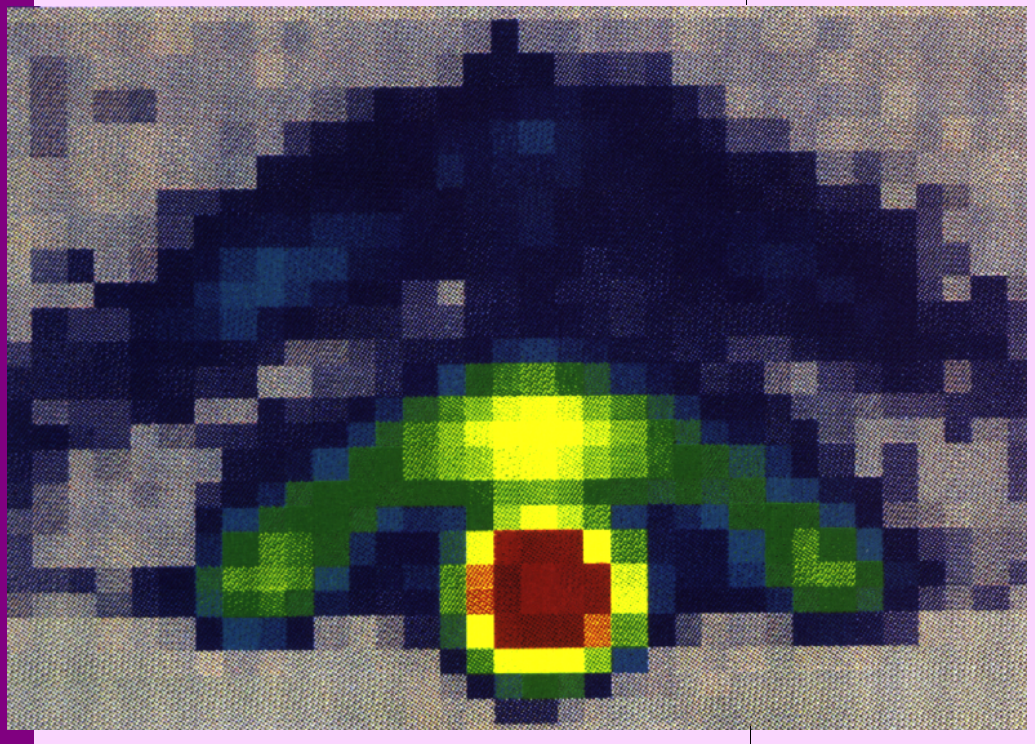
NEUTRON

Neutrons are a unique and effective tool for probing the structure of matter. Neutrons behave as particles which scatter off various objects, but also like quantum-mechanical waves which diffract to form interference patterns. Because the neutron is uncharged electrically, it can penetrate deeply into materials, and give precise information about the positions and motions of individual atoms in the interior of a sample. Neutrons are especially sensitive to the presence of light elements such as hydrogen, carbon, and oxygen which are found in many important hydrocarbon and biological molecules.



Beams of neutrons are particularly well-suited for measurement of the positions as well as the fluctuations in the positions of atoms (phonons), and the structure (position and direction) of atomic magnetic moments in solids as well as the excitations in this magnetic structure (spin waves). Such studies allow physicists to take measurements leading to an understanding of phenomena such as melting, magnetic order, and superconductivity in a variety of solids.

The Office of Basic Energy Sciences operates four neutron sources -two reactor sources (at Brookhaven National Laboratory in New York and at Oak Ridge National Laboratory in Tennessee), and two spallation neutron sources (at Argonne National Laboratory in Illinois and at Los Alamos National Laboratory in New Mexico.)

The High Flux Beam Reactor (HFBR) at Brookhaven National Laboratory produces beams of thermal and sub-thermal neutrons for neutron scattering research. With 15 experimental stations, the HFBR supports research in condensed matter physics, nuclear physics, structural chemistry, biology, and polymer physics. Irradiation thimbles provide access for production of specialty medical isotopes, neutron radiography, and neutron activation analysis.

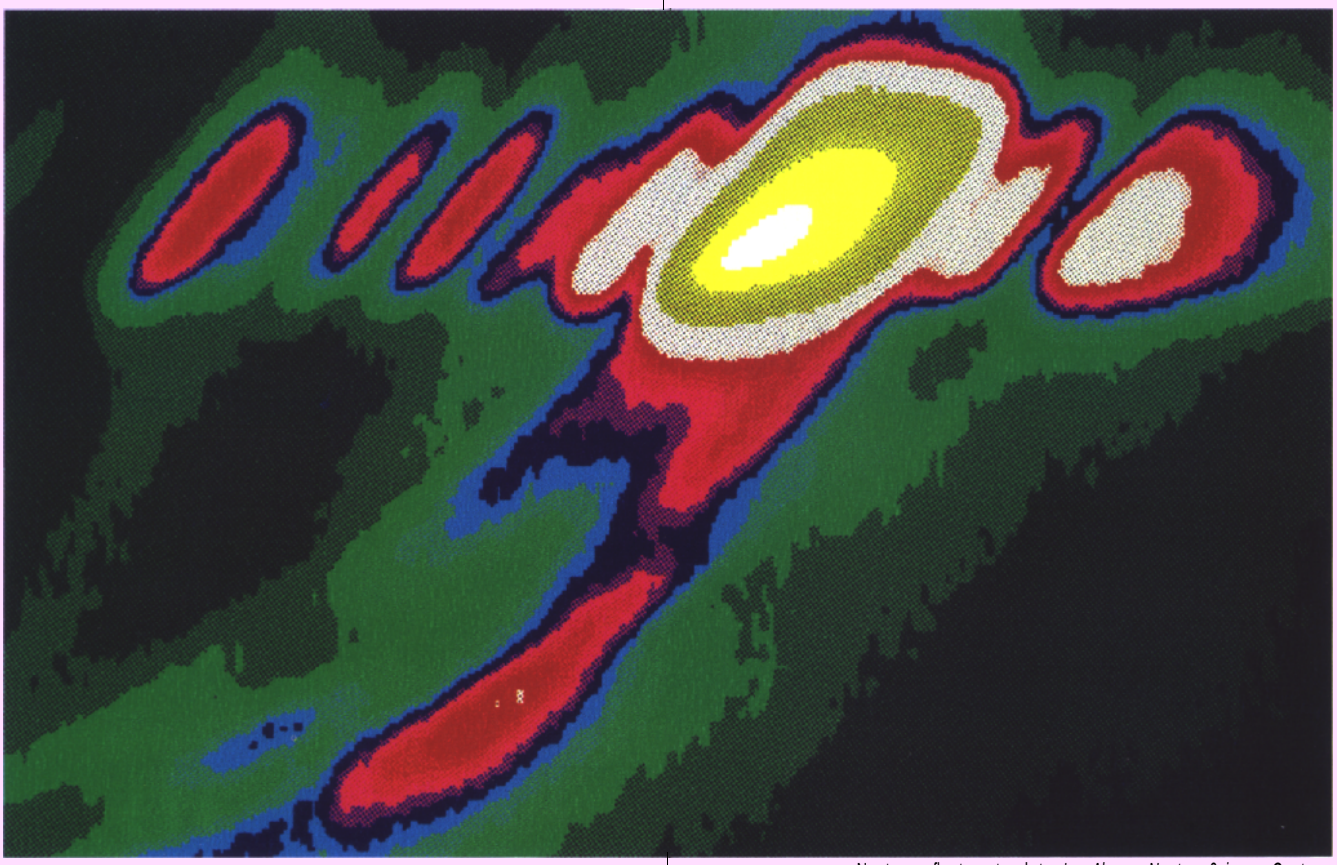
The High Flux Isotope Reactor (HFIR) at Oak Ridge National Laboratory supports 11 experimental stations for neutron scattering research. provides unique materials irradiation facilities, and is the only source of elements heavier than plutonium in the western world. Isotope production at HFIR is critical to medical research. Each year, thousands of patients receive diagnostic testing or cancer therapy using these isotopes. For example, cancer patients are now being treated with brachytherapy using caiifornium-252 produced at HFIR.

SOURCES

Spallation sources at the Intense Pulsed Neutron Source (IPNS) at Argonne National Laboratory and the Los Alamos Neutron Science Center (LANSCE) produce neutrons by firing a beam of accelerated protons at a target of heavy metal, such as tungsten or uranium. Because the protons are accelerated in bunches, spallation neutrons are emitted in pulses.

Scientists at IPNS have performed research on the residual stress in composites used in aircraft components, the structure of zeolites used in the petroleum industry, and the adhesion process in polymer layers.

Scientists at LANSCE have used the penetrating ability of neutrons for nondestructive studies of the effects of aging on nuclear weapons components – thus ensuring a safe, secure, and reliable U.S. stockpile without nuclear testing – and to improve the design of materials used in automobile and aerospace applications,



Neutron reflectometry data, *Los Alamos Neutron Science Center*