BROOKHAVEN NATIONAL LABORATORY

NEWSLETTER

national synchrotron light source

Winter 2005

National Synchrotron Light Source II Gets CD-0

Laura Mgrdichian, NSLS Science Writer

The NSLS received fantastic news in September: The Department of Energy granted "Critical Decision Zero" (CD-0) status to National Synchrotron Light Source-II, the planned world-leading NSLS successor. This is the key first step in the long process to make NSLS-II a reality at Brookhaven Lab.

Accompanied by Lab Director Praveen Chaudhari and Steve Dierker, Associate Laboratory Director for Light Sources, DOE Brookhaven Site Office Manager Michael Holland announced the news at an NSLS All-Hands meeting on Friday, September 9.

"This is a tremendous step forward for science," said Holland. "The effort that went into this by Steve Dierker and others on the project was tremendous. I thank everyone for their hard work and accomplishments."

Holland noted that as part of the process that leads to CD-1, the next critical decision for the project, the physical site for the facility will be chosen, determining whether NSLS-II will be located at BNL. "There will certainly be a strong case made for NSLS-II at Brookhaven. There is an awful lot of work ahead of us in the next eight to 12 months," he said.

An artist's rendering of the NSLS-II facility

In his comments, Chaudhari congratulated the NSLS staff and many others for their efforts in maintaining the NSLS while working to make the case for NSLS-II. "You ought to take a moment and clap for yourself," he said. "It's been difficult to keep the NSLS running and design a new machine. You are going to have to continue to work very hard, but I expect that you can do it."

Dierker called the announcement a "wonderful occasion." He then presented an overview of the history of the NSLS-II project, from the initial idea to the proposal to the major reviews by DOE, as well as the large and successful NSLS-II workshop in March 2004 — all the results of hard, hard work and cooperation. He thanked everyone for helping to achieve this critical milestone and emphasized the continuing teamwork necessary to continue the process and secure the site.

"There is a strong research community in the Northeast and a tremendous density of academic and research institutions," he said. "Moreover, U.S. synchrotrons are far oversubscribed. We need NSLS-II more than ever, or the science and benefits from that science will move overseas."

INSIDE THIS EDITION

NSLS Director's Farewell

Steve Dierker, Associate Laboratory Director for Light Sources & NSLS Chair

After nearly 5 exciting and rewarding years as Director of NSLS, it is time for me to step down and say thank you to all those who have helped to make those years so rewarding.

Thank you, first of all, to the NSLS staff, whose expertise and dedication have enabled the NSLS to continue its long tradition as a very cost effective, highly productive, and highly reliable user facility. A vigilant maintenance and upgrade program has kept the accelerators running with high reliability, and extraordinary efforts by the staff have minimized down time when faults have occurred. The user program has been dramatically strengthened, with many major beamline upgrades, better support to users, a new User Access Policy, an electronic proposal and scheduling system, and R&D in advanced detectors that are now in the hands of the users.

Thank you, as well, to our colleagues in the other BNL divisions, who have supported us in these endeavors. You have provided the infrastructure that has helped us operate our accelerator complex with high reliability and host a large international user community in a safe, secure, and environmentally sound way.

It is our users and the science you produce, of course, that makes it all meaningful. It has been a special joy over the years to see you develop the capabilities of the NSLS and then do important science with it. It was especially pleasing that one of our users, Professor Roderick MacKinnon (Rockefeller University), was the co-recipient of the 2003 Nobel Prize in Chemistry for work, much of which was done at the NSLS, explaining how proteins known as ion channels help to generate nerve impulses.

I step down with a sense that the NSLS has an outstanding future. It is running very well, and good science and

technology are resulting from its operation. I leave it in the capable hands of Chi-Chang Kao, who has taken over as Interim NSLS Director while a search for a permanent Director is mounted over the course of the coming year. Chi-Chang is leading the development of a five-year strategic plan, to be produced by the end of the summer, which will chart the course for the future operation and development of the NSLS.

As for me, I will focus my primary efforts on NSLS-II. NSLS-II will be a new state-of-the-art medium energy storage ring, highly optimized to deliver world-leading brightness and flux and exceptional beam stability. It will also provide advanced insertion devices, optics, detectors, robotics, and a suite of scientific instruments. NSLS-II will complement BNL's Center for Functional Nanomaterials, and together they will enable research that will address some of the most important scientific challenges of the future and play a pivotal role in fostering economic and energy security.

NSLS-II will be a major project, with an estimated cost of $800M, and will employ up to 200 people during the peak of construction. BNL has established the NSLS-II Project Organization in the Light Sources Directorate to put in place the management systems and infrastructure required to execute this complex undertaking. I will serve as NSLS-II Project Director and also retain my position as Associate Laboratory Director for Light Sources, with the NSLS reporting to me.

In order to fully exploit the unique capabilities of NSLS-II, we plan to establish the Joint Photon Sciences Institute (JPSI), an interdisciplinary institute devoted to basic research in areas of the physical sciences, engineering, and the life sciences that are united in employing synchrotron-based methods. A partnership between DOE and New York State, JPSI will serve as an intellectual center for development and application of the photon sciences and as a gateway for NSLS-II users. JPSI will enhance scientific programs that use the powerful photon beams of NSLS-II by cultivating and fostering collaborative, interdisciplinary R&D.

New York State Governor George Pataki recently committed to providing $30 million for the JPSI building. It will be located next to NSLS-II and will provide office space, meeting areas, and specialized state-of-the-art laboratories. Plans call for the operating expenses of the institute and its research programs to be covered by external funding from the federal government.

Collectively, these developments will be transformative, promising us a bright and exciting future, and launching synchrotron science at BNL into the forefront worldwide.

A Users' Perspective

Peter Stephens, Users' Executive Committee Chair
Stony Brook University

The biggest recent news for the NSLS community must surely be the signing of Critical Decision Zero (CD-0) for NSLS-II by the Department of Energy. This essentially signifies that the DOE acknowledges the need for the facility, and is receptive to proposals for a specific plan and design. Of course, it took a lot of detailed thought to come to this point – the DOE is not signing on to an abstraction. Defining the scientific needs and opportunities of what will be the world's brightest storage ring for synchrotron radiation is a very serious job. For this, we must acknowledge years of effort by many people: countless current synchrotron radiation users and members of the NSLS user science division, who organized and participated in workshops in 2003; the NSLS Accelerator and Operations & Engineering divisions, who have been working to reach the theoretical limits of storage ring brightness; and especially Steve Dierker and Pat Dehmer, who have advanced and refined the case within DOE.

Like the zeroth law of thermodynamics, CD-0 is a prerequisite to what comes next, which is much more interesting and useful, and much more difficult. First, the CD-0 document does not say anything about the site for the desired facility, and so Brookhaven Lab (and anybody else who wants to take a shot at it) must write a competitive proposal showing that they can do the job better than anybody else. The next step on that path is the Conceptual Design Report, which requires far greater detail, and will be subject to much closer scrutiny, than what has gone before. I think all NSLS users are concerned about the potential diversion of resources from the Accelerator and Operations & Engineering divisions. The NSLS plays an extremely vital role in science, which must not be sacrificed for a facility planned for many years in the future. The UEC looks forward to working with the NSLS, Brookhaven Lab, and the DOE to balance current and future needs.

The CD-0 that was signed in the DOE calls for capabilities to image with 1 nanometer spatial resolution, and to perform x-ray spectroscopic measurements with 0.1 millivolt resolution. This performance will require substantial new work on accelerator physics and x-ray optics. There are real opportunities for people interested in research on these topics, much of which has to be done long before NSLS-II opens.

The other necessary work falls more directly to the users. We must define the scientific case for NSLS-II and work to educate the scientific community, the public, and the executive and legislative branches of the government about its importance. We must focus on the research that will be performed with this facility that is simply not possible today. That is an absolute prerequisite to asking for such a machine to be built, and we researchers must self-organize into groups identifying scientific opportunities at the very frontiers of technical capability. In education and outreach, we have to recognize that we are asking for a very expensive machine indeed, and that it will not happen if we cannot convey our excitement, and convince others of the social benefits of the investment.

Getting back to the recent past and closer future, the NSLS has recognized issues of performance by convening an orbit task force within the Accelerator Division. Last August, we heard the first report at the NSLS Town Meeting from Igor Pinayev. His slides have been posted on www.nslsuec.org. I'm afraid that many users regard NSLS accelerator science as a static enterprise. Quite to the contrary, the improvements in brightness that I mentioned in my last newsletter article continue into such activities as the orbit task force, leading to direct performance improvements impacting user science.

Finally, the groundbreaking of the Center for Functional Nanomaterials across the street from the NSLS in early October was exciting for several reasons. Several speakers at the dedication spoke of the importance of nanoscaled materials for the energy future of the country, and while this is not news to the NSLS scientific community, it is nice to hear it reiterated. NSLS plays a very important role in nanoscience; the capabilities of NSLS-II will be even stronger. At the same time, many established users of the NSLS will find complementary characterization techniques such as high performance electron microscopy and proximal probe microscopy, as well as advanced capabilities for materials synthesis and nanopatterning to enhance their research. Accordingly, our next users' meeting in May will be a joint NSLS-CFN program, organized to highlight the connections between the two. Please stay tuned for details, and I hope to see you there.

SAVE THE DATE

Joint NSLS/CFN Users' Meeting
May 15-17, 2006

For meeting information see:
http://www.nsls.bnl.gov/users/meeting

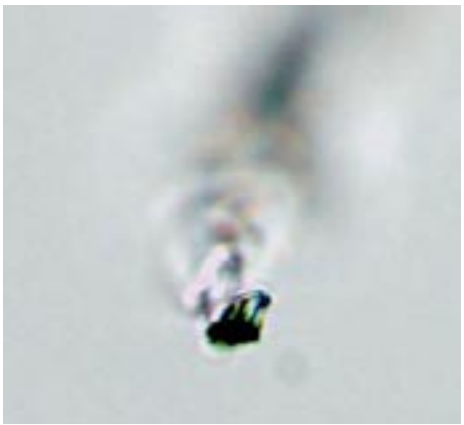
NSLS to Examine Pieces of Star Dust

Laura Mgrdichian, NSLS Science Writer

Beginning in early February, the NSLS will host a series of very exciting experiments — the analysis of space dust collected by NASA's Stardust spacecraft, which, after nearly seven years collecting cosmic matter during its travels through the solar system, landed safely in Utah on January 15.

Launched on February 7, 1999, Stardust's mission was to collect dust and carbon-based compounds from a passing comet, as well as tiny amounts of interstellar dust streaming towards Earth from deep space. Its delivery of this material marks the first time since Apollo 17 that a NASA spacecraft has successfully brought back a space-matter sample.

Now, at the NSLS and other synchrotron facilities, portions of that teaspoonful-sized amount of comet and star dust will be studied to determine its composition and properties. The variety of research techniques available at the NSLS will allow researchers to maximize the amount and type of information learned about the dust particles. The information scientists will gather could help answer some very important, very fundamental questions about the formation of the solar system and the Earth in particular.



Site of a Stardust particle impact on the surface of the aerogel collector. (Photo courtesy of NASA)

The initial analysis of these samples, known as the Preliminary Examination Period, has already begun in the Stardust Laboratory at NASA's Johnson Space Center. Following these first studies, the samples will then be divided, prepared, and distributed to qualified investigators, including those at the NSLS, for more intensive studies. These scientists are members of the Stardust Preliminary Exam Team.

At the NSLS, analyses will take place at beamline X26A, led by physicist and Stardust co-investigator George Flynn (SUNY Plattsburgh). Flynn is leading a worldwide group of scientists who will perform chemical composition measurements on the comet samples collected by Stardust. The extremely tiny and bright x-ray beams produced at beamline X26A will be an excellent tool for analyzing the particles, which are just 10-20 millionths of a meter in diameter (so small that five particles fit across the width of a single human hair). Using these capabilities, the X26A scientists will be able to extract chemical and mineralogical information from the sample without the need to remove the dust particles from the "aerogel" substance used to capture them in space.

After particles are extracted from the aerogel, they will be analyzed at other beamlines using both x-rays (X1A1), and infrared light (U10A and U10B). At beamline X1A1, a powerful imaging device called a scanning transmission x-ray microprobe (STXM) will be used to collect detailed images of the particles. The STXM employs a technique known as x-ray absorption near-edge structure (XANES) to gather information about the elemental makeup of the particles, especially the carbon found in organic compounds. Flynn's studies using the STXM may be able to identify organic compounds within some of the smallest Stardust particles — compounds that may have formed at the birth of our solar system.

Lindsay Keller (furthest to right), a member of the NASA "Tray Separation Team", examines the aerogel collector. Dr. Keller will bring Stardust samples to the NSLS in early February. (Photo courtesy of NASA)

In a concurrent set of studies, Flynn and Stardust co-investigator Lindsay Keller will use infrared light to identify specific minerals within the dust particles. Keller, who leads the group of scientists who will perform optical studies of the Stardust samples, is a lunar and planetary scientist with NASA's Johnson Space Center. The far-infrared microscope at beamline U10A, which can sense the unique vibrations of atoms in crystalline solids, is an excellent tool for identifying specific minerals within the Stardust sample. The mid-infrared light produced at beamline U10B will also be used to characterize any organic material found in the particles. Unlike x-ray methods, the information collected using these infrared techniques can be compared with the astronomical observations of distant interstellar dust clouds, including those involved with the formation of planetary systems like ours.

Protein Rush at the NSLS

Laura Mgrdichian, NSLS Science Writer

Recently, the Protein Structure Initiative (PSI) launched the second phase of its national effort to find the three-dimensional shapes of a wide range of proteins. Those structures, many to be determined at the NSLS, will help reveal the roles that proteins play in health and disease and will help design new medicines.

The highlight of the second phase is the announcement of 10 new research centers, slated to receive about $300 million in grants over the next five years. The first phase began in 2000 when the PSI established its pilot centers. The new centers will use protein-structure determination methods developed during the pilot period to rapidly determine thousands of protein structures found in organisms ranging from bacteria to humans.

BNL and NSLS involvement in PSI began when the New York Structural GenomiX Research Consortium (NYSGRC) was formed during the pilot program. The consortium determined approximately 200 new structures, the majority deciphered at the NSLS and many by BNL scientists.

Three protein structures determined at the NSLS as part of the Protein Structure Initiative. Images courtesy of NYSGRC.

In the second phase, the Brookhaven participants will continue to solve structures at the NSLS. Over the five years, the consortium will receive approximately $48 million, including $9.5 million to support research at BNL.

The consortium's other member institutions are Albert Einstein College of Medicine, Mount Sinai School of Medicine, The Rockefeller University, and Weill Medical College of Cornell University.

The Protein Structure Initiative is funded by the National Institute of General Medical Sciences and the National Center for Research Resources, both part of the National Institutes of Health.

New Grant for Catalysis Research at the NSLS

Laura Mgrdichian, NSLS Science Writer

A group of scientists has recently been awarded a three-year, $900,000 grant by the Department of Energy to create dedicated facilities for catalysis research at NSLS beamlines X18B and X19A. The two facilities will be operated by the Synchrotron Catalysis Consortium, charged with improving and expanding catalysis research at the NSLS.

The consortium's main investigation tool will be x-ray absorption fine-structure (XAFS) spectroscopy. "XAFS is well suited to studying catalysis, and can often yield more in-depth information on material's structural, electronic, and catalytic properties than more widely used techniques," said Anatoly Frenkel of Yeshiva University, one of the consortium's principal investigators. "We hope to help make more scientists aware of the advantages of using synchrotron radiation in general, and XAFS in particular, and provide support for scientists who wish to start catalysis experiments at the NSLS."

Some of the key members of the Synchrotron Catalysis Consortium. Front row, from left, are principal investigators Jingguang Chen and Anatoly Frenkel. Back, from left, is NSLS scientist Syed Khalid, who runs beamline X18B, and co-principal investigators Radoslav Adzic, Steve Hulbert, and Jonathan Hanson.

The two other principal investigators are Jingguang Chen (University of Delaware) and Radoslav Adzic (BNL-Chemistry). The consortium's co-principal investigators are Chi-Chang Kao and Steve Hulbert (NSLS), Jan Hrbek, Jose Rodriguez and Jonathan Hanson (BNL-Chemistry), David Mullins and Steve Overbury (Oak Ridge National Laboratory), and Simon Bare (UOP, LLC).

The grant will fund new hardware at X18B and X19A, and a beamline staff to run the new facility and provide support for visiting research groups.

Most components at X18B and X19A will be in place by April 2006. Catalysis users are now being contacted and the first users will start experiments in February 2006. For more information, see the consortium's website: *www.yu.edu/scc*.

NSLS Users Recognized

Laura Mgrdichian, NSLS Science Writer

Each year, a number of NSLS users win prestigious awards in their field of scientific research. The following represent a collection of some of the most recent awards.

Russell Hemley and David Mao Win the 2005 Balzan Prize

In 2005, the International Balzan Foundation Prize for Mineral Physics was awarded to Russell Hemley and Ho-Kwang (David) Mao, both with the Geophysical Laboratory at the Carnegie Institute of Washington.

Hemley and Mao received the award "for the impressive impact of their joint work leading to fundamental breakthroughs, theoretical and experimental, in the field of minerals submitted to extreme physical conditions." Much of their

Russell Hemley

David Mao

work — particularly their early, pioneering studies — has been, and is currently, performed at the NSLS.

They began working at the NSLS in 1986, using beamline X13A (later renamed X7A) to perform x-ray diffraction studies of materials subjected to extremely high pressures. Later, they helped build X17C — the world's first dedicated high-pressure beamline — and also conducted high-pressure infrared spectroscopy studies at U4IR, U2B, and U2A.

Philip Coppens Receives the Seventh Ewald Prize

Longtime NSLS user scientist Philip Coppens, a Distinguished Professor and Henry M. Woodburn Chair of Chemistry at the State University of New York at Buffalo, has been awarded the prestigious Ewald Prize by the International Union of Crystallography (IUCr).

The prize honors Coppens' contributions to developing the fields of electron density determination and the crystallography of molecular excited states. He is also recognized for his commitment to the education of future crystallographers.

Philip Coppens

Much of the work for which he received the award is the result of studies at NSLS beamline X3, where he was principal investigator for many years. At X3, Coppens developed many of the methods he now uses in his research, such as studies to determine the charge densities in various materials using x-ray diffraction. These experiments provided valuable insight into the properties of crystalline materials and the nature of chemical bonds within molecules and interactions between molecules.

2005 Chief's Honor Award for Distinguished Science Goes to Barbara Illman

Research plant pathologist and NSLS user Barbara L. Illman, Director of the Institute for Microbial and Biochemical Technology at the Forest Products Lab in Madison, Wisconsin, received the USDA Forest Service's 2005 Chief's Honor Award for Distinguished Science for her studies in four major areas of research.

Barbara Illman

The award recognizes Illman for "applying solid-state physics techniques to forestry problems, invasive species mitigation research, bioremediation research, and contributions to long-term ecological research programs."

At the NSLS, Illman developed techniques for using x-rays to study wood decay, recycling of wood biomass material, and bioremediation of toxic chemicals in the environment. This work led to discoveries about the biochemical mechanisms of brown-rot fungi, the most destructive wood-decay organisms, which could lead to improved methods for protecting wood from fungi.

Noel Clark: Co-Winner of the 2006 APS Oliver E. Buckley Prize

The 2006 American Physical Society Oliver E. Buckley Prize, recognizing "outstanding theoretical or experimental contributions to condensed matter physics," has been awarded to Noel Clark, a physicist at the University of Colorado and beamline X10 user, and Robert Meyer of Brandeis University.

Noel Clark

They received the award "for groundbreaking experimental and theoretical contributions to the fundamental science and applications of liquid crystals, particularly their ferroelectric and chiral properties."

Clark and Meyer have made very significant contributions to developing the concepts that underlie the fields of liquid-crystal science and technology. Individually, Clark has performed a great deal of significant research, such as his groundbreaking studies of ferroelectric liquid-crystal display cells, which made it possible for display-cell manufacturers to use them in commercial devices.

Beam Stability Tests at X18B

S. Khalid, I. Pinayev, and W. Caliebe, BNL-NSLS

One important parameter in the success of experiments at the NSLS is the stability of the x-ray beam on the sample. Properties such as intensity, beam position, energy stability, and, in a few cases, degree of polarization play crucial rules in this success, and some can be neglected based on the experiment. Ideally, these properties, when normalized by their dependence on ring current, do not change over the course of an experiment. Change from the ideal performance can be caused by motions of the electron beam in the storage ring or by motions of the beamline optics. The latter are often thermally driven, their effect is not proportional to beam current, and they can cause any combination of beam position changes, intensity changes, or energy changes. Ideally, these motions are eliminated by stable supports (beamlines and storage ring), feedback systems (electron beam and, in some cases, beamline optics), and efficient cooling schemes. In practice, however, both the electron beam and the beamline optics move slightly over time, requiring regular realignment.

During a beam-studies period, we measured the effect of beam motion on the intensity and energy of beamline X18B, which is equipped with a channel-cut Si(111) monochromator located at a distance of 18 meters from the source. X18B accepts a vertical (horizontal) divergence of 50 μrad (0.5-1 mrad). Since X18B is optimized for x-ray absorption spectroscopy, we do not care too much about position stability. In contrast, we care a lot about source angular stability, since this directly affects the photon energy selected by our monochromator.

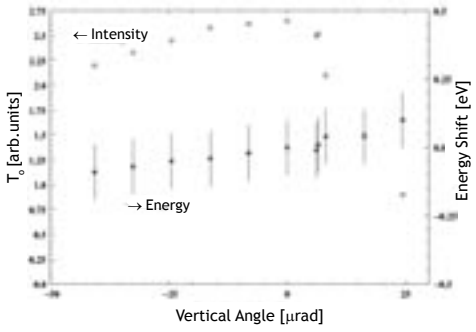


***Figure 1**. Intensity and energy shift for changes of the vertical angle. The stability of the beam is better than 5 μrad.*

Based on the geometry of the X18B beamline (slit sizes and positions), we calculate that vertical offsets of the source (electron beam) by 60 μm or angular changes by 5 μrad cannot be observed in a typical experiment. In order to test these calculations, we aligned the beamline slits such that the beamline becomes sensitive to beam motions in one direction (angle or position), but not the other. We then moved the beam (angle and position) around the nominal values and measured the intensity and energy stability. We did not study the effects of orbit motion (position or angle) in the horizontal plane, since X18B is not sensitive to motion in this plane.

The results of the orbit studies described above on the intensity and energy of beamline X18B are shown in **Figures 1 and 2**. It is apparent that vertical angular changes have only a small effect on the energy calibration, independent of the slit position, but have a relatively large effect on intensity. Theoretically, the energy should remain constant as a function of vertical source angle, which demonstrates that the X18B beamline saw a positional shift in addition to an angular change during these studies. The photon energy shifts significantly more for changes in the vertical source position, about 0.1 eV for 100 μm, as expected. The intensity profile in **Figure 2** is an asymmetric function of vertical source position relative to the standard orbit value. The reason for this is that we aligned our three beamline slits/apertures (5 mm vertical Be-window, 1 mm vertical white beam slit, 0.5 mm vertical hutch slit) such that the lower edges of their upper jaws were aligned, as viewed from the source point. In this situation, if the electron beam moves up, one of the slits intercepts the beam and the intensity is reduced immediately. Beam motions in the other direction, however, move the beam more towards the center of the three slits, so the intensity is much less strongly reduced, as can be observed in the data.

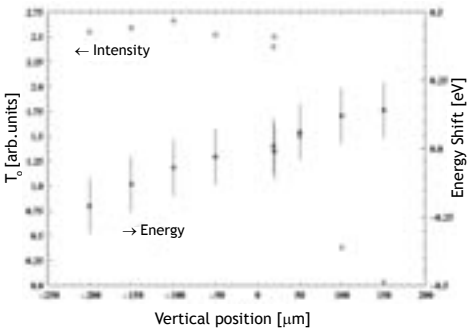
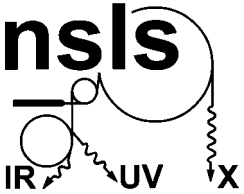


***Figure 2**. Intensity and energy shift for changes of the vertical position. The stability of the beam is better than 50 μm.*

In summary, we confirmed our calculations for the sensitivity of the X18B beamline to electron beam motions and demonstrated that the intensity can vary significantly if the beamline is not aligned appropriately. For normal operations, we align the slits symmetrically about the nominal beam axis in order to maximize intensity and to maximize the intensity stability. During normal operations, the intensity varies less than 0.4%, and the energy is stable within 0.05 eV.



X-Ray Ring Long-Range Schedule

January 2006

Sun	Mon	Tue	Wed	Thu	Fri	Sat
1 0000 Maint.	**2 Lab Holiday** 0000 Maint.	**3** 0000 Maint.	**4** 0000 Maint.	**5** 0000 Maint.	**6** 0000 Maint.	**7** 0000 Maint.
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February 2006

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March 2006

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April 2006

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VUV-IR Ring Long-Range Schedule

January 2006

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1 0000 Maint.	**2 Lab Holiday** 0000 Maint.	**3** 0000 Maint.	**4** 0000 Maint.	**5** 0000 Cond.	**6** 0000 Cond.	**7** 0000 Cond.
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February 2006

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

March 2006

Sun	Mon	Tue	Wed	Thu	Fri	Sat
			1 0000 Ops.	**2** 0000 Ops.	**3** 0000 Ops. 1800 Studies	**4** 0000 Ops.
5 0000 Ops.	**6** 0000 Ops.	**7** 0000 Ops. 0800 Studies	**8** 0000 Studies	**9** 0000 Ops.	**10** 0000 Ops.	**11** 0000 Ops.
12 0000 Ops.	**13** 0000 Ops. 1800 Timing	**14** 0000 Ops.	**15** 0000 Ops.	**16** 0000 Ops.	**17** 0000 Ops. 1800 Studies	**18** 0000 Ops.
19 0000 Ops. 1200 Studies	**20** 0000 Studies 0800 Maint.	**21** 0000 Maint.	**22** 0000 Ops.	**23** 0000 Ops.	**24** 0000 Ops. 1800 Timing	**25** 0000 Ops.
26 0000 Ops.	**27** 0000 Ops. 1800 Timing	**28** 0000 Ops.	**29** 0000 Ops.	**30** 0000 Ops.	**31** 0000 Ops. 1800 Studies	

April 2006

Sun	Mon	Tue	Wed	Thu	Fri	Sat
						1 0000 Ops.
2 0000 Ops.	**3** 0000 Ops.	**4** 0000 Ops. 0800 Studies	**5** 0000 Studies	**6** 0000 Ops.	**7** 0000 Ops.	**8** 0000 Ops.
9 0000 Ops.	**10** 0000 Ops. 1800 Timing	**11** 0000 Ops.	**12** 0000 Ops.	**13** 0000 Ops.	**14** 0000 Ops. 1800 Studies	**15** 0000 Ops.
16 0000 Ops. 1200 Studies	**17** 0000 Studies 0800 Maint.	**18** 0000 Maint.	**19** 0000 Ops.	**20** 0000 Ops.	**21** 0000 Ops. 1800 Timing	**22** 0000 Ops.
23 0000 Ops.	**24** 0000 Ops. 1800 Timing	**25** 0000 Ops.	**26** 0000 Ops.	**27** 0000 Ops.	**28** 0000 Ops. 1800 Studies	**29** 0000 Ops.
30 0000 Ops.						

NSLS Accelerator Complex Update

Erik Johnson, Associate Chair for Operations and Engineering

Machine Operations

From the perspective of user operations, fiscal year 2005 was quite successful. Reliability exceeded our internal goal of 95% on both machines for the first time in several years. This level of performance required the concentrated efforts of staff throughout the department. The achievement is all the more remarkable as the machines are now in their third decade of continuous operation, performing with parameters well beyond their original design specifications (see **Figure 1**).

> "I'm a great believer in luck and I find the harder I work, the more I have of it."
>
> *- Thomas Jefferson*

There is also some element of luck associated with this achievement, in as much as we did not experience any of the major age-related systems failures that have occurred over the last several years. However, at least some part of this luck has a Jeffersonian character to it.

Over the last several years a more focused effort has been devoted to monitoring systems and analyzing faults (see **Figure 2**). As in previous years, a few significant events can dominate user downtime, but for the past year catastrophic system failures were largely averted due to ongoing maintenance programs.

This year we also made an effort to enhance our machine operations perspective from a primarily systems-centered viewpoint to one that provides increased emphasis on the concerns and interests of our user community. For instance, the significant-disruption events can dominate the performance statistics, but the frequent small-duration failures can be more annoying and troublesome to our users. Factoring this into the decision-making process for what needs maintenance under a constrained budget can significantly contribute to the success of user experiments. This requires an ongoing dialog with the user community.

To facilitate this process, starting about mid-year we instituted a program of operations analysis that is reviewed at the weekly user and studies meetings.

2005 Performance

Group / Area/System	Number of Faults: Total	X- DT	U- DT	Downtime [hr]: X-ray	UV
Total Charges to Down Time					
Controls and Diagnostics	121	37	11	29.8	8.4
Power Systems	195	41	45	60.7	57.3
Utilities	95	47	26	54.3	10.7
Miscellaneous	136	86	8	36.1	1.6
	547	211	90	180.9	77.9
Significant Disruptions					
Ground Faults on XQB				22.5	
VUV RF System Intermittant Short					20.3
X-ray Sextupole overheating (XSD1)				13.1	
Trim system failures				8.1	
LIPA Switchover Power Dip				4.1	
VUV RF 100 W amplifier failure					4.3
XRF2 Contactor Replacement				3.6	
VUV Dipole PS Water Leak					3.7
				51.4	28.3
Balance to 'Routine' Faults					
				129.5	49.7

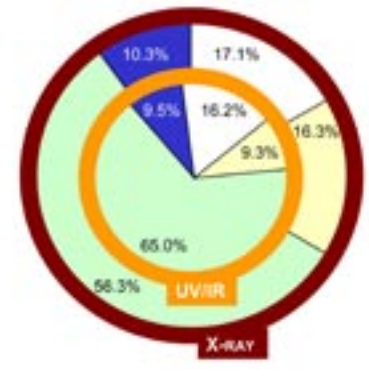
***Figure 2**. Summary of machine faults, including those that did not result in downtime, and hours of downtime on each machine. Individual disruptions over four hours duration accounted for 26% of downtime on x-ray (six events) and 36% of downtime on VUV (three events).*

In addition to the weekly reports, each four-week scheduling cycle is summarized from the user perspective of operations and reviewed with both users and staff.

The method of analysis and the data reported have evolved through the year, and will continue to do so as better methods or metrics become apparent. This is an important part of keeping the dialogue between users and NSLS staff up-to-date with respect to operations. Comments and suggestions from users and staff are always welcome.

Winter Shutdown

The winter shutdown schedule is now underway and it involves one of the most ambitious installation schedules undertaken for some time. The last of the new x-ray ring RF cavities is scheduled to be installed in the X9 straight section. This will be the most difficult of the cavity installations since it backs up against the LEGS tagging spectrometer area in the x-ray tunnel. The installation



User Metrics	UV/IR	X-ray
Reliability	98.7%	96.4%
Availability	113.2%	114.1%

Activity/Hours	UV/IR	X-ray
Operations	5694.7	4930.9
Unscheduled Operations	835.8	904.0
Maintenance	1414.8	1496.6
Other	814.7	1428.4

Other Activities	UV/IR	X-ray
Studies	2.3%	5.1%
Com/Con	2.8%	4.1%
Holiday	2.4%	2.4%
Injection	1.0%	1.9%
Unscheduled Downtime	0.8%	2.1%
Interlock	0.0%	0.7%

YTD 8760 Hrs 100 Hrs= 1.1%

Figure 1. Graphical summary of the operations activities for both machines for FY 2005

of the new cavity will pave the way for the development of an undulator-based beamline at X9 to support the research programs of the Center for Functional Nanomaterials.

The replacement of the X25 wiggler with a new mini-gap undulator is underway this shutdown. The new insertion device, when coupled with improved optics on X25, will significantly enhance the capabilities of the beamline.

The UV ring and utilities systems received routine maintenance and resumed operations mid-January. Because of the more extensive work scheduled for the x-ray ring, beam observation for users is not scheduled until February 6 and 7, with normal operations to resume on February 8.

Schedule

Finally, thanks again to all who provided input for the Winter 2006 schedule. In addition to adjustments made to accommodate the RapiData 2006 course, the x-ray studies schedule has been reduced from five days per four-week cycle to four days to provide more beam time for users. Comments on how that works out, as well as input for the summer 2006 schedule, would be most welcome. If there are any special scheduling considerations, please let me know before March 2006.

X-ray Statistics

for cycle starting on September 11, 2005

Operations		
Scheduled operations	504	[hr]
Expected number of scheduled fills	45	
Fills completed as scheduled (start and finish)	38	
Anticipated Fill Budget (45 min. per fill)	34	[hr]
Anticipated Operating Beam Available	470	[hr]
Total fill time during scheduled operations	28	[hr]
Delivered beam during scheduled operations	462.7	[hr]
Total beam available (including unscheduled ops)	571.5	[hr]
Fault Statistics over consolidated operating hours in cycle		
Number of Faults	10	
Total lost operations time	13.7	[hr]
Average time between faults	45.8	[hr]
Minimum time between faults	3.1	[hr]
Maximum time between faults	125.6	[hr]
Standard Deviation	43.0	[hr]

***Figure 3**. An overview of the x-ray operations characteristics for the four-week cycle that ran from September 11 through October 8. The fault statistics over a cycle are calculated as if all of the scheduled user operations were run as a single consolidated block of time.*

SAFETY

OHSAS 18001

Andrew Ackerman, NSLS Safety Officer

The NSLS is now registered as an OHSAS 18001 compliant facility and I thought I would take this opportunity to explain what that means and how it might affect your work here. The OHSAS (Occupational Health and Safety Assessment Series) program is a management system aimed at defining and controlling the risks presented by our varied work activities. Brookhaven management is working to register the whole site, and the NSLS was included in the second phase of that effort. Along with the Lab's Basic Energy Sciences directorate, we received a favorable report from independent auditors in November. This is an important step in getting the site registered, and we are pleased with that accomplishment and grateful for all the help we received. Building this program has required much work and input from many people.

The OHSAS program has numerous elements that pertain to recordkeeping, controlled documents, communication, emergency response, formalized objectives, etc., but what I think is most important to the user community is planning and analyzing the work we do. This part of the program, called a job risk assessment (JRA), provides a new structure in which to determine the hazards associated with each project or experiment. Risk assessment is not new to the NSLS, but OHSAS involves a different format and forces us to take a more quantitative approach to our analysis. We will still use safety approval forms to collect information about experiments and are taking credit for that planning as part of this program, but we have also been meeting with representatives from the department and the user community to help us analyze our more routine tasks and complete our JRAs. Those meetings have been very productive.

Our OHSAS manual is on the web, as are all of our completed JRAs, and we encourage you to take a look. The JRAs are a good reference and our assignment of numerical values to the various risks has helped ensure that our attention is focused where it is most needed. So far, we have found that our existing controls meet our needs, and we are pleased to see that. The development of this program has required considerable effort and, while we have not yet uncovered any hidden risks, the time we have spent meeting and talking with our people has been valuable. An important part of the OHSAS program is worker (or in our case experimenter) input, so if you have not yet been called you may get your chance. If you have been called, thank you, and as always, we encourage you to contact us if you see a concern that is not addressed. Help us keep the NSLS a safe place to work.

We've Come a Long Way!

Mary Anne Corwin, NSLS User Administrator

As many of you know, I recently accepted the position of NSLS Training Coordinator in the ESH&Q Division, a very exciting move for me.

During the transition to my new position, I've reflected on the many challenges, accomplishments, and changes in User Administration over the last seven years. It feels good to leave the position with very satisfying results…

The day I arrived at the NSLS in 1999, Hank Raimondo visited me to say, "FVA is coming." We spent the next 30 days completing 1600 foreign national visit requests. There were three new FVA orders and many procedural changes in guest registration, immigration status, check-in/out, escorting, gate access, and open-to-the-public events over the next few years. Users were re-badged three times during that time.

Development of the new NSLS guest database was another major project completed in 1999; and it was the prototype for BNL's Guest Information System, which went live in 2001. In 2002, the two systems were integrated (guests register online and records are imported to our system), enhancing our capabilities and eliminating redundant data.

In 1999, the Safety Approval Form was improved, but it became evident a more robust system was necessary. Meanwhile, plans for a web-based proposal system were being discussed. Development on the Proposal, Allocation, Safety and Scheduling (PASS) System began in 2001 to allow submission of web-based proposals (with online review, rating and allocation), improved safety approval processing and web-based scheduling. A group of 33 users, scientists, administrative, and safety staff worked more than a year making recommendations for the system, which debuted in May 2004. Proprietary proposals were incorporated this year and rapid access is planned.

Before 1999, beamlines submitted hard copy annual progress reports. Requirements were reduced and forms were generated electronically, and later incorporated into PASS in 2004.

Until 1999, citations were transmitted via text documents. We developed a web-based system to process the 1000+ references each year. The abstract system, which required LaTek code, was revamped for MS Word submissions.

Through 2001, User Administration administered more than 25,000 web pages for the NSLS. The web server transitioned to NT, and technology progressed to allow staff to maintain their own web pages. The hiring of a Webmaster for the vast domain was proposed by User Administration and accomplished in 2002. Later that year, the Activity Report, abstracts, science highlights, and publication citations, all handled by User Administration until then, were transferred to the newly formed Information & Outreach Office.

As a DOE reporting requirement, users are surveyed to provide feedback to the NSLS and DOE. Surveys from other DOE facilities were used as a foundation for our current End of Run form. While there are more questions than required by BES, the additional information provides valuable feedback for improving user services and the facility.

In 1999, 269 users attended the annual NSLS Users' Meeting. The numbers have increased steadily each year. By 2003, attendees rose to nearly 400. To ease administrative efforts in processing registrations, an online registration system was developed in 2000.

In 2001, User Administration worked with the Training Coordinator to implement online modules to fulfill user-training requirements. Training can now be completed from home, eliminating nearly two hours at User Administration on arrival.

A milestone was achieved in 2004 in converting User Administration into a paperless office. As time and resources permitted, existing records were scanned. New records are generated electronically. This accomplishment resulted in an $8K budget savings and eliminated the need for 280 cubic feet of office space. We exceeded our goals in reducing consumption and waste and are at the forefront in electronic records retention, significantly facilitating audits and records retrieval.

User Administration is central to a network of scientists, researchers, and staff in ESH&Q, safeguards and security, counterintelligence, cyber security, and administration. To comply with several orders, we implemented a process in 2004 to provide timed-access to the facility to coincide with training and immigration status, resulting in a dramatic decrease in facility access non-compliances.

As I leave this position, one thing is evident…User Administration staff have always been very productive, handling hefty workloads and challenges in an prompt, expert and courteous manner.

To sum it up, we've come a long way in the last seven years and I've learned quite a lot. The experience has provided me with a strong foundation for my new role and responsibilities as Training Coordinator.

The role of User Administrator is complex, challenging and demanding. Please welcome our new User Administrator, Kathleen Nasta (formerly the BNL Science Museum Program Coordinator), as your liaison between the NSLS and the user community. Your support will promote a smooth transition for the NSLS and our users.

Synchrotron Environmental Science III (SES-III) Meeting

Antonio Lanzirotti, University of Chicago/CARS

On September 19-21, 2005, the Synchrotron Environmental Sciences III (SES-III) meeting united scientists who use synchrotron-based techniques to study environmental issues.

During the opening remarks, BNL Director Praveen Chaudhari emphasized the growing role of environmental science research at BNL and Steve Dierker, Associate Lab Director for Light Sources, discussed NSLS efforts to accommodate more environmental science users. Department of Energy (DOE) program managers Nicholas Woodward (Geosciences Research Program) and Roland Hirsch (Environmental Remediation Sciences Division) described how the DOE supports environmental research.

Partcipants in the SES-lll meeting

Gordon Brown (Stanford U.) began the first day with an overview of environmental-science activities using synchrotron-based approaches. He was followed by more specific talks by Ken Kemner and Lynda Soderholm (Argonne National Lab), Neil Sturchio (U. of Illinois), Sanjit Kumar Ghose (U. of Chicago), and David Shuh (Lawrence Berkeley National Lab).

The second day's talks focused on biogeochemical interactions in the environment. Speakers included Graham George (U. of Saskatchewan), John Bargar (Stanford Synchrotron Radiation Laboratory), Maxim Boyanov (ANL), Stefan Vogt (ANL), Lisa Miller (BNL), Ryan Tapperro (U. of Delaware), Bhoopesh Mishra (U. of Notre Dame), John Parise (Stony Brook U.), Heather Jamieson (Queen's U., Canada), and Matthew Ginder-Vogel (Stanford U.).

The meeting concluded with a workshop on how microbeam methods are applied to environmental-science research. Steve Sutton (U. of Chicago), Daniel Grolimund (Swiss Light Source), Matthew Marcus (LBNL), Mary Gilles (LBNL), and Chris Jacobsen (SBU) gave talks.

Overall, the meeting was a rousing success. The organizers thank the attendees and co-sponsors EnviroSync, the NSLS, the SBU Center for Environmental Molecular Science, BNL, SBU, the National Science Foundation, and DOE.

EXAFS Course: Theory, Experiment, and Advanced Applications

Anatoly Frenkel, Yeshiva University

X-ray absorption fine structure (XAFS) courses have been held at the NSLS annually since 2001. While previous courses were aimed at beginners, this course, held September 28-30, was devoted to one technique: extended XAFS (EXAFS).

The course's 32 participants were familiar with the basics of the technique and wanted to learn how to correctly design, perform, and analyze EXAFS experiments. The course started with the fundamentals and proceeded to more advanced topics, including recent theoretical developments, data-analysis techniques, and applications of EXAFS.

The course consisted of three lectures each morning, two hands-on experimental sessions each afternoon, and one data-analysis session on the last day. The organizers identified four areas of interest: nanocatalysis, environmental/bio/geo chemistry, disordered alloys/thin films, and transition-metal oxides. They designed several research experiments for each of these areas.

Partcipants in the EXAFS course

Lectures were taught by invited speakers. They were Edward Stern and Josh Kas (U. of Washington), Grant Bunker (Illinois Inst. of Tech.), Anatoly Frenkel (Yeshiva U.), Trevor Tyson (New Jersey Inst. of Tech.), Joseph Woicik (NIST), Douglas Hunter (Savannah River National Lab), Scott Calvin (Sarah Lawrence College), and Douglas Pease (U. of Connecticut).

The beamline instructors were Tyson, Frenkel, Woicik, Faisal Alamgir (City U. of New York), Alexander Ignatov (Case Western Reserve U.), Kaumudi Pandya (BNL), Paul Northrup (BNL), Wolfgang Caliebe (BNL), and Syed Khalid (BNL). The data-analysis session was led by Calvin, Frenkel, Alamgir, Tyson, Woicik, Khalid, and Northrup.

The course administrator was Corinne Messana (BNL). The course was sponsored by the NSLS, Yeshiva U., and the DOE Synchrotron Catalysis Consortium.

Highlights from the 2005 NSLS Summer Sunday

Laura Mgrdichian, NSLS Science Writer

More than 700 enthusiastic visitors came to the National Synchrotron Light Source on August 7 as part of Brookhaven Lab's Summer Sundays program, crowding the lobby, seminar room, and front patio to see what the NSLS had in store for them. The program welcomes the public to the Lab on several consecutive Sundays in the summer, highlighting a different facility each week.

A steady stream of visitors filled the NSLS lobby.

Guests first arrived at Berkner Hall, where an NSLS scientist gave a brief NSLS overview talk and discussed how they use the NSLS to perform their own research. From there, visitors boarded a bus to the NSLS.

There were many things to do and see at the facility. Fifteen hands-on displays were set up in the lobby, seminar room, and patio to show visitors how the NSLS works and teach them about the science performed there. For example, the new "Electron Catapult" display showed visitors how different amounts of energy are required to propel an electron from an atom's "ground state" level to higher levels. This concept is key to many NSLS experiments.

At the "Crystals: Unlocking the Secrets of Life" display, many kids had a great time building "crystals" from toothpicks and gumdrops — some left with gigantic creations!

Another, always popular display was "Sounds of Silence," where guests watched how a vacuum pump caused Marshmallow Peeps to expand and then, when turned off, to shrivel down to a smaller size than when the experiment began. Guests learned that the shrunken candies were still edible (perhaps even tastier that way).

And at "See the Light," visitors could see actual synchrotron light, guided to the lobby from the experimental floor by a fiber-optic cable.

Upon entering the building, each guest received a quiz with several questions that could be answered by visiting each display. Every finished quiz was handed in and redeemed for an NSLS keychain flashlight and, every half-hour, one quiz was selected raffle-style to receive another prize — an NSLS baseball cap or BNL polo shirt.

Always a powerful sight for guests are the lobby and second-floor viewing windows that look down over the NSLS experimental floor. Looking down across the expanse of hardware, aluminum foil, and wiring is always fascinating for first-time visitors. At both windows, NSLS scientists were available to answer questions. Large neon numbers placed on the floor clearly labeled various components.

Outside the building, on the patio, NSLS scientists demonstrated how solar cars and water rockets worked, among other fun and interesting toys.

The day's success was made possible by many volunteers: Marc Allaire, Michael Appel, Steve Bennett, Mike Buckley, Wolfgang Caliebe, Shailendra Chouhan, John Dabrowski, Elaine Di Masi, Matt Engel, Larry Fareria, Ted Feldman, Ed Haas, Sarah Heins, Steve Hulbert, Anubav Jain, Ariane Kretlow, Kathryn Krycka, Tony Kuczewski, Tony Lanzirotti, Alan Levine, Andreana Leskovjan, William Little, Ebrahim Mahajna, Corinne Messana, Laura Mgrdichian, Laura Miller, Lisa Miller, Eileen Morello, Wendy Morrin, Susila Ramamoorthy, Perumal Ramasamy, Lydia Rogers, Ray Raynis, Meghan Ruppel, Sami Khouri Salameh, Sharadha Sambasivan, Cecilia Sanchez-Hanke, Anne Schirmer, Randy Smith, Peter Stephens, Raji Sundaramoorthy, Tejas Telivala, Heather Turbush, Gerry Van Derlaske, Adele Wang, Gary Weiner, Marty Woodle, Nancye Wright, Lin Yang, and Zhong Zhong.

"MC" Gerry Van Derlaske with a happy raffle winner

Three successful crystal-builders

The 2005 NSLS Barbeque Wraps Up the Year

Laura Mgrdichian, NSLS Science Writer

The warm, sunny weather of September 23 made for an enjoyable 2005 NSLS Barbeque, but it was the NSLS staff members in attendance that made the event memorable.

NSLS Chairman Steve Dierker

Service Awards

Nick Gmur and Dennis Carlson were honored for 30 years of service and 25-year awards went to Shu Cheung, John Klug, Gloria Ramirez, and Peter Zuhoski. In the 20-year category were Erik Johnson, Eileen Morello, Mihai (Mike) Radulescu, Lydia Rogers, David (Peter) Siddons, and Yong-Nian Tang. Mary Anne Corwin and Zhijian Yin celebrated 10 years.

Not available to receive their awards at the barbeque were Wayne Rasmussen, for a very impressive 40-year award; John Bohenek for 25 years; Sorin Pop, Leonard Pharr, and Madeline Hughes for 20 years; and Syed Khalid and Elio Vescovo for 10 years.

Spotlight Awards

The Spotlight awards are tributes to NSLS staff members who have shown exceptional dedication to their jobs during the year. This year, the winners were:

Steve Dierker presents a 30-year service award to Nick Gmur.

John Aloi: From January to April 2005, the Lab initiated new electrical safety requirements. John took on several activities to bring the NSLS into immediate compliance, including serving as the technical expert for the updates and developing and administering a training program for workers.

Angela Bowden: Angela worked under a tight deadline to bring the NSLS into compliance with a DOE "Corrective Action" item. She learned two new computer programs to create more than 3,000 safety warning labels for hazardous equipment on the experimental floor.

Michael Caruso: Caruso has provided invaluable assistance to the NSLS Vacuum Group over the past several years. Notably, he helped develop a coating process that greatly reduces the time necessary to coat a ceramic chamber, and then used the method to titanium-coat three ceramic chambers.

A group of NSLS staff members watch the awards ceremony.

Bob Kiss: Bob crafted and implemented new and improved procedures for the NSLS Hoisting and Lifting program. He created new check-out sheets for equipment, came up with a rigging-training program, took control of 49 NSLS overhead cranes, and assigned to each beamline a person responsible for hoisting and lifting activities.

Patrick Moylan: Pat demonstrated exceptional initiative and written skills by putting together Worker Qualification and Training forms for the Mechanical Tech Group. On top of that, he put together a training program designed to enhance on-the-job safety in the x-ray ring tunnel for workers who need unescorted access to the tunnel.

Dennis Poshka: By starting up a verification and maintenance routine for the facility beamline user interlock systems, Dennis uncovered many beamlines in which legacy interlocks were disconnected or inadequately instrumented, preventing a potentially huge loss of equipment.

John Vaughn: After repeated beam dumps on the x-ray ring in 2004, caused by random trips of a power supply, John assisted in several studies to trace the origin of the trips. When nothing surfaced, he set up diagnostics to establish a correlation between the trip frequency and the x-ray ring maintenance periods and found a solution after many others had failed.

Zhijian Yin: Zhijian installed and commissioned a complex request-tracking system for the User Science Division over a very short time period. He discovered an open-source software package and successfully incorporated it into the existing email, web, and database servers.

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Call for NSLS General User Proposals

For Beam Time in Cycle	Deadline
May - August 2006	Tuesday, January 31, 2006

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

https://pass.nsls.bnl.gov/

NSLS User Administration Office

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

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