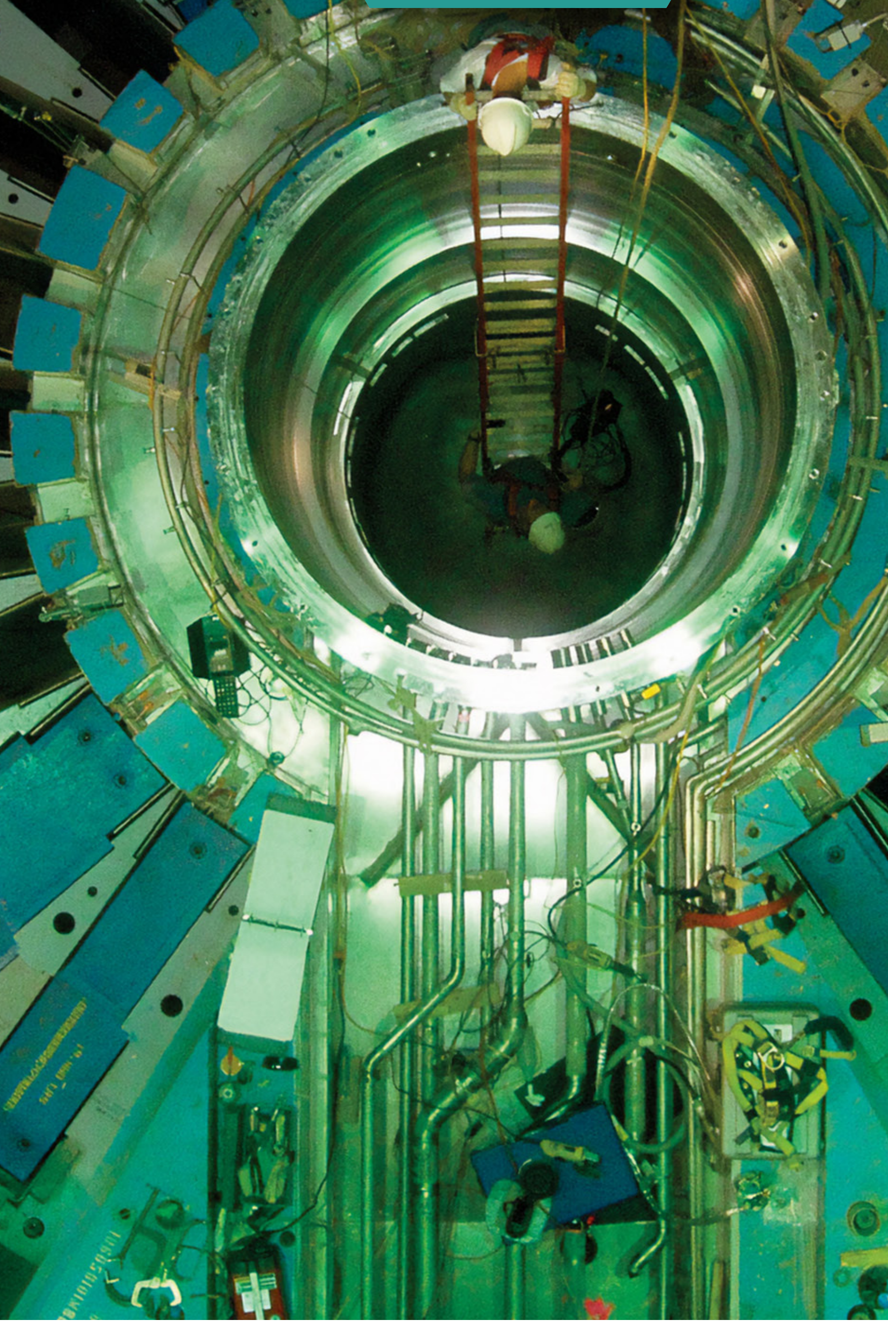
Spallation Neutron Source

Accelerating science



What is the Spallation Neutron Source (SNS) at Oak Ridge National Laboratory (ORNL)?

ORNL hosts two of the world's most powerful sources of neutrons for research that help us better understand materials that affect our daily lives: the SNS and the High Flux Isotope Reactor (HFIR), which produce beams of neutrons by two different processes.

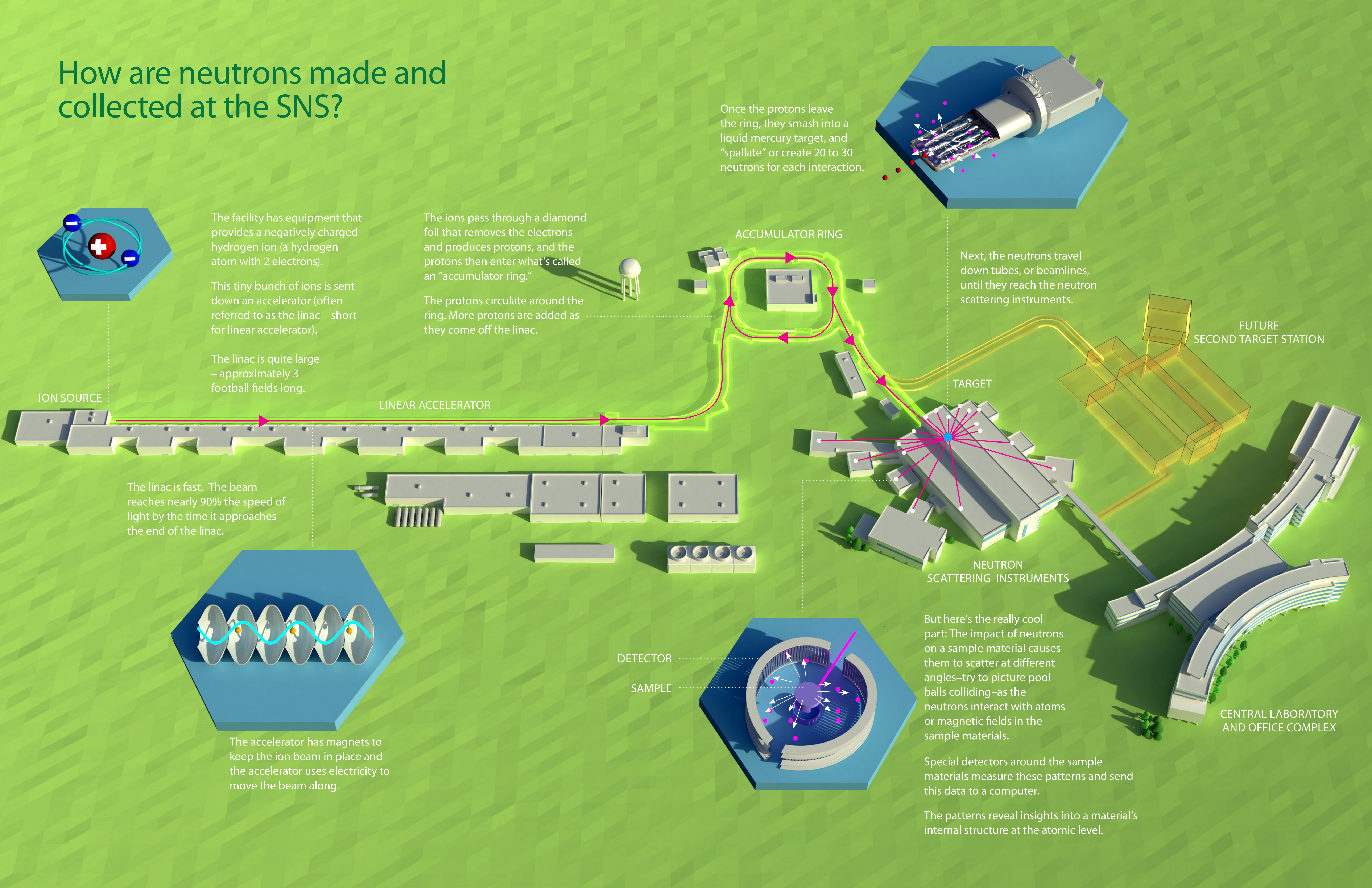
The SNS is an accelerator-based facility with the world's most powerful spallation source, providing intense neutron beams for scientific research and industrial development.

SNS delivers short pulses of protons—60 times a second—to a target system where neutrons are produced through a process called spallation.

Why neutrons?

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.

OAK RIDGE National Laboratory | SPALLATION NEUTRON SOURCE

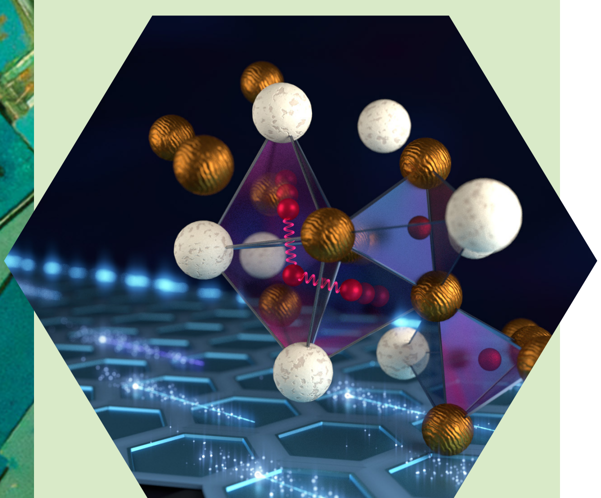

How are neutrons made and collected at the SNS?
The facility has equipment that provides a negatively charged hydrogen ion (a hydrogen atom with 2 electrons).
This tiny bunch of ions is sent down an accelerator (often referred to as the linac – short for linear accelerator).
The linac is quite large – approximately 3 football fields long.
ION SOURCE
The ions pass through a diamond foil that removes the electrons and produces protons, and the protons then enter what's called an "accumulator ring."
The protons circulate around the ring. More protons are added as they come off the linac.
LINEAR ACCELERATOR
The linac is fast. The beam reaches nearly 90% the speed of light by the time it approaches the end of the linac.
The accelerator has magnets to keep the ion beam in place and the accelerator uses electricity to move the beam along.
ACCUMULATOR RING
Once the protons leave the ring, they smash into a liquid mercury target, and "spallate" or create 20 to 30 neutrons for each interaction.
Next, the neutrons travel down tubes, or beamlines, until they reach the neutron scattering instruments.
TARGET
FUTURE SECOND TARGET STATION
NEUTRON SCATTERING INSTRUMENTS
DETECTOR
SAMPLE
But here's the really cool part: The impact of neutrons on a sample material causes them to scatter at different angles–try to picture pool balls colliding–as the neutrons interact with atoms or magnetic fields in the sample materials.
Special detectors around the sample materials measure these patterns and send this data to a computer.
The patterns reveal insights into a material's internal structure at the atomic level.
CENTRAL LABORATORY AND OFFICE COMPLEX

Neutron research

Neutron scattering is used to make new scientific discoveries and to provide a more fundamental understanding of materials. It's used in many applied areas of research, including industry—automotive, aerospace, steel, defense, industrial materials, energy storage, data storage, and biomedicine—to address many of the major scientific challenges of the 21st century.

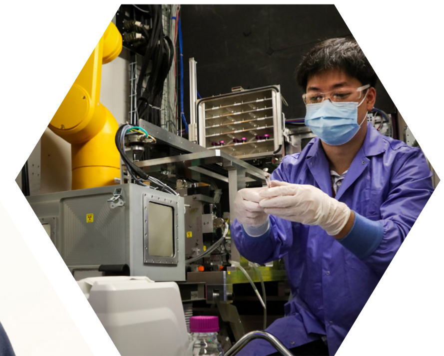
Neutron research helps improve:

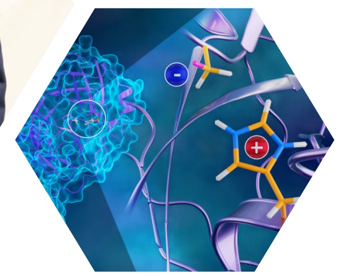
- batteries and electronic devices
- alternative energy sources, such as solar cells
- transportation materials such as bridge cables, engine parts
- drugs and biologics
- biofuels
- polymers
- computing technologies
- airport security systems and more



User program

Each year the User Office issues two calls for research proposals. Submissions are peer-reviewed by external panels, with recommendations based on scientific and technological impact. Experiments are also reviewed for feasibility and safety, and the experience of the research team. Those with the highest potential for scientific impact are approved and scheduled for instrument access.





The future: The Proton Power Upgrade (PPU) project and the Second Target Station (STS)

Work has begun on a Proton Power Upgrade (PPU) at the SNS that will increase the neutron flux, or rate of flow of neutrons, and significantly increase its capacity to support the national and international research community. The PPU is necessary to support a Second Target Station (STS), which will be a third neutron source at ORNL.

The STS will complement capabilities at the SNS First Target Station (FTS) and HFIR by providing new, transformative capabilities for materials research and will maintain US competitiveness in materials development as new European and Asian neutron facilities come online. With a new suite of world-leading instruments boasting the latest advances in high-resolution optics, instrument design and more, the STS will make it possible to conduct a wide range of experiments now not possible anywhere in the world.

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