NSLS-II: A Powerful New Photon Microscope

Science for the 21st Century

Brookhaven National Laboratory is building a new world-leading synchrotron light source. This scientific user facility is expected to reinforce U.S. scientific leadership, giving researchers here a competitive advantage in numerous scientific fields that will benefit our nation's economy.

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

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, 2,100 researchers from 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 more than 800 publications per year, many in premier scientific journals.

Meeting Critical Challenges

Though the current NSLS has been continually updated since its commissioning in 1982, today the practical limits of machine performance have been reached. Meeting the critical scientific challenges of our energy future will require advanced new capabilities that NSLS-II will uniquely provide.

NSLS-II will be a 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 more than 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 Genomics:GTL initiative, and the federal nanoscience initiative.

The facility will be a key resource for researchers at Brookhaven's Center for Functional Nanomaterials, allowing for analysis of new materials that are expected to transform the nation's energy future. Construction of the NSLS-II's ring building began in March 2009.

If plans are carried through as proposed, the new facility will begin operating in 2015.

With $150 million in accelerated funding under the American Recovery and Reinvestment Act, NSLS-II will generate several hundred local jobs in 2009. And, during its construction, the project is expected to create more than 1,000 construction and 300 scientific and engineering jobs. When operating, NSLS-II will support more than 500 permanent positions.

Advanced Tools

NSLS-II will provide very powerful beams of x-rays plus advanced instrumentation. Together, these attributes will allow researchers to:

- Image materials with 1-nanometer resolution
- Reveal chemical activity in unprecedented detail
- Determine the structure and chemical properties of a single atom buried inside a material.

Discovery-Class Science

Research at NSLS-II will focus on some of our most important challenges at the nanoscale:

Clean and Affordable Energy

NSLS-II will image highly reactive gold nanoparticles inside porous hosts and under real reaction conditions. This will lead to new materials that use sunlight to split water for hydrogen production and harvest solar energy with high efficiency and low cost.

Molecular Electronics

NSLS-II will allow scientists to observe fundamental properties with nanometer-scale resolution and atomic sensitivity. For example, new electronic materials that scale beyond silicon could be used to make faster, less-expensive, energy-efficient electronics.

Self-assembly

NSLS-II will enable scientists to understand how to create large-scale, hierarchical structures from nanometer-scale building blocks, mimicking nature to assemble nanomaterials into useful devices more simply and economically.

High Temperature Superconductors

NSLS-II will allow scientists to study how materials become high temperature superconductors, and may lead to materials that allow super-efficient electricity transmission at room temperature.

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:

$912 million to design and build
$150 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 NSLS

Users:

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

Key Milestones

Aug. 2005
Approve Mission Need (Complete)

Jul. 2007
Approve Alternative Selection and Cost Range (Complete)

Jan. 2008
Approve Performance Baseline (Complete)

Dec. 2008
Approve Start of Construction

Feb. 2009
Award for Ring Building

Mar. 2010
Award for Booster System

Feb. 2012
Beneficial Occupancy of Experimental Floor

Oct. 2013
Start Accelerator Commissioning

Jun. 2014
Early Project Completion; Ring Available to Beamlines

Jun. 2015
Approve Start of Operations

www.bnl.gov/nsls2

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