Neutrons for New Discoveries and Solutions

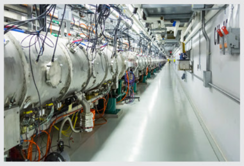
Breakthroughs in medicine, energy, technology, and industry follow advances in the understanding of materials. Oak Ridge National Laboratory is the US epicenter of one of the most powerful techniques for exploring the nature of materials—neutron scattering.

ORNL hosts two of the world's most powerful sources of neutrons for research: the Spallation Neutron Source (SNS) and the High Flux Isotope Reactor (HFIR), which produce beams of neutrons by two different processes. Because neutrons have no electrical charge, they can easily pass through a sample of material without harming it, revealing information about the material's structure and properties.

Neutron scattering is used in many industries—including automotive, aerospace, steel, defense, industrial materials, energy storage, data storage, and biomedicine—to address many of the major scientific challenges of the 21st century.

Ensuring US Leadership

Work has begun on a Proton Power Upgrade (PPU) at SNS that will increase the neutron flux and significantly increase its capacity to support the US research community. The PPU is necessary to support a Second Target Station that will maintain US competitiveness in materials development as new European and Asian neutron facilities come online.



The Second Target Station (illustration on left) will complement existing SNS and HFIR capabilities.

758
Unique users in FY 2019

780
Total experiments in FY 2019

67,896
Hours of beam time in FY 2019 for users

80%
Of users were affiliated with US institutions

654
Scientific publications in CY 2019*

"We can work together and really push our understanding of the world."

Bianca Haberl,
Physicist

*467 Instrument publications and 187 other scientific publications by ORNL's neutron science staff.

Oak Ridge National Laboratory

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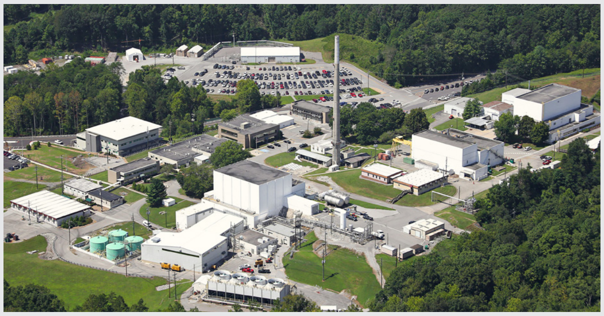
Impacts and Collaborations

- **Space flight:** NASA researchers used HFIR to study stresses in 3D-printed materials for use in space flight. The team studied a 3D-printed version of an engine component that could save years in building a flight-ready engine.
- **Infrastructure:** Columbia University researchers used neutrons at SNS to study small breaks in suspension bridge cable wires and how they affect the overall strength of the cable—and ultimately the bridge. SNS allowed nondestructive study of the wires to develop safe, cost-effective cable repair methods.
- **Stronger glass:** Researchers from Corning use neutrons to study how silica behaves as it heats and cools. Better understanding means better durability for products such as mobile devices, windshields, and TV screens.
- **Drug discovery:** Neutron analysis at HFIR helped researchers better understand a protein implicated in the replication of HIV, the retrovirus that causes AIDS. The enzyme is a key drug target for HIV and AIDS therapies.
- **Better batteries:** Researchers used HFIR to study a solid-core garnet, a material used in lithium batteries, that could be a key to safer, more reliable energy storage. Neutrons allowed them to directly observe battery behavior to explore ways of extending battery life.
- **Fuel injection:** HFIR was used to make the first neutron images of cavitation (gas bubble formation) inside an operating gasoline fuel injector. The HFIR data will enable improvements in injector design.

SNS is an accelerator-based facility that provides the world's most intense pulsed neutron beams for scientific research and industrial development. SNS delivers short pulses of protons—60 times a second—to a target system where neutrons are produced through a process called spallation.



HFIR uses highly enriched uranium-235 as the fuel to generate 85 megawatts of power for the highest neutron flux (continuous flow of neutrons) available in the United States.

- **Reliable aircraft:** NASA and Honeywell Aerospace used neutrons at SNS to examine nickel alloy samples containing a type of weld used in turbines. The measurements will help in designing and manufacturing more reliable aircraft components.

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