NSLS

NATIONAL SYNCHROTRON LIGHT SOURCE

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U.S. DEPARTMENT OF ENERGY
OFFICE OF BASIC ENERGY SCIENCES

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BROOKHAVEN NATIONAL LABORATORY
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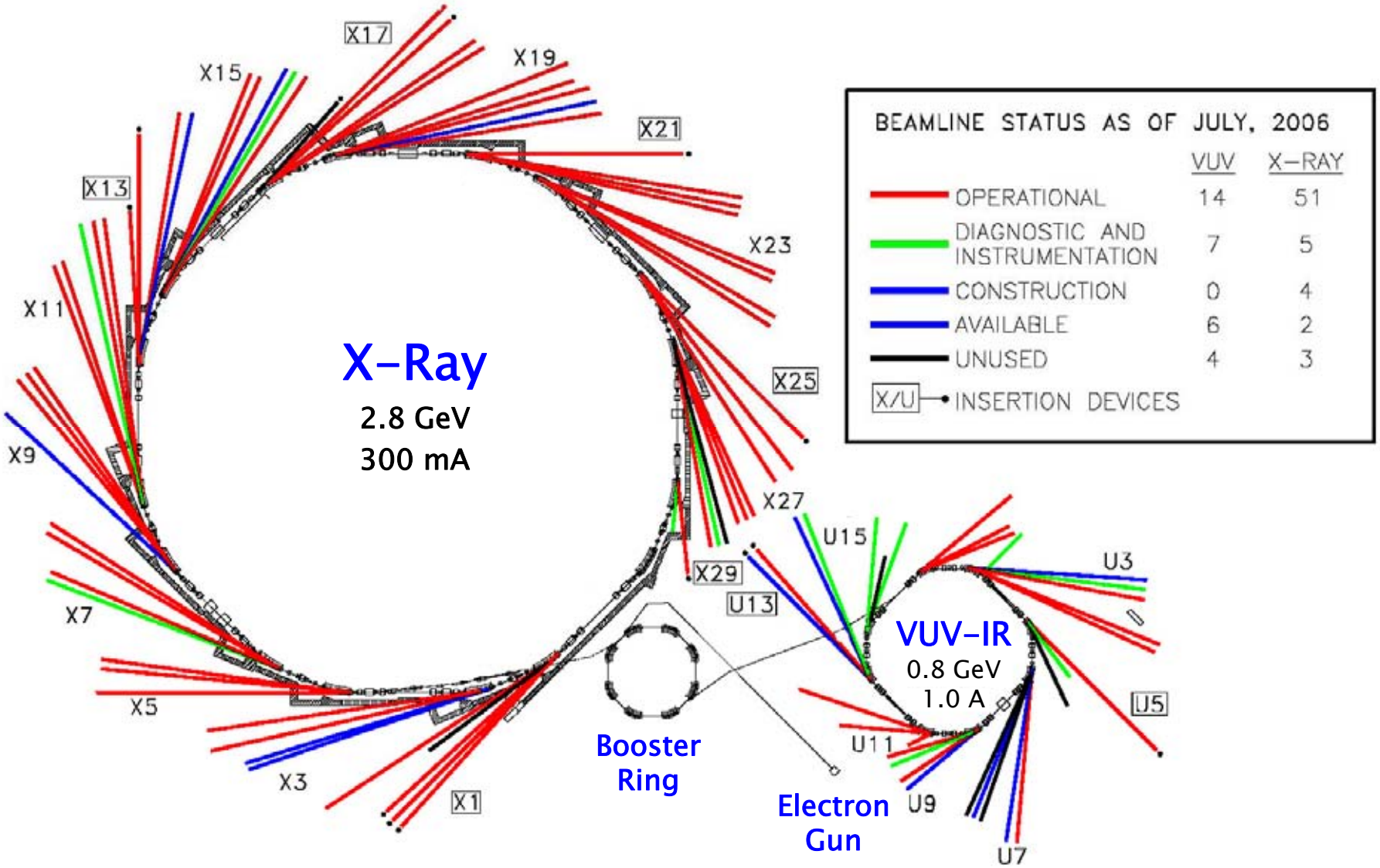
Infrared, ultraviolet, and x-ray: serving more than 2000 users per year



Major Synchrotron Techniques and Fields of Research at NSLS

SPECTROSCOPY

- Infrared spectroscopy
- Photoelectron spectroscopy
- X-ray absorption spectroscopy
- X-ray emission spectroscopy

DIFFRACTION/SCATTERING

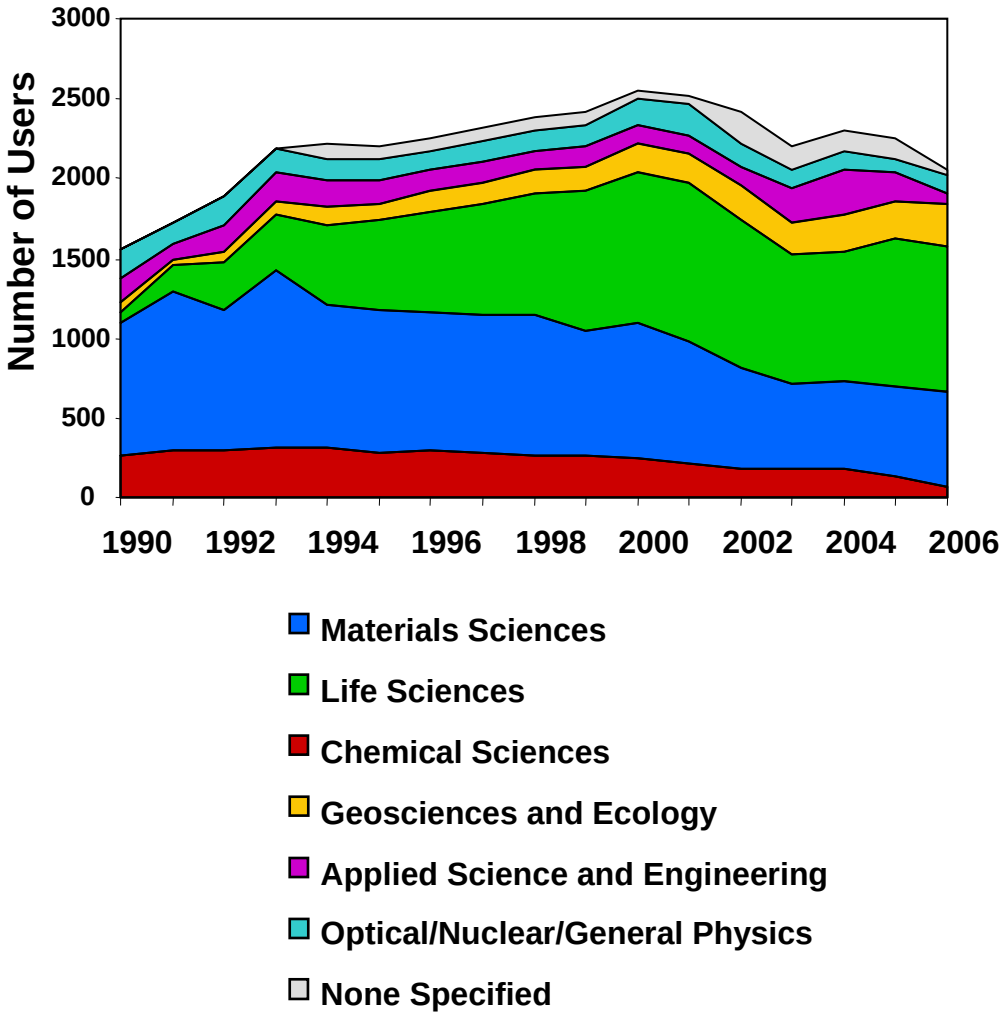
- Protein crystallography
- Small molecule crystallography
- Powder diffraction
- Small-angle x-ray scattering
- X-ray microdiffraction
- High momentum resolution x-ray scattering

IMAGING

- Infrared microspectroscopy
- Soft X-ray scanning microscopy
- Hard X-ray microprobe
- X-ray microtomography
- Diffraction-enhance imaging

OTHER

- Micro-machining
- X-ray footprinting



Research Highlight: Hydrogen Storage

Beamline: X19A

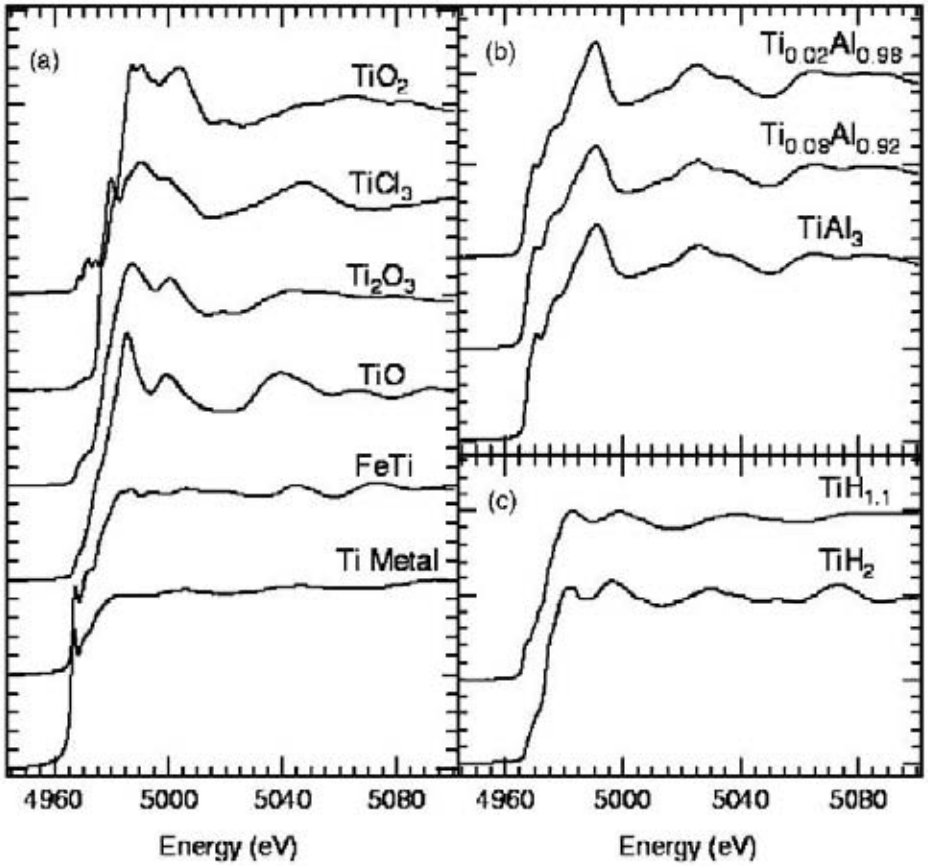
Technique: XAFS

Researchers:
J. Graetz, J.J. Reilly, J. Johnson (BNL) A. Ignatov, T. Tyson (NJIT)

Publication:
J. Graetz et al., "X-ray absorption study of Ti-activated sodium aluminum hydride," *Appl. Phys. Lett.* 85, 500-502 (2004)

Ti (2-4mol%) increases H up-take and lowers temperature to release H.

See significant differences in the Ti K-edge in different environments, which correlate edge with oxidation state.



RESULTS: Ti neutral, probably in form of amorphous $TiAl_3$ on surface, and no bulk lattice substitution (Ti^{4+})

Research Highlight: Real-Time Studies of Nanostructure Growth

Beamline: X21

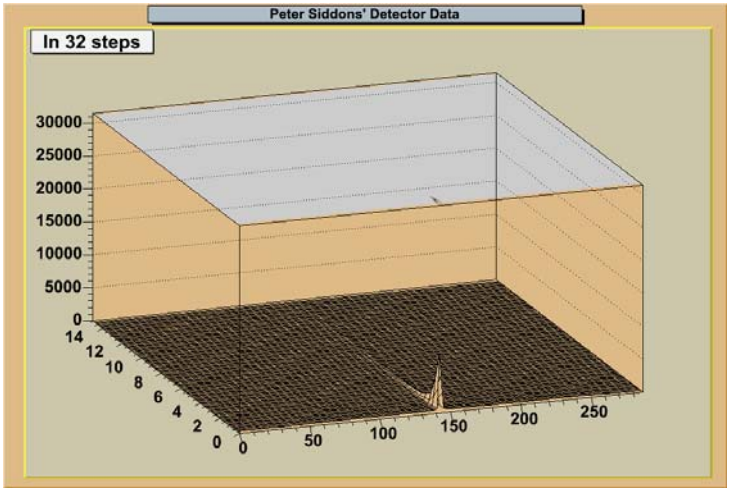
Technique: GISAXS

Researchers:
K. Ludwig, A. Özcan,
G. Özaydin, Y. Wang
(Boston University)
R. Headrick, H. Zhou
(University of Vermont)
D.P. Siddons (NSLS)

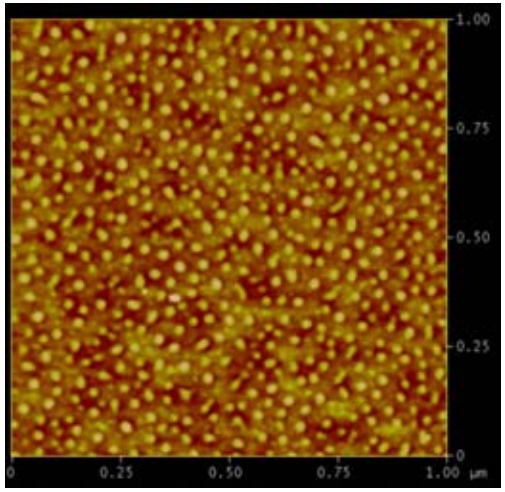
received a 2004 VT EPSCoR Equipment Grant

Si(100) During Ar^+ Ion Bombardment

In many conditions, nanoscale structures can form spontaneously on surfaces during ion bombardment. We are using real-time GISAXS to examine surface morphology evolution in several systems, including silicon. For normal ion beam incidence, dot-like structures form. The real-time x-ray data allows detailed comparison with theoretical predictions to better understand the physical mechanisms dominating the surface behavior.

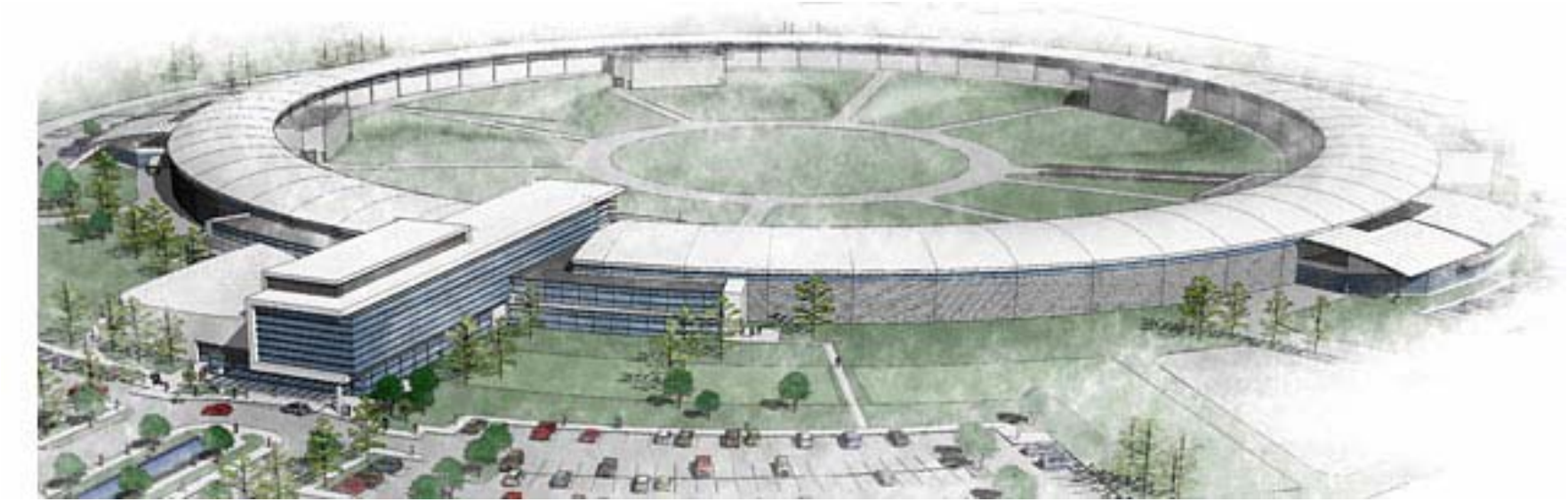


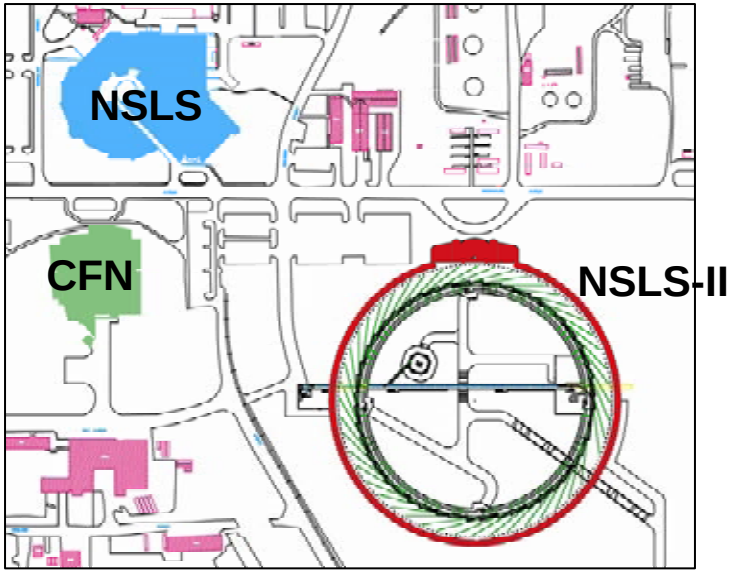
Evolution of GISAXS scattering patterns during Ar^+ ion bombardment of Si(100). Each time step represents approximately 3 minutes.



Post-facto AFM topograph of Si surface showing formation of dot-like structures.

NSLS-II: Brighter Light for the Future





- new synchrotron under design at Brookhaven National Lab
- $800M project to be completed in 2013
- x-rays and infrared light ~10,000 times brighter than current NSLS
- will be the brightest synchrotron in the world