National Synchrotron Light Source ◆ Brookhaven National Laboratory

Newsletter

July 2002

Successful Science, Exciting Plans, Record Attendance Characterize This Year's Annual NSLS Users' Meeting

Patrice Pages
Science Writer, NSLS

This year's Annual National Synchrotron Light Source (NSLS) Users' Meeting, held at BNL on May 20-22, was characterized by exciting presentations about the successful scientific record of the past year, and plans for upgrades of the NSLS and a new light source facility, as well as a record attendance of 380 participants coming from all over the world. The meeting consisted of a one-day plenary session and eight one-day-long workshops on the latest results achieved at the NSLS in the physical, biomedical, environmental, and instrumentation sciences.

Speakers included: Steven Dierker, NSLS Chair; Richard Osgood, Associate Laboratory Director for Basic Energy Sciences; Patricia Dehmer, Associate Director of Science for Basic Energy Sciences (BES) at DOE; and Satoshi Ozaki, Acting Deputy Laboratory Director for Science & Technology. John Marburger, Presidential Science Advisor and Director of the Office of Science & Technology Policy, was the meeting's keynote speaker.

In the plenary session, Ozaki opened the meeting by welcoming the participants and gave an overview of the major laboratory programs. Osgood followed with an outline of the reorganization of the material science effort at BNL, and the major initiatives within the Basic Energy Science directorate, in particular the proposed BNL Nanoscience center.

U.S. Representative Felix Grucci (R-New York, First District), who was scheduled to speak at the meeting, was detained in Washington. In a message read by meeting chair Leemor Joshua-Tor, he praised the current and future scientific programs at the NSLS, especially the ones linked to the war against terrorism.

In his keynote address, Marburger said, "We are beginning the 21st century with a profound revolution in science based on capabilities in computing and instrumentation. These capabilities have achieved an importance as the foundations of contemporary science that earns them a top priority for support. The National Synchrotron Light Source is one of the key representatives of this new instrumentation."

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Steven Dierker highlighted the qualities that make the NSLS such a successful facility. "With more than 2,500 scientists from over 400 institutions per year coming from academic, industrial, and government institutions, the NSLS is a widely used facility," he said. "Not only do we have a large contingent of users, but last year, they also produced more than 800 publications based on research performed at the NSLS, 150 of which appeared in premiere science journals."

In terms of budget, Dierker announced that DOE had recently added $600,000 to the NSLS budget for FY02. An additional $1.6 million is also contained in the President's FY03 budget request. "Altogether, we are looking at an increase of $2.2 million next year," Dierker said. "We are very grateful to DOE and Congress, and we are excited about the opportunities that this additional funding will allow."

Dierker also discussed changes under way at the NSLS that will improve support for current and future users.

Users' Executive Committee Chair Simon Bare (right), UOP-LLC, presents a photo of the NSLS to Office of Science & Technology Policy Director John Marburger.

One major change has been an administrative reorganization, to provide better coordination for project management and to place greater emphasis on support for user science. "We expect these changes to increase productivity and to enable our users to obtain better research results," Dierker said.

In announcing longer-term plans, Dierker first hailed a recent achievement by one of the near-term future light sources, the deep ultraviolet free electron laser (DUV-FEL). Last February, the facility generated radiation at 400 nanometers (billionths of a meter) by a process called self-amplified spontaneous emission process (SASE). By fall, Dierker added, the DUV-FEL is expected to provide radiation at 88 nanometers, to be used in pioneering chemistry experiments.

To advance beyond current NSLS performance by increasing beam brightness while reducing its pulse length,

Among the speakers at the 2002 Annual NSLS Users' Meeting were: (from left) Satoshi Ozaki, Richard Osgood, Steven Dierker, all of BNL; Patricia Dehmer, DOE; Leemor Joshua-Tor, Cold Spring Harbor Laboratory, NSLS Users' Executive Committee (UEC) Chair-Elect; Simon Bare, UOP-LLC, NSLS UEC Chair; and John Marburger, Presidental Science Advisor and Office of Science & Technology Policy Director.

Dierker announced plans for a new facility, which would benefit from two technological approaches. One, based on an ultra-low emittance storage-ring, would provide about a factor of 10,000 increase in brightness. The other, called Photoinjected Energy Recovery Linac (PERL), would produce high brightness and very short pulse lengths.

"The design would start with an ultra-low emittance storage ring, and evolve toward a PERL approach as that technology develops," Dierker said. The new facility would be located adjacent to the x-ray ring.

During her presentation on the current programs managed by DOE-BES, Dehmer was enthusiastic about the current and future projects at the NSLS. "I am delighted by the way Steve Dierker has done a tremendous job over the past year in rethinking the challenges that face the NSLS," she said.

(From left:) Mark Chance, Albert Einstein College of Medicine; Judith Vaitukaitis, Director, National Center for Research Resources, National Institutes of Health; Patricia Dehmer, DOE; and Richard Osgood, BNL..

Approximately 40 of the 55 posters at the NSLS Annual Users' Meeting poster session, organized by Lisa Miller, BNL, were the work of students and postdocs.

Users enjoy good food, conversation and entertainment at this year's banquet.

Another new project discussed at the meeting was a center dedicated to the study of the infinitesimally small. Called the Center for Functional Nanomaterials, or the Nanocenter, for short, this new BNL facility, which will investigate materials a billionth of a meter in size, has received a "very strong thumbs up" from initial reviews by DOE-BES, according to Ozaki, who gave the meeting's welcoming address.

The Nanocenter will be organized similarly to the NSLS, including laboratory clusters, user and visitor laboratories, and training and seminar facilities, and is expected to be built close to the NSLS and the Instrumentation Division.

"The NSLS and the Nanocenter will be portals to each other," said Osgood, who masterminded the Nanocenter project. "We envision both of these facilities as helping each other maintain a strong and vigorous user base."

"Brookhaven's Nanocenter will be a very bold departure from business as usual in the research communities of materials sciences and chemistry," Dehmer commented. "We are trying to change the face of small science by locating a lot of disciplines in one place, so that if scientists want to pursue a research program that mixes chemistry, biology and materials science, then they can do it."

Marburger, in his keynote address, also outlined some of the new changes facing science in the 21st century. "Scientists are opening the doors to a new kind of science," he said. "Never before had we been able to relate properties of large-scale matter and big things made of atoms to the detailed atomic structure. Now, we can, and the prospects are truly exhilarating. "I look forward to seeing what comes out of this Laboratory, as well as others that I fully expect society to continue to support," he added.

During the workshops and part of the plenary session, scientists presented current research and future light source projects, addressing topics as diverse as the use of synchrotrons in the environmental sciences, the study of ultrafast processes with x-rays, nanoscale materials, membrane protein crystallography, catalysis, materials processing, synchrotron micro-spectroscopy and imaging, and the development of more advanced light source detectors.

Users' Executive Committee

Term May 2002-2003

Chair	Leemor Joshua-Tor (Cold Spring Harbor)
Past Chair	Simon Bare (UOP, LLC)
Vice Chair	Antonio Lanzirotti (Univ. of Chicago)
Secretary	Bruce Ravel (Navel Research Laboratory)
Member	Steven Almo (AECOM)
Member	Fred Dyda (NIH)
Member	Daniel Fischer (NIST)
Member	Anatoly Frenkel (Yeshiva Univ.)
Member	Richard Reeder (SUNY @ Stony Brook)
Ex-Officio	Chi-Chang Kao (BNL, NSLS)
Ex-Officio	Mary Anne Corwin (BNL, NSLS)

Special Interest Groups

Bio. Scattering	Michael Becker (BNL, Biology)
Imaging	Susan Wirick (SUNY @ Stony Brook)
Industrial	Paul Stevens (Exxon)
Infrared	Laszlo Mihaly (SUNY @ Stony Brook)
Nuclear Phys.	Mahbubul Khandaker (JLab)
Students/Postdocs	Gregory D. Smith (BNL, NSLS)
Time Resolved	John Sutherland (BNL, Biology)
Topography	Michael Dudley (SUNY @ Stony Brook)
UV Photo	Peter Johnson (BNL, Physics)
XAFS	Bruce Ravel (Navel Research Lab.)
X-Ray Scattering	Peter Stephens (SUNY @ Stony Brook)

Secretary Abraham Gives Go-Ahead for BNL Nanoscience Center

Patrice Pages
Science Writer, NSLS

"On behalf of the Department of Energy, I am pleased today to officially announce our approval to begin the conceptual design of the $85 million Center for Functional Nanomaterials here at Brookhaven." With this statement, U.S. Secretary of Energy Spencer Abraham declared on Friday, June 14, that DOE will establish a Northeast center for nanoscience research at BNL, as one of five such facilities to be built around the country under the National Nanotechnology Initiative.

The study of materials the scale of billionths of a meter (or 1,000 times smaller than a human hair), nanoscience is expected to allow researchers to design materials tailored to specific needs, such as strong, lightweight materials, new lubricants, and more efficient solar energy cells.

Abraham announced this good news — BNL's first scientific facility construction project since the Relativistic Heavy Ion Collider (RHIC) — at a Lab-wide meeting in Berkner Hall, during the Energy Secretary's first visit to BNL. Abraham delivered his remarks after touring the Lab with BNL Interim Director Peter Paul, U.S. Representative Felix Grucci (R-NY, First District), and DOE Office of Science Director Raymond Orbach.

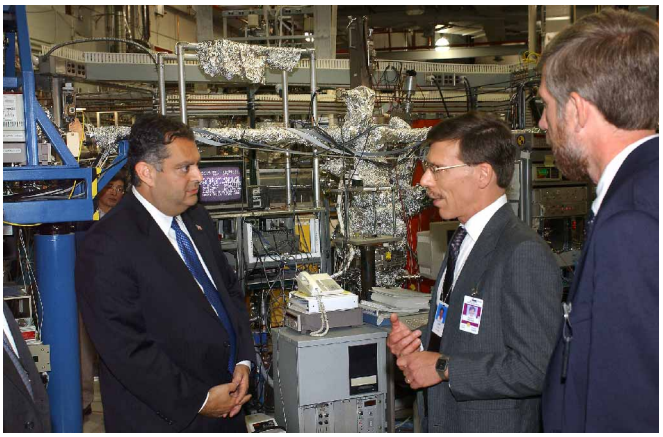
A standing ovation followed Abraham's announcement as the audience of BNL employees, facility users, and other guests showed its enthusiasm for this new scientific facility, which will allow BNL to become a major player in the new field of nanoscience. "Nanoscience offers the potential for a second industrial revolution," Abraham said. "The implications are enormous. That is why we are so serious about America's leading the way in nanoscience."

The new center at BNL will be a user facility open to researchers from across the country and around the world that will gain access to its state-of-the-art instruments and equipment through a peer-review process. "When this center is complete, physicists, chemists, material scientists, and biologists will work with computer scientists and engineers exploring the world atom by atom," Abraham said. "You need major facilities for this kind of work, major facilities with the best new technology and the best minds America has to offer," he continued. "We have all of this here at Brookhaven."

Abraham acknowledged that nanoscience is still a basic science with no clear applications yet. But he expressed his commitment to supporting basic science because of its unknown ultimate applications. "What is so exciting about the work we do [at DOE] is that we produce benefits to America and the world that go well beyond the original scope of our mission," he said. "No one really knows where nanoscience will ultimately lead us, but we do know that we are at the beginning of a science initiative that may change the way we look at, and can use, the world around us."

The design and construction activities of the nanoscience center at BNL are expected to start in fiscal year (FY) 2004, with commissioning planned for FY2007. The project's preliminary cost estimate is $70-85 million. Under DOE's Office of Science, the conceptual design report will be prepared immediately so that construction funding can be requested from Congress.

Secretary of Energy Spencer Abraham (left), BNL Interim Director Peter Paul, and BNL Associate Director for Basic Energy Sciences Richard Osgood (right).



Secretary Abraham (left) learns about research at beamline U7A from researcher Daniel Fischer, NIST; and NSLS Chair, Steven Dierker (right).

Origin of Superconductivity in Fullerenes Still a Mystery

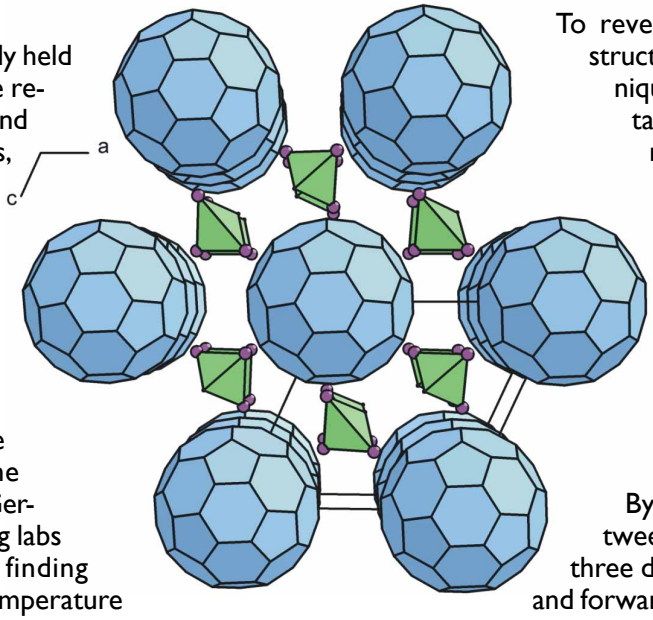
Patrice Pages
Science Writer, NSLS

Soccer ball-shaped molecules called fullerenes can carry electricity with no energy loss - a phenomenon called superconductivity - at temperatures below -387 degrees Fahrenheit. To increase this temperature, and thus make fullerenes' use more convenient for applications in electronics, drug delivery, and nanotechnology, scientists have long assumed that they simply needed to introduce larger and larger atoms inside fullerene compounds.

In the April 5 issue of Science, however, scientists working at the NSLS report an unexpected result: When they added molecules of bromoform and chloroform to a fullerene compound, the resulting compound changed its structure.

This result contradicts a widely held assumption that the structure remains the same in both pure and "mixed" fullerene compounds, and paves the way to a new understanding of how superconductivity works in these compounds.

"The theory of superconductivity in fullerenes is still too simple," says Robert Dinnebier, a physicist at the Max Planck Institute for the Physics of Solids in Stuttgart, Germany, one of the world leading labs in materials science. "Our finding means that the increase in temperature seems to be due to other causes than just an increase in spacing between the fullerene molecules."



Structure of a fullerene crystal (blue) with chloroform molecules (green/purple) inserted within the lattice. Although the structure was expected to be cubic, Dinnebier and his coworkers found that it was, in fact, hexagonal, as shown in the figure.

Dinnebier and his colleagues came upon this new result while attempting to understand findings published a month earlier in Science. A team of physicists led by Hendrik Schoen, of both Bell Laboratories in Murray Hill, New Jersey and the University of Konstanz in Germany, had, for the first time, reported that when chloroform and bromoform were added to fullerene compounds, their superconducting temperature increased dramatically.

"When this work was published, we immediately thought it would be very interesting to look at the structure," Dinnebier says. Detailed structural studies of the spacing between fullerenes might explain the increase in temperature, the scientists assumed. "Within two weeks, we prepared the material and sent it to the NSLS," Dinnebier says.

At the NSLS, Dinnebier's collaborators Peter Stephens, a physicist at the State University of New York at Stony Brook, and his doctoral student, Ashfia Huq, set up an experiment to look at the structure of the chromoform- and bromoform-based fullerenes. "When Robert [Dinnebier] told me that the material would be available, I was very excited," Stephens says. "We had to act quickly, because this was just before the Light Source would shut down for two months for routine maintenance."

To reveal the material's crystalline structure, the scientists used a technique called powder x-ray crystallography. They projected x-rays produced by the NSLS toward a powder of tiny crystals of the compound. Then, they determined its structure by looking at how the x-rays scattered off the crystals. In one week, the scientists had produced the necessary data and started analyzing them.

By measuring the distances between the fullerene molecules in three directions (up-down, left-right, and forward-backward), the researchers found that the expansion of the molecules due to the bromoform or chloroform mainly takes place in one direction, instead of three directions, as predicted. Surprised at first, the scientists later realized that the structure of the compounds was different from what was theoretically predicted.

In a fullerene compound, the molecules form a series of connected cubes in three directions. The molecules are on the corners of each cube, and at the center of the cube's faces. Schoen's group expected that when bromoform or chloroform molecules are inserted inside a fullerene compound, they would sit in between the fullerene molecules. In this way, the fullerene molecules would be pushed apart similarly in the three directions, Dinnebier explains.

The new results show that the fullerene compounds with chloroform or bromoform were no longer cubic. Instead, the fullerene molecules form six-sided hexagonal shapes. The compound is made of parallel planes, each containing a series of connected hexagons. "The chloroform and bromoform molecules sit in between the planes, pushing the fullerene molecules apart only in the direction perpendicular to the planes," Dinnebier says.

While these results give a clearer picture of how a fullerene compound can be modified by adding chloroform or bromoform, they still do not provide answers to what causes the increase of the superconducting temperature. One possibility is that when chloroform or bromoform molecules are added to the fullerene compound, their electrons add to the ones already existing in the compound. The collective motion of all the electrons then creates heat that increases the temperature. According to the theory, the number of electrons would have to increase by 25 to 35 percent to explain the measured superconducting temperature. However, theoretical physicist Olle Gunnarsson, a member of the Stuttgart team, showed that, in a hexagonal structure, the number of electrons increases by, at most, 10 percent.

Another possibility, suggested by Dinnebier and his colleagues in their article, is that the chloroform and bromoform molecules may play a role through interactions between their electrons, but this hypothesis has not yet been tested. "Understanding the causes of superconductivity and the origin of the temperature below which it operates are still elusive," Stephens says. "But these results form the basis for uncovering how fullerene-based compounds generate superconductivity at the atomic level.

"This kind of research is a beautiful advertisement for the way the NSLS works," he adds. "At the NSLS, like many other synchrotron sources, it is curiosity-driven scientists, not committees, that make the decisions to schedule most of the experiments. We owe the success of this work to this well-established culture at the NSLS."

For more details of this work see: R.E. Dinnebier, O. Gunnarsson, H. Brumm, E. Koch. P.W. Stephens, A. Huq, and M. Jansen, "Structure of Haloform Intercalated C_{60} and its Influence on Superconductive Properties," Science, 296, 109-113, (2002).

A User's Perspective

Leemor Joshua-Torr
Cold Spring Harbor Laboratory
Users' Executive Committee Chairman

As the new Chair of the UEC, I'd like to first express my deepest gratitude to Simon Bare who has done a tremendous job in leading the committee this past year. This was an important year at the NSLS, starting with the appointment of Steve Dierker as the new NSLS Chair. It was a year of a major reorganization of the department and a new management structure, as well as serious discussions regarding plans for the future of the NSLS, both in terms of beamline operations and plans for a ring upgrade. Simon worked hard to ensure a good communication with NSLS management on behalf of the users through all of these changes. I would also like to thank two valuable outgoing members of the UEC, Mark Chance and Michael Vaughan, and to the outgoing SpIG representatives for their hard work and efforts on the UEC for the benefit of the NSLS users community. I'd also like to welcome the newly elected UEC members and SpIG representatives; the results of the elections are listed on page 4. The UEC elected Tony Lanzirotti (University of Chicago) as Vice Chair and Bruce Ravel (Naval Research Laboratory) as Secretary.

The NSLS Annual Users' Meeting, held May 20-22, was a great success, with a record number of 380 participants. Scientists came from all over the country and from overseas to attend our annual gathering, including a packed main meeting and eight excellent workshops. Details on the meeting can be found in the cover story of this Newsletter. As a social highlight, the banquet this year featured the comedy improvisation group Chicago City Limits, who cleverly incorporated some NSLS user folklore into their sketches. This was done with a wonderful backdrop of a purple and black castle assembled by NSLS staff.

During the past few months, the UEC worked on a major revision of the NSLS Users' Association Charter. These revisions were posted on the web site and were included in the registration packet for the Users' Meeting attendees. Since the old charter stated that, in order for any revisions to take effect, it must be amended at the annual meeting, Simon Bare presented these revisions for a vote at the meeting and the proposed amendments were

passed by more than two thirds of those present. These changes included electronic voting procedures (for UEC members and charter revisions, for example), clearer definitions for membership in the Association and on the UEC, corrections of many inconsistencies and grammatical errors, and removal of sexist language. The new charter is posted on the web at: http://nslsweb.nsls.bnl.gov/nsls/users/uec/Default.htm.

Last year, the UEC has decided to initiate and sponsor an award called the "NSLS User Community Service Award". 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 an award for scientific achievement, but rather for contributions that have improved the quality of science at the NSLS. The first recipient of this award is Gary Nintzel, a member of the NSLS User Science Division Technical Specialists staff. "With his extensive knowledge of nearly all the beamlines on the VUV floor, he is able to diagnose problems very efficiently, minimizing lost beamtime." "In addition to his regular and untiring support for the growing number of beamlines under the control of the NSLS User Science Division, he has made time to provide significant support to nearly all the other beamlines on the VUV floor, plus X1 and X13." These were some of the

Gary Nintzel, member of the NSLS User Science Division Technical Staff, was awarded the UEC's first annual NSLS User Community Service Award.

comments received by the UEC supporting Gary's nomination. Gary was presented with a gift certificate and his name was engraved on a plaque, which is on display in the lobby of the NSLS.

The UEC is continuing to spear head our lobbying efforts for increased budgets for the Office of Science at the Department of Energy (DOE) and for the physical sciences in general. As you know, the NSLS as well as the other three DOE-run synchrotrons are funded through the Office of Science and the budget has essentially been flat over the last few years even though the number of users has increased dramatically. Simon Bare and I, together with the chairs and vice-chairs of the UECs from ALS, APS and SSRL visited Capitol Hill on April 17-18, with Simon acting as spokesperson for the group. We spoke with senior staff members of the Senate and House Energy & Water Appropriations Committees, the House Science Committee's staff and members of the Office of Management and Budget (OMB) and the Office of Science and Technology Policy (OSTP). With help from the NSLS Information and Outreach Office, we prepared a colorful brochure highlighting the science from all four DOE-run synchrotrons, stressing some of the scientific breakthroughs and benefits to industry. We also included important numbers regarding usage and budgets. Our presentation can be found on the BES web site at: http://www.sc.doe.gov/production/bes/ppt/BESpresentations.htm.

The meetings were set up by Pat Fulton, Science Lobbyist for Stanford University and Jack Bagley, Battelle's Vice President for External Affairs. On the second day, we split up into groups and the representatives from each synchrotron visited the offices of their respective Senators and House Representatives. Simon and I met with the legislative assistants in the offices of Senators Chuck Schumer and Hillary Rodham Clinton of NY and in the offices of Congressmen Grucci, Ackerman and Israel. We have yet to see real results from our efforts but we had an excellent response from some of the key people we met.

Due to the success of this visit, the UEC has appointed Simon Bare to coordinate our lobbying efforts on Capitol Hill and elsewhere this coming year. However, we do 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 and we would be happy to supply you with materials. We 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 (leemor@cshl.org) or Simon (srbare@uop.com) for more information.

In closing, I would like to reiterate that the UEC represents 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.

Frontiers in Synchrotron Research on Soft Matter and Biomaterials Workshop

Ronald Pindak
Workshop Organizer

A workshop on "Frontiers in Synchrotron Research on Soft Matter and Biomaterials" was held from April 24-27 at the Mary Duke Biddle Estate in Tarrytown, NY. Seventy-seven attendees from government, university, and industrial labs met at this magnificent site overlooking the Hudson River. The workshop participants related exciting advances and identified open issues in a number of soft matter and biomaterials research areas including: phase transitions in confined geometries and at surfaces, directed self-assembly of soft matter systems into functional nano-structures, controlled inorganic growth in an organic matrix, new behavior in complexes such as those formed by lipids and proteins or liquid-crystals and polymers, and the dynamics of protein-folding. The measurements described in these presentations were mainly carried out at the NSLS and SSRL synchrotrons. Measurements carried out at the APS and the ESRF synchrotrons were also presented. The latter measurements focused on the application of radiation from high brightness sources to study dynamics such as membrane fluctuations and polymer reptations. In order for all the synchrotron facilities to more effectively impact these problems, the participants indicated that faster detectors with energy resolution, flexible geometry, and wide dynamic range were essential, that barriers needed to be reduced to improve the accessibility of synchrotrons to new users, that better on-site facilities were required for sample preparation, and that existing information on mitigating radiation damage needed to be assembled into a report. Finally, a glimpse into potential new superconducting undulator insertion devices and energy-recovery schemes for high-brightness x-ray sources was provided. The interactions between the soft matter and biomaterials researchers were lively and productive in nature. A follow-up meeting to track progress and further encourage cooperative ventures is under consideration.

NSLS Annual RapiData Course in X-Ray Crystallography Again Successful

Karen McNulty Walsh
Senior Public Affairs Representative, Office of Public Affairs, BNL

Brookhaven's offering of RapiData 2002, the fourth in an annual series of crash courses in x-ray crystallography, was once again a huge success. Forty-eight students from around the world participated from April 21 to 26.

More formally titled "Rapid Data Collection and Structure Solving at the NSLS: A Practical Course in Macromolecular X-Ray Diffraction Measurement," the program was developed by BNL's Biology and National Synchrotron Light Source (NSLS) departments to introduce students to the best people, newest equipment, and latest techniques in the field of macromolecular x-ray crystallography.

Half the students came to observe; the other half came with their own specimens with the goal of solving the structure of a particular enzyme. About four structures were solved during the course, and each of these is likely a publishable result.

Designed and run by Bob Sweet and Denise Kranz of BNL's Biology Department, the program is funded by a range of agencies. Key support comes from the National Institutes of Health National Center for Research Resources, and significant support from DOE's Office of Biological and Environmental Research.

The course starts with two days of lectures and tutorials taught by BNL scientists and scientists from industry, academia, and other national labs - a total of 38 instructors, tutors, or helpers, many of them volunteers.

These mentors then serve as hands-on scientific supervisors when the students move to the NSLS beam lines to begin collecting data on their crystal samples. There are also plenty of occasions for stimulating conversation over drinks and meals.

"Everyone, teachers and students alike, finds the experience absolutely riveting. The 60 hours of data collection are near chaos on the NSLS floor. But each of us ends up exhausted but happy, having learned a little from each of the others," Sweet said.

For more information about this year's program go to: http://www.px.nsls.bnl.gov/.

Facility Update

Gerry Van Derlaske
NSLS Building Manager

Spring Cleanup has been in full swing during the past few weeks. Services provided by BNL's Plant Engineering Paint Shop have included reworking of the Main Entrance Lobby, all of the restrooms and lounge areas located on the experimental floor, along with wall and trim work near the Main Control Room. Touch-ups as needed were performed in Conference and Seminar rooms, East Stock Room entrance and the walkway leading from the Main Control Room to the West roll up door. Nearly 200 man-hours of labor were provided by the Paint Shop under the Supervision of Bruce Laakman and Victor Cassella, Sr.

Plantings of the front circular drive and the terraced garden as viewed from the George Hummer Memorial Lounge took place in time for the May NSLS Users Meeting. As we are constantly battling with the oversized deer population on site, many "deer resistant" perennials were planted this year. While being sensitive to the feeding habits of the deer, that have found that annuals in our gardens make for good snacking areas, planting perennials may minimize damage caused to the gardens as the deer graze.

Two new backflow prevention devices (reduced pressure zone valves) and associated isolation valves were installed during the May maintenance period on the main water feeder servicing Building 725. These devices replaced the original units, which did not pass test requirements as mandated by New York State/Suffolk County Department of Health standards.

Preparation work, which is necessary prior to the construction of the new NSLS User Addition, has begun. Liquid Nitrogen feed lines have been re-located. Prints for the new addition are in final review, prior to submission for bids from contractors. Expect groundbreaking and construction on the 2nd story northwest and west sides of Building 725 to begin in the very near future.

Lastly, if you have a free moment, check out the array of flat screen monitors now located in the Main Lobby. The information directory has a touch screen flat monitor to help bring up pertinent info on Staff and Users, as well as a digitized map leading visitors from the lobby to an individuals' office or beamline. Do an "about face" from this directory and look up at the four new status monitors which deliver a clear visual of both X-Ray and VUV Ring parameters and posted informational messages.

X-Ray Ring Long Range Schedule

X-Ray SCHEDULE – September 2002

Sun	Mon	Tue	Wed	Thu	Fri	Sat
1 00-2400 Ops.	**2 Holiday** 00-2400 Ops.	**3** 00-2400 Studies	**4** 00-1200 Studies 12-2400 Ops.	**5** 00-2400 Ops.	**6** 00-2400 Ops.	**7** 00-2400 Ops.
8 00-2400 Ops.	**9** 00-1200 Ops. 12-2400 Studies	**10** 00-0800 Studies 08-2400 Maint.	**11** 00-2400 Maint.	**12** 00-1200 Studies 12-2400 Ops.	**13** 00-2400 Ops.	**14** 00-2400 Ops.
15 00-1200 Ops. 12-2400 Studies	**16** 00-0600 Studies 06-1200 Intlk. 12-2400 Studies	**17** 00-1200 Studies 12-2400 Ops.	**18** 00-2400 Ops.	**19** 00-2400 Ops.	**20** 00-2400 Ops.	**21** 00-2400 Ops.
22 00-2400 Ops.	**23** 00-2400 Ops.	**24** 00-0800 Ops. Template 08-2400 Ops.	**25** 00-2400 Ops.	**26** 00-2400 Ops.	**27** 00-2400 Ops.	**28** 00-2400 Ops.
29 00-2400 Ops.	**30** 00-1200 Ops. 12-2400 Studies					

X-Ray SCHEDULE - October 2002

Sun	Mon	Tue	Wed	Thu	Fri	Sat
		1 00-2400 Studies	**2** 00-1200 Studies 12-2400 Ops.	**3** 00-2400 Ops.	**4** 00-2400 Ops.	5 00-2400 Ops.
6 00-2400 Ops.	**7** 00-1200 Ops. 12-2400 Studies	**8** 00-0800 Studies 08-2400 Maint.	**9** 00-2400 Maint.	**10** 00-1200 Studies 12-2400 Ops.	**11** 00-2400 Ops.	12 00-2400 Ops.
13 00-1200 Ops. 12-2400 Studies	**14** 00-0600 Studies 06-1200 Intlk. 12-2400 Studies	**15** 00-1200 Studies 12-2400 Ops.	**16** 00-2400 Ops.	**17** 00-2400 Ops.	**18** 00-2400 Ops.	19 00-2400 Ops.
20 00-2400 Ops.	**21** 00-2400 Ops.	**22** 00-0800 Ops. Template 08-2400 Ops.	**23** 00-2400 Ops.	**24** 00-2400 Ops.	**25** 00-2400 Ops.	26 00-2400 Ops.
27 00-2400 Ops.	**28** 00-1200 Ops. 12-2400 Studies	**29** 00-2400 Studies	**30** 00-1200 Studies 12-2400 Ops.	**31** 00-2400 Ops.		

X-Ray SCHEDULE - November 2002

Sun	Mon	Tue	Wed	Thu	Fri	Sat
					1 00-2400 Ops.	**2** 00-2400 Ops.
3 00-2400 Ops.	**4** 00-1200 Ops. 12-2400 Studies	**5** 00-0800 Studies 08-2400 Maint.	**6** 00-2400 Maint.	**7** 00-1200 Studies 12-2400 Ops.	**8** 00-2400 Ops.	**9** 00-2400 Ops.
10 00-2400 Ops.	**11 Holiday** 00-2400 Ops.	**12** 00-0800 Ops. Template 08-2400 Ops.	**13** 00-2400 Ops.	**14** 00-2400 Ops.	**15** 00-2400 Ops.	**16** 00-2400 Ops.
17 00-1200 Ops. 12-2400 Studies	**18** 00-0600 Studies 06-1200 Intlk. 12-2400 Studies	**19** 00-1200 Studies 12-2400 Ops.	**20** 00-2400 Ops.	**21** 00-2400 Ops.	**22** 00-2400 Ops.	**23** 00-2400 Ops.
24 00-2400 Ops.	**25** 00-0800 Ops. 08-2400 Maint.	**26** 00-2400 Maint.	**27** 00-2400 Maint.	**28** 00-2400 Maint.	**29** 00-2400 Maint.	**30** 00-2400 Maint.

X-Ray SCHEDULE – December 2002

Sun	Mon	Tue	Wed	Thu	Fri	Sat
1 00-2400 Maint.	**2** 00-2400 Maint.	**3** 00-2400 Maint.	**4** 00-2400 Maint.	**5** 00-2400 Maint.	**6** 00-2400 Maint.	**7** 00-2400 Maint.
8 00-2400 Maint.	**9** 00-2400 Maint.	**10** 00-2400 Maint.	**11** 00-2400 Maint.	**12** 00-2400 Maint.	**13** 00-2400 Maint.	**14** 00-2400 Maint.
15 00-2400 Maint.	**16** 00-2400 Maint.	**17** 00-2400 Maint.	**18** 00-2400 Maint.	**19** 00-2400 Maint.	**20** 00-2400 Maint.	**21** 00-2400 Maint.
22 00-2400 Maint.	**23** 00-2400 Maint.	**24** 00-2400 Maint.	**25** 00-2400 Maint.	**26** 00-2400 Maint.	**27** 00-2400 Maint.	**28** 00-2400 Maint.
29 00-2400 Maint.	**30** 00-2400 Maint.	**31** 00-2400 Maint.				

VUV Ring Long Range Schedule

VUV SCHEDULE – September 2002						
Sun	Mon	Tue	Wed	Thu	Fri	Sat
1 00-2400 Ops.	**2 Holiday** 00-2400 Ops.	**3** 00-2400 Ops.	**4** 00-2400 Ops.	**5** 00-2400 Ops.	**6** 00-1800 Ops. 18-2400 Studies	**7** 00-2400 Ops.
8 00-2400 Ops.	**9** 00-2400 Ops.	**10** 00-0800 Ops. 08-2400 Studies	**11** 00-2400 Maint.	**12** 00-2400 Maint.	**13** 00-1800 Ops. 18-2400 Timing	**14** 00-2400 Ops.
15 00-2400 Ops.	**16** 00-1800 Ops. 18-2400 Timing	**17** 00-2400 Ops.	**18** 00-2400 Ops.	**19** 00-2400 Ops.	**20** 00-1800 Ops. 18-2400 Studies	**21** 00-2400 Ops.
22 00-2400 Ops.	**23** 00-2400 Ops.	**24** 00-0800 Ops. 08-2400 Studies	**25** 00-2400 Studies	**26** 00-2400 Ops.	**27** 00-2400 Ops.	**28** 00-2400 Ops.
29 00-2400 Ops.	**30** 00-1800 Ops. 18-2400 Timing					

VUV SCHEDULE - October 2002						
Sun	Mon	Tue	Wed	Thu	Fri	Sat
		1 00-2400 Ops.	**2** 00-2400 Ops.	**3** 00-2400 Ops.	**4** 00-1800 Ops. 18-2400 Studies	5 00-2400 Ops.
6 00-2400 Ops.	**7** 00-2400 Ops.	**8** 00-0800 Ops. 08-2400 Studies	**9** 00-2400 Maint.	**10** 00-2400 Maint.	**11** 00-1800 Ops. 18-2400 Timing	12 00-2400 Ops.
13 00-2400 Ops.	**14** 00-1800 Ops. 18-2400 Timing	**15** 00-2400 Ops.	**16** 00-2400 Ops.	**17** 00-2400 Ops.	**18** 00-1800 Ops. 18-2400 Studies	19 00-2400 Ops.
20 00-2400 Ops.	**21** 00-2400 Ops.	**22** 00-0800 Ops. 08-2400 Studies	**23** 00-2400 Studies	**24** 00-2400 Ops.	**25** 00-2400 Ops.	26 00-2400 Ops.
27 00-2400 Ops.	**28** 00-2400 Ops.	**29** 00-2400 Ops.	**30** 00-2400 Ops.	**31** 00-2400 Ops.		

VUV SCHEDULE - November 2002						
Sun	Mon	Tue	Wed	Thu	Fri	Sat
					1 00-1800 Ops. 18-2400 Studies	**2** 00-2400 Ops.
3 00-2400 Ops.	**4** 00-2400 Ops.	**5** 00-0800 Ops. 08-2400 Studies	**6** 00-2400 Maint.	**7** 00-2400 Maint.	**8** 00-1800 Ops. 18-2400 Timing	**9** 00-2400 Ops.
10 00-2400 Ops.	**11 Holiday** 00-1800 Ops. 18-2400 Timing	**12** 00-2400 Ops.	**13** 00-2400 Ops.	**14** 00-2400 Ops.	**15** 00-1800 Ops. 18-2400 Studies	**16** 00-2400 Ops.
17 00-2400 Ops.	**18** 00-2400 Ops.	**19** 00-0800 Ops. 08-2400 Studies	**20** 00-2400 Studies	**21** 00-2400 Ops.	**22** 00-2400 Ops.	**23** 00-2400 Ops.
24 00-2400 Ops.	**25** 00-2400 Ops.	**26** 00-2400 Ops.	**27** 00-2000 Ops. 20-2400 Maint.	**28** 00-2400 Maint.	**29** 00-2400 Maint.	**30** 00-2400 Maint.

VUV SCHEDULE – December 2002						
Sun	Mon	Tue	Wed	Thu	Fri	Sat
1 00-2400 Maint.	**2** 00-2400 Maint.	**3** 00-2400 Maint.	**4** 00-2400 Maint.	**5** 00-2400 Maint.	**6** 00-2400 Maint.	**7** 00-2400 Maint.
8 00-2400 Maint.	**9** 00-2400 Maint.	**10** 00-2400 Maint.	**11** 00-2400 Maint.	**12** 00-2400 Maint.	**13** 00-2400 Maint.	**14** 00-2400 Maint.
15 00-2400 Maint.	**16** 00-2400 Maint.	**17** 00-2400 Maint.	**18** 00-2400 Maint.	**19** 00-2400 Maint.	**20** 00-2400 Maint.	**21** 00-2400 Maint.
22 00-2400 Maint.	**23** 00-2400 Maint.	**24** 00-2400 Maint.	**25** 00-2400 Maint.	**26** 00-2400 Maint.	**27** 00-2400 Maint.	**28** 00-2400 Maint.
29 00-2400 Maint.	**30** 00-2400 Maint.	**31** 00-2400 Maint.				

Tailor-Made Polymer Nanocrystals

Lei Zhu[1], Ping Huang[1], William Y. Chen[1], Qing Ge[1], Roderic P. Quirk[1], Stephen Z. D. Cheng[1], Edwin L. Thomas[2], Bernard Lotz[3], Benjamin S. Hsiao[4], Fengji Yeh[4] and Lizhi Liu[4]

[1]University of Akron, [2]Massachusetts Institute of Technology, [3]Charles Sadron Institute, Strasbourg, France, [4]State University of New York at Stony Brook

Chemicals made of chain molecules called block copolymers can self-assemble into various ordered structures, such as lamellae, cylinders, and spheres. Using self-assembled crystalline-amorphous block copolymers, scientists have grown ordered polymer nanocrystals, which are expected to be used in advanced optical applications. X-ray scattering studies at the NSLS revealed that, simply by varying the crystallization temperature, the tiny crystals can orient in different directions with respect to the interface between the crystalline and amorphous domains in the copolymer. Crystal growth can also be tailored in specific directions by conforming to the geometry of the block copolymer nanophases at high temperature.

Polymers in a confined space of a few nanometers, or billionths of a meter, are expected to exhibit a different structure, stability and morphology than ordinary bulk polymers. For instance, the polymers can be confined in mesoporous inorganic materials, which are made of pores that are 2 to 50 nanometers in diameter. But if no specific interactions occur between the inorganic material interfaces and the crystalline polymers, it is very difficult to drive polymers into the nanopores.

To avoid this constraint, a team of scientists from the University of Akron in Ohio, the Massachusetts Institute of Technology, the Charles Sadron Institute in Strasbourg, France, and the State University of New York in Stony Brook has been successfully using mesophases (typically ordered phases with submicron sizes) of a crystalline-amorphous diblock copolymer – which form by simultaneous self-assembly process – to study confined polymer crystallization in nanospaces.

The copolymer, called polystyrene-*b*-polyethylene oxide (PS-*b*-PEO), is made of polystyrene (PS), an amorphous polymer with a glass transition temperature of 100 degrees Celsius, and polyethylene oxide (PEO), a crystalline polymer with an equilibrium melting temperature of 69 degrees Celsius. Because of their distinct chemical

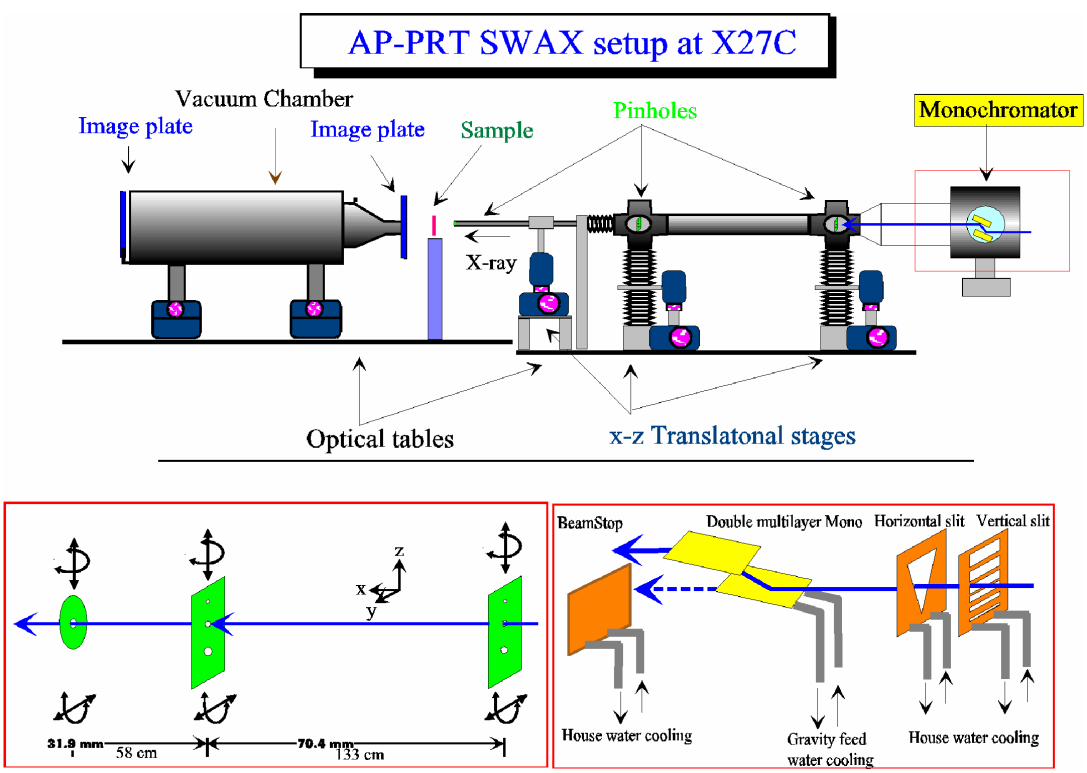


***Figure 1**. Experimental setup for simultaneous SAXS and WAXS at beam line X27C at NSLS.*

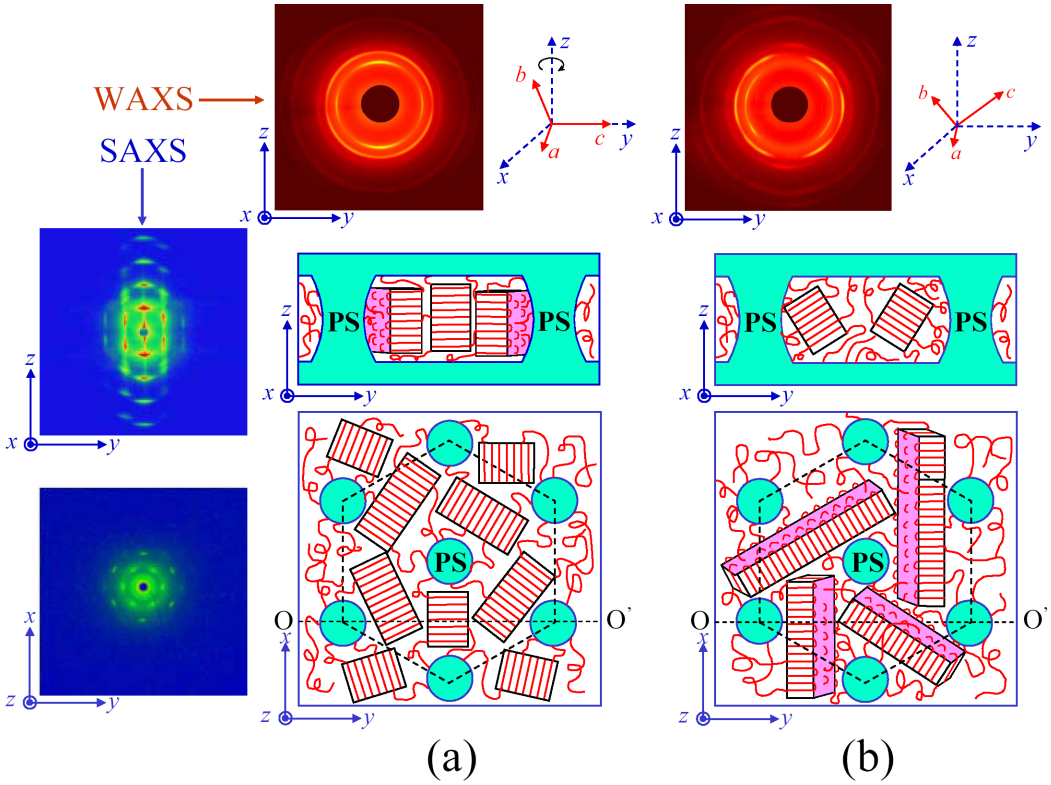


Figure 2. *Nano-tailored PEO crystalline morphologies at (a) -50 °C ≤ T_c ≤ -10 °C and (b) T_c ≥ 0 °C. A nanophase is defined by x, y, and z, and crystal unit cell axes are a, b, and c. The top view of the HPL phase is shown at the bottom, and the side view at the top.*

nature, PS and PEO strongly segregate from each other, so after the PS matrix glassifies, the crystallized PEO blocks are completely confined within the nanospaces of the copolymer.

The PEO nanocrystals were investigated on macroscopically-oriented (a single domain in microns or even milimeters) PS-*b*-PEO single crystals using simultaneous small and wide-angle X-ray scattering (SAXS and WAXS) techniques at the NSLS' Advanced Polymer beam line X27C. The detailed experimental setup is displayed in **Figure 1**.

High-resolution SAXS revealed that the PS-*b*-PEO sample with 0.39 percent of PEO in volume exhibits a hexagonally perforated layer (HPL) phase, where the PS and PEO layers are alternating and each PEO layer is made of two-dimensionally packed PS perforations, as shown in **Figure 2**.

The researchers also studied how the nanolayers and nano-PS cylinders in the PEO layers affect the crystallization behavior of the PEO blocks. The WAXS results showed that the PEO crystal orientation in the HPL phase changes with the crystallization temperature. At low temperatures, the PEO crystals preferentially arrange parallel to the layer plane (**Figure 2a** top), while above zero degree Celsius, the crystals become inclined with respect to the layer plane (**Figure 2b** top). The team also noticed that the ribbon-like PEO crystal grows along the arrays of the hexagonal PS perforations (**Figure 2b** bottom).

Surprisingly, the WAXS experiments showed that crystal orientation forms in an early stage of crystallization with a crystallinity of ~ 7 weight percent. The early stage crystal orientation clearly reflects the confined effect on polymer crystallization in nanospaces.

These results not only show the scientists' ability to manipulate polymer crystalline morphologies confined in nanospaces, but also reveal the details of polymer crystallization on the nanoscale. Further study will investigate the crystal orientation mechanism and explore polymer crystallization in compounds with more elaborate mesophases, such as double gyroids.

This work was supported by the National Science Foundation (DMR) and the Department of Energy (DOE). For more details of this work, see: Zhu, L. et al. "Nanotailored crystalline morphologies in hexagonal perforated layers of a self-assembled PS-b-PEO diblock copolymer," Macromolecules, ***35****, 3553 (2002).*

User Administation Report

Mary Anne Corwin
User Administrator

Safety Approval Form

Important! New URL!
http://130.199.76.84/safety/default.asp

Several modifications have been made recently to the safety approval form system. In May, the system was moved to a new server and is now accessed through the URL listed above and can also be found by going to the NSLS Home Page >> User Information >> 1. Getting Beamtime >> Safety Approval Form.

Information and Help links have been updated and certain functions that were unavailable during the transition to the new server, such as the ability to create a new form based on an existing one, have been fixed. Due to software upgrades on the new server, browser choices are now limited to Internet Explorer (v. 5.5 or later) and Netscape (v. 6.2 or later). Additional modifications will be made over the next few weeks.

End of Run Form

As part of our annual DOE reporting process, the NSLS is required to ask users to take part in a user satisfaction survey to provide requested feedback to the Office of Basic Energy Science (BES) and to improve user services and the NSLS facility. All users are asked to complete the survey after completion of each experiment. It is important to provide feedback so that appropriate NSLS staff and beamline staff can address any concerns or problems experienced. The form is completed online at http://nslsweb.nsls.bnl.gov/nsls/dbforms/end-of-run.asp.

Requests for Visits by Foreign Nationals

New Department of Energy orders are expected within the next few weeks regarding visits and assignments by foreign nationals to DOE sites. Users will be notified of any changes to policies and procedures by email as soon as we have them. In the meantime, however, it is important for new users and those users with expired appointments to register in BNL's Guest Information System at least 30 days prior to the intended visit. This is the same form used by all guests to register and is found online by going to the NSLS Home Page >> User Information >> 2. Before You Arrive >> Registration for All Users.

User Safety Training ONLINE!

As announced over the last year, User Administration and the NSLS Training Coordinator have made it easier for new users and those whose training has expired to complete their training online prior to arrival at BNL, saving considerable valuable time and allowing users to get onto the experimental floor quickly. More than 1100 users have taken advantage of the online system since it became available in April of last year. We encourage all our users to try out this system. Go to: NSLS Home Page >> User Information >> 2. Before You Arrive >> Safety Training. Then complete the two modules as requested.

Shopping Shuttle

Free

Courtesy of BSA

Free

The **Saturday Shopping Shuttle** is a free shuttle, which will make multiple trips between BNL and the Southport Shopping Center during the hours of 8:30 a.m. through 12:00 noon every Saturday.

Time and place of the first shuttle pick up:

8:30 a.m.	Fleming House, Bldg. 180
8:35 a.m.	Curie House, Bldg. 258
8:45 a.m.	Children's Outdoor Shelter (Lollipop House)
8:50 a.m.	Efficiency apartments 41-42

The last shuttle to return to the Laboratory will depart at 12:00 noon from Waldbaum's Supermarket.

The **Wednesday Shopping Shuttle** is a free shuttle, which will make multiple trips between BNL and the Southport Shopping Center during the hours of 5:00 p.m. through 8:30 p.m. every Wednesday.

Time and place of the first shuttle pick up:

5:00 p.m.	Fleming House, Bldg. 180
5:05 p.m.	Curie House, Bldg. 258
5:15 p.m.	Children's Outdoor Shelter (Lollipop House)
5:20 p.m.	Efficiency apartments 41-42

The last shuttle to return to the Laboratory will depart at 8:30 p.m. from Waldbaum's Supermarket.

for more information and store listings for the Southport Shopping Center:
https://fsd84.bis.bnl.gov/staffServices/menu/transportation/ShoppingShuttle.htm

X-Ray Ring Status

Jeff Rothman
X-Ray Ring Manager

The X-Ray ring has been running reliably since the end of the winter shutdown. During the spring shutdown the diagnostics group ran cables to begin the process of moving the beam position monitor receivers outside the ring. The receivers will be moved two at a time during the monthly maintenance periods. Increasing the ring energy to 2.8 GeV accelerated the rate of radiation damage to these devices. The resulting failures interrupt operations and are a maintenance nuisance. The receivers were originally installed inside the ring out of concern that long lengths of coaxial cable would introduce errors in the beam position measurements. Operation of the active interlock receivers at the end of long cables for 15 years has demonstrated that this is not a problem. The diagnostics group upgraded components of the active interlock system to prepare for the installation of future insertion devices. Micros were also upgraded to improve the video quality on monitors displaying X-Ray Ring parameters.

Technicians in the RF group have been carefully adjusting the output tuning and coupling of the 150KW amplifiers to damp out 1GHz oscillations. The newly purchased IMAC tubes are more prone to this problem than the old ones. The oscillation is sensitive to amplifier loading. As the ring is ramped, the loading changes, leading to instabilities and beam dropouts. We plan to solve this problem in the long run by isolating the amplifier from the cavity with a circulator. Unfortunately, a circulator had been installed but was damaged and needed to be removed. The Vendor is investigating the cause of the failure. RF cavity #1 developed a very small intermittent leak in April. While it did not significantly affect operations, it did cause the lifetime to fluctuate and drop as low as 12Hrs. Vacuum technicians tracked down the problem to one of the higher order mode damping probes. A small water leak had corroded the ceramic to metal brazed joint, leading to an air leak. Replacing the probe corrected the problem. The third new RF cavity was delivered on May 10th and will go through numerous pre-installation tests. All ancillary components have been assembled and tested and will be installed in the cavity for testing and conditioning. We will install the cavity during the winter shutdown.

Over the years, demand on the experimental water system has increased. A third pump was added during the spring shutdown to maintain the flow rate. As part of the preventative maintenance program, the water systems group replaced actuators and controls for the dampers in the cooling towers. The dampers control the airflow inside the tower. The chilled water was also chemically treated to reduce bacterial growth and the resulting loss of heat transfer.

VUV-IR Ring Status

Stephen Kramer
VUV Ring Manager

The VUV-IR ring came back from the spring shutdown on schedule, thanks to a major effort put forth by the Mechanical Group. The Booster and VUV-IR ring safety shutter started leaking several weeks before the start of the shutdown. The Mechanical Group made a major effort to build a replacement shutter, from scratch, in record time and install it during the one-week shutdown. Despite the tight time schedule, the dedication, skill and planning by everyone in the Mechanical Group, once again saved the day. The new shutter was welded into a tight spot where the welder couldn't even see the back surface, but worked using a mirror. The shielding was back together again within the week and final maintenance work was completed. Operations commenced 6 hours before scheduled operations. In addition, the Mechanical Group completed all of the other maintenance items that were originally scheduled for this shutdown.

Since there wasn't a ring vacuum chamber bleed-up during the spring shutdown, the lifetime recovered to the pre-shutdown level within hours of storing beam. The replacement of the front-end vacuum valves has been postponed due to lack of funding. Work has been continuing on the installation of the new front-end interlocks on the ring using the PLC system. This will provide increased flexibility for the interlock system as new and upgraded beamlines are added.

Need a Bicycle at BNL?

the NSLS has 5 new bicycles available

call Michelle Herman
(631) 344-8481

Focus On . . .

Operations Division

Where the light is ***always*** *on…*

Operations	Electrical	Mechanical
NSLS Operations Division		

Erik Johnson
Associate Chair for Operations

The NSLS has the highest reliability of any of the DOE synchrotron light sources. It has become so much a hallmark of the place that people take it for granted and assume it is no more difficult than flipping a light switch. In fact nothing could be further from the truth. Keeping the NSLS accelerator complex running at the high level of performance our users have come to expect is the passion and shared mission of the **O**perations **D**ivision staff. They are justifiably proud of their role in enabling our user community to make the NSLS the most scientifically productive of the DOE facilities.

In fact, the Operations Division might be more properly called the NSLS Operations and Engineering Division since we design, fabricate, and maintain the NSLS complex of accelerators and utilities, as well as operating them 24 hours a day, 7 days a week, on average 44 weeks a year. With its three sections (Operations, Electrical, and Mechanical) we are the largest of the four NSLS divisions, with 88 staff members and 6 assigned craftsmen from Plant Engineering.

Inevitably with a facility of this complexity something does go awry. When it happens, the staff quickly shifts gears from their development and preventive maintenance activities to focus on troubleshooting, and repairing the root cause of the problem to return to normal operations. Sometimes these problems are simple to resolve, or as in the case of the recent UV injection shutter failure, can be significant activities that require a coordinated effort across the whole division. Providing a detailed look at our staff and their work would require 20 or so of the usual 'Focus On' articles that highlight activities at the group level. Instead this article provides a broad overview of whole sections and their areas of responsibility.

The **O**perations Section
(Richard Heese, Head; Eric Blum, Deputy)
concerns itself with providing beam to the users efficiently, reliably and stably at or beyond scheduled operations levels. It includes the injection, VUV, and X-ray managers as well as the operators and operations coordinators. They provide user support on the floor to assure safe operations of the NSLS beamlines. The section also provides for the accelerator computing, control, and operational programs as well as administrative computing and networking for the NSLS staff and users. Should

the performance of the NSLS machines falter, the Operations Section is the first line to diagnose and if possible correct the problems. Should it prove necessary, they can call on our engineering sections for support.

The **E**lectrical Section
(Richard Biscardi, Head; Emil Zitvogel, Deputy)
is responsible for the design, implementation and operation of electrical and electronic equipment for the machines. At last count, this includes over 1600 discrete pieces of accelerator equipment, of which 96 are high power systems that generally cannot be serviced unless two qualified people are available. That doesn't include all of the distribution gear and wiring that delivers power from the NSLS's four 2.5 MW sub-stations to the machine and user beamlines. Most of the section staff are available for emergency call-in to aid in diagnosing and repairing problems that impact on user operations.

The **M**echanical Section
(Ed Haas, Head; Payman Mortazavi, Deputy)
provides mechanical project engineering, design, fabrication, assembly, alignment, and installation support to the NSLS community. With approximately 25,000 custom mechanical drawings on file, the Mechanical Section is involved with everything from systems that fit in the palm of your hand to projects spanning the entire Light Source. This also includes utilities (cooling water, compressed air, cryogens, HVAC) and vacuum engineering and technical support for both accelerator and user systems. The section's technicians additionally provide services that include machining, inspection, magnet winding, surveying, and preventive maintenance. As with the Electrical Section, the Mechanical Section staff provides emergency call-in services should the need arise.

NSLS has a long-standing tradition of 'keeping the light on' for our users. The Operations Division has played an integral part in making that a reality in the past. Looking to the future the experience and expertise of the **O**perations **D**ivision will be a key element of NSLS upgrade development to maintain the tradition that keeps the NSLS one of the liveliest and most productive research facilities in the world.

Conducting-Insulating Materials Reveal Their Secrets

Patrice Pages
Science Writer, NSLS

Research by physicists at Brookhaven National Laboratory provides new insight into why some materials made of stacks of metallic planes are conductors in the direction of the planes and are insulators in the direction perpendicular to the planes. Such behavior is in marked contradiction with scientists' traditional understanding of metallic conductivity, where the electrical current is carried by electrons in every direction. Understanding how materials that are both conducting and insulating will help scientists gain new insight into superconductors – materials that conduct electricity with no energy loss.

Scientists have suspected that the dual conducting-insulating property is due to electrons interacting so strongly with each other that they do not move individually, but collectively, to carry the current within the planes. But there has been no evidence of such interactions – until now.

"A material that is both conducting and insulating is quite intriguing," says Brookhaven physicist Tonica Valla, the lead author of the study, which appears in the June 6, 2002, issue of Nature. "Such a dual behavior has puzzled physicists for several years. And though theoretical explanations have been suggested, we now show for the first time that the strength of the interactions between excited electrons influences their behavior."

Valla and his collaborators from Brookhaven, the University of Connecticut in Storrs, Princeton University, and Osaka University in Japan studied two different conducting-insulating materials, and showed that electrons that were confined in the planes at high temperatures are able to move between the planes at lower temperatures, allowing the material to behave more like a metal.

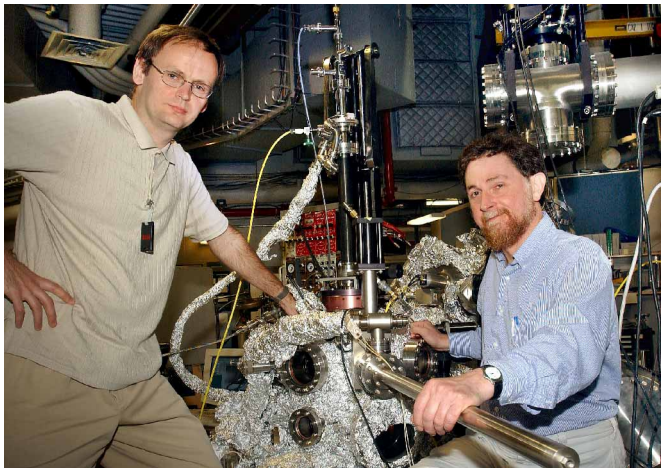
The "critical" temperature at which the change occurs ranges between -100 and -300 degrees Fahrenheit, depending on the material.

"These planes act like trains and electrons like passengers in the trains," says study coauthor Peter Johnson, a Brookhaven physicist. "At high temperatures, the electrons are bound together in the planes like passengers inside moving trains. Then, below the critical temperature, the electrons are not bound anymore and start moving around in the same way as passengers leave a stopped train."

To examine the interactions between the electrons, the scientists used extremely intense ultraviolet light generated by the NSLS. They looked at how the light excites the electrons in each of the three materials, and used a method called angle-resolved photoemission spectroscopy (ARPES) to accurately measure the intensity of the

light emitted by the electrons as a function of their energy. The resulting ARPES spectrum was determined for various temperatures.

Below the critical temperature, a signal started to appear in the spectrum. Weak at first, the signal became more apparent as the temperature decreased. "This signal is the telltale evidence of individual electrons," Valla says. "Theorists had predicted the existence of such a signal, but nobody had observed it before."



Physicists Tonica Valla (left) and Peter Johnson at the National Synchrotron Light Source, beamline U13, where they study the properties of conducting/insulating materials.

The results of this study promise to provide further insight into how superconductors conduct electricity without heat dissipation when they are cooled below a certain temperature. In particular, the cause of high-temperature superconductors, with critical temperatures ranging from -396 to -216 degrees Fahrenheit, remains mysterious, but is assumed to be due to strong interactions between electrons.

The new study also gives insight into materials with new electrical and magnetic properties, expected to arise from strong interactions between electrons. "We expect to see dramatic new results and applications stemming from the study of materials with strongly-interacting electrons," Johnson says.

This work was funded by the U.S. Department of Energy, which supports basic research in a variety of scientific fields.

The User's Role in Reviewing Experiments

Andrew Ackerman
Safety Officer

Early this year, we had an important event involving our experimental review program occur during one of our protein crystallography experiments. Although this was a protein experiment, the concerns raised pertain to our review process in general and have implications for all of the experiments at our beamlines. Please read on and help us get this message out to all of our Users.

In January, we had a new researcher come to a crystallography beamline to study a bacterial toxin. He knew our requirement for submitting the details of his experiment with a Safety Approval Form (SAF) and did provide that form several days before coming to the NSLS, but took no further action and did not check the status of his SAF before coming to the beamline. Upon his arrival, he called our Operations Coordinator to start his experiment. The Coordinator located his form in the system, but found that it was not yet approved and so he contacted me. When I read the form, I saw that the experiment was not a routine crystallography run. The sample to be studied was a potent toxin that could present risk to personnel who handle it. The toxin was also listed on the Center for Disease Control and Prevention (CDC) list of "Select Agents". This caused considerable disruption at BNL because there was concern over the potential hazards and because materials on the Select Agent list are carefully regulated, including fines for violation that could exceed one hundred thousand dollars.

After much discussion with several people at the Laboratory, we learned that the quantities of material involved with this experiment were exempt from the CDC requirements. We also were able to define acceptable handling requirements to control risks to the personnel working at the beamline and, although there was considerable delay, this researcher did have an opportunity to put his samples in the beam. Everyone was pleased with this happy ending, but we would have preferred to investigate these requirements prior to the researcher's arrival, and that is what I would like to emphasize in this article.

The success of our experimental review program relies on the receipt of timely information from our Users. We have always asked our researchers to be forthcoming with their plans and to actively pursue approval of their work before expecting to start an experiment. Please remember that the required one week lead-time for submitting Safety Approval Forms applies only to routine

experiments that present little risk. For all other work, we ask that you contact the NSLS ES&H staff directly as early as practical to involve us in the planning of your experiment. We also ask that you take an active role in the review of your proposal. For all experiments, please do not assume that your experiment is approved. If you have not heard from us, you can check on the status of your form at our Web page or you can call the Operations Coordinator in the Control Room and ask that he or she check its status.

I was really quite surprised when this event occurred as my experience has been that our Users always call or email long in advance when planning non-routine experiments. We have to maintain our good record with reviewing experiments and controlling the risks they present. This program gets considerable attention, and the Laboratory expects us to maintain adequate oversight and control of the experiments we perform. We believe we have a good program. Please help us keep it working well.

News and Notable

NSLS user elected into the National Academy of Sciences

Congratulations to NSLS user Jennifer Doudna (Howard Hughes Medical Institute and Yale University) upon her election into the National Academy of Sciences in April 2002. Election to membership in the Academy is considered one of the highest honors that can be accorded a U.S. scientist or engineer. The total number of active members is 1,907.
http://www4.nationalacademies.org/nas/nashome.nsf

Successful environmental audit at NSLS

The NSLS was successfully audited on June 6 by independent reviewers who examined the environmental management program for compliance with ISO 14001 standards. This review was part of a Laboratory-wide evaluation. The reviewers were very complimentary of the NSLS program and staff. During their review, the auditors examined such topics as: training records, procedures, inspection results, waste generation trends, program documents, and incidents. The program will continue to be audited annually.

2002 Dissertation Award in Beam Physics awarded to NSLS Scientist, Boris Podobedov

Congratulations go out to NSLS scientist, Boris Podobedov, for being awarded a 2002 Dissertation in Beam Physics Award from the American Physical Society. Boris' award was presented for "an experimental study of the microwave instability in the SLC damping rings using a streak camera to correlate each event to the RF. The development of this sophisticated technique provides a powerful tool for the study of non-linear instabilities above threshold."
http://www.aps.org/praw/dissbeam/02winner.html

Fun with Science on "Take our Daughters to Work Day"

On April 25, over 20 daughters learned about some of the scientific programs at the NSLS, and even performed their own scientific experiments. The one-day visit was part of the national "Take our Daughters to Work Day." For photos and details, visit:
http://nslsweb.nsls.bnl.gov/nsls/sci&tech/news_daughters02.htm

Mark your Calendar

Hands-on Short Course in
EXAFS Data Collection and Analysis
September 23-25, 2002
National Synchrotron Light Source

This course will cover all aspects of EXAFS data collection and analysis: from sample preparation to first shell fitting. The course is targeted towards new users and young scientists. For full details, check the NSLS homepage.

NSLS 2001 Activity Report Now Available

The 2001 NSLS Activity Report is now available in print and on the web. To view the online version, go to:
http://nslsweb.nsls.bnl.gov/nsls/pubs/actrpt/2001/title_page.pdf
If you would like to receive a printed copy, you can request one online at:
http://nslsweb.nsls.bnl.gov/nsls/pubs/actrpt/Default.htm

Imaging Guidebook Now Available for Download

Thanks to all of the speakers at the recent NSLS Imaging and Microspectroscopy workshop, held during the 2002 Users' Meeting, a new "Guidebook for Imaging and Microspectroscopy at the NSLS" has been compiled and is now available for download at:
http://nslsweb.nsls.bnl.gov/nsls/pubs/nslspubs/imaging0502/imaging0502.htm

The NSLS Newsletter is printed on paper containing at least 25 percent recycled materials, with 10 percent post-consumer waste.

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 2003	Monday September 30, 2002

General User Proposal and Beam Time Request Forms including instructions can be found at:
http://nslsweb.nsls.bnl.gov/nsls/users/procedures/proposals.htm
Proprietary Proposal Forms including instructions can be found at:
http://nslsweb.nsls.bnl.gov/nsls/users/procedures/proposals-prop.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. Do not send in SAFs with your proposal. Go to:
http://130.199.76.84/safety/default.asp

NSLS User Administration Office

General Information, User Registration, Training:
Phone: (631) 344-7976 Fax: (631) 344-7206

User Administrator
Mary Anne Corwin corwin@bnl.gov
Annual Users' Meeting
Lydia Rogers lrogers@bnl.gov
General User Proposals
Gretchen Cisco cisco@bnl.gov
Liz Flynn lflynn@bnl.gov

The *NSLS Newsletter* is published triannually by the Information and Outreach Office, National Synchrotron Light Source Department, Brookhaven National Laboratory

NSLS Information and Outreach Office

NSLSInfo@bnl.gov

Coordinator
Lisa Miller lmiller@bnl.gov
Layout/Design
Nancye Wright wright1@bnl.gov
Science Writer
Patrice Pages pages@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://nslsweb.nsls.bnl.gov