailed analysis of magneto-vibrational scattering studies, providing invaluable information about the static magnetic properties and the interactions between magnetic and other excitations in condensed matter systems. This instrument will meet the challenge posed for neutron inelastic spectroscopy in a wide range of science applications, including complex alloys (high Tc superconductors, spin valves, and photonic switches), nanosize magnetic molecules (spintronics and quantum computing), functional materials (superconducting cuprates and colossal magnetoresistance), strongly correlated electron systems, and quantum magnetism.