Neutron Methods

The NIST Center for Neutron Research (NCNR) is the premier neutron research center in the United States in terms of breadth of capabilities, scope of projects, and number of users. The operation and activities of the NCNR may be divided into three major components: (1) to operate and maintain the NIST neutron source in a cost-effective manner while assuring the public safety; (2) to develop and operate the neutron research facilities as a national center, which provides unique and essential measurement capabilities to U.S. researchers, and (3) to develop advanced neutron methods crucial to U.S. science and technology and to lead state-of-the art research in broad areas critical to U.S. and NIST needs.. These responsibilities are allocated, formally, among the NCNR Operations and Engineering Group, the Research Facilities Operations Group, and the Neutron Condensed Matter Science Group.

The first two groups oversee the engineering, maintenance and operation of the research reactor and world-class experi-mental facilities with a replacement value of about 700M$.

Reactor Operations and Engineering Group responsibilities include the safe and efficient operation of the research reactor in order to provide a cost-effective and productive unique national resource. This includes safe operation, upgrade and maintenance of the reactor, and ensuring compliance with all regulatory requirements. This activity also includes sample irradiations, helping users to design and install certain new experiments, and the monitoring many experimental systems (e.g., the helium refrigerator for cold source cooling).

The Research Facilities Operations Group is responsible for construction, operation, and maintenance of the NCNR facilities as a national resource to provide neutron measurement capability to a broad research and development community in the United States. This includes the maintenance of the cold neutron source, a network of eight neutron guides, eighteen experimental stations, and a full complement of ancillary equipment such as cryostats, furnaces and magnets. It also includes engineering design, construction and installation of new NCNR facilities such as the cold neutron source, instruments, and sample-environment equipment. The NCNR, as a national facility, provides measurement capability to outside researchers based on scientific or technological merit of long-term programs or individual experimental proposals.

The Neutron Condensed Matter Science Group leads broad-based research in chemistry, condensed-matter physics, materials science, and biology, often in collaboration with other divisions in MSEL, the Chemical Science and Technology Laboratory, the Physics Laboratory, the Building and Fire Research Laboratory, the Electronics and Electrical Engineering Laboratory, and with more than 175 universities, industries, and other laboratories from all over the U.S. (and the world). In collaboration with the Research Facility Operation Group, scientists participate in planning and conceptual design of state-of-the-art capabilities and instruments for the NCNR as a unique national resource for cold and thermal neutron scattering research. They also develop methods and techniques to solve new measurement challenges as they arise and to stay at the cutting edge of new scientific frontiers for which neutrons must play a key role.

Current areas of emphasis in the multidisciplinary research program include: studies of the structure and excitations of high technology magnetic and superconducting materials, thin films, and multilayers; crystallographic analysis of the atomic and molecular arrangements in catalysts, ceramics, superconductors, and alloys; neutron diffraction analysis of residual stress and texture which affect properties and performance of important industrial metallic, ceramic and composite structures and components; studies by neutron reflectometry and small angle scattering (SANS) of macromolecular and microstructures in materials and of polymer, magnetic, and chemical surfaces and interfaces; inelastic neutron scattering studies of molecular bonding states and dynamic processes in chemical catalysts, sieves, polymers and fuel cell materials, and molecular scale curing processes in cements; and studies of biomolecular structure and dynamics in proteins, lipid bilayers, and membranes.

The Neutron Condensed Matter Science Group also develops and guides partnerships with other government agencies, universities and the private sector to address NIST and national priorities advanced by the neutron methods. These partnerships include the NIST/NSF Center for High Resolution Neutron Scattering, which serves a broad national research community in the application of cold neutrons in materials research, chemistry and biology; the NIST/Exxon/U. Minn. high resolution small angle scattering spectrometer for key studies in macromolecular science and technology, and major cooperative research agreements with the University of Maryland and Johns Hopkins University to advance next generation neutron research and measurement capabilities for the nation. NIST Center for Neutron Research is also a partner in a new NIH-funded consortium of five universities (U. of Cal.-Irvine, U. of Penn., Rice U., Carnegie-Mellon U. and Duke U.) to advance cold neutron measurement technology and research on the structure of membranes and other low-dimensional biological assemblages.

In summary, the maintenance and development of facilities, the development of new applications of neutron measurement technologies, and encouragement of their use by the broadest possible community in the United States, are the primary goals of this program. It is anticipated that new uses of the unique resources provided by the NCNR and their associated experimental facilities will lead to continued dramatic increases in utilization, as has been the case over the last decade.