

Industry at the NSLS

For research that ranges from designing catalysts to developing computer chips, scientists from dozens of industries are drawn to the NSLS because the facility provides advanced analytical capabilities that are not available at their home laboratories.



This researcher from the Honeywell company UOP LLC uses light source techniques to study catalysis.

Pharmaceutical companies conduct experiments to design new drugs. The petroleum industry develops new catalysts for refining crude oil and making useful by-products, like plastics. The microelectronics industry investigates layers of materials and tiny structures used in such products as microprocessors for computers, with the aim of making them more efficient. Research at the NSLS reflects the diverse needs of the U.S. and international marketplace.

Future Technology

The NSLS has continually updated its technology and expanded its scientific capabilities since its first operations in 1982. As the boundaries of scientific discovery have been expanded, however, many researchers are looking for additional capabilities beyond those that can be provided by the NSLS or any other synchrotron in the world. As a result, Brookhaven has proposed building a replacement for the present facility – NSLS-II.

The new facility will be a state-of-the-art, world-leading synchrotron that will produce x-rays up to 10,000 times brighter than those generated by the current NSLS. Its superior capabilities will reinforce U.S. scientific leadership, enabling scientists to explore the challenges they face in developing new materials with advanced properties. Scheduled for completion in 2015, NSLS-II will lead to significant advances in condensed matter and materials physics, chemistry, and biology – advances that will ultimately enhance national security and help drive the development of abundant, safe, and clean energy technologies.

Conceptual rendering of NSLS-II



A View of Brookhaven

Brookhaven National Laboratory is a multipurpose research laboratory funded by the U.S. Department of Energy. Located on a 5,300-acre site on Long Island, New York, the Laboratory operates large-scale facilities for studies in physics, chemistry, biology, medicine, applied science, and advanced technology.

Brookhaven's 2,600 scientists, engineers, and support staff are joined each year by more than 5,000 visiting researchers from around the world.



Brookhaven's 5,300-acre site features research facilities for diverse scientific fields.



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managed for the U.S. Department of Energy
by Brookhaven Science Associates, a company
founded by Stony Brook University and Battelle



**National Synchrotron
Light Source**



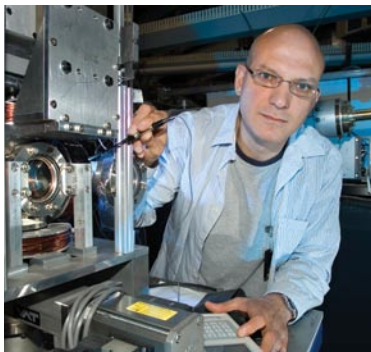
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NSLS: A Beacon for Research

The National Synchrotron Light Source (NSLS) is one of the most prolific scientific facilities in the world. Each year, about 2,100 scientists from more than 400 universities and companies use its bright beams of light for research in such diverse fields as biology, physics, chemistry, geology, medicine, and environmental and materials sciences. For example, researchers have used the NSLS to examine the minute details of computer chips, decipher the structures of viruses, probe the density of bone, determine the chemical composition of moon rocks, and reveal countless other mysteries of science.

Just as a laser pointer provides a small and very bright spot of red light, the NSLS provides an entire wavelength spectrum of extremely bright light — from very long infrared rays to ultraviolet light and super-short x-rays — to analyze very small or highly dilute samples. Scientists can use these



Scientists use bright beams of light at the NSLS to study magnetism, an important characteristic for developing advanced electronics and storage devices.

beams to study the electronic, chemical, and structural properties of materials at the atomic level.

Making Synchrotron Light

At the NSLS, an electron gun shoots bunches of electrons into one of two huge, donut-shaped tubes called electron storage rings. Guided by powerful magnets, the electrons are accelerated in a circular orbit to nearly the speed of light. As magnets accelerate and bend the beams, the electrons emit energy called synchrotron light, which is piped to about 65 separate beamlines where scientists perform their experiments.

The smaller of the NSLS rings, the ultraviolet ring, stores electrons at 800 million volts of energy to produce infrared, visible, and ultraviolet light. The x-ray ring stores electrons at 2.8 billion volts, and extends the spectrum of light available for research into the x-ray region. For comparison, a TV picture tube also has an electron gun, but its voltage is only about 30,000 volts.

Powerful Light, Diverse Research

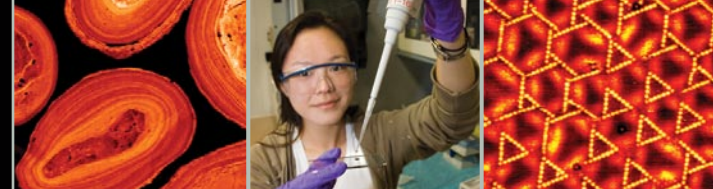
Researchers at the NSLS use sophisticated imaging techniques to get highly detailed images of materials, from biological molecules to semiconductor devices.

Scientists have used the NSLS to:

- develop a method for breast cancer detection that is more accurate than mammography
- look for signs of life in comet and space dust collected by NASA's Stardust spacecraft
- determine how one class of proteins helps to generate nerve impulses, which led to the 2003 Nobel Prize in Chemistry
- examine material dredged from the Port of New York/New Jersey to determine the nature of pollutants in the sediment
- study the structure and composition of plaques in Alzheimer's disease using infrared and x-ray imaging techniques
- probe electrolytes in lithium-ion batteries with the aim of improving their performance
- investigate magnetic materials to make better recording devices
- probe the properties of high-temperature superconductors, materials that conduct electricity with almost zero resistance
- explore new techniques for making denser, faster computer chips
- study the role of zinc in the development of age-related macular degeneration, the leading cause of blindness among elderly people in the developed world



Students prepare a biological crystal sample for analysis at an NSLS beamline.



Iron-oxide nodules seen through x-ray fluorescence microprobe; screening plants for use in bioethanol production; "dancing" nano triangles formed by sulfur atoms on a layer of copper

Studying the Ultra-small

In conjunction with Brookhaven's Center for Functional Nanomaterials (CFN), the NSLS provides researchers with state-of-the-art capabilities to probe the unique properties of matter at an extremely small scale — the nanoscale. Nanoparticles, particles with dimensions on the order of billionths of a meter, offer different chemical and physical properties than bulk materials and, therefore, could have revolutionary impacts, from more efficient energy generation and data storage to improved methods for diagnosing and treating disease.



Scientists work on the open, busy environment of the vacuum ultraviolet-infrared experimental floor.

At the nanoscale, NSLS researchers have:

- determined a new way to use x-rays to study carbon nanotubes, tiny cylindrical carbon molecules with exceptional strength, conductivity, and heat resistance
- described the role of titanium atoms in hydrogen-storage materials
- found a way to control the self assembly of nanoparticles using DNA, which could lead to advances in optics, electronics, and magnetic materials
- shown that copper nanomaterials can be used to keep fuel cells functioning longer while eliminating unwanted byproducts