November 1999 NSLS Newsletter

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Demonstration of High Gain Harmonic Generation in a FEL

Michael Hart
NSLS Chairman

Users of the Accelerator Test Facility (ATF) at Brookhaven National Laboratory achieved an important milestone this summer in the research necessary to develop the next generation light source. A collaboration of scientists from BNL and ANL led by Li-Hua Yu from the NSLS reported the successful demonstration of High Gain Harmonic Generation (HGHG) in a Free Electron Laser (FEL) at the FEL-99 conference in Hamburg Germany in August. This important result shows dramatically the potential benefits of a laser seeded FEL as contrasted with the self amplified spontaneous emission (SASE) approach pursued at other laboratories.

In a sub-harmonically seeded HGHG FEL, a seed laser beam is coupled with an electron beam in a short undulator. The interaction between the laser and the electron beam generates an energy modulation in the electron beam which is converted to a spatial modulation (microbunched electron beam) in a dispersive magnet. The microbunched beam then passes through a radiator undulator, where the microbunched beam radiates coherently at one of the harmonics of the seed laser signal. The signal is then amplified exponentially. In the experiment just performed at the ATF, the facilities CO_2 laser provided the seed at 10.6 mm and amplification (to saturation) was achieved at 5.3 mm.

When it can be applied, the HGHG approach brings several advantages to the experiment. In user experiments, perhaps the most important feature is that the FEL output properties are tied to the characteristics of a high-quality longer wavelength laser source. This includes the stability and control of the central wavelength, the bandwidth, the pulse energy and the pulse duration. In SASE schemes, these parameters are controlled by the stability of the accelerator and by the statistical fluctuations associated with the noise that is the starting signal for the SASE process. An additional advantage of HGHG is that the length of undulator needed to achieve saturated output from the FEL is reduced when a laser generated seed provides the initial signal. For example, the data shown in **Figure 1** are the saturated HGHG output spectrum (from the 2 meter radiator) and the SASE signal spectrum (from the same undulator) multiplied by a factor of *one million* to be on scale! To achieve the same power level from a SASE experiment with these properties, the radiator would need to be 6 meters long.

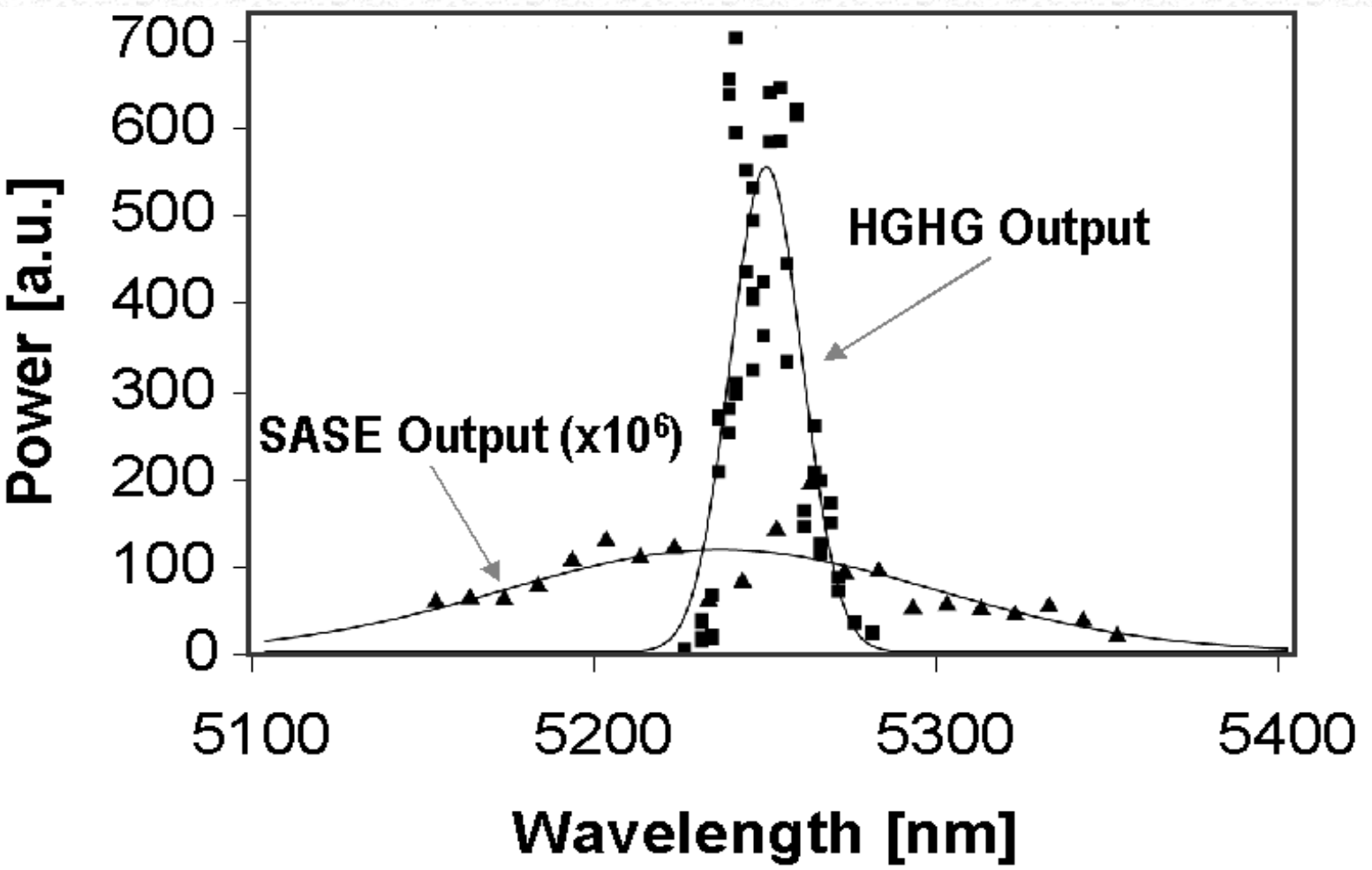

Figure 1: Power vs. wavelength for SASE and HGHG from the current experiment.

Further work is planned at the ATF on the current experiment, and the technique will be extended to shorter wavelengths when it is implemented at the DUV-FEL. The challenge will be to see if the technique can be extended still further, into the hard x-ray range, for a practical fourth generation x-ray source. Investigation of this question will be the cornerstone of our continued efforts to develop FEL science and technology.

The HGHG Experiment

The existing ATF photocathode rf gun, linac, and CO_2 laser, define the electron and seed beam design parameters shown in the schematic of the HGHG experiment (**Figure 2**). The value of the beam energy was specifically tailored to achieve the FEL resonance condition with the hardware described. Details of the collaboration are given in the box opposite. Based on the design parameters, the output power predicted by theory and simulation is 35 MW for the 2 m radiator.

Figure 2: Schematic of the HGHG Experiment.

As a prelude to performing the full HGHG test, beam was passed through the radiator section and SASE radiation was measured at 5.3μm. It was found to be about 10 times larger than the spontaneous radiation. Proceeding toward HGHG, the CO_2 laser was operated at high power to synchronize and align it to the electron beam in the energy modulation undulator. The energy spread of the electron beam was measured with a spectrometer, confirming the coupling of the laser to the electron beam. In fact, while this measurement confirms alignment and coupling, the energy modulation it produces is so large that the electron beam does not microbunch properly for FEL operation. To obtain optimum HGHG output, the power from the CO_2 laser was actually reduced to about 0.5 MW. To compare the SASE and HGHG power, an InSb detector was used, although to measure the HGHG power

attenuation of 10^6 was inserted to keep the detector from saturating. Even with this attenuation, the HGHG signal is two to three times that of the unattenuated SASE beam. In a separate measurement, a maximum HGHG pulse energy of 65µJ was directly measured using a Joule meter. At the same time, the electron pulse length was determined to ~6 ps FWHM. If the radiation pulse is also 6 ps (actually, it is more likely to be shorter), then the output would be 11 MW compared with the spontaneous radiation power of 0.5 W. These two independent measurements agree with theory that the HGHG output is $2x10^7$ times larger than the spontaneous power for this experiment. The HGHG beam was also imaged with a Pyroviewer camera (shown below).

Pyroviewer image of radiation

The camera was fitted with a series of filters to block the CO_2 light and select a 2% bandpass centered around 5.3µm. Images obtained with either the laser or electron beam off show only background, confirming that both are required to obtain an image at 5.3µm. Removing the bandpass filter made essentially no difference in the image, demonstrating that the observed radiation is centered about 5.3µm. The measurement of the spectra for the SASE and HGHG FEL output is shown in **Figure 1**. Note that the SASE bandwidth is six times larger than the HGHG bandwidth of ~20 nm. If the radiation is assumed to be Fourier transform limited, the observed bandwidth would translate to a pulse length of about 1.5 ps. Measuring the pulse length is an important aspect of continuing work on the experiment. If the 1.5 ps duration proves to be correct, the peak power would be 44 MW. This result would then be closer to the theoretical and simulated predictions of 35 MW. It is important to note that even at this preliminary stage, many of the theoretical predictions for the HGHG process have been confirmed. Harmonic generation has been demonstrated, and the HGHG power was measured to be $2x10^7$ larger than the spontaneous emission. As a proof of principle experiment for the DUV-FEL project, and future seeded X-ray FEL schemes, the HGHG experiment provides an opportunity for further detailed comparison with theory, and may pave the way for future x-ray FEL developments.

The Collaboration

Resources for the development of FEL's have been extremely limited so many collaborative teams have formed to push the field forward. The present HGHG experiment is a BNL experiment in collaboration with ANL.

The key principle is based on theoretical work of BNL scientists nearly a decade ago [L. H. Yu, Phys. Rev. A, 44, 5178 (1991)]. To implement the experiment, the bright electron beam of the BNL-ATF and its CO_2 laser were combined with some venerable hardware and ingenuity to arrive at the present result.

The ATF provides an ideal electron beam for single-pass free electron laser development and was the natural platform to support the HGHG experiment. To assemble the required magnetic structures, the BNL-NSLS `mini'-undulator (the X1 prototype) was called out of retirement as was the `Cornell Undulator' (the ANL-APS `Undulator A' prototype). These devices were rebuilt, remeasured and shimmed by their owners and combined with a new dispersive magnet built by NSLS for this experiment. New diagnostics were developed and correctors were borrowed from the DUV-FEL NISUS magnet for the radiator (the `Cornell Undulator') to complete its adaptation for use in the HGHG FEL.

The HGHG experimental team members from Argonne include: Sandra Biedron, John Galayda, Efim Gluskin, Jack Jagger, Vadim Sajaev, Issac Vasserman. At BNL, beside team leader Li-Hua Yu, the following individuals participated in the experiment: Marcus Babzien, Ilan Ben-Zvi, Lou DiMauro, Adnan Doyuran, Bill Graves, Erik Johnson, Sam Krinsky, Bob Malone, Igor Pogorelsky, John Skaritka, George Rakowsky, Lorraine Solomon, Xijie Wang, Marty Woodle, and Vitaly Yakimenko.

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Ribosome Redux at NSLS Crystallography Stations

Malcolm Capel

BNL Biology

Crystallographers from the Medical Research Council (Cambridge, UK) and Yale University have recently reported progress towards determination of the molecular structures of the small and large ribosomal subunits, with data obtained at NSLS crystallography beamlines X12B and X25[1,2]. The ribosome is the ubiquitous cellular organelle responsible for **R**ibo**N**ucleic**A**cid (RNA)-programmed chemical synthesis of protein molecules, a process also known as translation. Venki Ramakrishnan, *et al*., of the MRC (formerly of BNL's Biology Department and University of Utah) presented a model of the 30S (small) ribosomal subunit of the thermophilic bacterium *Thermus thermophilus*. Thomas Stets, Peter Moore and co-workers in the Department of Molecular Biophysics and Biochemistry, Yale University, reported the structure of the 50S (large) ribosomal subunit of halophilic bacterium *Haloarcula marismortui*. The ribosome is, by far, the largest and most complex component of the cell to be successfully studied via x-ray crystallography. These two independent research efforts, each a *tour de force*, point the way for future emphasis in biological crystallography: the study of large, multi-subunit functional complexes of proteins and nucleic acids.

Ribosomes are comprised of small and large subunits, conventionally labeled by their sedimentation rate constants: 30S and 50S, respectively (S=Svedburg units). In the case of bacteria, the 30S ribosomal subunit contains 21 different proteins and a single ribonucleic acid (rRNA) molecule, about 1540 nucleotides in length. The 50S ribosomal subunit contains 33 different proteins and two rRNAs, 120 and 2900 nucleotides in length. The total mass of the 30S subunit is ~ 900 kiloDaltons, while that of 50S subunit is ~1600 kiloDaltons. The ribosome translates the triplet-nucleotide genetic code of messenger RNAs (RNA transcripts of genes) into the chains of amino acids that make up proteins. The 30S ribosomal subunit is involved in recognition and editing processes that insure the accuracy of the translation of the mRNA nucleotide sequences into the protein amino acid sequences. The 50S subunit is known to contain the proteins and enzymatically active rRNA elements that actually perform the chemical steps involved in peptide bond formation.

Crystals of ribosomes were grown from solutions of purified subunits and flash frozen to -175ºC. Diffraction data was obtained from frozen crystals at NSLS crystallography beamlines X12B (Malcolm Capel, BNL Biology), X12C (Robert Sweet, BNL Biology) and X25 (Hal Lewis, Lonny Berman, NSLS). Experimental crystallographic phases were obtained from diffraction experiments using ribosome crystals modified with a variety of organic-heavy metal clusters (most importantly, clusters containing tungsten and osmium). The 30S subunit phasing effort used an Osmium cluster synthesized by Bruce Brunschwig of the Chemistry Department, BNL.

The MRC and Yale groups both presented electron density maps at about 5Å resolution. In density maps of this level of resolution, it is possible to differentiate protein from rRNA and to determine the positions and orientation of A-form helical regions of rRNA within the structure. The surface topology of both

subunits is revealed in detail, as is the geometry of the 30S-50S subunit interface, forming whole 70S ribosome complexes. This is important since the bulk of the enzymatic activities of the ribosome occur at the 30S-50S interface. The substrates that interact with the ribosomal surface during protein synthesis (transfer RNA, messenger RNA, initiation and elgation factor proteins) are large and bulky. Thus, even at 5Å resolution there is a reasonable chance of deducing the sites of interactions between substrates and the ribosome at different stages in the translation process.

Ramakrishnan's 30S subunit model (**Figure 1**) provides the location of all seven 30S ribosomal proteins for which molecular structures are known. The detailed topology (fold) of the central core of 30S subunit's 16S rRNA is traceable.

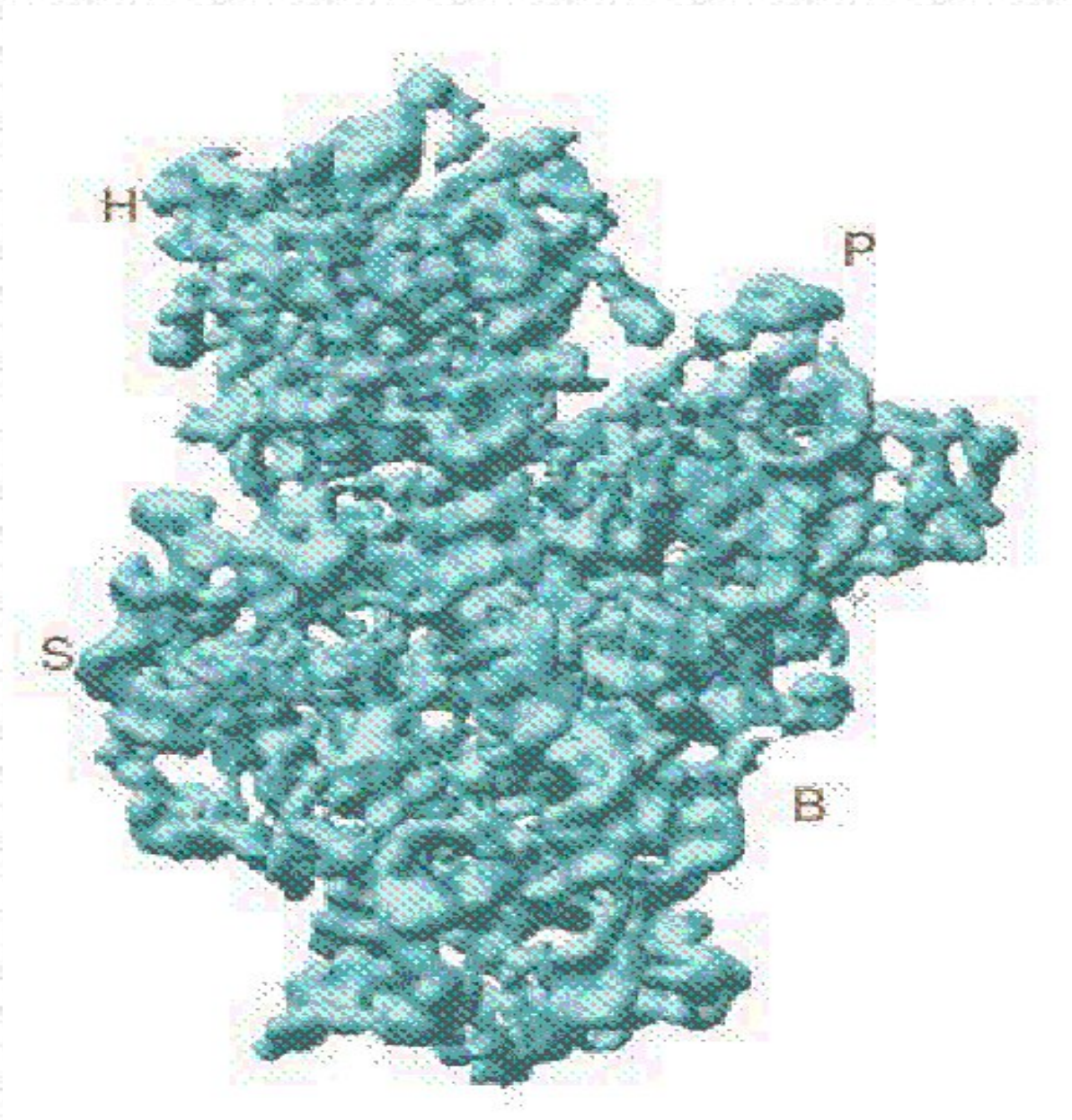

Figure 1: Ramakrishnan's 30S subunit model.

Interpretation of the 50S model (**Figure 2**) has yielded the position of the polypeptide exit channel, and

the locations of the binding sites for a number of translation factors including EF-G and transfer RNA (tRNA) complexed with elongation factor Tu. The positions of several large subunit proteins and a portion of the rRNAs have been determined.

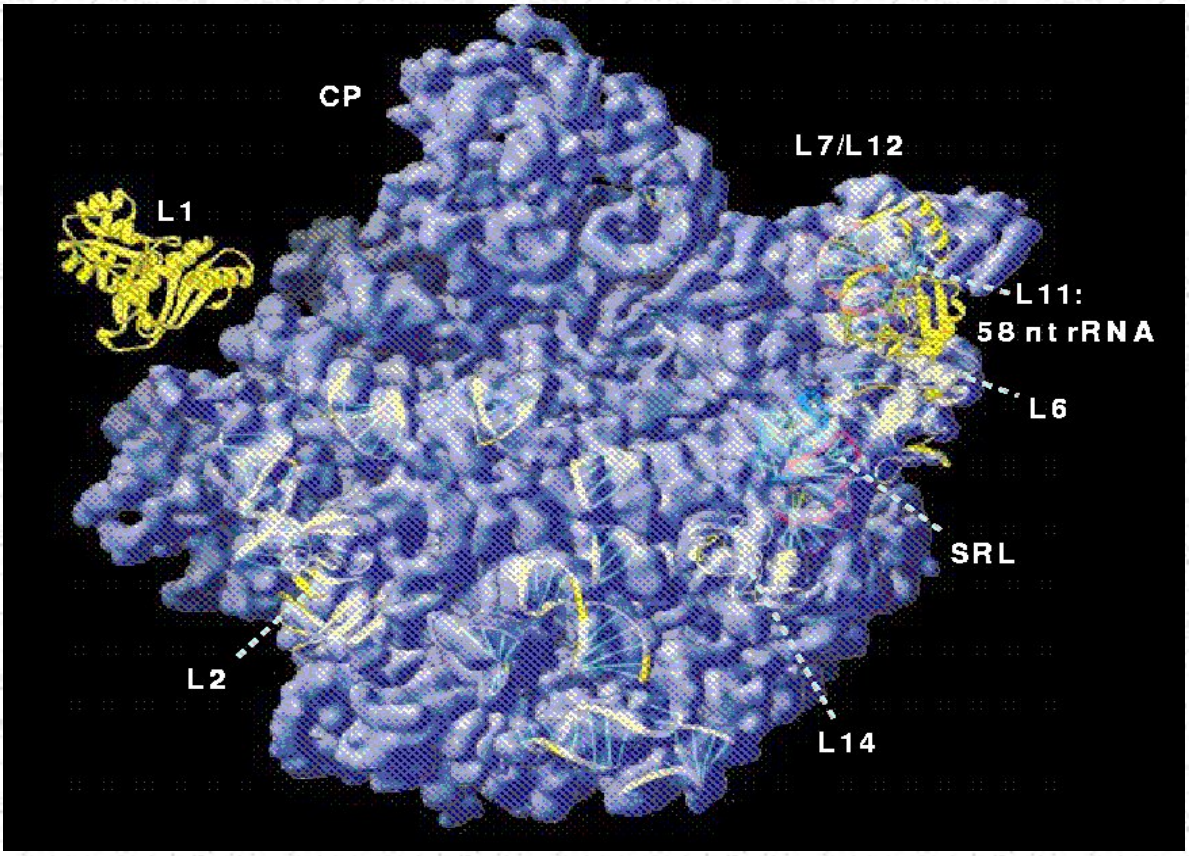

Figure 2: Ramakrishnan's 50S model.

Many medically important antibiotics are inhibitors of protein synthesis and interact directly with the ribosome or protein factors that act on the ribosome during protein synthesis. Detailed knowledge of ribosome structure may enable or assist rational drug design efforts targeting protein synthesis as the site of antibiotic action.

The ribosome has been the object of study of a number of long-term efforts that have relied on BNL structural biology facilities. In the 1970's and 80's Peter Moore, Don Engelman and co-workers from Yale used neutron diffraction to determine the 3-dimensional configuration of the 21 proteins of the 30S ribosomal subunit of the bacterium *Escherichia coli* [3]. The 3D map of the 30S ribosomal proteins was determined by measuring the distances separating the centers of mass of many different pairs of ribosomal proteins within the 30S subunit, in solution, by neutron diffraction methods at beamline H9B (Deiter Schneider, BNL Biology) of the High Flux Beam Reactor. The 30S neutron map, together with chemical crosslinking data showing where 30S proteins interact with 16S ribosomal RNA provided landmarks that were crucial to the interpretation of V. Ramakrishnan's x-ray diffraction data. Miroslav Boublik (deceased, formerly of the Roche Institute, NJ) collaborated with Joe Wall (BNL Biology), using BNL's Scanning Transmission Electron Microscope facility to study the process of reassembly of 30S and 50S ribosomes from their constituent proteins and rRNAs[4]. These observations were used to help understand the highly complex interactions between proteins and rRNA that are involved in ribosome assembly. In the early to mid 1990's V. Ramakrishnan and Steven White (then BNL Biology,

now in the Dept. Structural Biology, St. Jude's Children's Hospital, Memphis TN), isolated, crystallized and determined the molecular structures of a number of small and large ribosomal subunit proteins in isolation via x-ray crystallography[5,6,7], using data from NSLS beamlines X12B and X12C. The first low-resolution x-ray maps of the 50S ribosomal subunit were published a year ago by the Yale team, including Robert Sweet with data obtained at X12C and X12B[8].

The information from the two studies provides a firm basis for future work that also will rely on NSLS structural biology facilities. This work will include determining the location, orientation and fold of all ribosomal proteins within their respective subunit, and tracing out the complete fold of all of rRNAs not presently specified by the current model structures. In addition, both groups will extend their efforts to study functional complexes of ribosomal subunits representing different steps in the process of protein synthesis. The results in hand give much hope that a mechanistic understanding of the ribosome is a practical inevitability, in spite of the daunting complexity of the road ahead.

References

[1] W.M. Clemons Jr., J.L.C. May, B.T. Wimberly, J.P.

McCutcheon, M.S. Capel and V. Ramakrishnan, "Structure of a Bacterial 30S Ribosomal Subunit at 5.5? Resolution", *Nature*, **400**, 833-840, (1999).

[2] N. Ban, P. Nissen, J. Hansen, M. Capel, P.B. Moore and T.A. Steitz. "Placement of Protein and RNA Structures into a 5 ?-Resolution Map of the 50S Ribosoma subunit", *Nature*, **400**, 841-847, (1999).

[3] M.S. Capel, D.M. Engelman, B.R. Freeborn, M. Kjeldgaard, J.A. Langer, V. Ramakrishnan, D.G. Schindler, D.K. Schneider, B.P. Schoenborn, I.-Y. Sillers, S. Yabuki, and P.B. Moore. "A Complete Mapping of the Positions of the Proteins in the Small Ribosomal Subunit of *Escherichia coli"*, *Science*, **238**, 14031406, (1987).

[4] S.J. Tumminia, W. Hellman, J.S. Wall, and M. Boublik, "Visualization of the Protein-nucleic Acid Interactions

Involved in the *in vitro* Assembly of the *Eschericia coli* 50S Ribosomal Subunit", *J.Molecular Bio.*,**110**,84-89, (1994).

[5] V. Ramakrishnan and S. White, "Structure of Ribosomal Protein S5 Reveals Sites of Interaction with 16S RNA", *Nature*, **358**, 768-777, (1992).

[6] B.T. Winberly, S.W. White, and V. Ramakrishnan, "The Structure of Ribosomal Protein S7 at 1.9 ? Resolution Reveals a ?-hairpin Motif that Binds Double-stranded Nucleic Acids", *Structure*, **5**, 1187-1198, (1997).

[7] C. Davies, V. Ramakrishnan, and S. White, "Structural Evidence for Specific S8-RNA and S8-protein Interactions within the 30S Ribosomal Subunit: Ribosomal Protein S8 from *Bacillus stearothermophilus* at 1.9 ? Resolution", *Structure*, **4**, 1093-1104, (1998).

[8] N. Ban, B. Freeborn, P. Nissen, P. Penczek, R. Grassucci, R. Sweet, J. Frank, P. Moore, and T, T. Steitz, " A 9 Å Resolution Xray Crystallographic map of the Large Ribosomal subunit", *Cell*, **9**, 1105, (1998).

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Formal Close Out of Experimental Runs

Tom Dickinson

NSLS Safety Officer

A new beam-line close-out procedure has recently been adopted which is important to all users. Whenever a particular experiment has been completed on a beam line, it is important to notify operations that the run is over. It has been a long-standing requirement that an experimenter notify operations at the end of a run, but this can be easily forgotten and the Operations Coordinators have had no direct way to know when an experiment is no longer running at a beamline.

Without notification that the run is complete, it is possible for the next experiment to start up without involving the operation staff. Review by the operations staff prior to beam authorization is important to ensure that the conditions of the Safety Approval Form have been implemented before the experiment begins.

As a way to improve control of beamline turnover, the NSLS now requires that one experimenter listed on the SAF accept responsibility for notifying the Operations Coordinators at the end of the run. This is done with a short form, which lists the name and home institution phone number of the responsible individual along with a short explanation of how the system works. This form is posted at the beamline as a reminder, and the experiment is not placed on line until this is done. If a beamline is found on line after the experimental run is over, the responsible individual will be contacted for an explanation. Because of the importance of operations control of experiment start up, these events will be closely tracked. If you have accepted responsibility to make this notification, please pay careful attention to this requirement.

This program has been in place since late September and acceptance has been good. We expect to make refinements to minimize delays for users and extra steps for the Operations Coordinators.

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Administrative Update

Frank Terrano
Assistant to the Chairman

Work Permits

Web based work permits have become a reality. The NSLS Work Planning Manager along with the work Planning Coordinators are presently involved with BNL's Plant Engineering Division in implementing the next phase of the highly successful Work Planning and Control System at BNL. The initial system, also piloted by the NSLS, designed to provide a consistent method for identifying and analyzing job hazards, planning work and coordinating job activities, has thus far been a paper one. Presently, after having been routed for multiple reviews and signatures, a hard copy work permit is issued to allow a job to begin. Although the system does what it was designed to do, the process can sometimes be cumbersome and time consuming, especially when there are changes made to the work plan, and re-routing becomes necessary. The new Web based system will allow on line submission, review, and approval of the work permit, while also maintaining an historical database. This will eliminate the need for the physical routing of the document, and should streamline the overall process considerably. Its development is the result of a combined effort by the NSLS Department, Plant Engineering Division and Business Information Systems Division of BNL. The Web pilot program will be conducted at the NSLS until all are satisfied that it is running smoothly, at which time it will be released to the rest of the Laboratory.

User Office Moves

There have been a number of inquiries regarding the long awaited relocation of NSLS User offices from the third floor of Building #510 to Buildings #129 and #535. At this point we can only state that the plan has not changed. There have been delays in the relocation of present occupants of the offices in areas that have been promised to the NSLS Users. These delays have been primarily driven by difficulties in finding adequate space for the groups that are moving out of #535, and further delays in having to refurbish some of those spaces. The process is going on however, and we have been told that at least some areas of Building #535 will be available shortly. We will continue to pursue the Directorate to move on this issue, and will try to keep those affected informed as best we can.

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In Memoriam - Denny Klein

By Frank Terrano
Assistant to the Chairman

John (Denny) Klein, who had been with the NSLS Department for 17 years, passed away on April 15 at the age of 56. Denny started with BNL as a technician at the Accelerator Department on December 3, 1962. He joined the "NSLS Project" in July of 1980, which was then under the Physics Department and he stayed with the NSLS when it became a Department in 1982, where he served the remainder of his 36-year tenure at BNL. Denny worked at the NSLS with the Diagnostics & Controls Group as a Senior Technical Supervisor until 1992 when he moved to the Administrative Group to become the Department's first Training Coordinator. In his new role, Denny developed the initial NSLS training policies and procedures, which for the most part still remain in effect today. In 1995 Denny assumed additional responsibilities as the Department Quality Assurance Representative.

Over and above his formal duties, Denny also served as NSLS Employee Relations Representative and Chairman of the NSLS Spotlight Committee. Even after joining the Administrative Group, he continued to assist the Department on numerous projects with his technical expertise, and agreed to remain on call for emergency (off-hour) technical support whenever the need arose.

Some of Denny's other accomplishments while with the NSLS included: the establishment of the BNL Tech Trainee Program, the GERT training video and test which facilitated the "one stop shopping" concept for user registration at the NSLS, the formation of the Tech. Supervisors Group, and the lobby information system (TV wall & directory).

Denny's genuine concern for helping people is reflected as John Gallagher relates his experience working as a new hire with Denny. "Very often Denny would use the jobs he assigned us as teaching opportunities. He would intentionally omit a few details and expect us to make the corrections ourselves. When we couldn't, he would patiently show us what we had overlooked …. In the beginning it may have taken a little longer...but ultimately, it made us better technicians."

In spite of personal health problems in his last year, Denny managed to "be there" for the Department under difficult circumstances involving audits and reviews.

He will be missed by many.

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Changes in Radiation Protection Procedures

Bob Casey

Associate Chair for ESH

Since December 1998, changes in radiation protection procedures have been occurring at BNL to improve radiological practice and control of radioactive materials. Further changes in procedures can be anticipated throughout the rest of this calendar year. Most changes have not significantly impacted the NSLS one important change has been made recently that everyone should note.

A Radiation Work Permit (RWP) is now required for entry into a Radiation Area. At NSLS, there are few radiation areas. Where they do exist, radiological postings have been changed to reflect this change in requirements.

In general at BNL, the posting of a Radiation Area will typically read "Radiation Area - RWP required for Entry." At the NSLS, the signs are usually further qualified to identify a particular condition during which the radiation area exists, e.g., "Radiation Area during VUV injection."

Entry into the posted area when the radiation area exists requires that a formal work-planning document (a RWP) be completed and approved prior to entry. Take note of the new postings that are now on the floor. If you foresee a need now or in the future to enter these areas under the identified conditions, get together with a member of the NSLS Safety Staff, and together we can prepare the RWP before you need it.

Please take note of this change in requirements. Entry into these areas without a RWP would be a significant violation of BNL radiological requirements and could result in disciplinary actions to the offender, and penalties to NSLS and BNL.

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Radiation Badges Cost Money!

Nicholas F. Gmür

NSLS ES&H Coordinator

Personal Dosimeters, Thermoluminescent Device or TLD Badges, Radiation Badges (Not Film Badges anymore!)…whatever you call them…are worn to determine if you acquire any dose while working on the NSLS, ATF or SDL experimental floors. The good news is that of the 500-700 badges analyzed every month, typically only a few show any recordable doses, and these are low. This means that our shielding, machine operations and administrative controls are working very well.

What may be news to you is that it costs about $15.00 to analyze each badge. The annual total analysis cost for badges (borne entirely by the NSLS) is about $100,000.

As you know, radiation badges come in two "flavors." One version is the so-called permanent badge. This type is meant for staff and users who are here all the time or very frequently. A permanent badge has an assigned slot on a badge board and is replaced with a new badge automatically at the beginning of each month (12 badges/yr. = $180. for analysis). If you own a permanent badge and your research schedule changes such that you visit us only 2 or 3 times a year, have your permanent badge cancelled and sign out a temporary badge each visit (3 badges/yr. = $45…a savings of $135.). Multiply that by 50 badges and you can see the cost savings escalate.

The second type of radiation badge is the temporary badge. A temporary badge is meant for individuals who are infrequent visitors to the NSLS. You sign out a new one each time you come here and return it before you leave. At least that is what you are supposed to do! Unfortunately, a significant number of these badges are never returned. We assume that they are either lost or taken back to home institutions…we never see them again. The NSLS is still responsible for those badges and is charged for their replacement at a cost of $52/badge, not to mention the additional time spent addressing lost badge issues. If 10 badges are lost in a month, that amounts to $520!

So, the message is clear! Return your badges… on time. If you no longer work at the NSLS constantly, have your permanent badge cancelled and use temporary badges. If you leave the NSLS for good, have your permanent badge cancelled. In these days of ever tightening budgets, every badge and dollar counts. Please help!

If you need assistance, please contact the User Administration Office at (516) 344-7976 (for temporary badges) or Marlon McAvoy, (516) 344-6389 (for permanent badges).

"Wear your Radiation Badge this way!"

- when working in a Controlled Area
- between your neck and belt.
- fully visible, not covered.
- yellow or blue color bar facing out.

For Temporary Radiation Badge Users

If you are working at the NSLS over a badge exchange weekend, go to User Administration or the NSLS Control Room to return your old badge and sign out a new one.

When your experiment is finished and before you leave, always put your radiation badge in any "Returned Badge" box located near the badge boards.

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Extending the Scope of X-Ray Crystallography

Jianwei Miao and *David Sayre*

SUNY @ Stony Brook

X-ray crystallography, based on Laue's discovery in 1912 of the diffraction of x-rays by crystals, has developed today to the point where it can produce 3-dimensional atomic-resolution images of virtually anything that can be crystallized. Indeed a sizeable fraction of the photons produced at NSLS today goes toward the making of such images. Now four of us, working at beamline X1A at NSLS, may have taken the decisive step toward producing similar (although at present much lower-resolution) images of *non*-crystalline structures. Examples of the latter include amorphous materials, which are inherently non-crystalline, or objects like the individual biological cell, which even when present in large numbers successfully resists aggregating with the necessary precision for forming a crystal. The work is reported in a letter which appeared in the June 22 issue of Nature[1], and also in a news article in the June 23 issue of Science[2]. Of the four authors, Charalambous is at Kings College, London and the rest are from Stony Brook.

The diffraction pattern of a single non-crystalline object is extremely faint compared with the diffraction spots found in crystal diffraction patterns. A well-monochromatized source with very high brightness, and extreme high-sensitivity low-noise detection, are therefore needed. These requirements were met by using the soft x-ray undulator installed at section X1 of the x-ray ring, cooled back-thinned CCD detection, and careful design of the apparatus to prevent particles other than the diffracted photons from reaching the detector.

Next, the large x-ray exposure involved raises the problem of radiation damage to the specimen. In the present work, this was combated by using an artificially fabricated radiation-resistant test object as a stand-in for a future single small biological cell. This test object was fabricated by Dr. Charalambous in London, and is shown in **Figure 1**. **Figure 2** shows its diffraction pattern as measured by Jianwei Miao and Janos Kirz on beamline X1A.

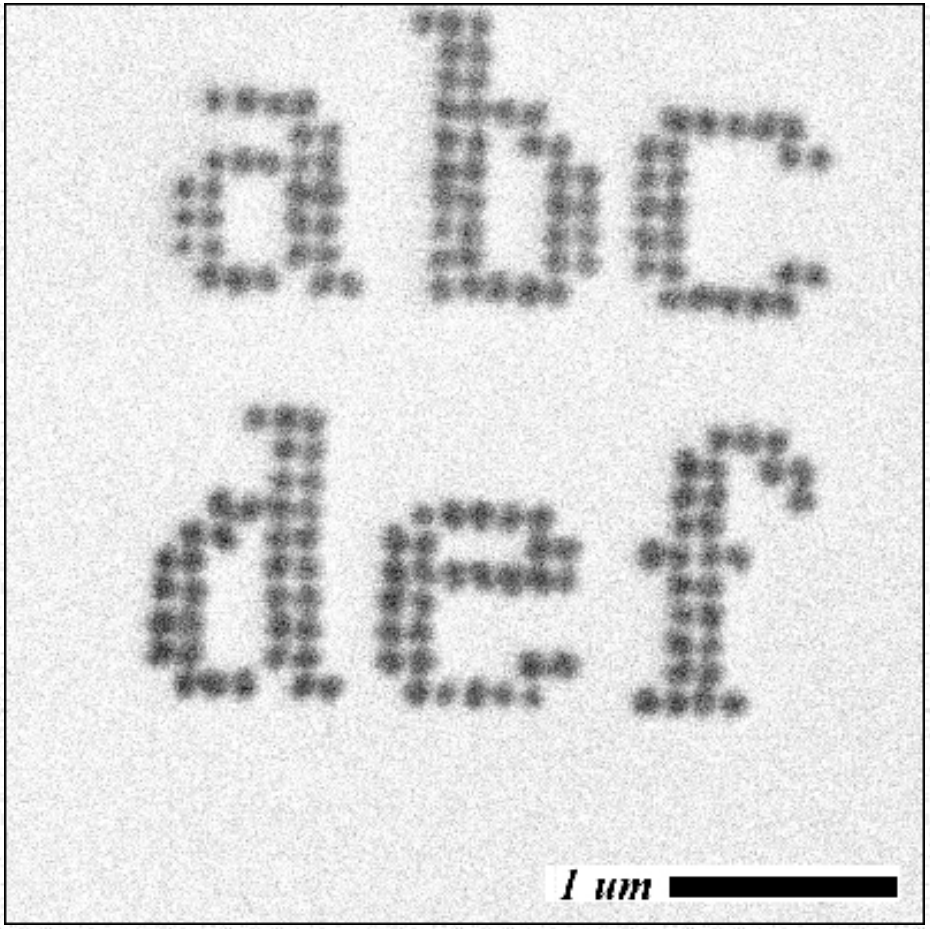

***Figure 1**: A scanning electron microscope image of the specimen. The specimen was fabricated by depositing gold dots, each ~ 100 nm in diameter and 80 nm thick, on a silicon nitride membrane.*

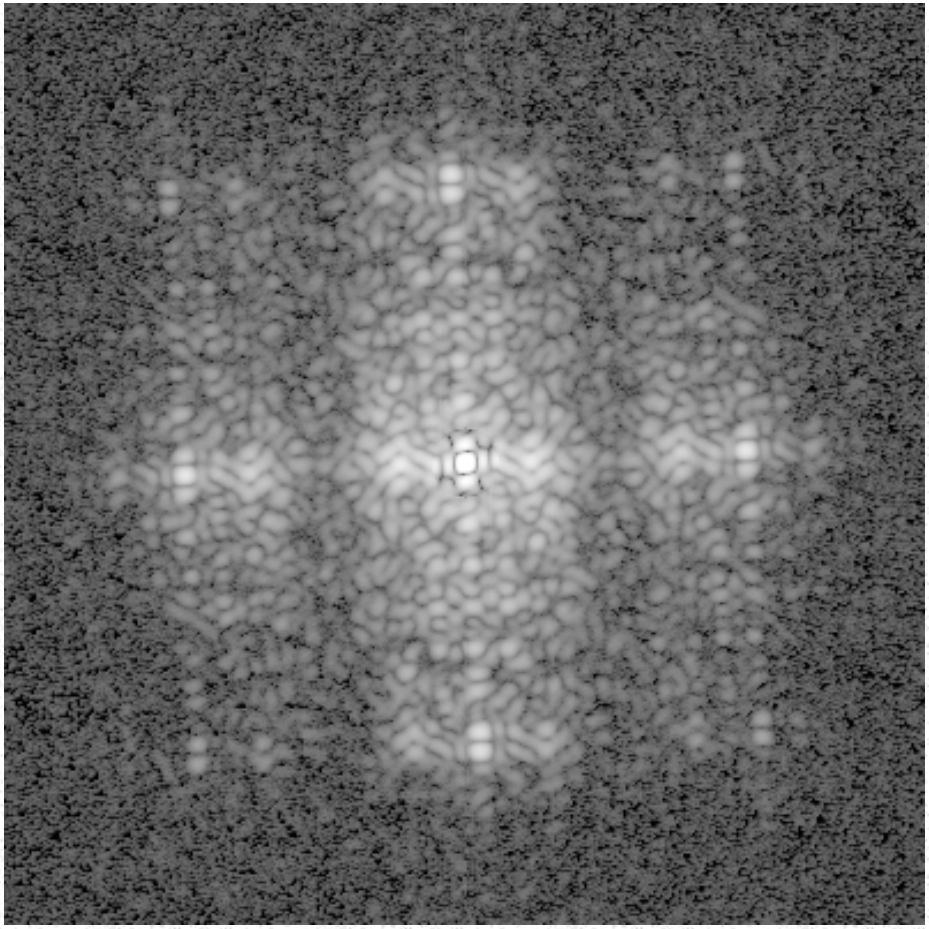

***Figure 2**: A diffraction pattern of the specimen (using a logarithmic intensity scale).*

Finally, it was necessary to find a new technique for solving the well-known "phase problem" which occurs in x-ray crystallography. This was accomplished by making use of the fact that **Figure 2**, not being confined to showing the Bragg spots of a crystal, gives a large amount of additional information lying between what would have been those Bragg points. This "oversampling technique" for phasing was proposed by David Sayre and Gerard Bricogne on the basis of methods[3] worked out in optics in the 1980s. It was then implemented in the form of a computer program by Henry Chapman at X1A a few years ago, and has more recently received important fundamental strengthening by Jianwei Miao[4]. The final image of the specimen as produced by the new non-crystalline diffraction method is shown in **Figure 3**. In all, the entire development of the methods necessary to reach the successful result extended over a period of more than 10 years. The thought that with synchrotron radiation success might be possible was first

expressed by Sayre in 1980[5].

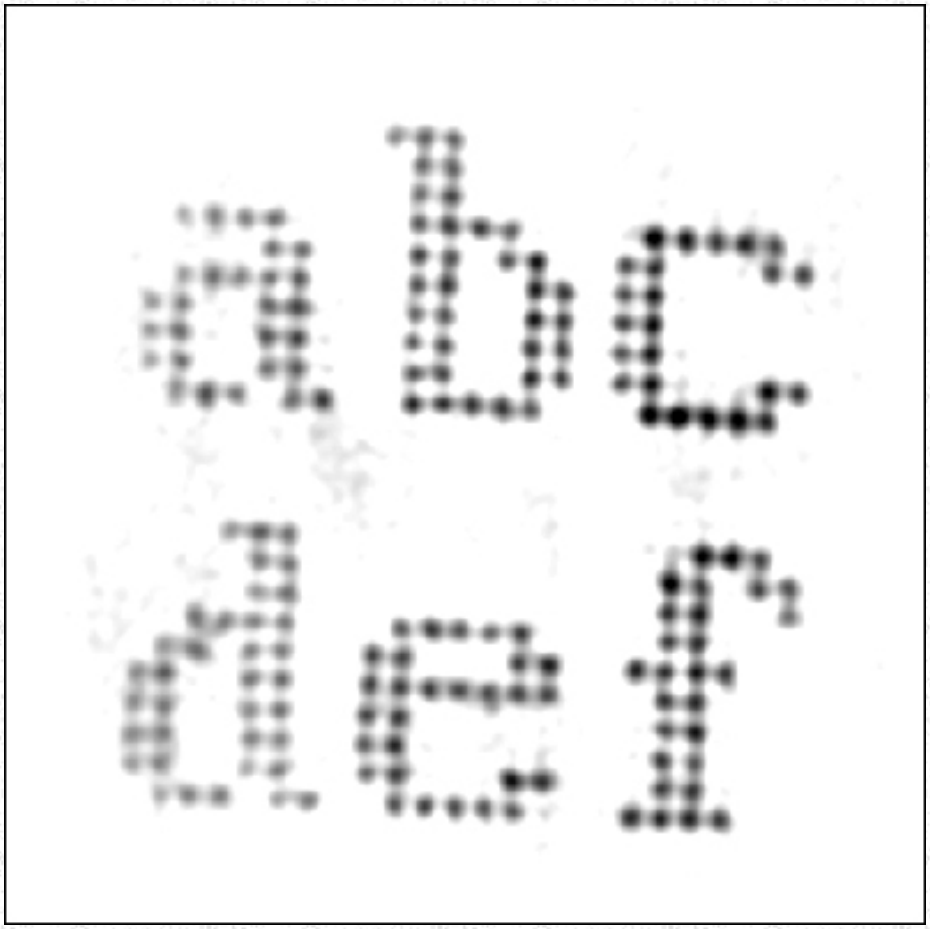

Figure 3*: The specimen image as reconstructed from the diffraction pattern of Figure 2.*

With this proof of principle, the work will now turn in two directions. Miao has developed ideas for imaging amorphous and imperfectly crystalline specimens by the new method, and hopes to pursue those[6]. At the same time he and others at Stony Brook will now try to achieve 3-dimensional imaging of a complete small biological cell at considerably higher resolution than in the present work. Defending the cell against radiation damage will be a critical part of this work, and will be attempted by carrying out the diffraction experiment at low temperature. (At a later point, x-ray sources based on free electron lasers, with the possibility of femtosecond exposure times, could provide a yet stronger method of circumventing the effects of radiation damage.) Should these lines of work prove successful, the extended scope of x-ray diffraction imaging could be important in the study of the extremely complex structures which are likely to engage much of the attention of science in the next century.

References

[1] J. Miao, P. Charalambous, J. Kirz and D. Sayre, *Nature*, **400**, 342-344, (1999).

[2] *Science*, 285, 510-511, (1999).

[3] R.H.T. Bates, *Optik*, **61**, 247-262 (1982). Also J.R. Fienup, *Appl. Opt.*, **21**, 2758-2769 (1982).

[4] *J. Opt. Sci. Am.*, **A15**, 1662-1669, (1998). Also *Acta Cryst.*, **A54**, 232-239 (1998).

[5] *Springer Lecture Notes in Physics*, **112**, 229-235, (1980).

[6] Manuscript in preparation.

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User Administration

Mary Anne Corwin

NSLS User Administrator

PC-Based Web Server

With good foresight and a lot of research and work by Gary Frisbie and Jim Murphy, NSLS began construction of a new, more manageable website. Transfer of webpages from the current website to the new pc-based web server will take place over the next few months. Each webpage will be reviewed to eliminate redundancy, update any outdated information and apply a new look. New software will allow us to create online webforms which submit data directly to a database. This will greatly enhance our capabilities in submission of required forms. User Administration has already placed online a pre-registration system for users, the Form IA-473 for foreign nationals, and a publication references form for NSLS staff. Reports from this system are easily produced.

Foreign Nationals and BNL Gate Access

It seems, daily, our office must modify our procedures to keep up with new regulations and policies instituted at federal levels. We realize many new procedures at BNL may present an inconvenience to our users. NSLS Management and User Administration would like our users to know we sympathize with you. While we must follow the policies we are presented with, the NSLS is attempting to make your use of our facilities as simplified as possible. Many of our required forms will be available through online web submissions. As policies continue to evolve, we will try to make them as transparent to you as possible.

To comply with recent changes in the Standard Practice Instruction (SPI), the following policies were incorporated into the NSLS Policy and Procedures Manual and became effective September 24, 1999:

Section 2.3.6 - Foreign Nationals

All foreign nationals must submit Form IA-473, "Request for Foreign National Unclassified Visit or Assignment," within the timeframe and manner prescribed by the NSLS User Administrator. A visit

request is necessary to conduct work at the NSLS. Approval of the visit request must be verified at the time of the foreign national's arrival at BNL. All foreign nationals who are visiting the NSLS for the first time or whose appointments have expired must arrive during normal workdays (Monday through Friday between the hours of 8:00 a.m. and 3:00 p.m., except holidays) to allow for proper verification of the visit request. Any foreign national arriving at any other time must possess a valid, active appointment with the National Synchrotron Light Source or will be requested to leave the NSLS to return on the next normal workday."

[Refer to BNL's SPI 5-09 "Visits and Assignments of Foreign Nationals"]

Section 2.3.7 - User Pre-Registration

"All users are required to notify the NSLS User Administrator of the date of their intended visit to NSLS to conduct work. The NSLS User Administrator will make available an online pre-registration system to allow users to notify the NSLS User Administrator of the user's date of arrival and other pertinent information as required by the NSLS User Administrator. The NSLS User Administrator shall prescribe the number of advance days required for such notice."

[Refer to BNL's SPI 5-01 "Site Administration"]

Links to Form IA-473 and our online pre-registration system can be found on our home page at http://www.nsls.bnl.gov. Users must pre-register at least seven (7) days prior to arrival at BNL. Users who cannot meet this deadline must phone NSLS User Administration office, during normal office hours, at (516) 344-7976 at least two (2) days prior to arrival at BNL. Office hours are Monday through Friday, 8:00 a.m. to 5:00 p.m. (EST). A link to the SPI can be found through https://sbms.bnl.gov.

The NSLS Policies and Procedures Manual is online and supercedes all paper versions. From the Home Page, to go User Information, then User Administration, then Policies and Procedures, Section 2-Users.

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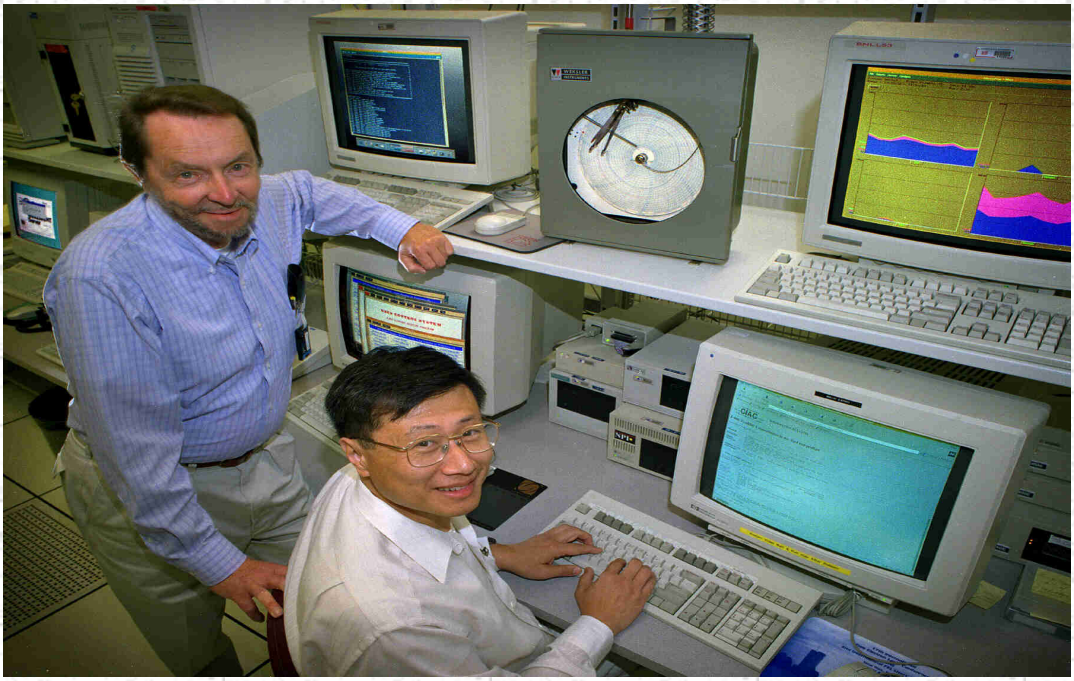
November 1999 NSLS Newsletter

FOCUS ON ..... Computer Security

H. J. Langenbach
Computer Security Representative



Herb Langenbach and Cheo Teng, (left to right)

Due to recent events both at BNL and at outside facilities, a review of computer security issues, pertaining to unclassified systems, seems appropriate. During the past several months numerous government facilities, including BNL, have had their Web pages defaced by hacker groups. The motive behind the majority of these events has been to state some political position or to cause embarrassment to the host site. On average, BNL experiences one to two probes per week of late and these are normally the precursors to further attacks. One of the more serious penetrations took place in August when several on-site Sun systems were compromised and then used for denial-of-service attacks on off-site systems. This also caused packet flooding of local routers which rendered the BNL network to intermittently appear to be inoperative. A SGI beam line system was recently infiltrated by hackers and had several system programs replaced with hacked versions. No additional evidence was found to indicate that any further misuse of the system had been accomplished up to that time. For a brief period, hackers were using the BNL anonymous FTP server to warehouse commercial games and other types of proprietary software in hidden directories. Public bulletin boards were then used to announce the location of these files to the underground community. Numerous computer viruses have infected PC's throughout the laboratory. I'm sure that everyone is also aware of the alleged security breaches at Los Alamos. All of this activity has brought both DOE and BNL to a heightened state of awareness relating to security issues.

Several initiatives by DOE and BNL are currently either under consideration or being actively implemented. DOE has issued a new order (N 205.1) as of July 26 of this year covering "Unclassified Computer Security." This notice replaces DOE 1360.2B and facilities have no more than 180 days for implementation. Some of the areas covered in the order are still being formulated, such as plain text passwords, their length, frequency of change and computer usage by foreign nationals. Based on this new order, BNL will issue a new "Cyber Security Protection Plan" no later than January 2000.

In the mean time, Information Technology Division (ITD) has installed a firewall at BNL's connection to the Internet. It currently is being used to log traffic into and out of the laboratory and to block traffic from sites that have been identified as sources of hostile activity. Plans are also being looked at to divide the laboratory into different security zones. This would allow the directorate to implement some institution wide restrictions, as deemed necessary, for traffic coming into the laboratory. The NSLS is also currently initiating the installation of a firewall. In the near future both the staff and the user community will be consulted to help in the formulation of a comprehensive security plan that will be given wide acceptance.

Changes in the anti-virus software that we use are also forthcoming. BNL is replacing Norton anti-virus software with a product called "Trend Micro." Distribution and implementation is expected to begin before the end of October. Mac users will continue to use the Norton software. The new software will provide for remote installation, centralized virus detection reporting and automatic signature file updates as often as every 24 hours when needed. Web installation will be available in cases where individuals do not want to allow ITD personnel to have administrative access to their systems. For rare cases, where a system is not network connected, a 3.5" disk will be provided. Another nice feature of this software is it's ability to detect and uninstall any other anti-virus programs that are present on a system at installation time. Experimenters may be able to utilize this software. It is not clear whether the number of licenses purchased by BNL, or other legal restrictions, will allow for this at this time. If not, experimenters will still be responsible for having their own anti-virus software on their systems.

A review of existing computer security mandates and guide lines, for unclassified systems is as follows: all systems are required to display the DOE issued logon banner (reference Dr. Marburger's memo dated 5/25/99). The wording of this banner can easily be changed for use by outside institutions. Check http://nt.bnl.gov/banner for instructions. All systems should have a password protected screen saver to prevent others from using systems that are unattended for brief periods during the day. Outside of normal working hours, offices and laboratory areas should be locked to prevent access and theft of equipment. Systems in open areas should have theft prevention devices employed. Staff access to HP systems from outside of the 194/195 subnet requires SecureID card authentication. All Unix based operating systems are required to run the public domain TCP Wrapper program. Services and access should be restricted as much as is practical. Modems are not permitted unless special permission is granted from the department chairman's office. Any BNL system processing sensitive data, or in a mission essential function, must have a Security Features Package (SFP) filed with the NSLS Computer Security Representative (CSR) and the BNL Computer Protection Program Manager CPPM. The plans include risk analysis and contingency/disaster recovery procedures. Some examples of sensitive unclassified information would include any information that the loss of, misuse or unauthorized access to could adversely affect the national interest, the conduct of Federal programs or the privacy to which individuals are entitled. This would include salary data, medical history, department budget data, proprietary and protected CRADA information and disclosure of scientific research prior to publication by the authors. All systems should have a person responsible for the proper installation of operating system software and the maintenance of

such with regard to updates and security patches. Computer Incident Advisory Capability (CIAC) notices are posted inside the main building entrance and outside of the computer room on the second floor. These postings are advertised in the Message of the Day (MOTD) file displayed on the CRT when logging onto BNLLS1, BNLLS2 or BNLLS3. Any detected virus infection or evidence of hacker intrusion should be reported immediately to me at X5330 or Wayne Rambo at X2284. If an intrusion is suspected, the system should be looked at by security personnel before any further action is taken on the part of the owner. Any use of commercial or proprietary software should be properly licensed. Last, but certainly not least, the first line of defense against intrusions are account passwords. They must be a minimum of six characters and not be made up of words, names or other easily guessed personal information that associates might be familiar with. The use of both upper and lower case characters, numerals and other punctuation characters is highly desirable. The use of a numeral before, after or in the middle of a word DOES NOT produce a secure password. The best clear text, reusable passwords are formulated using the first character of the words in a familiar phrase, lyric, poem or quotation. Buzz words, very widely known quotations and things like the resistor color code fall easy prey to public domain password cracking programs. If a written reminder is required to protect against forgetfulness, the password should be placed in a sealed envelope marked private and kept in a safe place.

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A Users' Perspective

Barbara Illman

UEC Chair

As an optimist, I'm pleased to find that the members of the Users' Executive Committee (UEC) make tangible the aphorism "Realize that if you have time to whine and complain about something then you have the time to do something about it" by Anthony J. D'Angelo. The committee members don't just complain, they are actively involved in the NSLS upgrades of infrastructure collectively known as Phase III, BNL food service over weekends and in vending machines. The UEC will improve communication with users by preparing an information brochure and maintaining a BNL-independent web site.

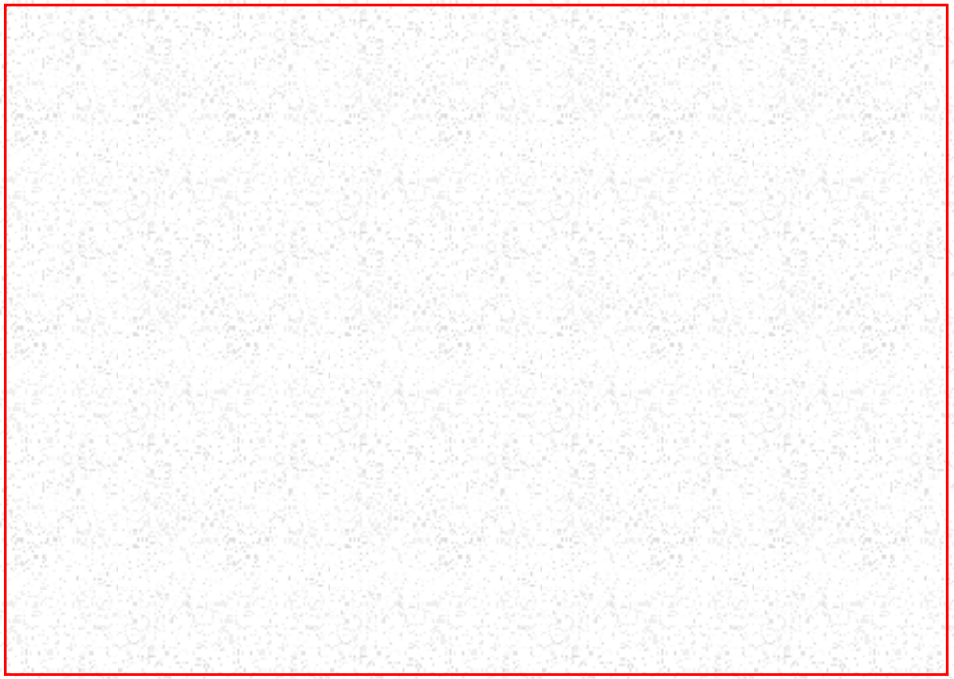
Members of the Users' Executive Committee are:	
Chair:	Barbara Illman (USDA/FS Forest Products Laboratory, University of Wisconsin)
Vice-Chair:	Mark Chance (Albert Einstein Coll. of Med.)
Past Chair:	John Parise (SUNY @ Stony Brook)
Secretary:	Lisa Kelly (U. of Maryland Baltimore County)
Member:	Carol Hirschmugl (University of Wisconsin)
Member:	John Hill (BNL-Physics Dept)
Member:	Kenneth Evans-Lutterodt*
Member:	Chris Jacobsen* and 10 Special Interest Group (SPIGs) members
*New members, elected 5/24/99	

On the morning of August 26, the Users' Executive Committee held its summer Town Meeting. When Michael Hart presented his Director's overview, it became apparent to many people at the meeting that difficulties lie ahead for NSLS in balancing new research with the repair of old infrastructure. The current problems associated with computer security at BNL were addressed by Bill von Elm. Users were assured that BNL is now getting computer firewalls. Mary Anne Corwin reported good news from the BNL lab-wide Users' Advisory Committee. It has been suggested to the committee that users have an online bulletin board to post advertisements for a 2-week period, to have ethernet connections in dormitories, purchase essential items on BNL campus (e.g. shampoo, toothpaste, etc.) through Flick or the BERA office, and possibly have a lab-wide shuttle service. The User Community would like to thank Denis McWhan, BES, for providing a lunch and collegial atmosphere for users following the Town Meeting.

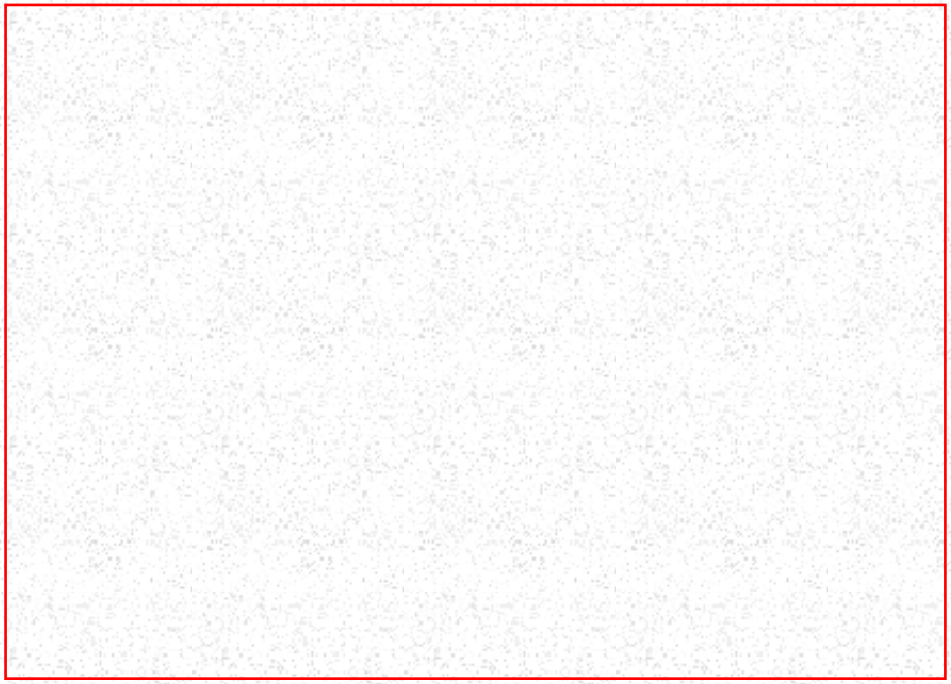
During the UEC meeting held in the afternoon, strategies were discussed for users to send letters to the appropriations subcommittee members and the White House that describe the negative impact that the current appropriations bills in the House and Senate that would significantly cut science funding. And, plans were made to have workshops at the next users meeting on the applications of NSLS in new and evolving areas.

Clearly, the UEC members are involved in all aspects of the community that make it possible for them to conduct good science. All users can take part in this community by contacting any of the UEC members listed above or sending comments and questions to me at billman@facstaff.wisc.edu.

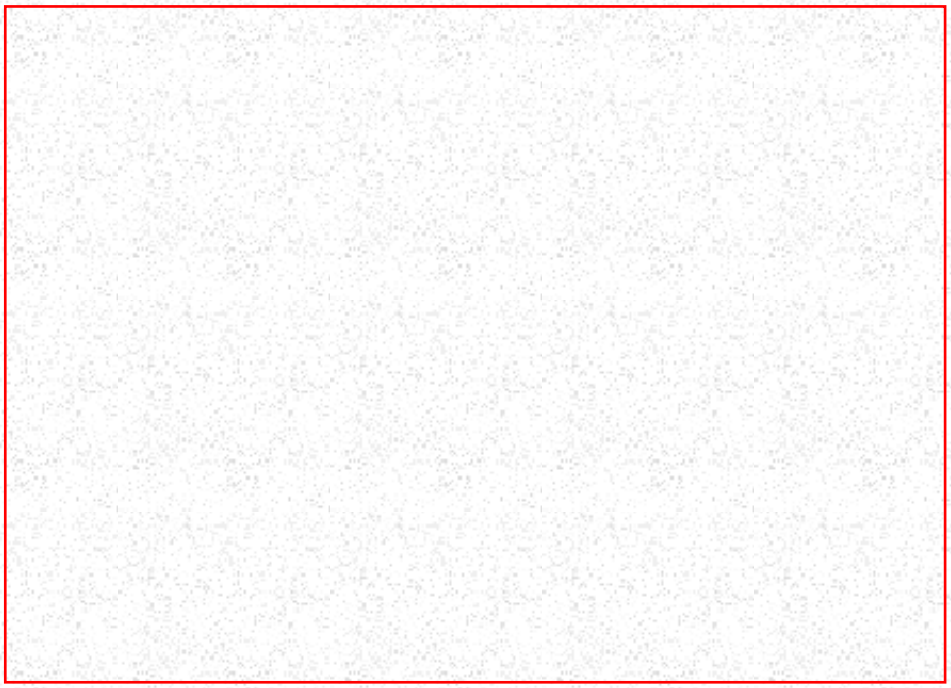
Photos from the 1999 Annual Users' Meeting



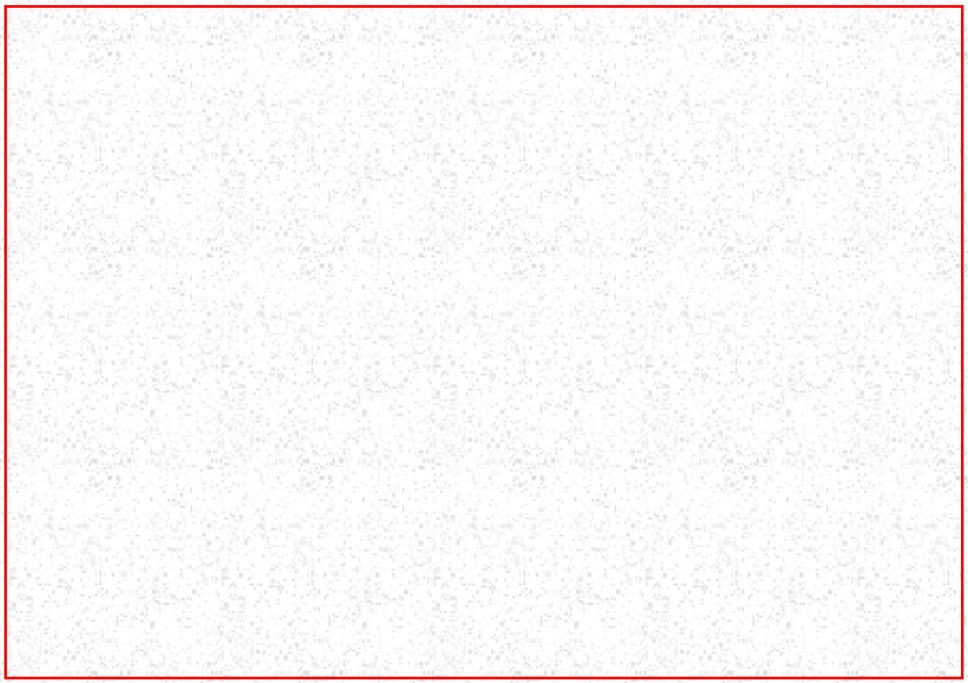
Dave Johnson (BNL-Chemistry), Michael Hart (BNL-NSLS) and Mark Chance (AECOM), (from left to right).



Ilan Ben-Zvi and Bob Casey (BNL-NSLS)



John Norvell (Assistant Director of National Institute of General Medical Sciences, NIH), Craig Ogata (HHMI) and Lonny Berman (BNL-NSLS), (from left to right)



First row: March Chance (AECOM), Paul Stevens (Exxon), Steve Hulbert (BNL-NSLS), Second row: Nancye Wright and Linda Feierabend (BNL-NSLS), and Sue Wirick (SUNY @ Stony Brook).

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Facility Report

Mike Kelly

NSLS Building Manager

The following improvements have occurred or will occur to the NSLS Building 725 by the November 1999 shutdown completion.

Lighting Improvements

The upgrade of the High-Pressure Sodium lamps, replaced by Metal Halide lamps is 90% complete. The lights to be installed are located near the X-ray saw teeth. The lights are positioned either over the top of a beamline or other obstructions. Most of this work is in difficult locations that require the construction of scaffolding to perform the work safely. This takes time to coordinate with experimental operations. We expect this project to be completed during the Fall 1999 shutdown.

Sound Absorption Panels

This fall, we will start installing sound absorption panels on the Xray experimental floor. Panels will be installed on the sawtooth wall and the outer wall behind the beamlines. Panels will also be attached atop the cable trays that radiate out from the xray ring and attached to the hutches wherever there are large flat sound reflective surfaces. A yellow stick-on has identified the locations where the panels will attach to the hutch.

In the area of X23 through X26, background noise has been a consistent complaint. Investigation led us to discover the noise was a result of high volume water moving inside two 12-inch pipes, which was amplified as it passed through the pipes. It varied in intensity depending on the position of the throttling valves. After wrapping the pipes with special noise suppressing insulation, background noise was greatly reduced.

Coldbox Upgrades

The Biology Coldboxes located in Laboratories 1-161,1-162, 1-163,1-164 and 1-170 have been modified to increase their reliability; they have been added to the NSLS emergency generator. In case of a site wide power outage, the coldboxes will automatically switch over to the NSLS emergency generator. A backup system to water cool the condensers was also installed. In the event the Central Chilled Water Plant goes off line, the coldboxes will be switched to domestic water to keep them up and running at their set temperature. Previously, if the temperature went high, an audible alarm would sound at the coldbox and in the control room. This would notify the Operations Coordinators to go to each Mechanical Equipment Room and manually switch the water systems.

Card Readers

Recently the "insert" card readers in the NSLS building were replaced with "swipe" card readers. The old card readers were not Y2k compliant and did not meet new DOE requirements. It will read your card swiped from either direction.

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November 1999 NSLS Newsletter

X-Ray Ring Update

Rich Biscardi

X-Ray Ring Manager

Steven Ehrlich recently joined the NSLS staff in the position of Experimental Operations Manager. This is the position long held by Roger Klaffky, and most recently held jointly by Steven Hulbert and Zhong Zhong. Many of you may already know Steve Ehrlich since he has been a guest at the NSLS since 1986, working for Purdue University as beamline scientist and local contact for X18A. As Experimental Operations Manager, Steve's main responsibility is to act as liaison between the NSLS users, both X-ray and VUV, and machine operations. The main avenue for this interface is the weekly X-ray and VUV users meetings, which he is now running. Steve can be reached in his office, Rm. 2-210, by phone, 344-7862, or by e-mail, ehrlich@bnl.gov.

The new X-17 wiggler has been repaired and returned from Oxford Instruments. It is currently undergoing acceptance tests in Building 902 at BNL. Thus far, room temperature leak tests and electrical tests have been passed without problems. Electrical and cryogenic connections were finalized in September. Cooldown commenced in October. During and after cooldown, additional leak tests and electrical checks will be made. These will be followed by magnetic testing to optimize the field while ramping. Cryogenics consumption testing will be performed at the same time. We will also be testing the computer control system and interlocks to verify their operation. Acceptance testing is scheduled to be completed by November 1st.

The wiggler is currently scheduled for installation in the December '99 maintenance period. This effort will include removal of the existing X-17 wiggler, its electronics, power and control systems and its cryogenics supply system. To install the new wiggler, modifications must be made to the X-17 straight section, as well as, installation and commission of the ancillary subsystems. All tasks leading up to these efforts are currently on-schedule.

Final assembly of the sextupole power supply for the 2.8 GeV low emittance lattice upgrade has begun at Dynapower in Vermont. BNL representatives are in close contact with Dynapower making preparations for acceptance tests. Electricians are pulling the cable in the X-ray tunnel during the monthly maintenance periods. Junction boxes have been mounted on uni-strut in the tunnel. A plan is in place for providing AC power to the supply and parts for its implementation are on order. All work is currently on schedule for installation during the winter shutdown.

Representatives of the NSLS visited ACCEL in Germany the week of August 30th to view the progress on the repaired 52MHz rf cavity and to help set the proper resonant frequency. The final assembly is completed and initial frequency and vacuum measurements were witnessed. During the first two weeks of September, the cavity was acid cleaned and rinsed. Subsequently, the cavity was baked. After final frequency and vacuum measurements, the cavity was shipped to BNL. Upon arrival at the NSLS, the cavity will be conditioned. Final acceptance tests will then be performed at the NSLS with the goal of installation during the winter shutdown.

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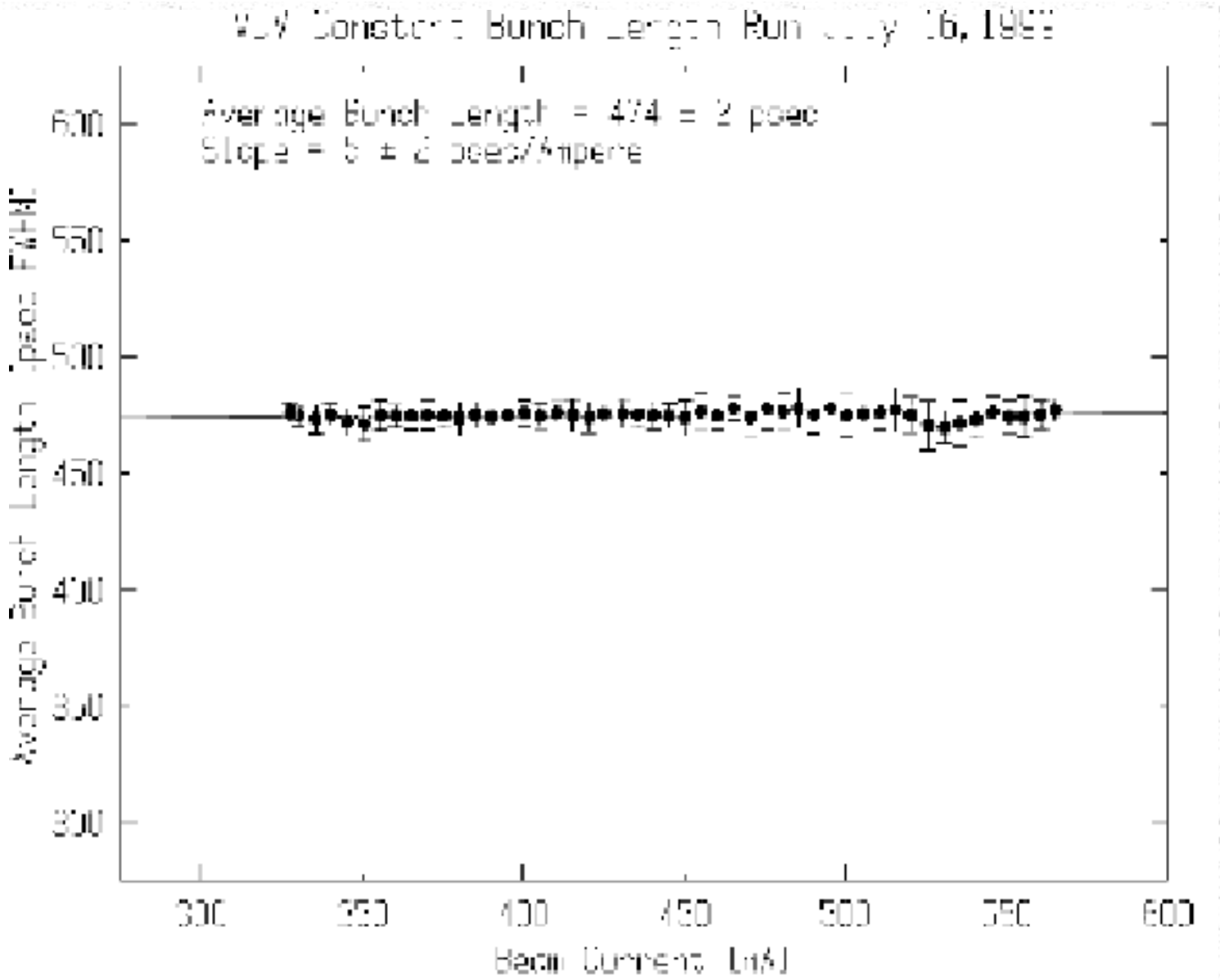
November 1999 NSLS Newsletter

VUV Status Update

Stephen Kramer

VUV Ring Manager

The VUV ring has been performing quite well since the May shutdown of the ring. The average beam availability during scheduled operations has been 98.5% for the last three months. During this period there were no major problems that resulted in a large blocks of downtime. During the May shutdown, a vacuum accident on RF2 cavity caused the RF cavities to vent to atmosphere. The maintenance period was extended into the commissioning period to recover the vacuum in the cavities, resulting in only a 2-hour loss of scheduled operations. Some of the downtime resulted from power dips during the storms in August and September, when the Superconducting Magnetic Energy Storage (SMES) trailer was offline due to refrigerator problems caused by a plugged heat exchanger.



Measured average bunch length for a seven bunch fill in July 1999, with the bunch length held constant using a power level control on the 4th harmonic RF cavity.

The IR Noise Task Force, under Jim Murphy's guidance, has been making considerable progress on isolation of the vibration sources on the VUV floor. A plan has been developed to reduce the vibration from VUV Ring components such as the RF bunch lengthening cavity chiller unit. Cooling and temperature control of this cavity will be switched to the low pressure copper system. The ring now has the option to run with or without the chiller operating. This will allow the option to turn off the 58.5 Hz vibration signal, which sometimes exceeds the 60 Hz noise level on the beam. A plan was developed and is being implemented to damp the vibration resulting from the large number of user mechanical vacuum pumps on the VUV experimental floor. This plan will result in retrofitting existing pumps with vibration damping feet and making sure they are fitted to any new pumps brought to the VUV floor. Gradually the low frequency noise on the experimental floor is being reduced and the sensitive FTIR beam lines are being isolated from the floor vibration. Emphasis will now shift to solving the beam motion sources at 60.0 Hz and in the kHz region.

The RF Group has developed a new method of operation which uses the 4th harmonic RF system to counter

the natural bunch lengthening that occurs with an increase in bunch current. By switching the phase of the voltage in the cavity, the bunch length can be reduced rather than lengthened. Varying the cavity power, roughly proportional to the bunch current, the bunch length can be held constant at all currents. A program was written to control the power in this cavity as the current decays and the resulting bunch length was measured. The figure shows the average bunch length (FWHM) in pico-seconds for a 7 bunch fill to 600 mA total current, with subsequent decay to about 320mA. Other tests have demonstrated that the average bunch length remains constant to currents as low as 50 mA; a current range of over a factor of 12. The individual bunches have a variation in bunch length (resulting from the asymmetric fill) with a standard deviation of +/-5 psec about the average value of 474 psec. A fit to the measured data shows a linear dependence on current of less than 5 psec/A and residuals of less than 5% of the average bunch length.

Additional improvements have been made in the Global Orbit Feedback System (GOFS). The VUV GOFS was the original system from the late 1980's, and did not permit rapid adjustment of its gain coefficients, making it difficult to use with different machine lattice settings. A new GOFS is being installed that will make it possible to change these coefficients and to implement new algorithms that might provide greater orbit stability. The horizontal system has been installed and commissioning is under way. The subsequent installation of the new vertical system will complete the upgrade of the GOFS. It will allow the ring to operate with the new short bunch lattice or other lattices, while maintaining the excellent orbit stability that has become a hallmark of operations at the NSLS and an essential User requirement for routine operations of the ring.

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PROPRIETARY RESEARCH AT THE NSLS

You can perform research at the NSLS while retaining all intellectual property rights instead of publishing your results in open literature. Proprietary beam time can be requested through the General User Program or through a beamline Participating Research Team.

There are basically three requirements:

1) Your institution must sign a Proprietary Users' Agreement with Brookhaven Science Associates, operator of Brookhaven National Laboratory. Many institutions have already signed - check your institution's status with the User Administration Office. The Agreement covers all users from that institution, for an indefinite period of time.

2) Submit a Proprietary Research Proposal for each experiment or program. It must include a brief non-proprietary description of your work.

3) Pay for the beam time you used - if you do not pay for the beam time you do not own the data and potential patent/marketing rights. Beam time usage is reported after-the-fact. Charges for proprietary use are charged in 8-hour units.

If you would like more detailed information about performing proprietary research at the NSLS, please contact NSLS User Administration or visit our web site at
http://www.nsls.bnl.gov/Proposal/Propriet/propriet.htm

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CALL FOR GENERAL USER PROPOSALS

Deadline for proposals and requests for beam time on the NSLS X-Ray and VUV Rings is

Monday, January 31, 2000 for scheduling May - August 2000

Prior to Submitting a Proposal

You must contact the beamline personnel responsible for the beamline(s) selected in order to verify technical feasibility on the beamline(s) and discuss any special arrangements for equipment. Your chance of getting beam time is improved by being able to use more than one beamline.

Preparing Your Proposal

The same form is used for both new proposals and beam time requests against existing proposals. Follow the instructions on the information sheet and complete and submit all the required sections. Type or print all information legibly. MAIL OR FAX **ONE COPY** of the proposal form and any attachments to the NSLS User Administration Office. Only **one copy** is required - *do not mail a hard copy if you have already faxed one.*

Special Notes for Macromolecular Crystallography (PX)

NEW PROPOSALS: The proposal represents a two-year program. Provide an overall plan for your research according to the instructions on the proposal form. If you can, estimate the number of crystals you plan to measure over the two years. If you require the use of an insertion device beamline like X25, be sure to indicate your need for the enhanced performance. New proposals must also include your plans for the upcoming cycle for which you are requesting time (below).

BEAM TIME REQUESTS: Be specific about what you plan to study in the upcoming cycle. Submit PX Forms only for the crystals you plan to study in that cycle. Answer all the questions, use the back of the form if you need more space. Be clear about what crystals you already have, which you expect to have, and how you would use the beam time you requested if you were unable to obtain the planned crystals in time (i.e., other crystals described in your program).

Proposal Deadline

The complete proposal package must be received by the User Administration Office on or before 5:00 pm Eastern Standard Time Monday, January 31 in order to be considered for the May - August cycle. **The fax machine is always extremely busy on the deadline date; please do not rely on faxing the proposal successfully on January 31**. We encourage submitting new proposals by mail or fax prior to the deadline. Beam time requests for active proposals will be accepted after the deadline, but will be allocated beam time only after requests received on time have been allocated. Late requests are not eligible for a rating upgrade if beam time could not be allocated to them.

Each proposal will receive a prompt preliminary review to verify that it is complete and legible. If there is a problem with the proposal, you will be contacted immediately. Submitting your proposal well in advance of the deadline date assures that the User Administration Office has time to reach you and that you will have enough time to correct any deficiencies.

Proposal Forms and Additional Information

Blank proposal forms and instructions are available on the World Wide Web. From the home page at http://www.nsls.bnl.gov, go to User Information, then Forms to Fill Out. **The PX form must now be completed online**. A guide to the NSLS beamlines and more information about the General User Program can be found through our homepage, **http://www.nsls.bnl.gov** or by contacting E. Pinkston or L. Rogers in the NSLS User Administration Office. Office hours are Monday through Friday, 8:00 a.m. to 5:00 p.m. Eastern Standard Time (EST). Contact information is on the back page of this Newsletter.

Safety Approval Form

Reminder. Submit online ***at least one week before*** your scheduled beam time. Do not send in SAFs with your proposal. **Complete all fields** on the SAF Web form - use "NA" or "not applicable" if you need to, but answer each question! The SAF can be found at: **http://130.199.76.30/safety/**

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Identification and Tagging of Equipment

The Department of Energy requires that all capital equipment at BNL have bar codes or tags to indicate ownership. If your organization does not have tags (logo's, etc.) we will supply blank tags (see sample at right).

Tags are available at the NSLS stockroom free of charge. Please obtain tags, fill in your organization in the space provided, and apply to all unidentified equipment belonging to your organization. The serial numbers on the blank tags are for your optional use in recordkeeping.

BNL's Supply & Materiel Division will be conducting periodic inspections to ensure proper identification of all equipment. If, during the inspection, untagged equipment is found, a tag will be applied.

If you need assistance or have any questions, please call Donna Buckley at X3599.

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NSLS Annual Users' Meeting and Workshops

May 22 -24, 2000

Workshops

The program of one-day workshops will focus on specific scientific topics and techniques of interest to the synchrotron community. The following workshop topics are currently planned:

- Very Bright Infrared Sources and Applications, *Gwyn Williams, NSLS*
- New Approaches to Solving Protein Crystal Structures, *Zbigniew Dauter, Science Applications International Corporation*
- Environmental and Geological Sciences, *Barbara Illman, U. of Wisconsin/USDA/FS Forest Products Laboratory*
- XAFS of Dilute Systems, *Kumi Pandya, North Carolina State University*
- Chemical Applications of Synchrotron Radiation, *Jose Rodriquez, BNL-Chemistry*
- Collaboratoria, *Malcolm Capel and Robert Sweet, BNL-Biology*

Social Functions

A reception will be held for all meeting/workshop registered attendees on Monday evening in Berkner Hall. Both the equipment exhibit and poster session will be on display for viewing. A varied selection of hot and cold hor d'oeuvres will be served along with complimentary refreshments. The conference Banquet will be held Tuesday evening, May 23, at Giorgios Restaurant, Baiting Hollow.

Equipment Exhibit

An instrumentation and equipment exhibit will be held beginning on Monday evening at 5:30 pm in Berkner Hall with a reception for all registered meeting/workshop attendees. The exhibit will close on Tuesday afternoon at the end of Tuesday's Annual Meeting session.

Contributed Posters

Poster Sessions will be held concurrently during Monday's opening Reception and Tuesday's Annual Meeting in Berkner Hall. Detailed information will be available in the Registration Booklet and at our meeting web site linked from www.nsls.bnl.gov. The deadline to submit an application for poster session submission is **May 2, 2000**.

Registration

Complete registration, housing, and transportation information will be sent to those who request it (lsusrmtg@bnl.gov). Individuals registering on or before May 2, 2000 with full payment will receive a discount on the Users' Meeting registration fee. Mail, or e-mail to lsusrmtg@bnl.gov, your response card early! Don't miss out on this year's meeting!!

Planning Committee Members

Mark Chance, *Chair AECOM*

Chris Jacobsen, *Program Chair SUNY @ Stony Brook*

Simon Bare, *Workshop Chair UOP*

Peter Stephens, *Poster Session SUNY @ Stony Brook*

Linda Feierabend, *NSLS Meeting Coordinator*

Nancye Wright, *NSLS Equipment Exhibitor*

Mary Anne Corwin, *NSLS User Administrator*

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Weekly Users' Meetings

X-Ray Users: Wednesdays,
11:30 am, Seminar Room

VUV Users: Thursdays,
11:30 am, Conference Room A

To subscribe to the X-Ray Users and/or VUV Users List Server and receive the minutes each week: Send an e-mail message to listserv@bnl.gov. Leave the subject of the e-mail message blank, and place the following text in the body of the message:

subscribe nsls-vuv-l Your Name or subscribe nsls-xray-l Your Name (that's "-L", not the number 1)

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Work Procedures at BNL

Reminder...The Laboratory recently established new procedures for issuing "Stop-Work" orders for situations involving "Imminent Danger" or violations of Radiological Requirements. All BNL employees are being trained on these procedures, as well as all guests who hold appointments to work in our facilities.

Any users who receive the NSLS Safety Orientation or request radiation dosimeters in User Administration will receive this brief training. The training involves reading two short pamphlets and answering 5 multiple-choice questions.

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Important Upcoming Dates

Nov. 5, 1999	1:00-3:00 NSLS Town Meeting 3:00 UEC Meeting
Dec. 15, 1999	Deadline for Scientific Highlight Articles for 1999 Activity Report
Jan. 10, 2000	Deadline for submissions, March Newsletter
Jan. 31, 2000	Deadline for General User Proposals (May-Aug. 2000)
Feb. 11, 2000	Deadline for return of NSLS Annual Users' Meeting Response Cards.
May 22-24, 2000	NSLS Annual Users' Meeting and Workshops

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