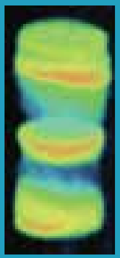
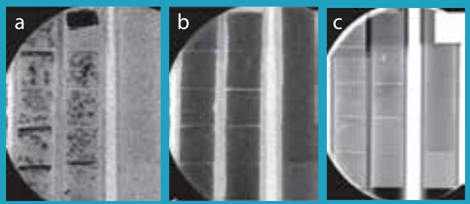
ENERGY-RESOLVED NEUTRON IMAGING

With spatial resolution up to ~100 µm and element sensitivity, energy-resolved neutron imaging and tomography was recently developed and applied at LANSCE. Such capability can be placed in numerous beamlines in the facility, allowing diffraction or inelastic characterizations combined with imaging. Time-dependent experiments have been successfully performed using a broad-spectrum neutron beam.



Tungsten (red) diffused into UO_2 rod.



Fuel pellets selectively gated on tungsten inclusions (a), or uranium-238 resonances (b), or using the broad spectrum neutron beam (c).

RADIATION EFFECTS IN SEMICONDUCTORS

Semiconductor devices are susceptible to failures caused by high-energy neutrons produced by naturally occurring cosmic radiation. To test the reliability and vulnerability of electronics, the semiconductor industry and other companies rely on the experimental capabilities of the LANSCE ICE (for Irradiation of Chips and Electronics) House.

With a neutron spectrum designed to simulate the cosmic-ray neutron spectrum, yet six orders of magnitude more intense, the ICE House is ideal for studying cosmic-ray-induced failures of modern electronic components.

USER PROGRAM

The nuclear and materials science research capabilities at LANSCE are operated as a DOE-designated user facility in service to the nation. We provide neutron and proton beams as well as instrumentation and sample environments for basic, applied, industry, and defense-related research in nuclear physics and materials science. A yearly call invites proposals for beam time for experiments from other national laboratories, academia, and industry users. Proprietary and nonproprietary industry projects are considered for beam time.

For more information about the LANSCE user program, contact lansce-user-office@lanl.gov.

Kurt Schoenberg
LANSCE User Facility Director

CONTACT

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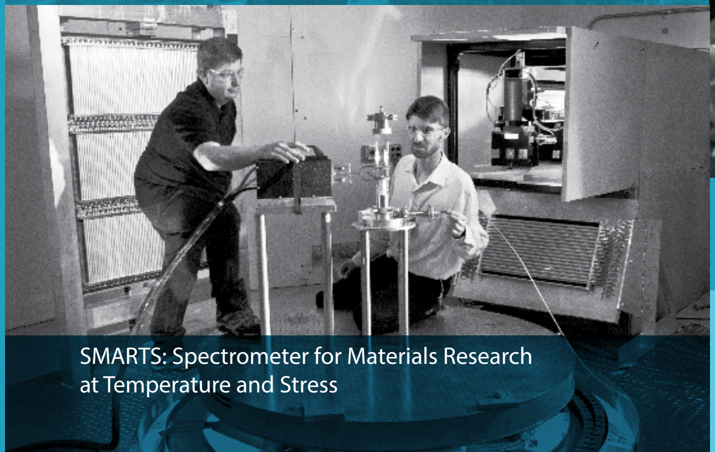


SMARTS: Spectrometer for Materials Research at Temperature and Stress

Los Alamos
NATIONAL LABORATORY
EST. 1943

NUCLEAR & MATERIALS SCIENCE RESEARCH AT LANSCE

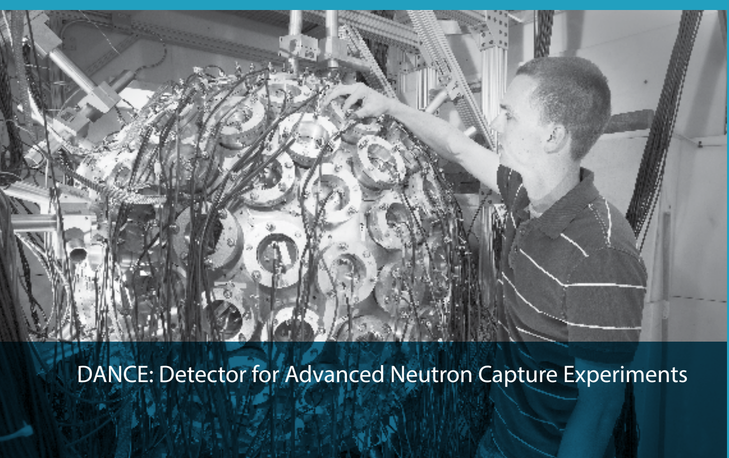
Chi-Nu detector array

LANSCE
Los Alamos Neutron Science Center

ADVANCING NUCLEAR & MATERIALS RESEARCH

The LANSCE Weapons Physics group operates two user facilities supported by the Los Alamos Neutron Science Center (LANSCE) accelerator, delivering science for academia, national security, and industry by exploiting the unique characteristics of intense beams of unmoderated (**Target 4**) and moderated pulsed neutrons (**Target 1**) and protons (**Target 2**). Nuclear and materials science—from fundamental understanding of nuclear structure and reactions to the characterization of materials under extreme environments—is intimately connected with Los Alamos National Laboratory's mission to solve national security challenges through scientific excellence.

The broad energy spectrum provided by the two complementary neutron production targets (from ~1 meV - ~600 MeV) enables energy dispersive neutron imaging, a variety of fission and nuclear reaction properties measurements, study of radiation effects in semiconductor devices, and characterization of the structure of materials (powders, single crystals, thin films, surfaces). These structural characterizations range from interatomic distances to micrometers length-scales under a variety of extreme conditions (pressure, temperature, magnetic fields). Our efforts advance fundamental and applied research of materials and stockpile stewardship science.


DANCE: Detector for Advanced Neutron Capture Experiments

NUCLEAR & MATERIALS RESEARCH: CAPABILITIES

Target 4: Capabilities for high-energy (0.1 - 600 MeV) neutron research

- **Chi-Nu**: Fission neutron emission spectrum
- **Fission Time Projection Chamber**: High-precision total fission cross sections
- **Germanium Array for Neutron-Induced Excitations (GEANIE)**: Nuclear structure studies, spectroscopy, and cross sections
- **Irradiation of Chips and Electronics (ICE) House and ICE II**: Neutron-induced failures testing in semiconductor devices
- **4FP15R:** General-purpose flight path

Target 1: Capabilities for cold, thermal, and epi-thermal (1 meV - 100 keV) neutron research

- **Energy dispersive neutron radiography**
- **Detector for Advanced Neutron Capture Experiments (DANCE)**: Fission gamma emission spectrum and reactions on short-lived radioactive nuclei
- **Spectrometer for Ion Determination in Fission Research (SPIDER)**: Fission product yields
- **Neutron Diffraction**: Crystallography, engineering and strain, large-scale structures and disordered materials
- **Neutron Reflectometry**: Surface and interface materials characterization
- **Inelastic Neutron Spectrometry**: Molecular and crystal lattice excitations in materials

Target 2: Experimental area for proton irradiation


Weapons Nuclear Research Facility

Featured Capabilities

11 orders of magnitude of neutron energy available

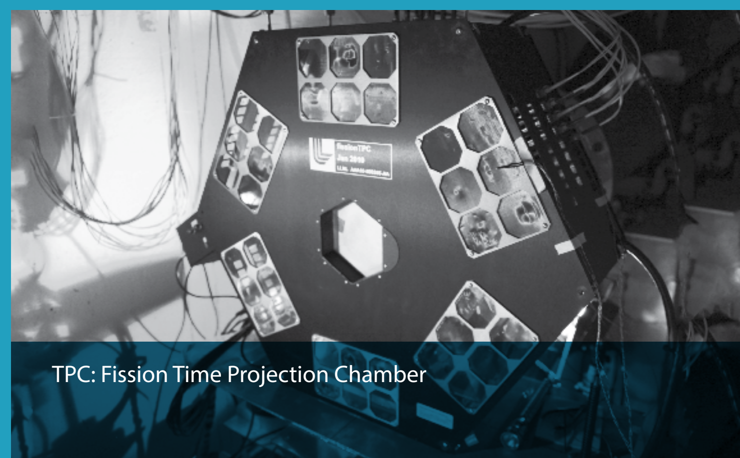
- Energy dispersive high-energy and thermal neutron imaging
- Semiconductor electronics testing for cosmic-ray neutron spectrum and thermal neutron energies

Complex experimental settings

- Classified experiments
- Hazardous materials studies (highly radioactive, high explosives, actinides, etc.)
- National security research
- Proprietary research
- Work for others

Sample environments

- Low temperatures down to 300 mK
- Magnetic fields up to 11 T
- High temperature furnaces up to 2,733 K and uniaxial stress (Fmax=250 kN)
- Fluid and anvil cell pressure capabilities (10 GPa - up to 2,000 K)


TPC: Fission Time Projection Chamber