NSLS-II: A Bright New Light Source

Purpose:
To provide extremely bright x-rays for basic and applied research in biology and medicine, materials and chemical sciences, geosciences and environmental sciences, and nanoscience

Sponsor:
U.S. Department of Energy (DOE), Office of Science, Office of Basic Energy Sciences

Costs:
$400 million to design and build
$70 million per year to operate

Features:
State-of-the-art, medium-energy (3-billion-electron-volt, or GeV) electron storage ring that produces x-rays up to 10,000 times brighter than the current NSLS

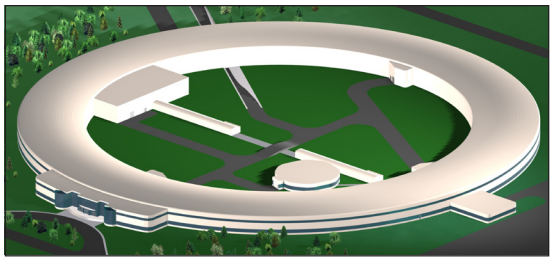
Users:
Researchers from the northeastern U.S. and from around the world

Complementary Facilities
- *Advanced Photon Source at DOE's Argonne National Laboratory*
- *Advanced Light Source at DOE's Lawrence Berkeley National Laboratory*
- *Stanford Synchrotron Radiation Laboratory at DOE's Stanford Linear Accelerator Center*

www/nsls2.nsls.bnl.gov

The existing National Synchrotron Light Source at Brookhaven National Laboratory

Brookhaven National Laboratory is proposing to build a new world-leading synchrotron light source. This scientific user facility is expected to have enormous impact in numerous scientific fields.



Conceptual drawing of the ultra-high brightness (3 GeV) storage ring known as NSLS-II

About the NSLS

Brookhaven's current light source — the National Synchrotron Light Source (NSLS) — is one of the world's most widely used scientific facilities. Each year, about 2,400 researchers from more than 400 universities, government laboratories, and companies use its bright beams of x-rays, ultraviolet light, and infrared light for research in such diverse fields as biology and medicine, chemistry and environmental sciences, physics, and materials science. The scientific productivity of the NSLS user community is very high and has widespread impact, with approximately 800 publications per year, of which some 130 appear in premier scientific journals.

Planning for the Future

Though the current NSLS has been continually updated since its commissioning in 1982, today the practical limits of machine performance have been reached. In order for the productivity of its user community to continue, and in order to tackle the "grand challenge" scientific problems of tomorrow, it is essential that the NSLS be upgraded.

NSLS-II is a proposed new state-of-the-art, medium-energy electron storage ring (3 billion electron volts) designed to deliver world-leading intensity and brightness, and will produce x-rays up to 10,000 times brighter than the current NSLS. The superlative character and combination of capabilities will have broad impact on a wide range of disciplines and scientific initiatives, including the National Institutes of Health's structural genomics initiative, DOE's Genomes to Life initiative, and the federal nanoscience initiative, among others.

Brookhaven proposes that the design and engineering of NSLS-II begin in 2005, and construction begin in 2008. If plans are carried through as proposed, the new facility will be operating in 2012.

New Capabilities, New Science

The extremely bright x-rays at the new light source will make possible new discoveries in numerous areas of science:

• Biological Sciences

Scientists use x-rays to determine the three-dimensional atomic structure of biological molecules, which is essential for understanding their function. A wide range of pharmaceuticals and chemicals for medicine and agriculture are derived from these studies. At the new facility, researchers will be able to examine highly complex molecules, biological processes, and smaller samples with unprecedented detail.

• Materials and Chemical Sciences

Researchers study a wide range of materials at the NSLS, from computer chips and artificial joints to novel magnetic and superconducting films. The new light source will dramatically change and enhance the experimental probes available to researchers. In addition, new techniques will be available for investigating chemical reactions, including catalysis.

• Geology and Environmental Science

Researchers will be able to study the composition of Earth and other planets as they have evolved, as well as dynamics of chemical reactions, at a wider range of temperatures and pressures. Also, the new light source will allow for a more detailed understanding of environmental contaminants, important for designing cleanup strategies and setting environmental standards.

• Nanoscience

The study of materials at ultra-small dimensions — on a scale of a nanometer, or a billionth of a meter — may be the basis of the products and processes of tomorrow. NSLS-II capabilities will complement the Center for Functional Nanomaterials at Brookhaven, due to be built in 2005 and become fully operational by 2008, to investigate and manipulate nanoscale properties.

5/04