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newsletter

national synchrotron light source

July 2004

2004 NSLS Annual Users' Meeting Caps Off Another Successful Year

Laura Mgrdichian, NSLS Science Writer

Almost 400 participants at the 2004 NSLS Annual Users' Meeting, held May 17-20 at Brookhaven National Laboratory (BNL), came together for a successful event full of interesting talks and important messages for the future. The meeting affirmed that the NSLS continues to be a facility that produces important science.

In his welcoming remarks at the main meeting on May 18, the new Users' Executive Committee (UEC) Chair, Larry Shapiro, discussed the continuing excellence of NSLS research, such as the cellular ion channel structures determined by user Roderick MacKinnon, performed at the NSLS and the Cornell High Energy Synchrotron Source. This work earned MacKinnon the 2003 Nobel Prize in Chemistry.

Steve Dierker, NSLS Chairman and Associate Laboratory Director for Light Sources, described another important crystal structure, a cellular protein channel, recently determined here and featured on the cover of *Nature* in January 2004.

He also described other research highlights – a new liquid crystal phase in polar ordered materials, featured on the cover of *Science* in August 2003; a new material texture type, appearing in *Nature* in December 2003; and a new way to store hydrogen in molecular compounds, published January 2004 in the *Proceedings of the National Academy of Sciences*.

"These give you a flavor of the diversity and quality of science that continues at this facility," he said. "The NSLS has a well-deserved reputation for outstanding productivity."

Among the main meeting speakers at the Annual NSLS Users' Meeting were (from left): Bob Casey (BNL-NSLS), Pedro Montano (DOE), Mark Croft (Rutgers University), Steve Dierker (BNL-NSLS), John Hill (BNL-Physics), Lois Pollack (Cornell University), Simon Billinge (Michigan State University), and Chris Jacobsen (Stony Brook University).

The main meeting's scientific talks focused on user research from a more in-depth perspective. Chris Jacobsen, of Stony Brook University (SBU), gave an overview of the many x-ray and infrared imaging techniques available to users at the NSLS. Mark Croft, from Rutgers University, described his research on strain fields in macroscopic materials, in which he uses an energy dispersive x-ray diffraction method.

Simon Billinge, of Michigan State University, presented his work on the structures of complex materials that display order on the nanoscale, using the rapid acquisition pair distribution function technique he developed with his group.

INSIDE THIS EDITION

Brookhaven Lab's John Hill discussed how he uses soft x-ray scattering to probe the behavior of electrons in solids.

Another speaker, Cornell University's Lois Pollack, described an apparatus designed by her research group, which allows them to observe, using small angle x-ray scattering (SAXS), how an RNA chain molecule compacts and folds into a three-dimensional structure. Following this, Yvonne Akpalu, of Rensselaer Polytechnic Institute, presented her work, which investigates how to solve the crystal structure of a copolymer using SAXS.

The new NSLS Users' Executive Committee Chair, Larry Shapiro, gave welcoming remarks at the main meeting.

On the days before and after the main meeting, users divided up to listen to additional talks on specific topics. These talks were organized into the following workshops: "Better Ways to See the Light: Advanced Detectors for Synchrotron Radiation," organized by Peter Siddons (BNL) and Gianluigi De Geronimo (BNL); "Anatomy of a Virus," organized by Marc Allaire (BNL) and Paul Freimuth (BNL); "Grazing Incidence Small Angle Scattering," organized by Ben Ocko (BNL) and Detlef Smilgies (Cornell University); "Pharmaceutical Applications of Synchrotron Radiation," organized by Evgenyi Shalaev (Pfizer Inc.), Raj G. Suryanarayanan (College of Pharmacy), and Peter Stephens (SBU); "Advanced Optical Systems and Metrology for High Power and Coherent Beamlines," organized by Peter Takacs (BNL) and Steve Hulbert (BNL); "Applications of Synchrotron Based Methods to Hydrogen Storage Materials," organized by Trevor Tyson (New Jersey Institute of Technology) and Wolfgang Caliebe (BNL); "Nanoprobes for Nanoscience," organized by Cecilia Sanchez-Hanke (BNL) and Peter Sutter (BNL); and "Crystallization, Membrane Proteins," organized by Naomi Chayen (Imperial College of Science, Technology & Medicine) and Vivian Stojanoff (BNL).

Yvonne Akpalu (RPI) discussed the use of light and x-ray scattering on copolymers.

Now and Ahead

On the performance front, Dierker said the facility did well overall in the last year, with the VUV ring achieving 98 percent reliability and 108 percent availability. The x-ray ring didn't perform quite as well, operating at 89 percent reliability and 99 percent availability. He noted that more than 60% of the downtime on the x-ray ring was due to three unusual major events, including the Northeast electrical power blackout last August.

In a message users are very familiar with, he stressed that the NSLS, designed 30 years ago and the only remaining second-generation DOE light source, is now performing at the limits of its capabilities. Pedro Montano, manager of the X-ray and Neutron Scattering Facilities program within the Department of Energy's Office of Basic Energy Sciences, acknowledged this in his talk, referring to the NSLS as the "working horse" of the DOE light sources.

Dierker and Montano repeated the need and excitement for NSLS-II, the proposed third-generation light source that would replace the NSLS. Currently, Montano said, an international panel of scientists is reviewing the proposal – the first step in the process. He urged the current and prospective users of NSLS-II to contact their representatives in Congress and tell them how vital the facility is.

"I think NSLS-II is necessary," Montano said. "There are a huge number of scientists in the Northeast that would benefit from it."

All of the day's speakers affirmed this idea – that NSLS-II is needed to broaden and enrich their research.

BNL and the NSLS

In his "CFN Update" talk, Robert Hwang, director of the Center for Functional Nanomaterials (CFN) facility, discussed how the CFN will be "an interdisciplinary environment for nanoscience research," performed in conjunction with several BNL departments, including the NSLS and NSLS-II.

Center for Functional Nanomaterials (CFN) Director Robert Hwang gave the CFN Update at the main meeting.

In this way, the research the CFN will enable promises to be very exciting. "The Northeast is becoming a hotbed for nanoscience," said Dierker. "Brookhaven is becoming a focal point for much of that research."

The future of Brookhaven Lab was the subject of Lab Director Praveen Chaudhari's talk. In his vision for the Laboratory in the next 20 years, Chaudhari said NSLS-II plays a significant part in his desire to see more integration between departments, and the emergence of a new culture and way of thinking at the Lab.

Brookhaven National Laboratory Director Praveen Chaudhari discussed his vision for the Laboratory in the next 20 years.

"In a research lab, departmentalizing can be a hindrance," he said. "To reach the frontiers in the life, physical, and environmental sciences, we need to find the major challenges at these interfaces between disciplines, and begin to address them."

Another Lab-wide initiative – safety – was discussed by Bob Casey, the NSLS

Poster prize winners at the 2004 NSLS Users' Meeting were (from left to right): Dario Arena (BNL-NSLS), Xianqin Wang (BNL-Chemistry), Marianna Kissell (SBU), Mehmet Aslantas (BNL-NSLS), and Alexei Grigoriev (Harvard University). Not pictured: Meghan Ruppel (SBU).

Tuesday night's reggae banquet was enjoyed by all, including (from left to right): Gene Ice (ORNL), Pedro Montano (DOE), Peter Siddons (BNL-NSLS), Chi-Chang Kao (BNL-NSLS), and Chris Ryan (CSIRO, Australia).

Associate Chair for Environment, Health, Safety, and Quality. While the NSLS safety record hovers around the DOE average, "We're being asked to really improve," Casey said. "We want to be best in class."

The types of accidents that occur at the NSLS are sometimes considered routine, such as slips and muscle strains, but as Dierker said in his talk, "Accidents have consequences." Additionally, there have been near misses at BNL in the special-hazard category, which include more serious electrical, radiation, and laser accidents. Casey made it clear that these must also be avoided, ending his talk with a series of photographs showing obvious safety violations in several areas of the NSLS. The pictures made it clear that safety really is an issue everybody must take seriously.

Honorable Mentions

Numerous honors and awards were presented at the close of the meeting. Outgoing UEC chair Tony Lanzirotti presented the UEC Community Service Award to Sue Wirick of Stony Brook University. Additionally, Lisa Miller, the meeting's poster session and publicity chair, gave out awards for the best posters. The winners were Dario Arena (BNL-NSLS), Mehmet Aslantas (BNL-NSLS), Alexei Grigoriev (Harvard University), Marianna Kissel (SBU), Meghan Ruppel (SBU), and Xianqin Wang (BNL-Chemistry).

At the evening banquet, Shapiro presented the meeting's organizers – Mary Anne Corwin, Liz Flynn, Gretchen Cisco, and Melissa Abramowitz – with framed letters of appreciation. This year's banquet was reggae-themed, complete with a reggae band, colorful hats, and island fare.

Current UEC Members and SpIG Representatives

Term May 2004-2005

Users' Executive Committee

Chair	Larry Shapiro (Columbia Univ.)
Past Chair	Antonio Lanzirotti (Univ. of Chicago)
Vice Chair	Peter Stephens (Stony Brook Univ.)
Member	Fred Dyda (NIH)
Member	Daniel Fischer (NIST)
Member	Trevor Tyson (NJIT)
Member	Dean Hesterberg (N.C. State Univ.)
Member	Hao Wu (Cornell Univ.)
Ex-Officio	Chi-Chang Kao (BNL-NSLS)
Ex-Officio	Mary Anne Corwin (BNL-NSLS)
Ex-Officio	Lisa Miller (BNL-NSLS)

Special Interest Groups

Bio. Scattering	Tom Hollis (Wake Forest Univ.)
Imaging	Jeff Fitts (BNL-Environ. Sci. Dept.)
Industrial	Laura Silvian (Biogen Inc.)
Infrared	Randy Smith (BNL-NSLS)
Nuclear Phys.	Mahbub Khandaker (TJLab)
Students/Postdocs	Meghan Ruppel (BNL-NSLS)
Time Resolved	John Sutherland (BNL-Biology)
Topography	Michael Dudley (Stony Brook Univ.)
UV Photo	Elio Vescovo (BNL-NSLS)
XAFS	Simon Bare (UOP LLC)
X-Ray Scattering	Valery Kiryukhin (Rutgers Univ.)

Notes from the UEC

Larry Shapiro, Users' Executive Committee Chair
Columbia University

As the new Chair of the UEC, I'd like first to express my gratitude, on behalf of the entire NSLS user community, to Tony Lanzirotti, who did a tremendous job in leading the committee this past year. I would also like to thank the outgoing members of the UEC and the outgoing SpIG representatives for their hard work and efforts, which were a great benefit to the NSLS user community. I'd also like to welcome the newly elected UEC members and SpIG representatives; the results of the elections are listed on page 3. The UEC elected Peter Stephens (Stony Brook University) as Vice Chair and Hao Wu (Cornell University) as Secretary.

This was an important year at the NSLS. Under the leadership of Steve Dierker, Associate Lab Director for Light Sources and NSLS Chair, over two dozen meetings were held for the purpose of accumulating users' input on their specific requirements from a new source, NSLS-II. The DOE has indicated its likely support for this project, and a strong application has been submitted. We hope this application will soon be approved, enabling design work to begin in 2005. The construction of NSLS-II is critical to the future of great synchrotron-based science in the Northeast, therefore, we must all, as NSLS users, support this effort in every way we can. In the coming year, the UEC will try to help to pave the way by finding the best means to ensure that users' input will be effectively heard.

In this turning-point period for the NSLS, the UEC will have two primary responsibilities: First, we must find ways to enable all NSLS users to catalyze the decisions in Washington necessary for NSLS-II construction, and ensure that NSLS-II is the source we need to fulfill our future scientific needs. Second, and of greater importance to our every day scientific lives, we must make certain that the current NSLS runs well and continues to improve in order to provide the tools necessary to continue producing great science. These two overriding goals will define the direction of the UEC this year and years to come.

This coming year will likely see substantial changes in the mechanics of user access to the NSLS with the introduction of the PASS system. There are also a number of substantial ongoing technical advances that include the installation of in-vacuum minigap undulators at X1 and X29. These undulator lines will provide highly collimated beams of extraordinary brightness, giving the NSLS capabilities to perform experiments that were once in the exclusive realm of third-generation sources.

The NSLS Annual Users' Meeting, held May 17-20, was a great success, with more than 390 participants. Scientists came from all over the country and overseas to attend our annual gathering, which included an exciting main meeting and eight excellent workshops. Details on the meeting can be found in the cover story of this newsletter.

The 2004 NSLS User Community Service Award was presented to Sue Wirick (Stony Brook University Physics Department), a beamline scientist for the X1A insertion device beamline. The goal of this award is to recognize an individual from the NSLS user community for service, innovation, and dedication to users of the NSLS. This award is not given for scientific achievement, but rather for contributions that have improved the quality of science at the NSLS. For the complete story on this award, see page 15. Congratulations and thank you, Sue.

As you know, the NSLS, as well as the other three DOE-run synchrotrons, are funded through the DOE Office of Science. The budget has been essentially flat over the last few years, even though the number of users has increased dramatically. The UEC will continue to spearhead lobbying efforts for increased budgets for the Office of Science and for the physical sciences in general. We need to communicate our message to more members of Congress, especially those who represent districts that do not include a national lab in their backyard. We encourage you to visit your local representatives in their home office - we would be happy to supply you with materials. We have learned, though, that the most effective way to communicate is to describe one's own work, which you would be most excited about. Please watch for more structured information from the UEC in this regard in the next few months. In the meantime, please don't hesitate to contact me (lss8@columbia.edu) for more information. In closing, I would like to reiterate that the primary goal of the UEC is to represent the NSLS user community. I encourage you to communicate with me, other members of the UEC, and/or your SpIG representative with any concerns or ideas you might have as a user of the NSLS, so that we can be as effective as possible.

NSLS UEC Website:

http://www.nslsuec.org

for information on all ongoing Users' Executive Committee activities

What's New at User Administration

Mary Anne Corwin, NSLS User Administrator

PASS System

Thanks to a tremendous effort by Brian Bindert (our developer), all the staff at User Administration, and 33 NSLS staff members and users, we are very happy to announce the arrival of the Proposal, Access, Safety and Scheduling (PASS) system, which debuted in May for general user proposals for the fall.

PASS was developed to facilitate submission proposal and review allocation and scheduling of beam time at the NSLS. To meet DOE reporting requirements and to ensure safety compliance, PASS incorporates the safety approval form.

The first phase (proposal submission, safety approval, and the scheduling) is online. Proposals (and PX Forms when appropriate) are submitted in one system and routed for beamline review for feasibility and safety purposes, then routed for review and ratings, allocation, safety review and approval, and finally for beam time scheduling. Each principal investigator and reviewer is granted access according to their permissions.

Instructions are provided throughout the system for user friendliness and accessibility. Further development will take place over the next few months to integrate proprietary proposals, safety approval for Participating Research Team (PRT) experiments, additional scheduling capabilities, and to add more functionality. The final phase will incorporate a reduced lead-time for rapid access.

Some proposal process changes introduced in the PASS system are:

- Proposals are assigned to three reviewers who have reviewed the lowest number of proposals for the given cycle to date, ensuring an even distribution of reviews. Plans are to increase the pool of reviewers. PASS does not assign proposals to a reviewer whose institution is the same as the PI.
- PASS notifies reviewers by email to review proposals as soon as they are submitted by the PI.
- Lifetime days are no longer requested. The number of days needed in a given cycle is the information vital for review, allocation, and scheduling.
- Penalties for canceling beam time after allocation have been eliminated. Our goal is to re-assign the time to users who were not allocated due to high demand.
- PIs must assign a lead experimenter for the experimental team while present on the NSLS experimental floor, who will in turn receive an email with links to his/her roles and responsibilities.

User Administration Staff Roles

A few hats were shuffled in User Administration in time for the Users' Meeting and the introduction of the PASS system. Gretchen Cisco now coordinates the annual Users' Meeting, assists the Users' Executive Committee, acts as back-up to the Proposal Coordinator, and handles many non-routine tasks as the Deputy User Administrator. Liz Flynn has taken over the enormous role of Proposal Coordinator and assists PIs, PRTs, and NSLS staff with the PASS system. Melissa Abramowitz processes user appointments, provides training and orientation, and oversees many database systems. And, we welcome Gina Paveglio to our staff, who arrived in time for the annual Users' Meeting. Gina will be working with the Users' Meeting Planning Committee, email list servers, guest registration and training, and reporting requirements.

Brian Bindert

Gina Paveglio

NSLS Users' Meeting

Coordinating responsibilities for the annual Users' Meeting can be very complex. Below are the Planning Committee members, whose admirable efforts made certain that workshops and talks were diverse in discipline, schedules went as planned, and events were well organized.

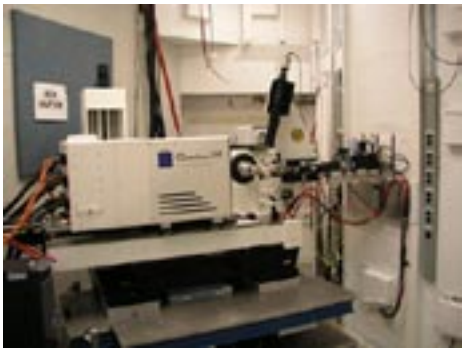
I extend my personal gratitude and special appreciation for the commendable efforts and long days that Gretchen, Liz, Melissa, and Gina worked to make this year's meeting so successful. Thanks also to the exceptional, professional HR support staff that assisted in meeting preparation, maintaining tight schedules, and assisting meeting attendees.

Larry Shapiro (Columbia Univ.); Liz Flynn, Mary Anne Corwin (BNL-NSLS); Tony Lanzirotti (Univ. of Chicago); Gretchen Cisco, Lisa Miller, Vivian Stojanoff (BNL-NSLS); Paul Stevens (Exxon Mobil); and Dan Fischer (NIST).

A New X-ray Undulator Beamline for Macromolecular Crystallography

A new experimental station dedicated to macromolecular crystallography has been completed and has commenced operation at beamline X29. The mini-gap in-vacuum undulator beamline was built in a collaboration between the BNL Biology Department, the Center for Synchrotron Biosciences at Albert Einstein College of Medicine, and the NSLS.

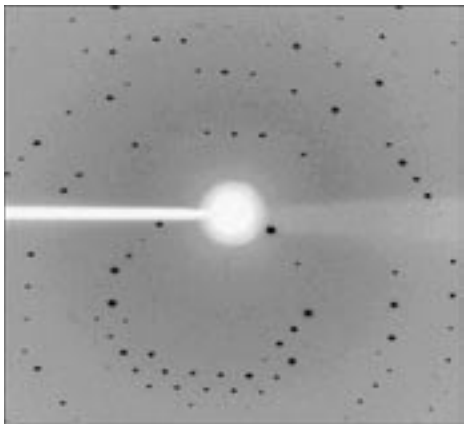
The funding for construction and operation comes from the Department of Energy's Offices of Basic Energy Sciences and Biological & Environmental Research, and the National Institutes of Health (specifically, the National Center for Research Resources, the National Institute for Biomedical Imaging and Bioengineering, and the National Institute of General Medical Sciences).



The new diffractometer and detector system in the X29 x-ray hutch. This device is equipped with a high-speed and high-precision crystal axis suitable for operation with a robotic specimen changer.

The beamline was constructed especially to meet the increasing demand at the NSLS for a high-brightness x-ray beam for state-of-the-art macromolecular crystallography research, which had previously been served by a single beamline, X25.

The x-ray optics for the beamline consists of a Si(111) double crystal monochromator, with the first crystal being cryogenically cooled and second crystal bendable to provide sagittal focusing of the horizontal beam fan, followed by a vertically focusing mirror. The experimental station includes a Crystal Logic diffractometer, an ADSC Q315 CCD x-ray area detector, and an Oxford Instruments Cryojet sample conditioner. Already in heavy use by conventional means, the focus of this facility will be automation and high throughput operation. A fraction of this new beamline's use will be devoted to both "FedEx" (mail-in) crystallography and structural genomics.



This is an example of the central region of a diffraction pattern recorded at X29. One can see that the undulator, the x-ray optics, and the detector provide excellent sensitivity and resolution. The system will work quite well for study of the largest and most difficult molecular systems.

A New Micro-Focused Branch is Added to the U5UA Beamline

The U5UA beamline is an intense undulator beamline operating in the 15 to 200 eV photon energy range. It can excite valence bands electrons as well as shallow core levels from solid surfaces, and is also equipped with a four-reflection circular polarizer that operates in the 15 to 70 eV range.

U5UA has been upgraded with a new branch (#2) added downstream from the existing branch (#1). The new branch consists of a pair of ellipsoidal mirrors that demagnify the U5UA #1 sub-mm-sized beam by a factor of approximately 10, forming a micro-focused spot.

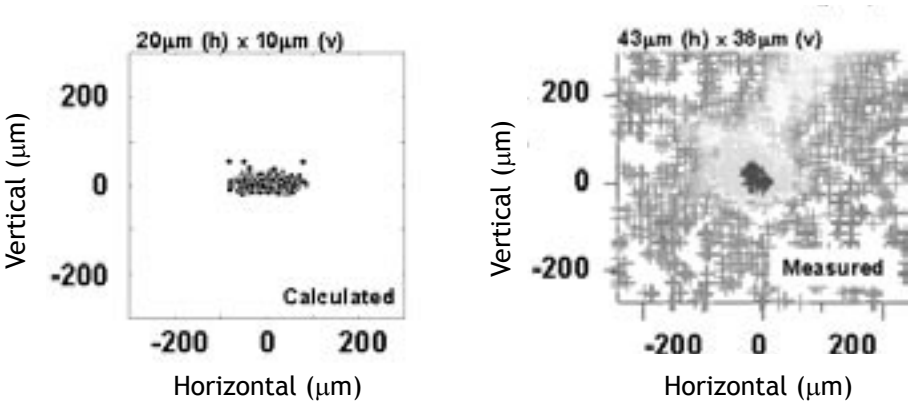
The new micro-focused branch is therefore particularly appropriate because it can be used as an intense excitation source in LEEM/PEEM experiments.

Furthermore, even conventional VUV spectroscopy techniques, such as angle-resolved photoemission, are currently spot-size limited in their quest for better and better energy resolution.

The U5UA beamline optics are capable of delivering very high photon energy resolution light. For example, a resolving power of 10,000 has been demonstrated at ~30 eV. However, in order to match this source ideally to a high-resolution electron spectrometer, a micro-focused light spot is required.

The new branch was constructed to meet the increasing demand of nanoscience users. The small spot will be of major importance in microscopy studies, such as LEEM/PEEM, where combining a small spot size with tunable synchrotron photon energy enables VUV spectromicroscopy experiments to be performed. The micro-spot will also benefit ultra-high resolution photoemission and emission experiments.

The new branch is now operational and available to users. Presently the performance of the new beamline is being characterized, and preliminary results indicate a spot-size of approximately 25 microns in diameter at fwhm.



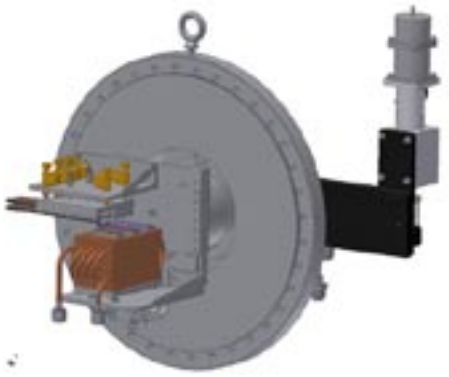
The new micro-focused branch at the U5UA undulator beamline meets the increasing demand of nanoscience users. The small spot will be of major importance in microscopy studies. In the figure the calculated spot-size is compared with direct measurements, obtained by scanning the light-beam with a 5 μm pinhole.

A Renovated X-Ray Wiggler Beamline for Materials Science

The X21 hybrid wiggler x-ray beamline and its endstations are devoted to elastic x-ray scattering for materials science research. To meet the increasing needs of these programs, the beamline optics and endstations have been upgraded.

The first optical component is a new non-dispersive double silicon crystal or multilayer monochromator, which contains selectable pairs of silicon crystals or multilayer elements that can be chosen in-situ to suit the experiment at hand. The first silicon crystal and multilayer element are mounted side-by-side on a helium-gas-cooled cryogenic support that suppresses thermal distortions of the crystal or multilayer when subjected to the 500 W wiggler beam.

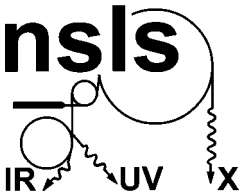
The monochromatic beam that emanates can be used as is, or can be further conditioned by the original high-resolution four-reflection Si(220) monochromator, which remains installed in the beamline, if high energy resolution is desired.



The new X21 monochromator internal assembly contains silicon crystal and multilayer pairs that can be selected in-situ via transverse alignment of the appropriate pair in the beam path. The first silicon crystal and multilayer element are mounted on a cryogenically cooled copper support. The second silicon crystal and multilayer element are mounted on their own motor-driven kinematic supports. The entire assembly is mounted on a rotary vacuum feedthrough, which is driven by the motorized assembly shown behind the mounting flange.

Finally, the beam is then focused and delivered to the appropriate experimental setup by one of two bent cylindrical mirrors, each of which is shaped to focus the beam into one of the two experimental stations.

The X21 experimental endstations have been rebuilt to accommodate new experimental programs that address elastic x-ray scattering studies of materials under high magnetic fields, thin films grown *in-situ*, and materials studied with small angle x-ray scattering, with appropriate setups permanently installed in the endstations. The renovated beamline and both experimental endstations, including their dedicated instruments, are now in operation.



X-Ray Ring Long Range Schedule

September 2004

Sun	Mon	Tue	Wed	Thu	Fri	Sat
			1 0000 Studies 1200 Ops.	**2** 0000 Ops.	**3** 0000 Ops.	**4** 0000 Ops.
5 0000 Ops.	**6 Lab Holiday** 0000 Ops.	**7** 0000 Ops. 1200 Studies	**8** 0000 Studies 0600 Maint.	**9** 0000 Maint.	**10** 0000 Studies 1200 Ops.	**11** 0000 Ops.
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October 2004

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November 2004

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December 2004

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VUV Ring Long Range Schedule

September 2004

Sun	Mon	Tue	Wed	Thu	Fri	Sat
			1 0000 Ops.	2 0000 Ops.	3 0000 Ops. 1800 Studies	4 0000 Ops.
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October 2004

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31 0000 Ops. 1200 Studies						

November 2004

Sun	Mon	Tue	Wed	Thu	Fri	Sat
	1 0800 Maint.	2 0000 Maint.	3 0000 Ops.	4 0000 Ops.	5 0000 Ops. 1800 Timing	6 0000 Ops.
7 0000 Ops.	8 0000 Ops. 1800 Timing	9 0000 Ops.	10 0000 Ops.	11 Lab Holiday 0000 Ops.	12 0000 Ops. 1800 Studies	13 0000 Ops.
14 0000 Ops.	15 0000 Ops.	16 0800 Studies	17 0000 Studies	18 0000 Ops.	19 0000 Ops.	20 0000 Ops.
21 0000 Ops.	22 0000 Ops. 1800 Timing	23 0000 Ops.	24 0000 Ops.	25 Lab Holiday 1900 Maint.	26 Lab Holiday 0000 Maint.	27 0000 Maint.
28 0000 Maint.	29 0000 Maint.	30 0000 Maint.				

December 2004

Sun	Mon	Tue	Wed	Thu	Fri	Sat
			1 0000 Maint.	2 0000 Maint.	3 0000 Maint.	4 0000 Maint.
5 0000 Maint.	6 0000 Maint.	7 0000 Maint.	8 0000 Maint.	9 0000 Maint.	10 0000 Maint.	11 0000 Maint.
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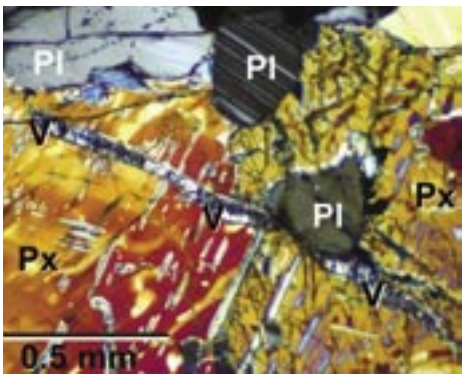
Evidence of Ancient Water on an Asteroid May Help Lead to New Information on the Formation of Earth

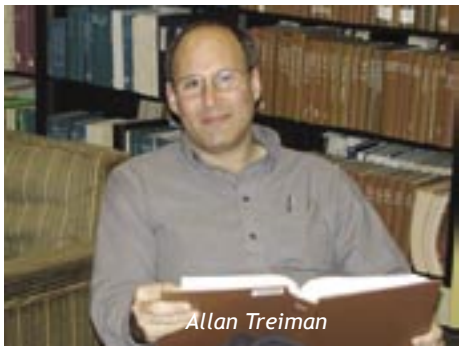
Laura Mgrdichian, NSLS Science Writer

Working in part at the NSLS, scientists have discovered evidence of ancient water on a large asteroid previously thought to lack water. The findings indicate that water was most likely deposited *onto* the asteroid, suggesting it came from an outside source, such as a collision with an icy comet. The discovery may give scientists new insight into the rules governing the mobility and availability of water in the solar system at the time Earth was formed. The results appear in the March 15, 2004 issue of *Earth and Planetary Science Letters*.

The scientists learned about the asteroid, named 4 Vesta, which orbits the Sun in our solar system, by studying a meteorite that is believed to have once been part of it, due to the two bodies' very similar chemical compositions. The meteorite, called Serra de Magé, fell to Earth in 1923. When analyzing it, the researchers discovered a sign that water had once been present: threads, or "veinlets," of quartz, a mineral that is often deposited onto rocks by liquid water solutions. The appearance and condition of the veinlets suggested that water existed on the meteorite long ago, and could only have been deposited before Serra de Magé broke away from 4 Vesta.



The largest quartz veinlet in the meteorite (V), surrounded by the minerals pyroxene (Px) and plagioclase (Pl).



Allan Treiman, a geologist from the Lunar and Planetary Institute and the study's lead scientist, explained, "The veinlets are quite old – 4.5 billion years – so they formed when the solar system was quite young. Because Vesta is now so dry, our best guess is that the veinlets' water came from an outside source, such as comets or water-rich meteorites that hit Vesta."

According to Treiman, this hypothesis has some important potential implications. "Scientists have theorized water delivery by comets for the early solar system, especially for how the Earth got enough water to make our oceans. However, gathering evidence for or against this theory has been difficult, because few Earth rocks (or Moon rocks) are old enough. But this ancient meteorite from Vesta appears to show that it received water somehow, which suggests that water could have been delivered to Earth in a similar way."

To analyze Serra de Magé, the researchers bombarded it with x-rays at NSLS beamline X26A. In this method, called x-ray diffraction, the x-rays entered the sample, scattered off its molecules, and emerged from the sample in a distinct pattern. A camera created an image of the diffracted x-rays, and, from this, the scientists were able to determine what materials make up the sample based on known diffraction patterns of many different substances. This is how they identified the quartz veinlets.

4 Vesta is the third-largest asteroid in the Main Asteroid Belt – the ring of cosmic debris that orbits the Sun outside Mars' orbit and inside Jupiter's. The asteroid is 320 miles in diameter and is roughly spherical in shape. Unlike other large asteroids, Vesta appears to have once contained a hot molten center, as Earth does. This finding contradicts conventional ideas that asteroids are cold, rocky remnants of the early days of planet formation. Studying Vesta may help scientists learn how Earth formed, as the asteroid has other characteristics similar to terrestrial planets, such as evidence of ancient lava eruptions.

In the future, Treiman and his colleagues plan to study other meteorites from 4 Vesta and look for similar quartz veinlets. They will also study them for more definitive signs of water on the asteroid, such as actual water – very small droplets trapped in the quartz – or water-bearing minerals. Another approach is to look for excess hydrogen in Serra de Magé as compared to meteorites without quartz veinlets, which would indicate that water, a hydrogen-oxygen compound, may have been present.

The collaboration that performed this research also includes Antonio Lanzirotti, of the University of Chicago's Consortium for Advanced Radiation Sources at Brookhaven National Laboratory; and Dimitrios Xirouchakis, of the National Aeronautic and Space Administration's (NASA) Johnson Space Center.

The work is funded by NASA, the Lunar and Planetary Institute, and the U.S. Department of Energy's (DOE) Geosciences Research program within the Office of Basic Energy Sciences in the DOE Office of Science.

NSLS EXAFS Data Collection and Analysis Short-Course "Graduates" 32 Students

Simon R. Bare, UOP LLC

A hands-on EXAFS Data Collection and Analysis Short-Course was held June 22-25, 2004 at the NSLS. The course was co-organized by Bruce Ravel (Naval Research Laboratory) and Simon Bare (UOP LLC), with excellent administrative support by Lisa Tranquada (SFA, Inc.) and Melissa Abramowitz from User Administration.

Thirty-two eager participants (graduate students, postdocs, and institution and industrial scientists), representing universities, national laboratories, research institutes, and industry, attended the four-day course.

Among the 32 participants, 15 were new users to the NSLS. The participants had diverse research interests across a broad spectrum of scientific fields, including materials science, geological and environmental sciences, catalysis, and biology.

Participants in the 2004 NSLS EXAFS course

The four-day course was divided into morning lectures, with two afternoons of hands-on data collection using seven different NSLS spectroscopy beamlines (X9B, X11A, X11B, X18B, X19A, X23B, and X26A), and two afternoons of data analysis. The instructors on the beamlines were Faisal Alamgir, Wolfgang Caliebe, Scott Calvin, Syed Khalid, Tony Lanzirotti, Nebojsa Marinkovic, and Kaumudi Pandya.

The eight morning lectures were: "Introduction to XAFS" and "Basics of Sample Preparation" by Matt Newville (CARS, University of Chicago), "XANES Measurements and Interpretation" by Simon Bare (UOP LLC), "Detectors and Synchrotron Radiation" by Peter Siddons (BNL), "Basics of Data Processing" by Scott Calvin (Sarah Lawrence College), "A Practical Introduction to Multiple Scattering Theory" by Bruce Ravel (Naval Research Laboratory), "Introduction to Data Analysis" by Shelly Kelly (Argonne National Laboratory), and "Incorporating XAFS into a Research Program" by Vince Harris (Northeastern University). The morning lectures included ample time for stimulating questions and discussion.

For the first two afternoons the participants were divided up into small groups in order to spend time on the NSLS floor at an EXAFS beamline. There, they learned first hand how to collect high quality EXAFS data. Each student became familiar with beamline operation and sample preparation while collecting EXAFS data on representative samples from their own individual research projects. It was fascinating to see the diverse array of samples and projects in which EXAFS was being used.

During the last two afternoons the participants learned EXAFS data analysis techniques using the data they had collected the prior two days. The participants enjoyed informal discussions during coffee breaks, lunches, and the dinners that were included in the course fee.

There was a tremendous amount of information disseminated over the four days. All the participants left the course with new friends and armed with the basic tools to apply x-ray absorption spectroscopy to their own research programs. The organizers thank all those who made the course the great success that it was!

We plan to offer the course again in 2005. Please check the NSLS website for updated information.

The course was sponsored by the NSLS, with support from the Center for Environmental Molecular Science at SUNY Stony Brook.

For the complete workshop agenda, visit: http://www.nsls.bnl.gov/newsroom/events/workshops/exafs/agenda.htm

NSLS Accelerator Complex Update

Erik Johnson, Associate Chair for Operations and Engineering

While the user community may greet the spring shutdown as a welcome respite from routine operations, it is a time of intense activity for the Operations and Engineering Division staff. The May 2004 shutdown was fully scheduled with utilities upgrades and maintenance when the x-ray ring injection septum vacuum chamber started failing on April 21. It quickly became evident that the septum, the most complex vacuum chamber on the x-ray ring, would need to be replaced. This 'add-on' job became the pacing item for the spring shutdown.

The x-ray injection septum chamber was last replaced in 1987. Fortunately, a spare was constructed at that time and thus a replacement was available for this emergency. The difficulty is, of course, that the chamber is deeply buried in shielding and is captured by two of the large quadrupole magnets. The first revised shutdown schedule had installation continuing up to the end of May, followed by conditioning time. As soon as we knew this, we advised the user community to expect *at least* a week delay in operations, and probably more.

The installation effort was led by Bob Scheuerer from the Mechanical Section, and involved the coordination of the activities of several groups within the Operations and Engineering Division, as well as trades from Plant Engineering. Through careful planning and execution as well as some very long hours, the actual installation only took four days longer than the original shutdown schedule. A major factor in this achievement was the cleanliness of the vacuum work, which significantly reduced the required bakeout time.

Since more than 1/8 of the ring was vented, we expected that a full conditioning cycle would be needed, which was not built into the original shutdown schedule. The rule of thumb gained from years of operation of the x-ray ring is that an accumulation of 50 ampere-hours is required to return to standard operating conditions. As soon as the machine was turned over to the Operations Section they were able to start the commissioning process, which required about four more days than originally scheduled. Shutters were enabled on May 28 for users who could take advantage of the beam with the more frequent injections required for conditioning.

Routine operations were established on June 1, just eight days later than planned back in January when the schedule was released. Without the hard work and dedication of the staff, as well as the existence of the spare chamber, this problem could well have stretched into the summer and beyond. The whole activity emphasizes the importance of preparing for surprises, no matter how improbable they seem.

The injection septum replacement overshadowed a significant body of other shutdown work. The power distribution maintenance on May 8 revealed problems

(A) Upstream before replacement: This photograph shows the injection point into the x-ray ring . It is a heavily shielded area because there can be significant losses on injection. The failing injection septum chamber is buried within this part of the ring. Replacing it required removing all of the shielding visible in the photograph, parting two large quadrupole magnets, removing the kicker magnet and supply, and removing the trims and all of the diagnostics attached to the injection septum. An activity of this magnitude would normally be reserved for a winter shutdown. (B) Upstream during replacement: This photo was taken during the installation process on May 11. The extent of the disruption of the machine is quite obvious. To protect against inadvertent damage as the machine components were reinstalled, the ceramic chamber was covered in bubblewrap. (C) Replacement Chamber: The spare Injection Septum Chamber is shown during preparations for the installation. The small port in the foreground is where the injected beam enters the machine. The ceramic chamber has a copper sleeve inside of it that surrounds the circulating beam to shield it from the field of the pulsed magnet that steers the injected beam into the ring. The replacement chamber dimensions were checked against the pulsed magnet (BXISH) and the ring girder to assure smooth installation. The entire assembly was prebaked before installation, which was a significant factor in the fast commissioning of the machine.

in each of the three substations that were resolved. While none of the issues would have resulted in an unsafe failure, returning the substations to service would have involved time consuming recovery of operations. Catching these problems while they were still small illustrates the value of a diligent preventative maintenance program for our aging switchgear.

No less significant were several major activities by the Utilities Group aimed at improving the reliability of the NSLS cooling systems. One involved the addition of a third pump to act as a rotating spare for the low pressure copper system that provides cooling for the machine power systems. Cleaning the high pressure copper system heat exchangers was also required to bring the efficiency of that system back to specification.

We have been experiencing significant difficulty keeping these systems clear and fully functional since last year, when a failure on the BNL chilled water system dislodged debris from the distribution piping. This fine silt-like material has been migrating to the low point of the system (the NSLS) ever since, clogging equipment strainers and fouling the heat exchangers for the machines. To head off continuing fouling, full flow strainers were installed on the 12" lines from the site central chilled water supply to the machine cooling equipment.

A large number of less visible, but no less important, maintenance tasks were completed that should stand facility operations in good stead. Through June 1 of Fiscal Year 2004, the NSLS achieved reliability (availability) of 90% (99%) on x-ray and 99% (114%) on the UV ring. The x-ray figures were significantly impacted by the extra time consumed by the x-ray injection septum chamber replacement.

Finally, Winter 2005 will be coming sooner than you think! The schedule starting in January 2005 should be issued sometime in September 2004, so if there are any special scheduling considerations please let me know by the end of August.

SAFETY

Don't Mess with Beamline or Equipment Configurations

Bob Casey, Associate Chair for ESH/Q

Among the responsibilities for beamline personnel and users that were defined last year (http://www.nsls.bnl.gov/organization/ESH/safety/r2a2.htm), you will note a common item identified for everyone working at a beamline:

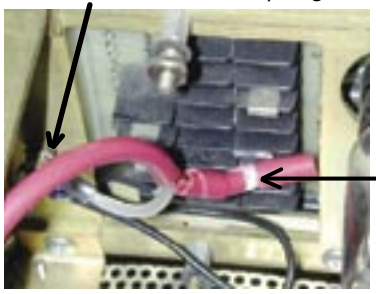
"Maintain configuration control of the beamline and experiment and report all proposed change to PRT management."

We recently experienced an electrical incident that illustrates the potential consequences of not maintaining control of beamline equipment configurations in a safe manner.

A user group began an experimental run at a VUV beamline and developed a need to provide a negative electrical potential between their sample and detector. The sample was connected to a 2000 V DC, 100 mA power supply configured to provide a positive polarity to the sample (the set-up was established to provide electron beam heating to periodically clean the sample). Members of the group asked the local contact and others whether it was possible to provide a negative bias to the sample and were advised that it was, and that it was typically done with batteries.

Without further discussion, the team members reconfigured the high voltage connection between the power supply and the sample (see photo). In this configuration, the ground sheath around the cable was connected to the positive high voltage output of the power supply and the center conductor was simultaneously connected to ground and the negative high voltage output. As such, the power supply would not function as intended and, more importantly, the shielding of the SHV cable and its connectors were energized to the setting of the power supply output. Unable to bias their sample, the group abandoned the effort and left the configuration as they had modified it. They did not advise the PRT of the change and left no information regarding the change when they departed.

In the new configuration, there was a clear risk of electrical shock to anyone touching the connectors when the power supply was on. Fortunately, the members of the group subsequently seeking to utilize the equipment were not shocked before the error was determined and the equipment taken out of service. This incident is an example of why configuration control is so important at the beamlines. There are numerous ways (e.g. radiation, electrical, cryogenic, lasers) in which unsafe conditions can be created through improper changes in the beamline or equipment configuration. Don't mess with beamline configurations unless the people responsible for the beamline have approved it. In some cases, departmental review may be required.

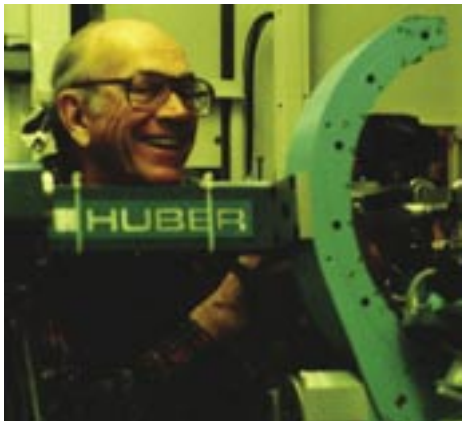


Kepco DC Power Supply output connections

Cullie Sparks: In-Memoriam

Gene Ice, ORNL

Cullie Sparks, a charter member of the NSLS users group and one of the first UEC chairmen, died March 19, 2004. Dr. Sparks made major contributions to materials science, x-ray physics, and synchrotron science that continue to have a worldwide impact. He was a particularly enthusiastic supporter of synchrotron radiation and threw himself into developing beamline X14 when the NSLS was still on the drawing board.



Cullie Sparks aligning a sample on beamline X14.

After earning a metallurgical Ph.D. from the University of Kentucky, Sparks joined Oak Ridge National Laboratory (ORNL) in 1957. In the mid 60's, Sparks and his group leader, Bernard Borie, used symmetry to interpret variations in the diffuse x-ray scattering from crystalline alloys. By studying patterns in the scattering, they found that local structural fluctuations could be measured with unprecedented sensitivity, leading to NSLS experiments that measured bond distances to less than a tenth of a picometer. Their Borie-Sparks method is still used worldwide to interpret diffuse neutron scattering and forms the basis for modern diffuse x-ray techniques.

Also in the 60's, Dr. Sparks recognized the potential of artificial graphite crystals for high-performance x-ray and neutron monochromators. He worked with researchers at Union Carbide Corporation to perfect the manufacture and performance of graphite monochromators, and created powerful doubly-focusing crystal optics.

Armed with this powerful source of x-ray beams, Sparks began searching for inelastic x-ray scattering contributions to the background in his diffuse scattering measurements, and uncovered a resonant-inelastic scattering mechanism. Although a respected reviewer from Bell Labs could find no fault in Sparks' 1974 Physical Review Letters paper, the reviewer personally tested the results at Stanford Synchrotron Radiation Laboratory (SSRL) -- verifying that Sparks was correct! Resonant Raman X-ray Scattering or "Sparks Scattering" is still widely used to study the dynamics of x-ray-induced atomic transitions.

In 1976, proton microprobe measurements in micas from Madagascar indicated the presence of primordial superheavy elements. This "discovery" reverberated throughout the scientific community, as the presence of these elements suggested that the earth might be only a few thousand years old, a compact atomic weapon might be made with them, and the shape of their nuclei might differ from standard materials.

To settle the issue, Sparks designed the first synchrotron-based x-ray fluorescence microprobe and led a test at SSRL. Sparks and his team showed that primordial superheavy elements do not exist in these micas. This experiment clearly illustrated the need for intense synchrotron radiation sources.

In the summer of 1979, during a sabbatical at BNL, Dr. Sparks began studying how to focus x-rays with bent perfect crystals. He was motivated by the fact that crystals, with roughly 20 times larger scattering angles than mirrors, can collect and focus much larger divergences. Working with BNL and ORNL scientists, he discovered that, in a nondispersive geometry, the Bragg angle of each ray reflected from a flat crystal is virtually the same off a crystal bent to focus at magnification = 1/3. This revealed the possibility of dynamically bent sagittal focusing optics. Despite major technical challenges and a general skepticism, sagittal focusing optics were demonstrated, paving the way for beamline X14. Sagittal focusing optics are now installed in multimillion-dollar facilities around the world.

In addition to his other contributions at the NSLS, in 1985 Cullie and three associates contributed the after dinner show at the NSLS users meeting (see photo). This legendary performance of bluegrass songs with synchrotron themes was topped off with a round of authentic moonshine for users and staff brave enough to try.

In short, Sparks was a gifted experimentalist and a good friend of the NSLS. His scientific legacy continues through advanced x-ray optics, new fields of atomic physics, materials, and synchrotron science.

Cullie (left on banjo) and the Earsore Quartet playing at the 1985 NSLS users meeting.

UEC Community Service Award Presented to Sue Wirick

Tony Lanzirotti, Past UEC Chair

The recipient of the 2004 Users' Executive Committee Community Service Award is Sue Wirick of Stony Brook University's Physics Department. Sue is a beamline scientist for the X1A insertion device beamline. This award is given for service, innovation, and dedication to users of the NSLS, and Sue is well deserving of that honor.

Members of the NSLS user community nominated Sue for this award. Here are some of the comments users have made about her wonderful contributions:

- Since joining X1A more than a decade ago, Sue Wirick has played a central role in the development of the scientific program and in supporting user access to the spectromicroscopy facilities. Quite simply put, she is the key to outside users' ability to carry out experiments.

Tony Lanzirotti (Past UEC Chair) presents the 2004 NSLS User Community Service Award to Sue Wirick at the 2004 Users' Meeting.

- Our research team owes very much to the assistance that Sue Wirick was able to give us. She was available day and night, gave excellent advice, steered us through the experimental process with ease and provided a positive and friendly environment that made it a pleasure to work at the beamline.
- Sue Wirick has been a godsend to the NSLS community. She is one of the rare people who will help anyone, including the most difficult personalities, when they have a problem. She will do this anytime, even on weekends and evenings. She is the person that I recommend first to outside users who want to find out more about NSLS and Brookhaven. She always provides detailed and concise advice on instrumental capabilities, and also on the more mundane aspects of how to get beam time, availability, etc.

Tony Lanzirotti, Past Chair of the UEC, presented the award to Sue at the NSLS Users' Meeting on Tuesday, May 18th. Sue received a $250 gift certificate and her name was engraved on the plaque in the NSLS lobby. Congratulations Sue!

NSLS Hosts 100 Children on "Take Our Sons and Daughters to Work Day"

On April 24, more than 100 BNL daughters and sons learned about some of the scientific programs at the NSLS and performed their own experiments. The one-day visit was part of the national "Take our Daughters and Sons to Work Day."

The children learned that the NSLS produces many types of light, from microwaves to x-rays. They played a game to test their knowledge of everyday light sources, such as laser pointers, cell phones, radios, and TV remote controls.

They also toured the experimental floor, where NSLS Control Room Operator Gary Weiner explained how synchrotron light is made. NSLS scientists Marc Allaire, Lisa Miller, Cecilia Sanchez-Hanke, and Vivian Stojanoff showed the students a few x-ray and infrared beamlines, where they discovered how synchrotron light is used to study the composition of rocks and minerals and to develop new drugs.

After the tour, Marc Allaire, NSLS student Tejas Telivala, and NSLS postdoc Adele Qi Wang demonstrated the refraction of light through a prism. Each child then had the opportunity to test their skills with their own prism.

NSLS beamline scientist Randy Smith showed the students how a vacuum is created using a bell jar and vacuum pump. The children observed the effect of vacuum on balloons, a bell, a candle, soda water, and marshmallow Peeps candies, which dramatically expanded under vacuum and shriveled to half their size when re-exposed to air.

NSLS Information and Outreach Office
Brookhaven National Laboratory
NSLS Building 725B
P.O. Box 5000
Upton, NY 11973-5000

Call for NSLS General User Proposals

For Beam Time in Cycle	Deadline
January-April 2005	Thursday, September 30, 2004

General User Proposal and Beam Time Request Forms with instructions can be found at:
http://www.nsls.bnl.gov/users/usersguide/experiments.htm
Proprietary Proposal Forms with instructions can be found at:
http://www.nsls.bnl.gov/users/usersguide/experiments_proprietary.htm

Safety Approval Forms

Safety Approval Forms (SAFs) are required for every experiment. Your SAF must be submitted online **at least one week before** your scheduled beam time. To submit, go to:

http://130.199.76.84/safety/default.asp

NSLS User Administration Office

User Information, Registration, and Training:
Phone: (631) 344-USER Fax: (631) 344-7206

User Administrator
Mary Anne Corwin corwin@bnl.gov
Annual Users' Meeting
Gretchen Cisco cisco@bnl.gov
General User Proposals
Liz Flynn lflynn@bnl.gov
Registration & Training
Melissa Abramowitz abramowitz@bnl.gov
Gina Paveglio paveglio@bnl.gov

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NSLS Information and Outreach Office

NSLSinfo@bnl.gov

Coordinator
Lisa Miller lmiller@bnl.gov
Layout/Design
Nancye Wright wright1@bnl.gov
Web Administrator
Steve Giordano giordano@bnl.gov
Science Writer
Laura Mgrdichian mgrdichian@bnl.gov

For additional information about the NSLS (including this Newsletter in electronic format) see the NSLS Home Page on the World Wide Web at:

http://www.nsls.bnl.gov/