



# Careers in Neutron Sciences

---

at Oak Ridge  
National Laboratory

---



# Oak Ridge National Laboratory



AT A GLANCE

Established in **1943**  
as part of the Manhattan Project

**\$2.2B** annual budget

**9** national  
user facilities

**5,400** employees

**3,200** visiting  
scientists

**221** R&D 100 Awards

**2** Nobel Prize winners

**46** National Academy  
members

**17** UT-ORNL Governor's Chairs

**9** university core  
research partners

**9** new elements discovered

## Contents

- 2 Big Science. Big Opportunities.
- 3 Building the World's Premier Research Institution
- 4 About the Neutron Sciences Directorate
- 6 Pioneers in Neutron Science
- 7 Lab of the Future
- 8 Community and Culture
- 9 How to Apply



## Big Science. Big Opportunities.

Oak Ridge National Laboratory (ORNL) was created to help win a war and change the world. We have always adapted to meet national needs, developing expertise, tools, and even entirely new fields to solve the most difficult scientific and technical challenges.

- **We pioneered nuclear energy, science, and engineering**, developing techniques, technologies, and training programs that led to commercialization of nuclear power and creation of the nuclear navy.
- **We produce life-saving medical isotopes** and operate the National Isotope Development Center for the Department of Energy (DOE).
- **We developed neutron diffraction**, a scientific technique available to researchers who use two of the world's most powerful neutron sources at ORNL for studies of materials, medicines, disease progression, and more.
- **We create new materials** including alloys with billion-dollar impacts on industry and unique properties that enable NASA to explore outer space.
- **We build some of the world's most powerful supercomputers**, with three No. 1 systems since 2009 and one of the world's first exascale systems, Frontier, due in 2021.
- **We printed a car** (and a house, jeep, boat ...) to study methods for improving the efficiency and productivity of manufacturing processes that give American industry a competitive edge.
- **We secure the nation** with expertise from across our research portfolio, sending teams worldwide to keep nuclear materials safe, pursuing cybersecurity for the power grid, and more.
- **We discovered the sex-determining role of the Y chromosome** and make breakthroughs in biology from genes to ecosystems, providing insights benefiting biotechnology, biosecurity, and biofuels.
- **We invented radioecology** and lead large-scale experiments in the Arctic and other remote locations.

*Join us on  
our quest to  
deliver scientific  
impact that  
changes the  
world.*

We always ask, "What's next?" We stand ready for the unexpected. Today, we are applying our expertise in several areas in the global fight against COVID-19, and we are looking to the future.



## Building the World's Premier Research Institution

National labs are distinguished by their ability to assemble large teams of experts from a variety of scientific and technical disciplines to tackle compelling national problems. They also design, build, and operate powerful scientific facilities that are available to the international research community.

From the start, ORNL has applied scientific discoveries and new technologies to address pressing challenges in the areas of clean energy and global security and to create economic opportunity for the nation. Today, Oak Ridge is the most diverse of the Department of Energy's 17 national laboratories, providing leadership in energy research and technology, advanced materials, nuclear science and engineering, neutron science, isotope production, national security, environmental and biological sciences, and high-performance computing.

Resources like these enable the US to compete in what former ORNL Director Alvin Weinberg called the arena of "Big Science" and they empower our researchers to pursue knowledge that's fundamental to solving some of our world's greatest challenges.

### **Biology and Environment**

We sequenced the poplar genome and are leveraging these data with ORNL-developed algorithms and supercomputing to engineer better bioenergy feedstocks and more climate-resilient crops.

### **Fusion and Fission**

A multidisciplinary team is printing a microreactor to help industry address high costs and lengthy deployment timelines that threaten the future of nuclear energy—the nation's largest carbon-free energy source.

### **National Security**

The Mobile Uranium Facility equips ORNL staff members to characterize, process, package, and transport uranium materials anywhere in the world. We are using our scientific capabilities to counter enduring and emerging threats to national security.

### **Materials**

We developed a new class of affordable, lightweight superalloys that can withstand temperatures almost 100 degrees Celsius hotter than existing commercial alloys in complex engine parts.

### **Clean Energy**

Our magnetic coils and power electronics enable the extreme fast charging of electric vehicles—wirelessly. ORNL's expertise also supports industry and has set standards for energy efficiency.

### **Isotopes**

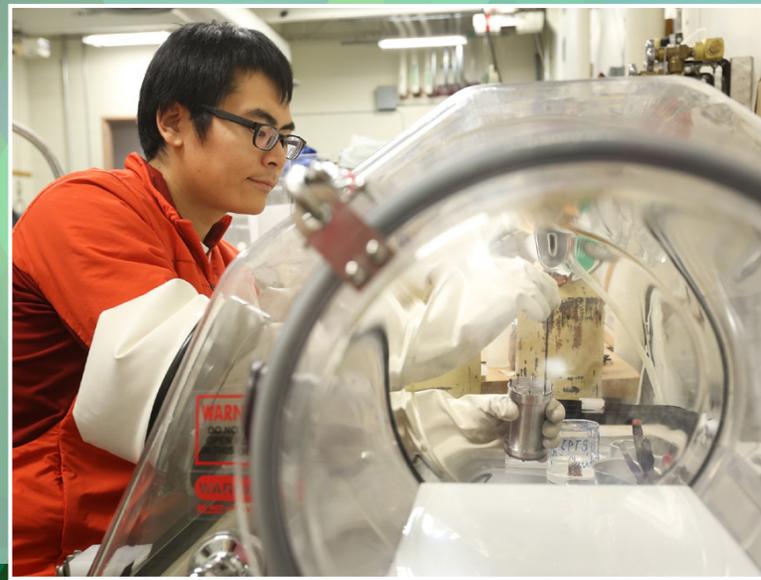
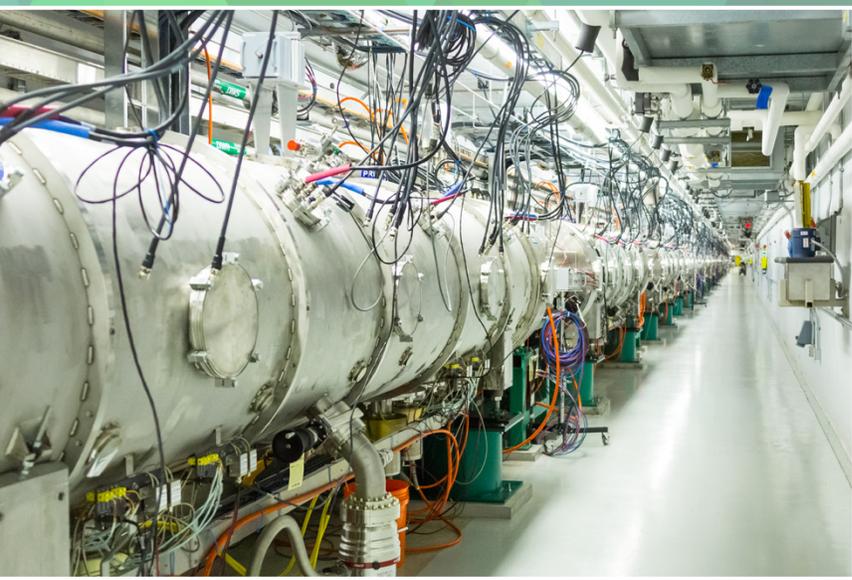
We produce unique medical isotopes for life-saving treatments and diagnoses, including actinium-227, a critical material for making a highly effective prostate cancer drug.

### **Neutron Science**

We use neutrons to directly observe battery behavior in pursuit of safer, more reliable energy storage and extended battery life, to study the behavior of drugs in combating disease, and much more.

### **Supercomputing**

Our scientists are cracking the code on opioid addiction using Summit, one of the world's fastest supercomputers, to perform immense calculations on genomic data. Summit provides unique multi-precision computing capabilities that are ideal for artificial intelligence and machine learning applications.



## About the Neutron Sciences Directorate

The Neutron Sciences Directorate (NScD) seeks to answer big science questions about the fundamental nature of materials at the atomic scale. 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.

Using special detectors, scientists learn details about the nature of materials ranging from liquid crystals to superconducting ceramics, from proteins to plastics, and from metals to metallic glass magnets.

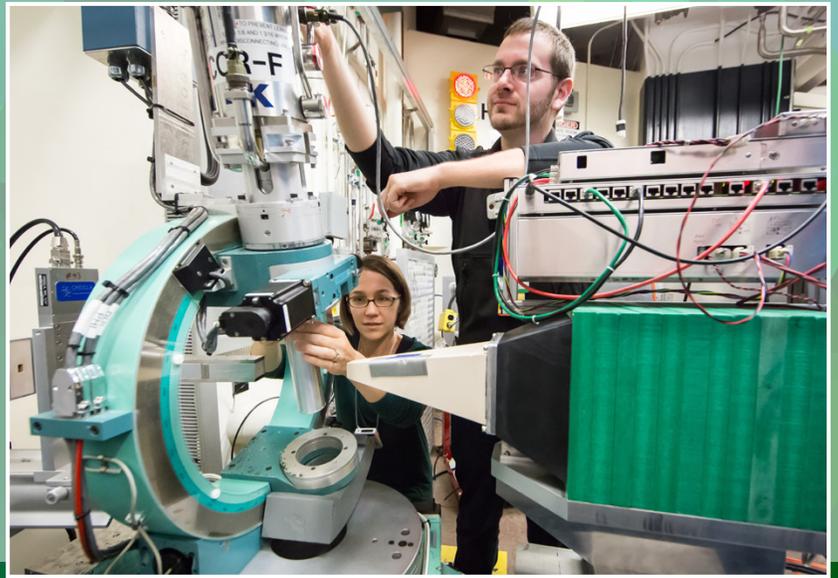
Neutron scattering is used in many industries—including automotive, aerospace, steel, defense, industrial materials, energy storage, data storage, and biomedicine—to address many of the major scientific challenges of the 21st century.

This information leads to advances that can lower the cost, improve the efficiency and safety of everyday products including electronic devices, batteries, cars, medicine, power lines and more.

### SCATTERING NEUTRONS FOR BIG DISCOVERIES

More than 3,000 researchers from around the world travel each year to ORNL to use two of the world’s most powerful neutron sources, the HFIR and the SNS, to solve some of the most challenging scientific questions and spur innovation.

Thirty world-class neutron scattering instruments, with an additional instrument under construction, are available to the research community for materials research. The most promising proposals are selected by a scientific panel through peer review. Scientists who have their proposals selected use the facilities and instruments at SNS and HFIR free of charge in return for making their data and findings public.



The research portfolio for Neutron Sciences Directorate spans four research divisions to advance key science, technology and engineering capabilities while building a competitive, world-class workforce to meet our future mission needs.

- The **Research Accelerator Division** operates the Spallation Neutron Source (SNS) accelerator complex, which consists of a negative hydrogen-injector, a 1 GeV linear accelerator, a proton accumulator ring, and a liquid mercury target system. At 1.4 megawatts, the SNS accelerator is the most powerful of its kind in the world and provides the proton power to the SNS target system, where neutrons are produced. With upgrades, it also has the flexibility to operate beyond 2.0 megawatts in the future to permit increased scientific output.
- The **Research Reactor Division** operates the High Flux Isotope Reactor (HFIR). At 85 MW, HFIR is the highest flux reactor-based source of neutrons for research in the United States and provides one of the highest steady-state neutron fluxes of any research reactor in the world.
- The **Neutron Scattering Division** provides scientific and technical expertise to support and develop world-class neutron scattering user facilities. We work with scientists from around the world and across a wide range of research fields who are using ORNL's 30 neutron scattering instruments to solve critical research problems and foster breakthrough scientific discoveries.
- The **Neutron Technologies Division** provides innovation in neutron technologies and methodologies to improve performance and expand science capabilities of the Spallation Neutron Source (SNS) and High Flux Isotope Reactor (HFIR).

## AT A GLANCE



30 world-class neutron scattering instruments



85 megawatts, HFIR operates as the highest flux reactor-based source of neutrons for research in the United States



1.4 megawatts, SNS operates as the most powerful accelerator of its kind in the world



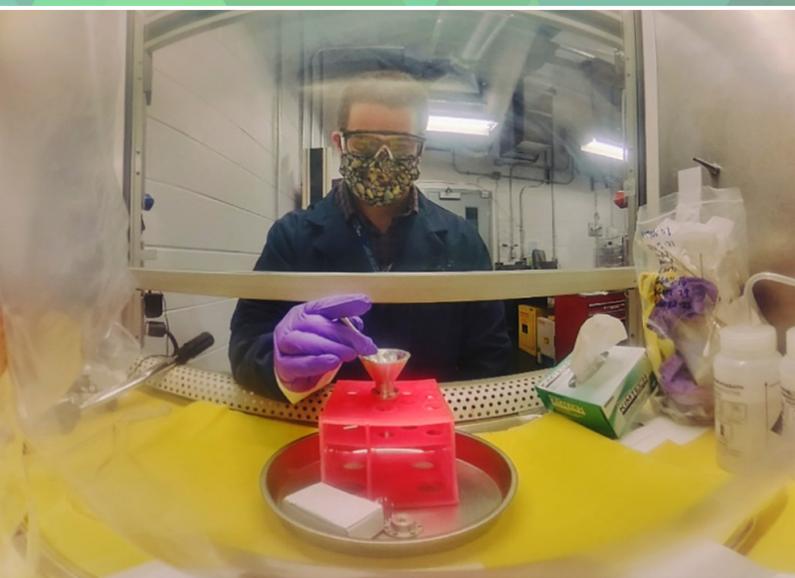
677 scientific publications in 2019



67,896 hours of beamtime 2019 fiscal year



1,200 experiments in a typical year



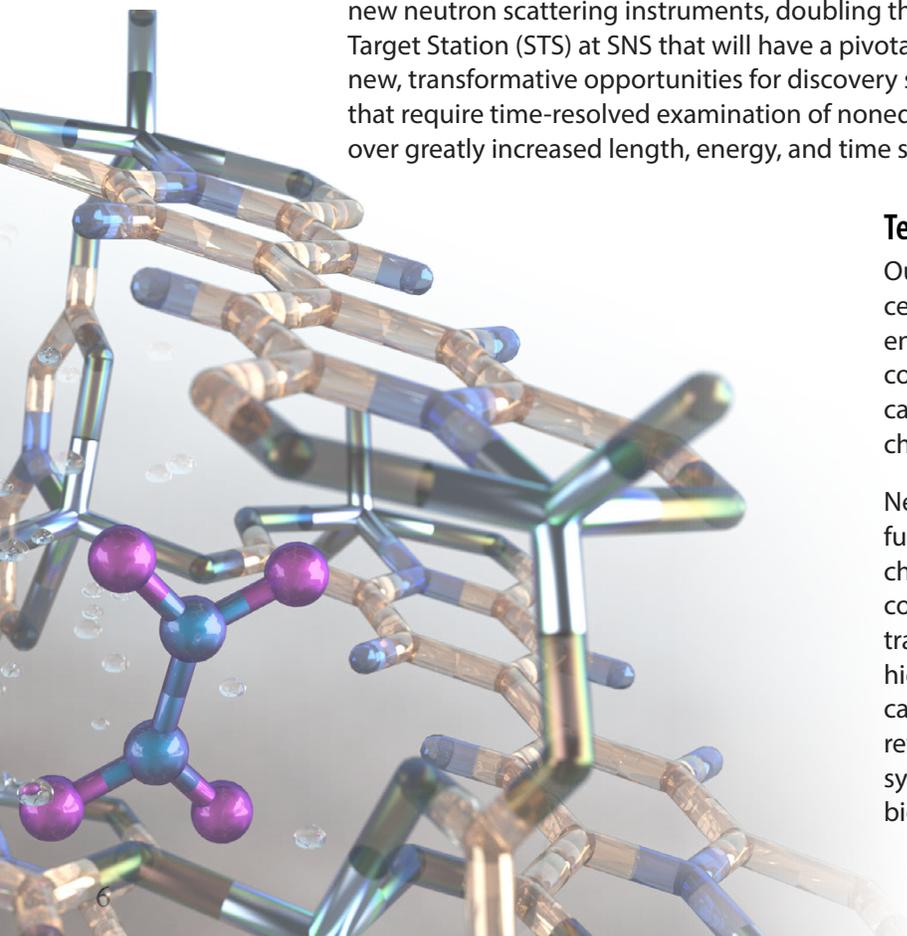
## Pioneers in Neutron Sciences

Neutron scattering grew from the nuclear science of the Manhattan Project during the 1940s at what is now ORNL. For more than 7 decades, neutron scattering has been a vital tool for studying materials across many scientific fields and applications, including automotive engines, batteries, data storage, geology, polymers, and biomedicine. Today, that pioneering spirit continues at ORNL, where both world-leading reactor and accelerator neutron sources continue to be enhanced to provide the wholly new capabilities needed to tackle tomorrow's research challenges. Developments include building new neutron scattering instruments, doubling the SNS accelerator's power and constructing a Second Target Station (STS) at SNS that will have a pivotal role in extending the reach of neutron scattering to new, transformative opportunities for discovery science. These will include, in particular, applications that require time-resolved examination of nonequilibrium processes in dynamic hierarchical systems over greatly increased length, energy, and time scales.

### Ten-Year Vision

Our vision is for SNS and HFIR to be world-leading centers for neutron sciences and innovation. Scientists, engineers and other valuable team members collaborate to provide unparalleled neutron scattering capabilities to make new science discoveries and solve challenging problems in materials and energy research.

Neutron scattering is ideally positioned to address future challenges that include discovering and characterizing new quantum effects that can be controlled in novel materials that underpin new, transformational technologies, understanding how hierarchical structures with desired materials properties can enable breakthroughs in novel materials, and revealing how the structure and dynamics of biological systems can be used in new applications in energy, biotechnology and biosecurity.





## Lab of the Future

In May 2020, we launched an internal initiative to strategically expand opportunities for scientific leadership aligned with growth in key programs, mission needs, and emerging research areas. As part of the effort, ORNL's Leadership Team considered how to sustain global leadership in research and development, a relentless pursuit of operational excellence, and an inclusive environment that fosters innovation, creativity, and collaboration.

Our goal is to serve the nation as the world's premier research institution, empowering leaders and teams to pursue breakthroughs in an environment marked by operational excellence and engagement with the communities where we live and work.

### Join Us!

ORNL's research groups and sections are the building blocks of a premier research institution and will focus on the disciplines essential to our missions and to leadership in emerging fields. We're creating new, focused teams to accelerate leadership in core capabilities identified by our sponsors, partners, and research staff.

- New **Section Heads** will provide R&D leadership to groups in common thematic areas, set consistent expectations, coordinate across disciplines, and help to align the activities of groups with the vision of the directorate and the Lab as a whole.
- New **Group Leaders** will sustain individual excellence in research and development while building a group of peers who pursue global leadership and exemplify ORNL's commitment to solving some of the world's most difficult problems.

*We're seeking passionate leaders who will help us become the world's premier research institution.*

### Leadership Opportunities in Neutron Sciences

- Accelerator Operations, Integration and Maintenance
- Accelerator Science and Technology
- Accelerator Systems
- Target and Mechanical Systems
- Control Systems
- Small Angle Neutron Scattering
- Neutron Imaging
- Neutron Diffraction
- Neutron Spectroscopy
- Beamline Operations and Support
- Sample Environment
- Neutron Instrument Technologies
- Neutron Technologies Engineering
- Site Operations



## Community and Culture

The strong partnership between DOE and ORNL contractor UT-Battelle, LLC, has created a national resource that draws outstanding researchers in a wide range of disciplines to world-class facilities where they tackle fundamental scientific challenges, couple discoveries with applied research, and work with industry to translate results into commercial applications. The work of the laboratory is being performed safely and efficiently in a modern campus setting. Throughout the region, ORNL is regarded as a high-value asset for innovation, education, and economic development.

### Discover East Tennessee

East Tennessee offers a variety of resources and experiences ranging from mountains, rivers, lakes, and a full menu of outdoor adventures to championship college teams and minor-league baseball to the arts and culture of Knoxville, including the internationally recognized [Big Ears Festival](#). The city is recognized as one of the country's best places to live, in part thanks to its [Urban Wilderness](#) system linking residential and commercial areas with the great outdoors. ORNL is within a day's drive of 50 percent of the nation's population and all of the East Coast's major cities.

### Our Workforce

ORNL is a great place to chart your own research course, work with like-minded colleagues, and build an extraordinary career. With more than 5,400 employees representing more than 60 countries, we assemble teams of experts from diverse backgrounds, equip them with powerful instruments and research facilities, and address compelling national problems.

In addition, ORNL offers professional development training at no cost to employees, provides professional networking opportunities, and sponsors employee resource groups that support diversity and inclusion efforts across the lab.

### Diversity and Inclusion

ORNL's ability to build and sustain a highly skilled workforce in a rapidly changing competitive environment for talent is greatly influenced by our ability to plan and forecast workforce needs and promote diversity. Maintaining an inclusive environment is a business imperative that focuses on people in all areas of the laboratory and on maximizing the unique talents of individuals, teams, and business partners to pursue world-leading scientific impact.



## We Welcome Your Application

Our challenge now is to sustain our leadership and build on our success. Thank you for your interest in ORNL and how we are helping to address some of the big science challenges facing our nation and the world.

## Apply Today

Apply at [jobs.ornl.gov](http://jobs.ornl.gov)

### Equal Employment Opportunity

ORNL is an equal opportunity employer committed to a diverse and inclusive workplace that fosters collaborative scientific discovery and innovation. All qualified applicants, including individuals with disabilities and protected veterans, are encouraged to apply.

## CONTACT

Gary Worrell  
Director, Talent Acquisition  
worrellgs@ornl.gov  
1 Bethel Valley Road  
Oak Ridge, TN 37831  
jobs.ornl.gov

Oak Ridge National Laboratory is managed  
by UT-Battelle for the US Department of Energy.



**U.S. DEPARTMENT OF  
ENERGY**