

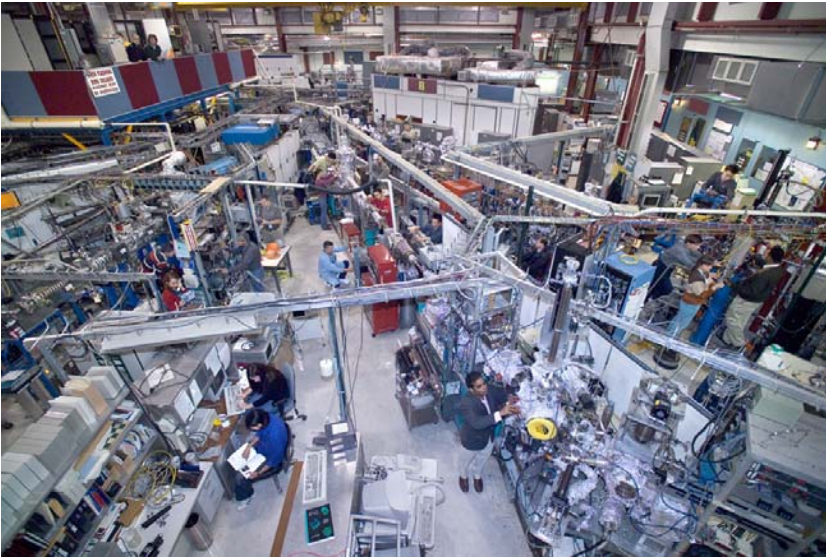


Introducing Synchrotrons
into the Classroom

Office of Educational Programs



NSLS



RHIC



NSLS-II



CFN



Cyber-enabled Remote Access

The image displays a remote access interface for a microscope system. The interface is divided into several sections:

- Video Feed:** A central window shows a live video feed of three individuals (two women and one man) in a laboratory setting. The window title is "Sayville 2".
- Technical Control Panel:** A large window titled "Shared part of your desktop" contains a technical interface for a microscope system. It includes:
 - Graphs:** A plot titled "713b FC73 IP 3 plaques" showing a signal over time. A zoomed-in view of the signal is shown in the bottom right.
 - Motor Controls:** A section for "Motor 1" and "Motor 2" with fields for "San. Hor. X (mm)", "Current position", "Start (abs)", "Stop (abs)", "Step", "Start (rel)", "Stop (rel)", and "# points".
 - Regions of Interest:** A section for defining regions of interest with "Add" and "Delete" buttons.
 - KLM Markers:** A section for defining KLM markers with "Add" and "Delete" buttons.
 - Display:** A section for display settings with "Zoom" and "Shift" buttons.
 - Vertical Scale:** A section for vertical scale settings with "Logarithmic" and "Linear" options.
 - Counts Table:** A table showing counts for different markers.
- System Information:** A section at the bottom left shows "Scan file name" (13b_FC73_P.001) and "Scan title" (713b FC73 IP 3 plaques).
- System Status:** A section at the bottom right shows "Z" position (66,8850) and "Counts" (0).

Bringing Big Science into the Classroom: BNL's NSLS and CFN

Monday, May 24, 2010



**Over 100 Registered Attendees, over 50% were
High School Teachers and Administrators**



What is InSynC?

- A program to enable high school teachers and students to gain remote access to synchrotron beamtime through a competitive, peer-reviewed proposal process.
- The program will train both teachers and students to formulate a hypothesis-driven scientific problem and learn the skills of writing a competitive beamtime proposal.
- Supported and Funded the NSLS and DOE's Office of Workforce Development for Teachers and Scientists (WDTS) to enhance science education at the high school level.



Who Can Participate?

- This program has started with local Long Island high schools.
- Any high school science program can participate.
- We anticipate that in the future the program will be expanded to a nationwide competition and involve all US synchrotrons.

Implementation

3-Day Teacher Training Course



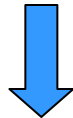
Teachers & Students formulate
a hypothesis and experiment



Teachers & Students submit
proposal



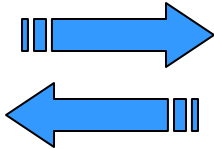
Peer Review



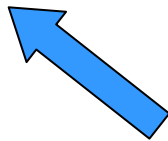
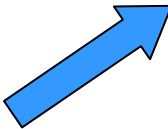
Proposals receive 1-4 rating



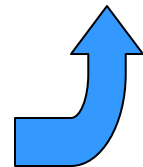
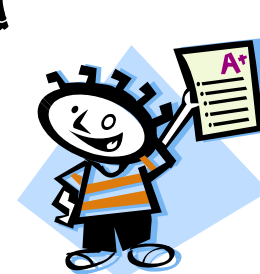
July 2010



Score too low
for this cycle:
Classroom Visit



Highest rated
scheduled for
beamtime



Where Are We Now?

- First set of proposals were submitted on October 22nd.
- Reviews were completed and proposals scored by a panel of synchrotron scientists worldwide with expertise in education and outreach.
- Proposal Examples: collection and analysis of micrometeorites, effectiveness of household water filters, chemistry of biofilms, structural biology
- Two proposals were allocated beamtime in December 2010.

Beamtime Allocation Ceremony

Monday, November 29, 2010



- Proposals allocated beamtime:
 - Microbial Biofilm as a Remediation Tool for Copper Contaminated Freshwater (Diana Soehl, Elwood-John H. Glenn High School)
 - Effectiveness of Common Household Water Filters Using X-Ray Fluorescence Microprobe (Ashley Bloch, Islip Middle School; Michael Vaccariello, Sachem East High School)

What's Next?

Available Beamlines & Beamtime:

- Initially, approximately 1-2 days of beamtime per cycle will be allocated on 3 beamlines at the NSLS.
- These will include:
 - X-ray fluorescence microprobe beamline
 - Infrared microscopy beamline
 - Protein crystallography beamline
- As additional beamlines are outfitted, more beamlines will be made available.



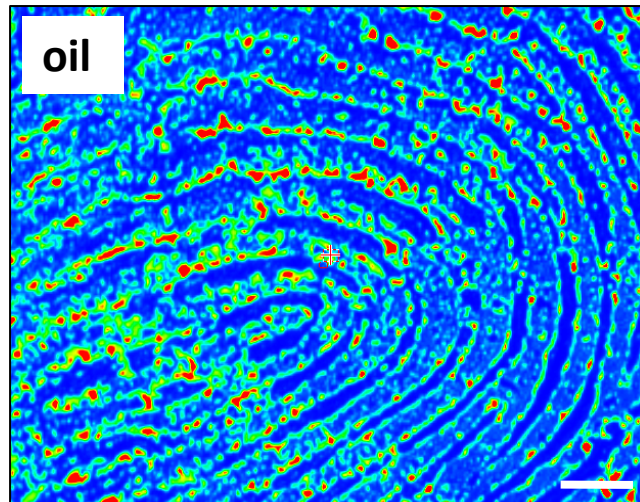
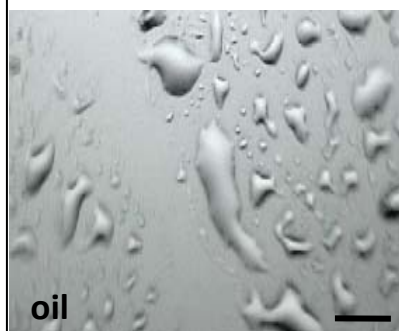
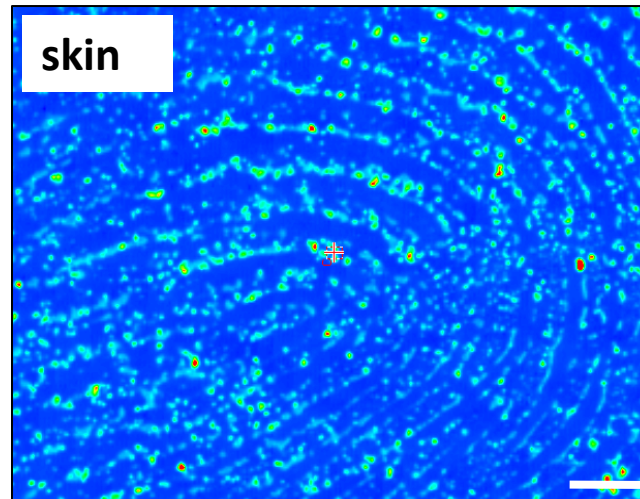
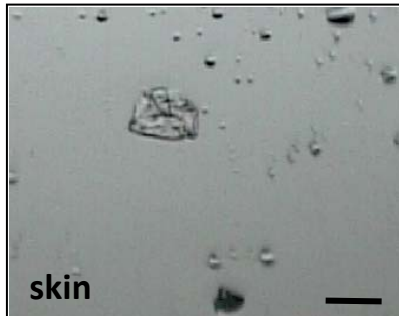
Infrared Microscopy Beamline



These beamlines focus bright beams of infrared light to a very small size (1/10 size of human hair) to image the organic makeup of materials

Examples: biological materials, plastics, fibers, soils

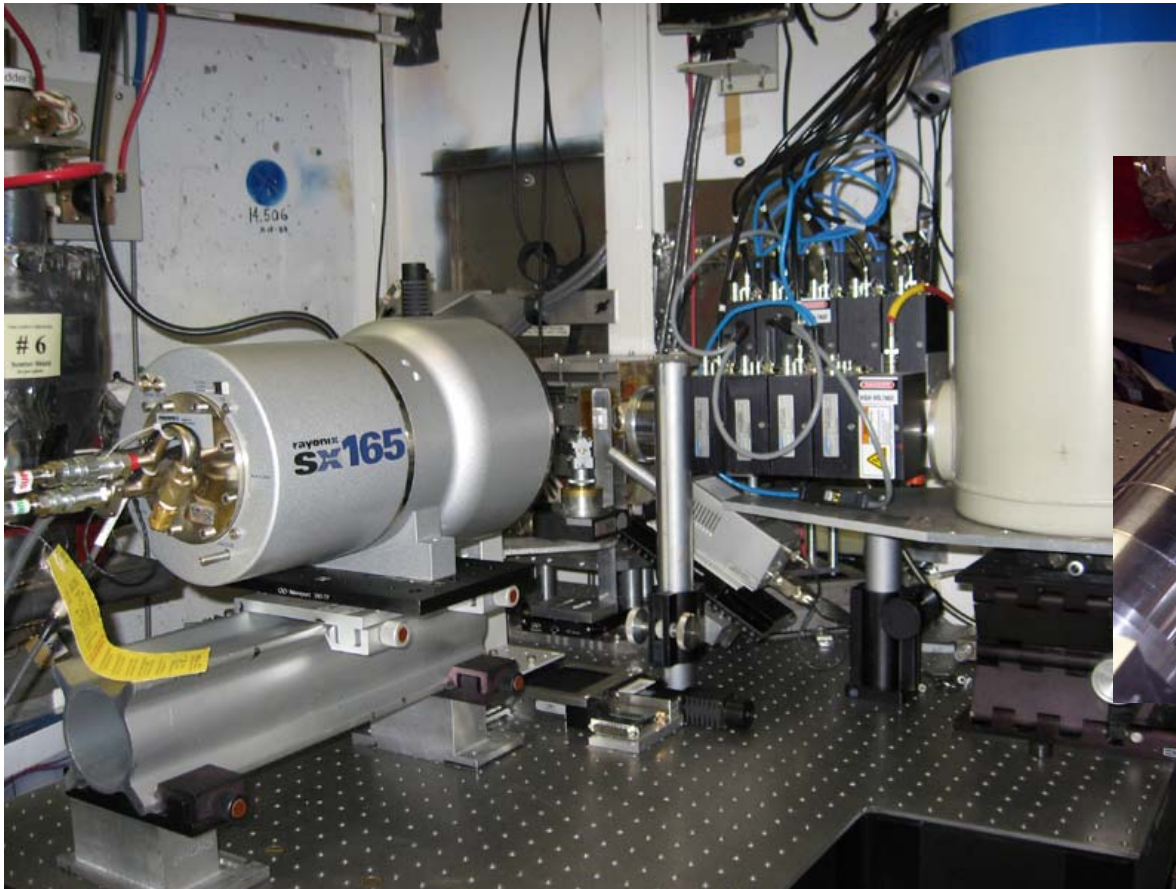
Science Example: Fingerprint Composition



- **Problem:** Forensic evidence shows that children's fingerprints "disappear" faster than adults' prints
- **Experiment:** The infrared microscope images the oil and protein components of fingerprints.
- **Results:** Differences in oil composition are responsible for the volatility of children's prints

Synchrotron X-ray Microprobes

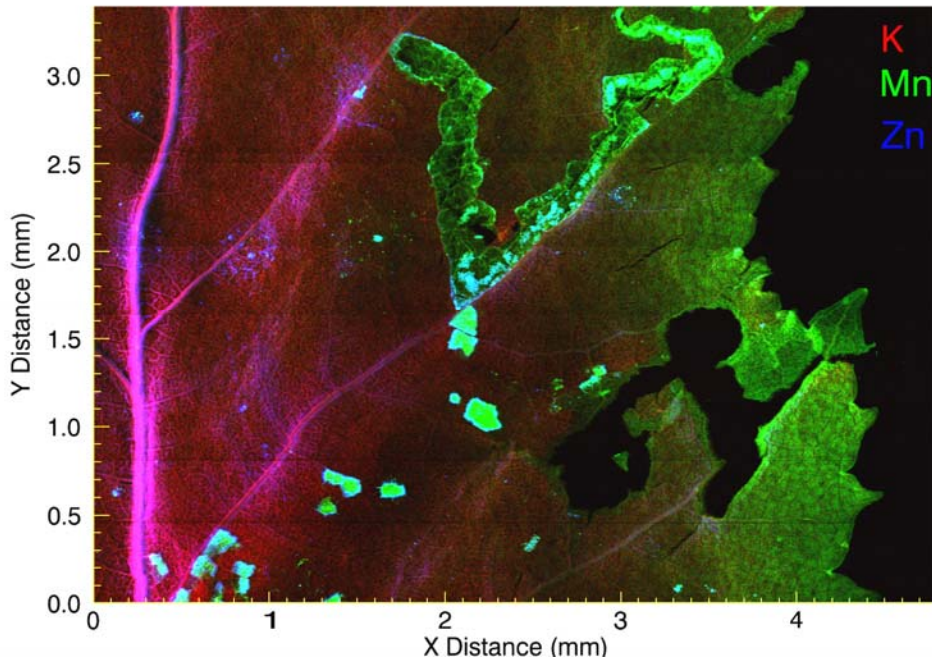
- These beamlines focus these bright X-ray beams to very small size ($<10\ \mu\text{m}$...f.y.i human hair is $\sim 100\ \mu\text{m}$ diameter) to:
 - Examine the distribution of elements at micron scale with femtogram sensitivity (0.000 000 000 000 001 g)
 - Evaluate the molecular form of these elements in natural samples
 - Provide chemical information as an imaging experiment



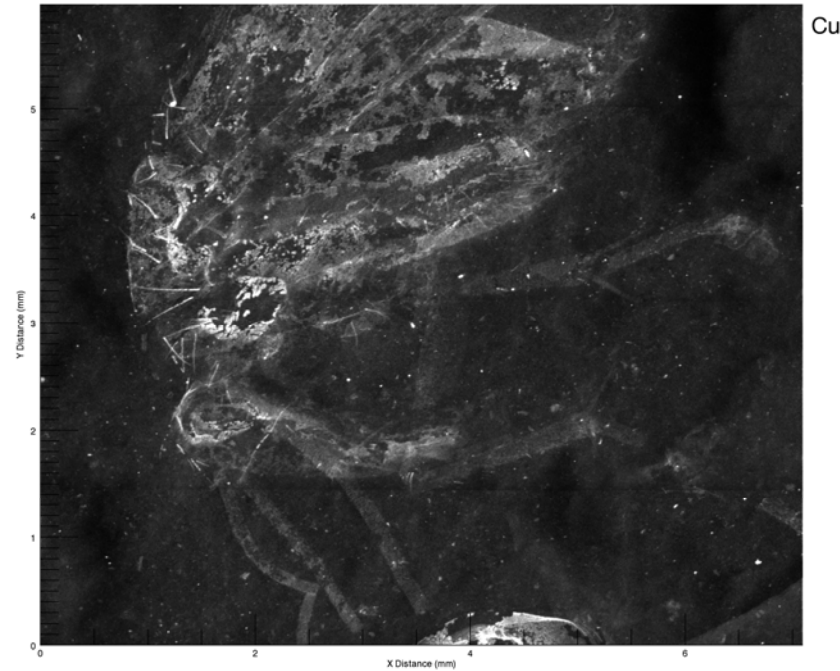
Science Examples: X-ray microprobe

- Pollutants in urban NJ brownfields
- Increasingly converted into green spaces by allowing natural succession to proceed unassisted
- insects such as leafminers alter and cycle metals

Liberty State Park, NJ - Leafminer damage - Birch Site 48



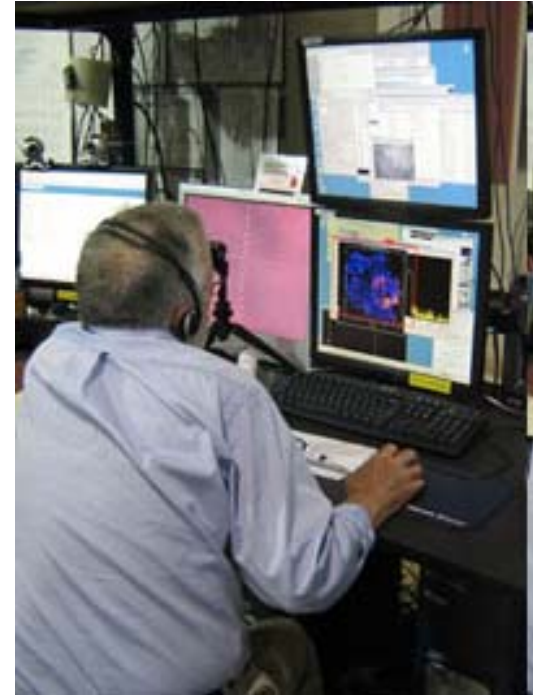
Cretaceous Stonefly Liaoning China - Zoom



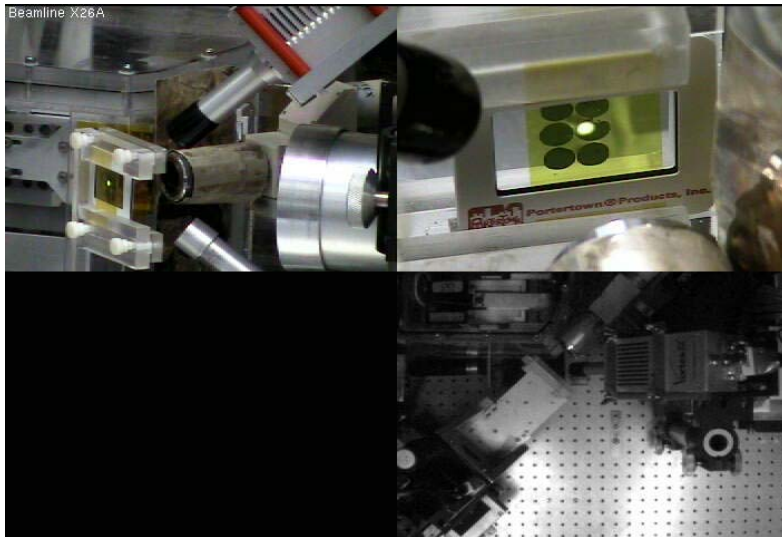
- Cretaceous fossil of a stonefly (Liaoning, China, ~125 million years old)
- X-ray fluorescence microprobe allows for chemical imaging of remnants of soft tissue that is not optically visible

Ideal for analysis of samples as-is with no sample preparation

Remote Access from the Classroom



Beamline X26A



Summary

InSynC...

- Engages high school teachers and students to formulate hypothesis-driven experiments
- Provides research experience to entire classrooms rather than individual students
- Addresses many of the key recommendations made by the National Academies in the National Curriculum Standards (i.e. inquiry based learning)
- Provides student access to the Nation's premier science facilities, the same facilities Nobel-prize winning researchers have used



2003 and 2009

Nobel Prizes in Chemistry



Rod MacKinnon



*Venkatraman
Ramakrishnan*



Thomas Steitz

Participating School Districts so far

Longwood

Riverhead

William Floyd

Bellport

Patchogue-Medford

Sayville

Babylon

Shelter Island

Islip

Hauppauge

Deer Park

Northport

Eastport South Manor

Mt Sinai

Elwood

North Babylon

Sachem

For additional information...



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