Spallation Neutron Source

SNS site including support facilities and the Center for Nanophase Materials Sciences.

The next generation of materials research

Purpose: Provide intense neutron beams for research on the structure and dynamics of materials in fields such as physics, chemistry, materials science, and biology

Benefits: Technological discoveries that could provide breakthroughs in medical, environmental, safety, and many other challenges in the world today

Users: Scientists and engineers from universities, industries, and government laboratories around the world

Staff: About 450 permanent staff

Sponsor: U.S. Department of Energy, Office of Basic Energy Sciences

neutrons.ornl.gov

HFIR

SNS

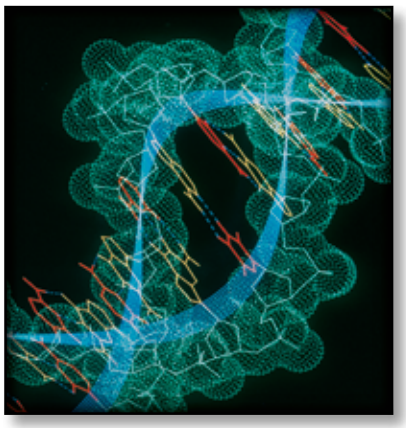
OAK RIDGE National Laboratory

www.ornl.gov

The Spallation Neutron Source (SNS) is an accelerator-based science facility that will provide neutron beams with up to ten times more intensity than any other such source in the world. This unique facility will provide opportunities for up to 2000 researchers each year from universities, national laboratories, and industry for basic and applied research and technology development in the fields of materials science, magnetic materials, polymers and complex fluids, chemistry, and biology.

What is the importance of neutron science?

The superior ability of neutrons to determine where atoms are and how they move makes them an important tool for physics, chemistry, biology, materials science, and engineering. Just as we prefer a bright light to a dim one to read the fine print in a book, researchers prefer a brighter source of neutrons that will give more detailed snapshots of material structure. SNS is such a tool.

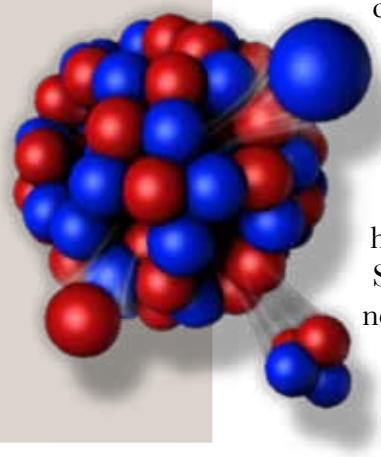


The building blocks of DNA direct the synthesis of proteins. Research at SNS could help determine the shape and structure of those proteins.

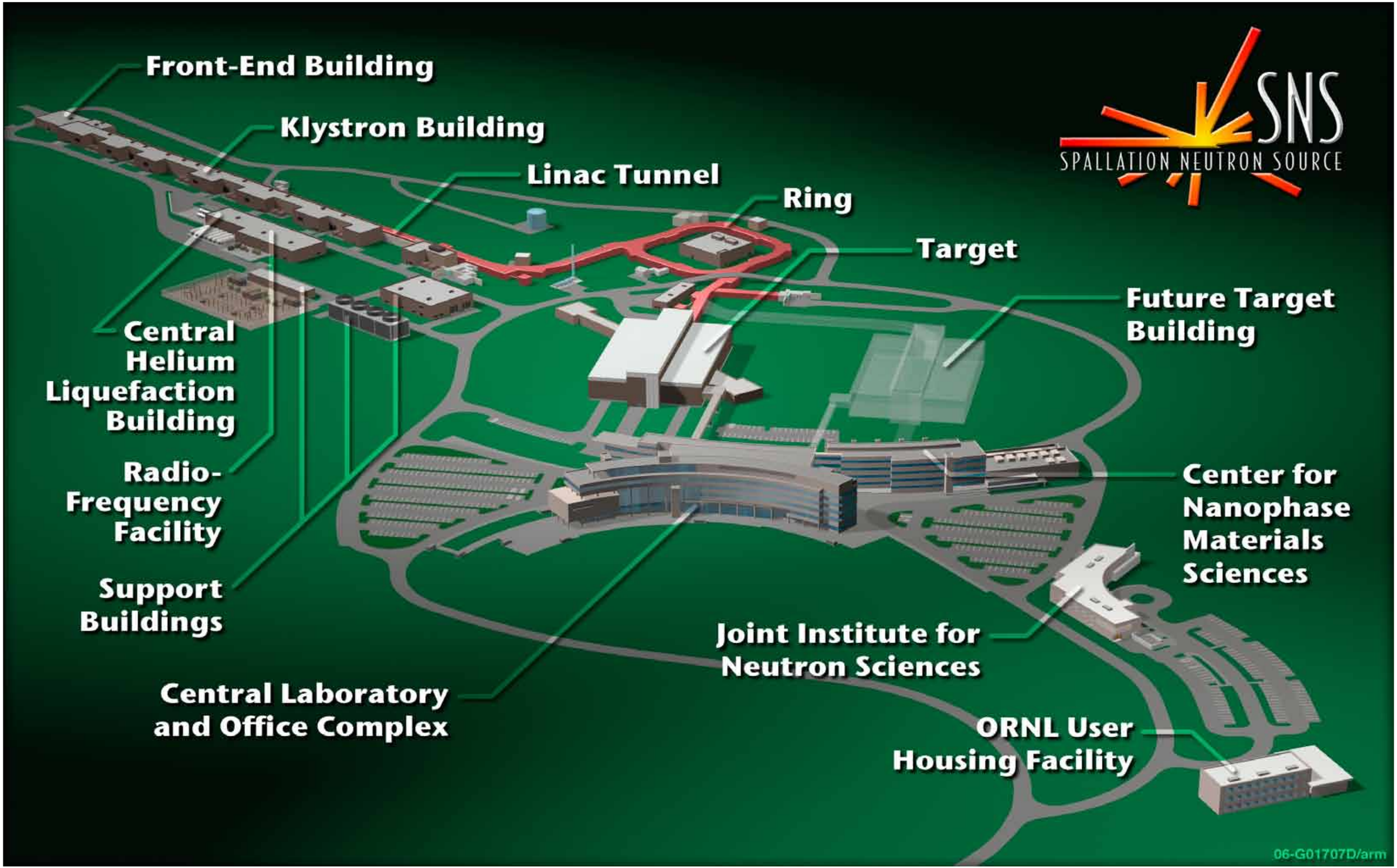
What is spallation?

When a fast particle, such as a high-energy proton, bombards a heavy atomic nucleus (such as mercury), some neutrons are "spalled," or knocked out, in a nuclear reaction called spallation. Other neutrons are "boiled off" as the bombarded nucleus heats up. It's something like throwing a baseball at a bucket of balls, resulting in a few being immediately ejected and many more bouncing around and falling out. For every proton striking the nucleus, 20 to 30 neutrons are expelled.

How does SNS work?



Negatively charged hydrogen ions are produced by an ion source. Each ion consists of a proton orbited by two electrons. The ions are injected into a linear accelerator, which accelerates them to very high energies. The ions are passed through a foil, which strips off each ion's two electrons, converting it to a proton. The protons pass into a ring where they accumulate in bunches. Each bunch of protons is released from the ring as a pulse. The high-energy proton pulses strike a heavy-metal target, which at SNS is a container of liquid mercury. Corresponding pulses of neutrons freed by the spallation process will be slowed down in a moderator and guided through beam lines to areas containing special instruments. Once there, neutrons of different energies can be used in a wide variety of experiments.


Front-End Building
Klystron Building
Linac Tunnel
Ring
Target
Future Target Building
Central Helium Liquefaction Building
Radio-Frequency Facility
Support Buildings
Central Laboratory and Office Complex
Joint Institute for Neutron Sciences
Center for Nanophase Materials Sciences
ORNL User Housing Facility
SNS
SPALLATION NEUTRON SOURCE
06-G01707D/arm

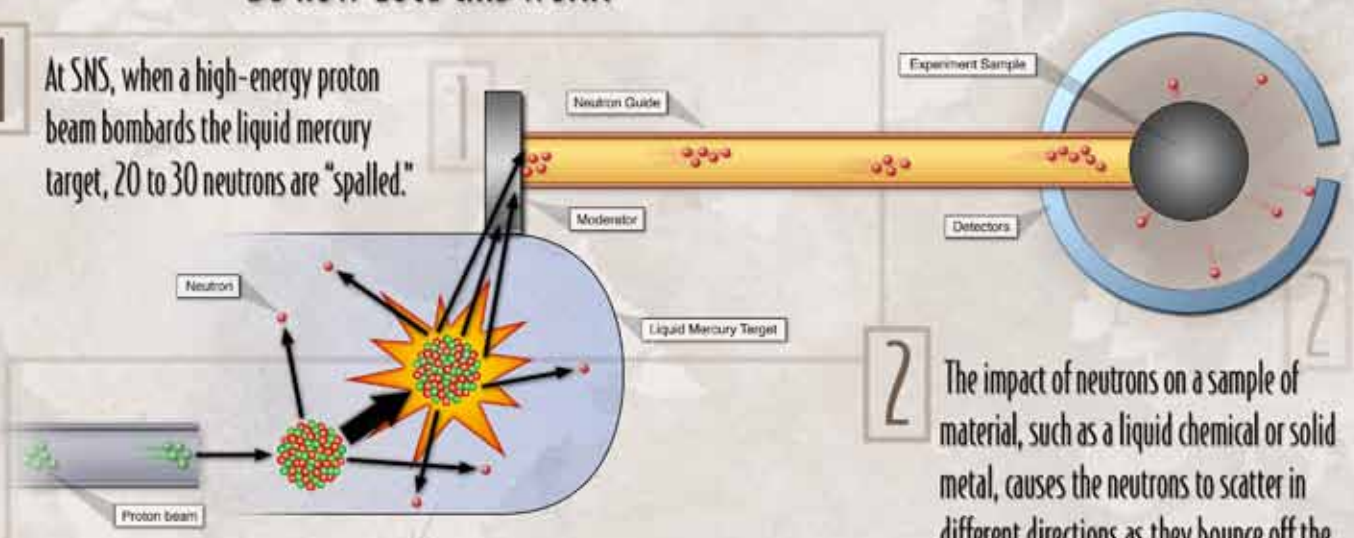
Spallation Neutron Source

SNS
SPALLATION NEUTRON SOURCE

Neutron research at SNS will lead to technological advances and help us better understand materials that affect our everyday lives.

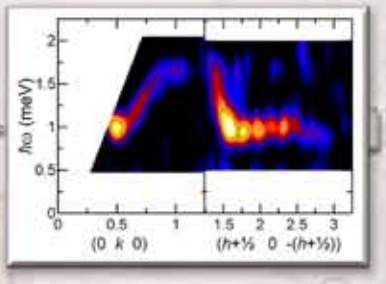
So how does this work?

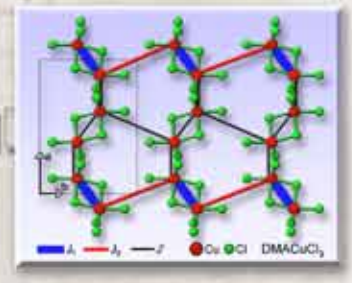
1 At SNS, when a high-energy proton beam bombards the liquid mercury target, 20 to 30 neutrons are "spalled."



2 The impact of neutrons on a sample of material, such as a liquid chemical or solid metal, causes the neutrons to scatter in different directions as they bounce off the sample material. Special detectors around the sample material measure these scattering patterns and send the data to a computer.

3 These data are analyzed and processed in a variety of ways, depending on the experiment. Often, a three-dimensional image of the molecular structure of the material is created. This molecular-scale image gives scientists valuable information about the material such as its structure, vibrations, and magnetism.





Data processing and analysis

Data are collected from specially designed detectors.

4 By learning more about the molecular structure of everything around us—and within us—we can improve the world we live in.