NOVEMBER 1998 NSLS Newsletter

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November 1998 NSLS Newsletter

Newly Commissioned 5 - 30eV Undulator Beamline U13UB

S. L. Hulbert (NSLS)

P. D. Johnson (BNL-Physics)

It is important to realize that the low-K (undulator regime) output of the insertion devices on both NSLS storage rings is essentially "third generation", by being nearly diffraction-limited in one direction (vertical). As such, they represent and important and unique component of the synchrotron radiation facilities available in the US. The NSLS undulator sources are U5U and U13U in the VUV photon energy range and X1 and X13 in the soft x-ray range.

The brightness (flux per unit phase space) of the U13U undulator in the photon energy range covered by the U13UB beamline, 5 to 30 eV, is shown in **Figure 1**. This figure plots the spectral brightness for six values of the magnetic strength parameter K, for which the fundamental photon energy spans the 5 to 30 eV range. Note that the brightness of the fundamental is greater than that of all higher harmonics in the 5-30 eV photon energy range, and is three orders of magnitude greater than a VUV bending magnet.

In terms of flux, the U13U undulator produces fundamental output greater than $2x10^{15}$ photons/sec/0.1%bandwidth/Amp in the 5-30 eV photon energy range. This range of fundamental photon energies (hn_1) is readily achieved by changing the magnetic strength K from 4.7 to 1.4. The radiation is directed into a narrow spatial cone, e.g. the 1-s opening angle is 210mrad at hn_1 = 15 eV.

This article focuses on the new U13UB beamline, which has been in operation since June 1998. The properties of the U13U source and the U13UB beamline are provided, followed by a general overview of the scientific opportunities which we envision for this beamline. Finally, a descriptive overview of two angle-resolved photoemission endstations destined for use at U13UB is given, including a sampling of the first experiments, which are ongoing.

Comparison with Bending Magnet Source

In order to justify the use of a unique resource such as the U13U insertion device, is it necessary to show that a NSLS VUV bending magnet beamline could not produce the desired flux density at the sample. The flux output of 1 mrad horizontal of an NSLS VUV bending magnet is approximately $1x10^{13}$ photons/sec/0.1%bandwidth/Amp, and the vertical opening angle of radiation in the 5-30eV photon energy range is 5-10 mrad. In order to compete with U13U in terms of raw flux, a bending magnet beamline must collect a large horizontal fan, e.g. NSLS U11 collects 55 mrad in the horizontal plane. However, such a beamline is saddled with problems related to the large phase space area of the bending magnet source (horizontally, vertically, and in depth). Clever optical designs, such as the modified Wadsworth monochromator at U11, provide fairly good energy resolution, but at the expense of providing a rather large focal "spot" (1 mm). The transverse (horizontal and vertical) phase space volume

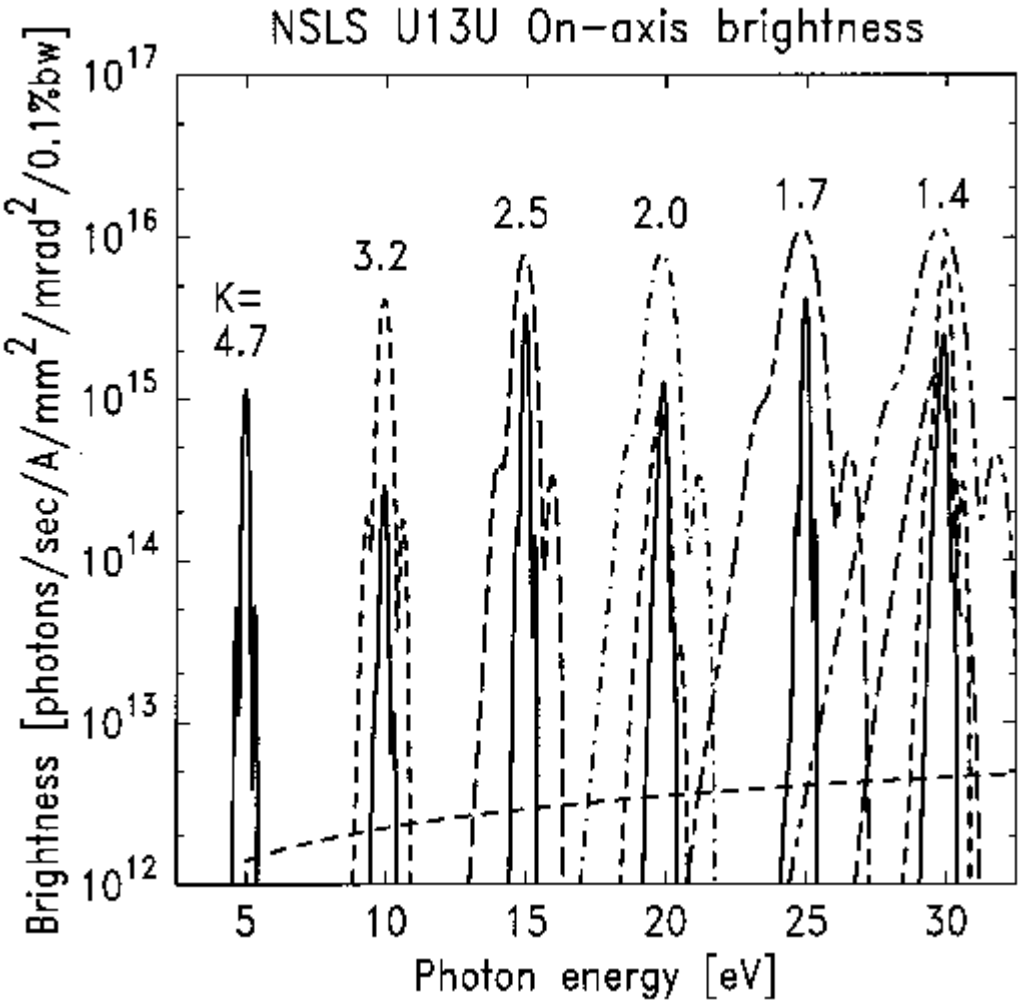

Figure 1: On-axis spectral brightness (flux per unit phase space) of the U13U undulator for six values of the magnetic strength parameter K (proportional to the product of magnetic field strength and spatial period) spanning the photon energy range covered by the U13UB beamline, 5 to 30 eV. The highest brightness curve at each photon energy is associated with output at the fundamental wavelength. The underlying peaks are higher harmonics ($n \geq 2$) associated with higher K values which, for non-zero-emittance electron beams, appear at all integer multiples of the fundamental wavelength. Note that the brightness of the fundamental is greater than that of all higher harmonics in the 5-30 eV photon energy range, and is three orders of magnitude greater than a VUV bending magnet.

of the U13U radiation is on the order of 250 to 500 times smaller than that of U11, which enables U13U to provide significantly higher flux density at the sample.

From this discussion, it is clear that the experiments which will benefit the most from the high brightness undulator beam at U13UB are those for which flux density on the sample defines the figure of merit. This class of experiments includes all of angle-resolved photoemission, for example, since the electron energy analyzer in these experiments can accept emission from only a finite area on the sample. Further, as the energy resolution of these analyzers is improved, the size of this acceptance spot decreases dramatically.

U13UB Beamline Description

Beamline U13UB is one of three branch beamlines which share the output of the U13U NdFeB hybrid wiggler/undulator (0.5 < K < 7.6) insertion device on the VUV Ring. The other two branches are U13UA, a focused white light beamline, and U13UC, a coherent optics characterization beamline. **Figure 2** is an elevation layout drawing of the U13UB beamline, which was constructed by McPherson, Inc. of Chelmsford, MA.

The U13UB beamline is separated from the U13U centerline by a horizontally-deflecting (12° grazing angle of incidence) variable-radius (50m < R < 200m) integrally-water-cooled spherical mirror (M0B), which collects 1.66 mrad and focuses on the exit slit of the U13UB monochromator. The M0B mirror material is glidcop (ceramic copper alloy) explosion-bonded to a stainless steel substrate.

The second optical element is a vertically-deflecting (7° angle of incidence ¾ nearly normal incidence) integrally-water-cooled spherical (R = 1.9m) mirror (M1B), which collects 2.4 mrad and focuses (with ~15:1 demagnification) on the entrance slit (S0B) of the monochromator. The large total output power (287W at K = 8, 500mA ring current) and significant output power densities (up to 32.5W/mrad^2 at K = 8, 500mA ring current) require water cooling of M0B, M1B, and S0B. Owing to its nearly normal incidence geometry, the lion's share of the source power is absorbed by the M1B mirror. The M1B mirror is a one-inch thick piece of CVD SiC and is integrally water cooled: finite element calculations show that the temperature rise, stress, and resulting deformation are well within the mechanical limits of this material (in fact they are all small).

The U13UB beamline features a Normal Incidence Monochromator (NIM) in which a spherical (R = 3m) grating is used in fixed included angle geometry. The grating chamber houses two gratings on a rotating turret with detents to select either of the two gratings *in situ*. These two gratings (1200 and 2400 line/mm groove densities), and the ~3m entrance and exit armlengths in this monochromator, produce >10,000 spectral resolving power in overlapping photon energy ranges spanning 5 eV to 30 eV. The entire grating housing moves, under interferometric control, along the angle bisector between the entrance and exit beams, in order to track the photon energy-dependent focus of the diffracted exit beam. The grating angle scanning motion is provided by a DC servo system, also under interferometric control. The variable radius of the M0B mirror can be used to correct for the photon-energy-dependent astigmatism of the NIM as it scans through the 5-30 eV range.

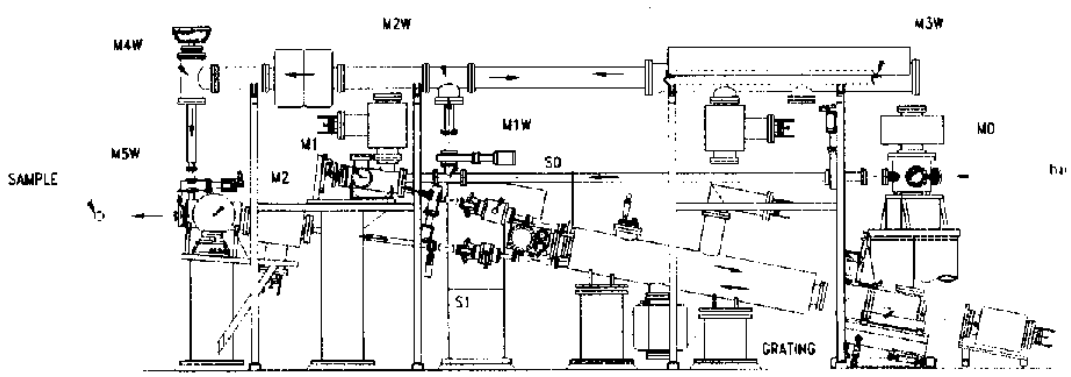

Figure 2. Elevation layout view of the U13UB high resolution VUV spectroscopy beamline, showing the paths of the monochromatic (lower) and white-light (upper) branches.

Overview of Scientific Opportunities Using Beamline U13UB

Several types of scientific programs could be expected to benefit greatly by instrumenting the U13U wiggler for high resolution VUV work in the 5 to 30 eV range. Perhaps the most obvious application in solid state physics is ultra-high resolution angle resolved photoemission. In cases where the states of interest lie near the Fermi level, self-energy corrections are small, and reductions in the photon energy spread will significantly enhance the experiments. High T_c superconductors and heavy fermion systems are examples of such problems. In addition, surface photo voltage measurements, chemical dynamics applications, and photoelectron spectromicroscopy are all experiments for which spatial flux density is the relevant figure of merit, and could therefore be expected to be well matched to the U13UB beamline.

The section of beam pipe located vertically above the NIM beamline (see **Figure 2**) houses relay optics which will provide a time-delayed (or advanced) white light beam, the focus of which will be collinear and coincident with that of the NIM beamline, for the purpose of pump-probe experiments. This capability is expected to be central to a large fraction of the biology experiments planned for U13UB.

Angle-resolved Photoemission Endstations and Experiments

Angle-resolved photoemission, developed in the 1970s, still represents the premier tool available for the study of the momentum dependence of the electronic structure in solids. Here the energy of the emitted photoelectron is measured as a function of the angle of emission. Combined with beamlines such as U13UB, a whole range of new electron spectrometers is expected to lead to a resurgence of activity in this area. By multiplexing in energy and angle, these new instruments allow a considerable reduction in data acquisition times. At the same time, they offer extremely high energy and momentum resolution. Two instruments are scheduled to exploit the high photon fluxes available from U13UB. The first is a 200 mm radius Scienta SES200 analyzer that has recently been commissioned in the group of Peter Johnson (Physics Department, BNL), the second will be a Gamma Data 50 mm radius spectrometer commissioned by Eric Jensen (Brandeis U.) and Kevin Smith (Boston U.). Initial experiments using the SES200 have already been completed. These detailed temperature dependent studies of optimally doped $Bi_2Sr_2CaCu_2O_8$ (BSCCO) have found evidence for the opening of a gap in the spectral response with the onset of long range coherence at the superconducting transition temperature T_c. **Figure 3** shows the temperature dependent "angle-integrated" spectra recorded from the BSCCO sample in the GM direction. The figures show that the sharp feature immediately below the Fermi level characterizing the superconducting state appears in the spectra even above the transition temperature T_c, 91°K, and that it remains at constant binding energy at all temperatures. Further, the spectra show that the intensity of this feature changes continuously on passing through T_c. This latter observation is surprising because within the framework of a mean field or BCS model, if the sharp peak reflects the super fluid density, it should disappear at T_c and further, the separation between it and the Fermi level should also disappear at T_c. However, the authors of the study, Fedorov, *et al.*, noted that at the transition temperature, a dip rapidly develops in the spectra immediately beyond the sharp peak. By fitting angle-resolved spectra collected within an angle of 0.5°with three components (a background, a broad peak at higher binding energy and a lorenztian to describe the sharp peak) Fedorov, *et al.* were able to show that the development of this dip may be associated with the opening of a gap between the broad peak and the Fermi level. The magnitude of the gap, as a function of temperature, is indicated in **Figure 4**. As one can see from **Figure 4**, the

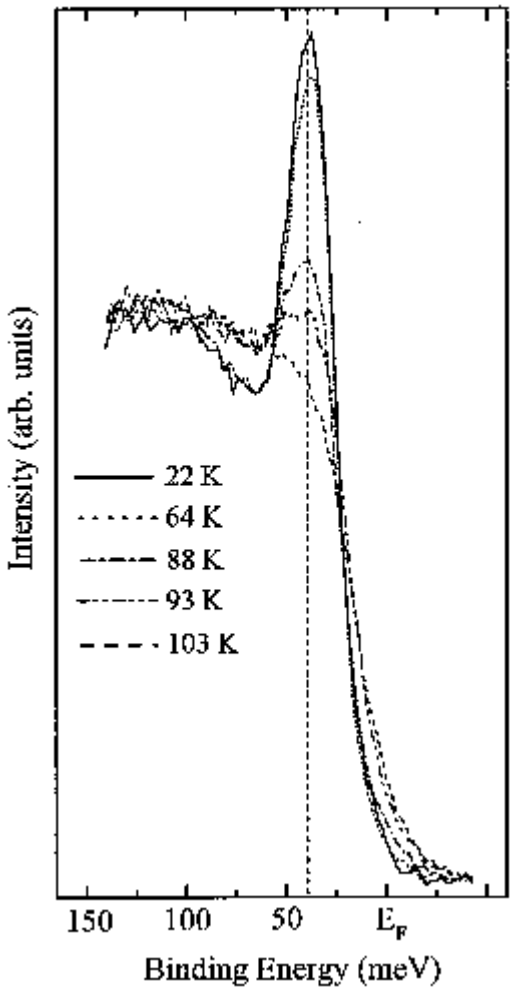

Figure 3: Angle-integrated photoemission spectra of optimally-doped $Bi_2Sr_2CaCu_2O_8$ recorded as a function of temperature and integrated along the GM line of the Brillouin zone. The different temperatures are indicated.

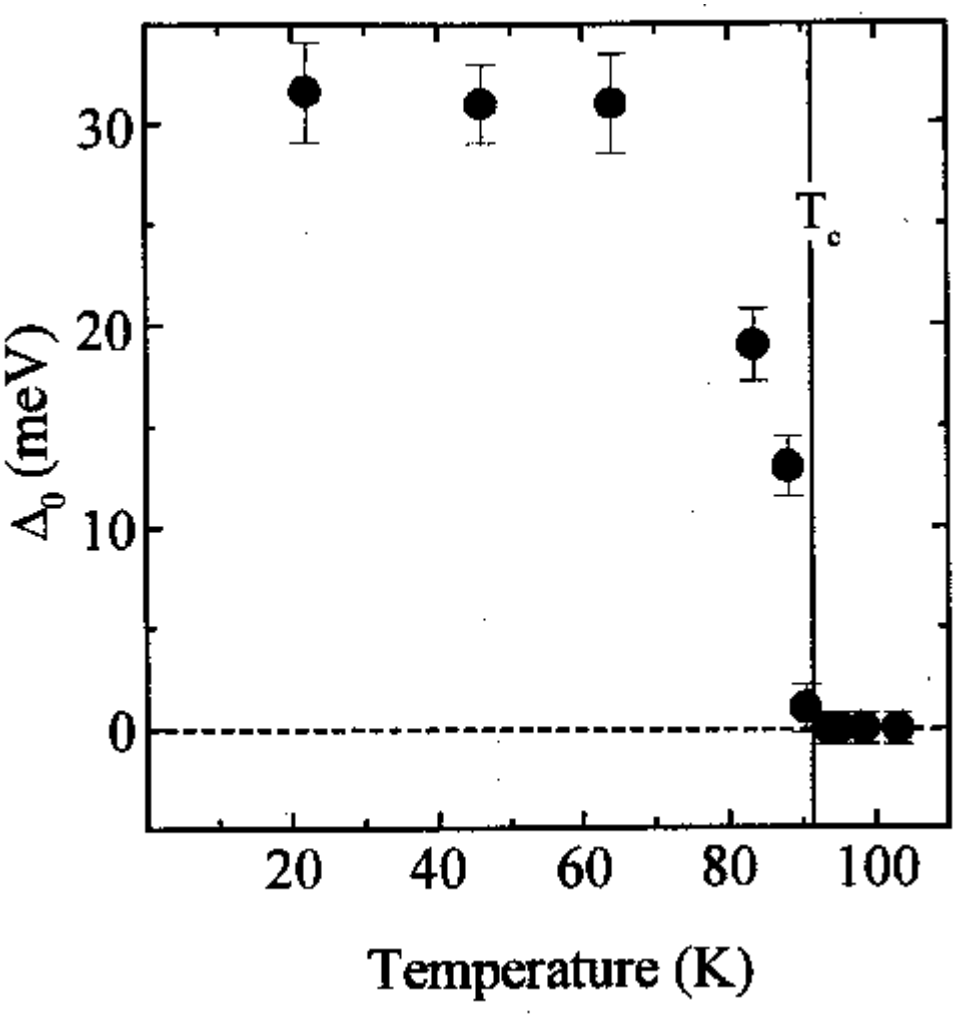

Figure 4: The magnitude of the gap, D_0, between the leading edge of the broad peak and the Fermi level in angle-resolved photoemission spectra of optimally-doped $Bi_2Sr_2CaCu_2O_8$, as determined from the fitting procedure of Fedorov et al. The superconducting transition temperature of 91K is indicated.

initial development of the gap coincides with the onset of long range coherence as defined by the transition temperature T_c. This behavior is different from that of a pseudogap, which even in the optimally-doped materials has been shown to exist in the materials at temperatures above T_c.

Reference: A. V. Fedorov, T. Valla, P. D. Johnson, Q. Li, G. D. Gu, and N. Koshizuka, "Temperature Dependent Photoemission Studies of Optimally Doped $Bi_2Sr_2CaCu_2O_8$ ", to be published.

Acknowledgements: *The U13UB beamline was assembled, installed, leak tested, and mechanically debugged by the technical members of the NSLS Experimental Systems Group, especially Gary Nintzel and Dennis Carlson. The beamline components were positioned by the NSLS Survey Team, headed by R. Scheuerer, to such a precision that getting undulator light to the sample was easy. All of the U13UB beamline components were designed and fabricated by McPherson, Inc. of Chelmsford, MA, including alignment of the NIM gratings and interferometer.*

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Introduction

Michael Hart, NSLS Chairman

On September 27, a low horizontal emittance lattice became operational at 2.584 GeV. This results in approximately a 50% decrease in the horizontal beam-size on dipole bending magnet beamlines, and somewhat less of a decrease on the insertion device lines. The beam lifetime is not degraded by the low emittance lattice. This represents an important achievement, enhancing for all users the x-ray ring brightness, following several years of machine R&D.

In the November NSLS Newsletter last year our series "Focus on....." described the work of Sam Krinsky's Accelerator R&D Group and reported that "Machine physics studies on the X-Ray Ring, carried out by James Safranek (now with SSRL), resulted in the reduction of the vertical emittance from 2 nm*rad down to the present operational value of 0.1 nm*rad. James has also implemented, in studies, a new configuration of the X-Ray Ring lattice which reduces the horizontal emittance from its present value of 90 nm*rad down to 45 nm*rad. With continued work, this lower emittance lattice may well become the preferred operational mode of the X-Ray Ring." For perspective I want to describe these improvements and indicate future potential. **Figure 1** shows more than 100 times brightness improvement on the X-Ray Ring during the 1990s. Most of the improved brightness has been achieved by increases in current and reductions in the vertical emittance, but the latest improvement is, from a technical point of view, exquisite.

Based on the measured orbit response matrix, comprised of orbit displacements at each beam position monitor due to excitation of each trim dipole magnet, a very accurate model of the storage ring lattice has been developed. This model has been utilized to first correct imperfections in the lattice and then move to a new tune having lower horizontal emittance. Technical details have been outlined in a paper titled "A Low Emittance Lattice for the NSLS X-Ray Ring" published in the 1995 Particle Accelerators Conference, Dallas, Texas by James Safranek. The following updated extracts from that paper give a flavor of what has been achieved and places the work in context:

In the past the focussing gradients of the NSLS X-Ray Ring magnets were not known to high precision but recent R&D during studies has enabled us to precisely determine the true focusing gradients in all the X-Ray Ring magnets. With this improved understanding of the ring optics we are now better able to control the horizontal dispersion and beta function. The dispersion in the operations lattice lacks the 8-fold periodicity of the magnet structure, because the orbit is offset in the sextupoles. We can now correct for local gradient errors, arising from displaced orbits in sextupoles, that break the periodicity of the dispersion, and we can modify the quadrupole family strengths in order to minimize the horizontal emittance. The focusing effect of the sextupoles is compensated using trim supplies on the quadrupoles in the dispersive straight sections.

The present X-Ray Ring optic design gives a horizontal emittance of 113 nm*rad. With minimal hardware changes, this emittance can be reduced to 45 nm*rad. The emittance could be further reduced

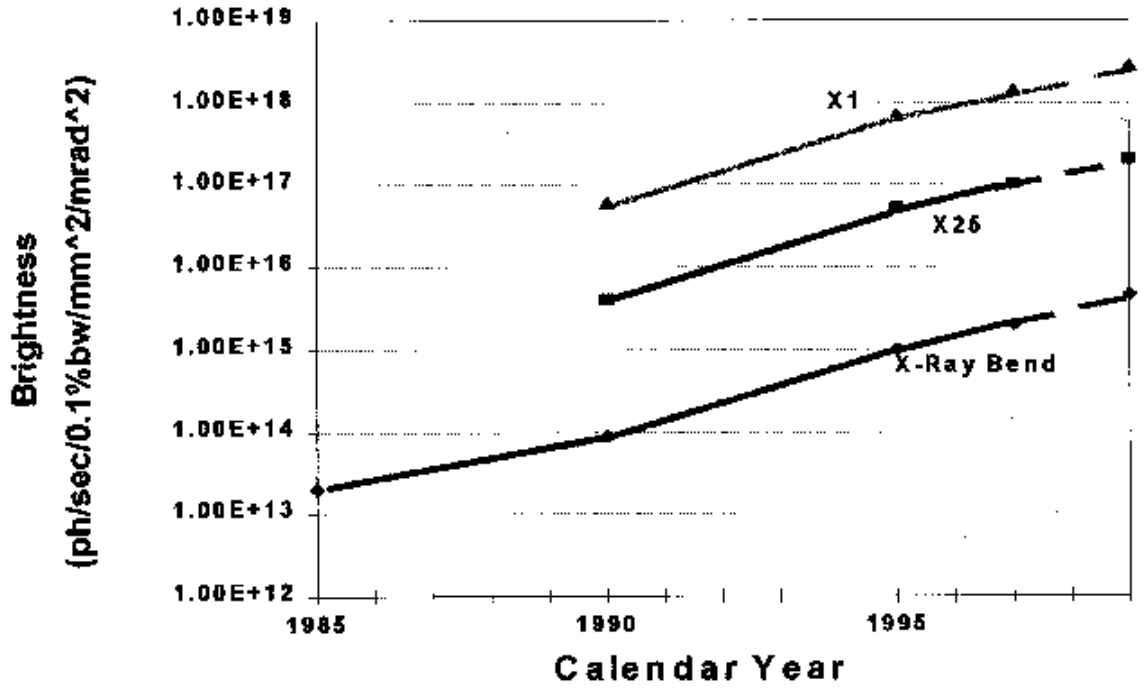

Figure 1: shows the more than 100 times brightness improvement on the X-Ray Ring during the 1990s.

to 38 nm*rad, but this would require replacing the sextupoles used for correcting the vertical chromaticity. This reduced horizontal emittance electron beam would produce a brighter x-ray beam for the NSLS users, adding to other recent increases in the X-Ray Ring brightness. When the dispersion is not constrained in the insertion straight sections, the minimum emittance is 21 nm*rad, but the optics for the 21 nm*rad lattice would require huge sextupole strengths which would result in a very small dynamic aperture.

The increase in horizontal beam size in the insertion straight sections due to dispersion is more than offset by the reduction in emittance, so the beam size is still reduced in the insertion straights as well as everywhere else in such a lattice.

Users are now gaining experience of the new running mode and plans are in place to do the same at 2.8GeV after increasing the strength of the chromaticity correction sextupoles. Independent evidence of the reduced emittance is shown in Figure 2. This is a pinhole camera scan showing the x-ray beam profile, obtained on the diagnostic beamline X28.

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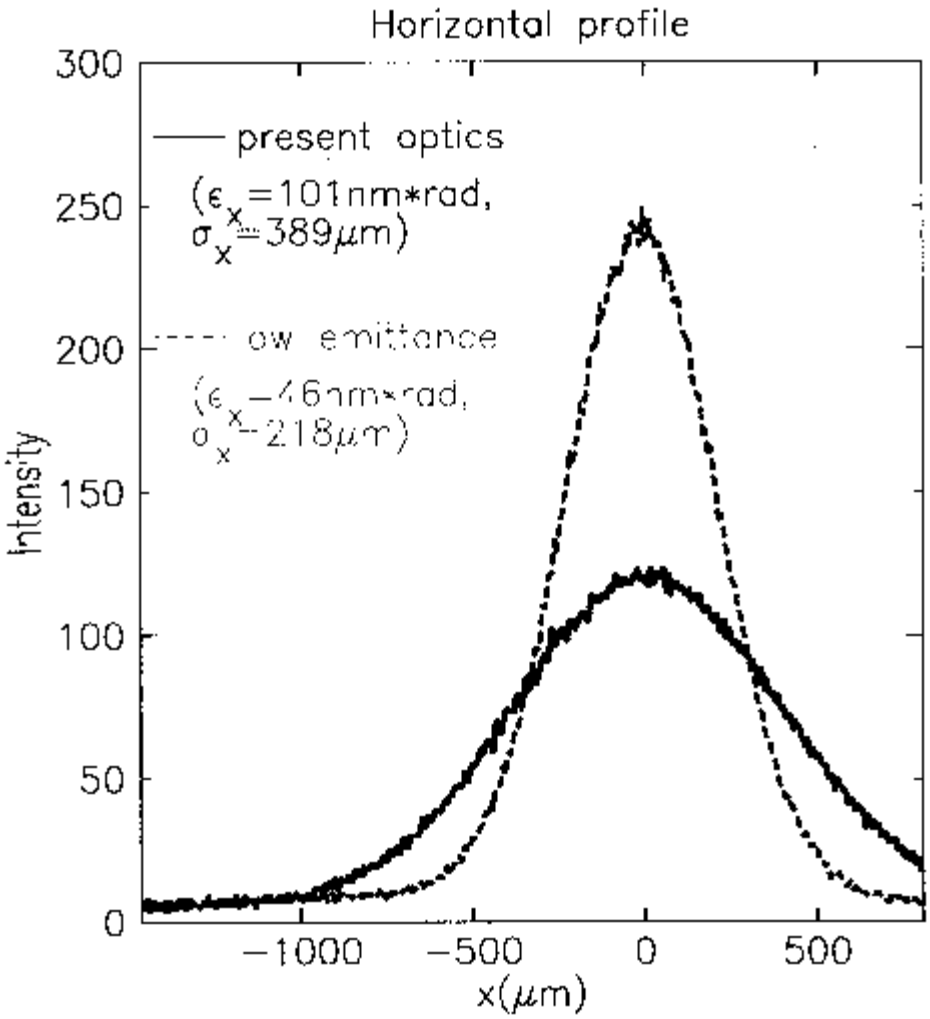

Figure 2: shows the horizontal profile with the present optics as well as with the proposed changes to the lattice.

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Crystal Clear View of a Lyme Vaccine

Catherine Lawson

BNL Biology Department

In the past few years, our molecular understanding of the mysterious, wavy bacterium that causes Lyme disease has grown tremendously. First identified in 1982, *Borrelia burgdorferi* has been present on Long Island for at least the past century and pathogenic strains exist worldwide. The organism, a spirochete, exists in the wild and is spread by transmission between a tiny invertebrate arthropod, the *Ixodes* tick, and its natural animal hosts, which include small mammals, birds, and deer. Human infection, with its characteristic bull's-eye rash, fever, and subsequent (if untreated) arthritic, neurological, and/or cardiac symptoms, can result from prolonged attachment of an often unseen infected tick.

Study of the Lyme bacterium has been hampered by poor growth of the organism in culture. Nonetheless, we are beginning to understand how it evades immune attack and is able to transfer between and survive in both tick and animal hosts. The key to the organism's stealth and mobility appears to lie in its ability to change its surface to suit its current environment. When the spirochete migrates between different tissues of the tick or animal, it will alter the composition of its predominant surface-exposed proteins.

Outer surface protein A (OspA) is a 31 kDa lipid-modified protein that was discovered soon after *B. burgdorferi* was isolated. Plentiful in cultured organisms, OspA can also be detected by immunochemical techniques in infected ticks. It was therefore a mystery why antibodies against OspA are usually not found in Lyme disease patients. It was subsequently discovered that a slight temperature increase will cause cultured organisms to stop production of OspA and begin production of a completely different surface protein, OspC. A similar phenomenon was confirmed to occur in the feeding tick: spirochetes migrating toward the warm skin of the mammalian host lose their OspA and begin to express OspC. Since that time, variable expression of a number of other surface proteins has been documented, and sequencing of the entire *B. burgdorferi* genome has revealed the presence of about one-hundred other genes encoding proteins predicted to be targeted to the cell surface. One such gene, called VlsE, can mutate rapidly in a mammalian host so the protein it encodes may play a critical role in evasion of immune attack.

Despite its scarcity on bacteria within the infected animal host, OspA, either isolated from bacteria or produced recombinantly, can act as a protective vaccine. Remarkably, although OspA-generated antibodies cannot stop an established infection, they will kill spirochetes within a feeding tick. The effort to test OspA as a first-generation vaccine against Lyme disease has recently culminated in side-by-side reports in the ***New England Journal of Medicine*** showing that two OspA-based vaccines are effective in protecting humans.

Before granting approval for general use, the FDA will have to consider several unusual features of these vaccines, which will have both positive and negative impacts on their ultimate utility. Because the gene encoding OspA is not under pressure to evolve within the environment of a stringent immune system, its

regional variability is low, and breakthrough mutations are therefore unlikely (though in Europe, several antigenically distinct strains are present, so migration, *e.g.*, through bird hosts, could be a problem). However, because spirochete killing takes place only in the tick, OspA-based vaccines are ineffective after infection is established. Traditional vaccines depend on immune memory (the so-called anamnestic response) to quickly augment low antibody levels. This type of response simply will not occur in an OspA-vaccinated individual, so it is likely that frequent boosters will be necessary to maintain protection.

In the past several years we have performed diffraction experiments on crystals of two OspA/antibody fragment complexes at the NSLS that not only have allowed us to determine the overall fold of OspA, but also have permitted definition of non-protective and protective epitopes (the ~800-1200 $Å^2$ surface of a protein antigen that is recognized by an antibody). The formation of crystals suitable for diffraction resulted from a dedicated collaborative effort between BNL and SUNY at Stony Brook, aided by support from BNL, NIH, and DOE. The information gleaned from these crystal structures is now being employed in the design of improved vaccines that incorporate mainly protective regions, and diagnostics that can measure protective antibody levels directly.

Our first atomic view of this vaccine candidate (**Figure 1**) came about when we determined the crystal structure of a soluble unlipidated form of OspA in a complex with a fragment of a nonprotective antibody. Interpretable electron density maps were obtained by combining phases from a molecular replacement solution for the antibody fragment with conventional multiple isomorphous replacement phases using native, platinum, and iodine derivative data collected at X12C, one of two bending-magnet beamlines operated by the BNL Biology Department for protein crystallography. The structure was subsequently refined against high resolution native data collected on X25, the NSLS-run wiggler beamline that is being used increasingly for crystallographic study of biomolecules.

Like many membrane-anchored proteins, OspA is elongated, stretching 80 Å from tip-to-tip. OspA consists of 21 antiparallel b-strands that fold hairpin-style into four antiparallel b-sheets, plus a single C-terminal a-helix. This unique fold appears to have evolved from 11 repetitions of a basic 25-residue b-hairpin element. Surprisingly, NMR analysis by our University of Rochester collaborators has indicated that the unusual region of "freestanding" b-sheet connecting globular N- and C-terminal domains has stability equivalent to the interior of a globular protein. High stability may derive in part from unusual arrays of alternating charges along the length of the sheet, along with extensive van der Waal's contacts between side-chain atoms.

The nonprotective antibody fragment used to crystallize OspA binds to a remarkably well-conserved surface near the N-terminus. The mature N-terminal cysteine residue is the site of triacyl lipid modification that provides a membrane anchor for the otherwise highly soluble protein. The proximity of the conserved surface to the lipid anchor, along with its inaccessibility in the intact spirochete, suggests that it may contact other proteins on the membrane surface.

We have recently determined the structure of a second OspA/antibody fragment complex, this time derived from a monoclonal antibody, called LA-2, that will recognize and kill *B. burgdorferi*. In fact, vaccine effectiveness strongly correlates with the ability of an individual's antibodies to interfere with LA-2 binding. LA-2 recognizes the three loops at the C-terminal end of OspA, opposite the end predicted to be anchored to the membrane. This structure therefore confirms the hypothesis that the C-terminal end of the molecule is accessible on the intact spirochete, and identifies key variable residues that need to be considered when formulating vaccines for world-wide use.

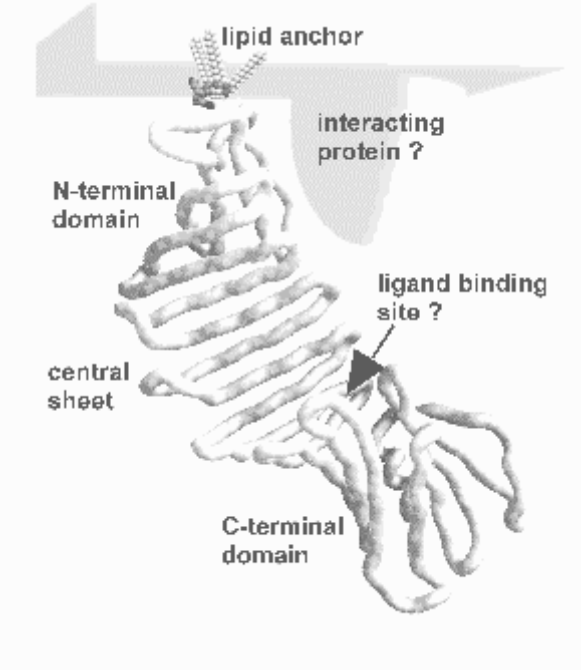

Figure 1: Anatomy of Lyme vaccine candidate OspA.

A cellular function for OspA has not yet been identified, and the complex architecture and dynamics of the cellular surfaces on which OspA reside are still not well understood. Spirochetes are gram-negative bacteria with inner and outer membranes, and they are distinguished by the fact that the rotating flagellar bundles that propel them forward are buried in the intervening periplasmic space. Interestingly, although OspA is readily detected on the outer membrane of cultured organisms, it appears to be even more abundant in the periplasm, presumably attached to the inner membrane. It is not known how OspA gets to the outer membrane, or whether cycling of OspA occurs between inner and outer membranes.

Characteristic of an obligate pathogen, the genome of *B. burgdorferi* encodes an extremely limited repertoire of enzymes for biosynthesis. Its survival therefore depends heavily on transport of premade components into the cell. The relatively flexible C-terminal domain of OspA possesses a highly conserved region that includes a trio of partially buried charged residues and a small hydrophobic cavity within a pronounced cleft. These features strongly suggest that OspA can bind to a small molecular ligand of unknown identity, probably with negative charge. OspA might therefore have a functional role within a nutrient sensing or transport system.

In addition to utilizing the structural information we have gathered for OspA, we are now investigating the structures of *B. burgdorferi* proteins such as OspC and VlsE that are expressed within the tissues of infected mammals. Accurate structural models of these proteins will aid in the design of improved vaccines that will be able to provide protection in an infected individual. We are also likely to uncover structural features that underlie *B. burgdorferi*'s ability to evade destruction in its mammalian hosts.

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A User's Perspective

John B. Parise

SUNY at Stony Brook

UEC Chair

A town meeting was held on the 17th of November. This was the first opportunity in quite a while for the users to gather and air opinions on two important issues. Both the closing of the cafeteria on weekends and the formation of a Community Advisory Council (CAC) can dramatically affect the way users do science at the BNL. Both illustrate how interconnected the welfare of the NSLS and other user facilities are with the laboratory. A follow-up town meeting will be held Friday November 13 at 10 AM. Please try to attend as both issues will be revisited and require your input.

The town meeting was opened with a vigorous but civil discussion of the cafeteria and plans to replace the food services it provided on weekends. Representatives of the BNL administration and the cafeteria management, the Flick Corp., attended. As was pointed out, weekend cafeteria operation was a "loser" in the financial sense and was subsidized to the tune of about $35,000 per year. This in itself is no justification for closing off access to some users who work on tight schedules and have neither the time nor vehicle to travel off site for food.

The closing of the cafeteria was first suggested, or perhaps rumored would be more accurate, in late May of this year. I was assured at that time that viable alternatives would be presented to the users, before the closing date. These assurances came from close to the highest levels, were made to me, personally, before a substantial crowd. They were also made in a manner suggestive of paranoia on my part and that I was woefully misinformed. I was inclined to take these assurances at face value. Not that I was paranoid, that's a given, but that alternatives would be presented at the town meeting. Although some ideas were presented by the administration, I confess to being a tad disappointed at the lack of a real plan prior to the cafeteria's closing. The users at the town meeting were similarly concerned about the lack of viable alternatives. For example, the provision of more machines, stocked with the fare presently available, was roundly criticized when presented as an alternative. Several options were suggested from the floor however, once again proving that if consulted the users can be counted upon to come up with ideas. We hope the administration will follow through on these. They included: 1) looking into a contractor who could stock the NSLS vending machines with fresh fare and 2) a contractor who could provide fresh fare at the Brookhaven Center on weekends 3) reducing any subsidy at the Brookhaven Center and redistributing this to benefit the operation of a fresh food service on weekends. Other suggestions, such as regular van service off site, shuttles and more advertising for delivery services will also be explored, and indeed in the later case are being included on the "user information" page at http://www.nsls.bnl.gov/Intro/usermenu.htm. At a meeting on the following day, the UEC was assured that an administrative committee is working to fulfill the users' need for weekend nourishment. We hope an update of this situation will be provided on November 13.

Members of the NSLS Users' Executive Committee: (seated) Malcolm Capel (BNL - Biology), Lisa Kelly (U. of Maryland); Michael Dudley (SUNY @ Stony Brook); John Parise (SUNY @ Stony Brook); Jean Jordan-Sweet (IBM); Luz Martinez-Miranda (U. of Maryland); Carol Hirschmugl (U. of Wisconsin); Mark Chance (Albert Einstein College of Medicine).

(standing) Eva Rothman (NSLS); George Cody (Carnegie Inst. of Wash.); Joel Brock (Cornell U.); Steve Whisnant (U. of S. Carolina); Paul Stevens (Exxon); Gwyn Williams (NSLS); Larry Carr (NSLS); Barbara Illman (U. of Wisconsin/USDA Forest Products Lab).

Missing from photo are: John Hill (BNL-Physics), Erik Johnson (BNL-NSLS), Patrick Dai (Tufts U.), and Boris Sinkovic (U. of Connecticut).

One final thought on a recurring theme emerging during these discussions: comparisons with other national laboratories should not be the sole justification for presenting a less than helpful face to the user community. Certain laboratories are so dismissive of their users they presume they can pay $100 per night for hotels off site. Brookhaven has traditionally provided users with a cost-effective way to carry out their science and the good will engendered in this simple act provides the BNL with a loyal user base. The NSLS users as a group value their access to the Laboratory. They have been its staunch supporters. They have written letters on its behalf and have advocated before committees. They have dedicated long hours to building the reputation of the NSLS and therefore the BNL. They do not come looking for unreasonably generous treatment. They merely wish to be provided with a reasonable infrastructure, including the ready availability of nutritious food on weekends that will allow them to continue their research in a timely manner.

The second major topic for discussion was the formation of a Community Advisory Council (CAC) and the participation of the NSLS users in this forum, intended to advise the BNL. The draft charter states "The CAC's mission is to address concerns about the Laboratory's policies and operations, explicitly those related to environment and public health issues". The charter further states "Its recommendations are advisory". Jean Jordan-Sweet (IBM, Beamline X20) has been our representative through the early stages of the discussions to institute this Council, from August 1997. The members include representatives from the local business, government, educational and activist communities. The opportunity for mischief on such a body was clearly on the mind of the UEC when former chair, Joel Brock, wisely insisted on the NSLS users' having a voice on such an "advisory" committee. The users are fortunate indeed to have Jean Jordan-Sweet as their representative on the CAC, and to have Peter Stephens designated as the alternative. There will be two CAC meetings before the town meeting on November 13. These meetings are open to the public and are held on every second Thursday of the month at Berkner Hall at 7:30 PM. Long Island users in particular may wish to attend the October 8 and November 12 meetings to obtain a flavor of the proceedings. Jean and Peter will report at our town meeting on the 13th.

Another, not unrelated topic, was highlighted by NSLS Chairman Michael Hart. This concerned the funding of a NRC panel to study the "running" of the synchrotron sources. No doubt the users will be asked to respond in some manner to requests from the panel and Chairman Hart asked us to keep that in mind. Finally, Eva Rothman described the electronic submission of safety approval forms (complete description on page 10).

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November 1998 NSLS Newsletter

Radiation Badge Reminders

Nicholas F. Gmür

NSLS ES&H Coordinator

Periodically, it is useful to remind you, the NSLS staff and users, about important issues concerning your personal dosimetry, i.e. your radiation badges. Please read this carefully.

• Certain NSLS areas are classified as Radiological Controlled Areas. Entrances to these areas are clearly marked with the standard magenta-and-yellow signs. The areas include the NSLS Experimental Floor (725A) and posted offices (725B/C), the Source Development Laboratory (729), and posted areas in the Accelerator Test Facility (820).

• You must wear a radiation badge whenever you are in these Controlled Areas. If you are found without a radiation badge, you will be told to leave the Controlled Area and recover your badge before returning.

• When you arrive at the NSLS, first obtain your badge, and only then go to your beamline.

• You must wear your badge in full view on the front of your torso between your waist and neck. Do not wear your badge inside a pocket. Do not cover your radiation badge with your BNL ID badge.

• Always wear your badge with the blue or yellow color bar facing out. These colors alternate each month.

• Always make sure your name is on the badge your are wearing.

SPECIAL NOTES FOR TEMPORARY BADGE WEARERS

If you wear a temporary badge (you request a new one for each month you visit the NSLS):

1. Always place your badge on a badge board whenever you leave the NSLS building. Use the un-numbered slots marked "VISITOR". When you leave the NSLS at the end of your experimental run and know you won't be returning within this calendar month, place the badge in the collection bin located at any badge board.

2. Make sure you request and receive a new badge during badge exchange days. Do not keep using the previous month's badge. Badge exchange days are well-advertised with flyers and posters by all badge boards.

SPECIAL NOTES FOR PERMANENT BADGE WEARERS

If you wear a permanent badge (your new badge appears automatically each month on its board):

1. Always place your badge on its badge board at the end of each work day. This is especially important before you leave for a trip or on vacation.

2. At badge exchange time, if your new badge does not appear on your badge board, do not just keep your old badge. Immediately contact Marlon McAvoy (x6389), Rudy Zantopp (x5565) or Chris Weilandics (x2593). They will guide you through the exchange process.

3. When you are told that your radiological training due date is approaching, please redo your training as quickly as possible. Delays will result in the withholding of your badge by ES&H Services. Training assistance can be obtained from the NSLS Training Coordinator (x2743) or the User Administration Office (x7976).

4. When you leave the NSLS for good, return your permanent badge to Nicholas Gmür (x2490) or any person listed in #2 above so that your badge can be retired. This saves the NSLS $160/yr./badge.

If you have any questions regarding the above, please come talk with Chris Weilandics (x2593) or Nicholas Gmür (x2490).

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November 1998 NSLS Newsletter

1998 Annual Users' Meeting at the National Synchrotron Light Source

John B. Parise

SUNY at Stony Brook

UEC Chair

The NSLS users held their Annual Users' Meeting on Tuesday May 19, 1998 at Brookhaven National Laboratory (BNL). It allowed many users to meet the new BNL contractor, Brookhaven Science Associates (BSA), for the first time, obtain the latest news from the Department of Energy (DOE), and review and celebrate scientific accomplishments. On the Monday and Wednesday bracketing this meeting, users attended a total of six workshops.

The meeting began with an extended introduction by Peter Paul, BNL Deputy Director for Science & Technology. John Marburger, Director of BNL then elaborated on these remarks, pointing out that users of the facilities at BNL are its primary customers and summarizing some of the trauma which resulted in the termination of the AUI contract to operate BNL and the successful bid by BSA. He indicated a willingness to represent the interests of users in Washington DC, and particularly the need to improve infrastructure and user support.

John Marburger, new Director of Brookhaven National Laboratory, updating users on recent changes at BNL and its new manager, Brookhaven Science Associates.

The subject of the meeting then turned to science. Larry Carr of the NSLS gave a presentation entitled

"Infrared at the NSLS - A Long Wavelength Probe of Small Things on Short Time Scales". Larry described the facilities at U12IR along with spectra showing the performance advantage over conventional sources. The signal throughput for small samples exceeded that obtained with the spectrometer's internal source (a high pressure mercury arc lamp) by more than 2 orders of magnitude in the far infrared. Spectra down to 1 cm^{-1} were shown, including an observation of enhanced signal at 1.4 cm^{-1} (42GHz).

Lisa Kelly (U. of Maryland) and Larry Carr (NSLS) comparing notes between scientific presentations at the NSLS Users' Meeting.

Cev Noyan of the T.J. Watson Research Center of IBM described the "Determination of Mechanical Properties of Thin Film Interfaces with X-Ray Microdiffraction" at the X20A beamline. The (buried) interfaces between polycrystalline Al, Cu and W thin-film features and their substrate (single crystal Si) were characterized using the Si (004) reflection. Topographic images of the Si around and under the metallization features were constructed, showing that a fully elastic "mosaic" structure develops in the Si under the thin film features.

The first speaker after the morning break was Michael Hart, Chairman of the NSLS. He pointed out the positive light in which the NSLS was painted by the recent BESAC review and that the FY99 presidential budget includes an increase for support of users of some 5.2%. He cautioned, however, that these increases might prove illusory. Michael Hart also pointed out the dramatic increase in the number of life science users over the past 5 years and the expectation that they will soon constitute the largest user group at the NSLS.

Some of the concerns with funding by the U. S. Department of Energy (DOE) were addressed by Robert Marianelli, Director of the Division of Chemical Sciences for the Office of Basic Energy Sciences (BES). He assured the users of the importance of basic science to the mission of the DOE. The BES program contributes 2 billion dollars per year, or 17% of all federal funding for the physical sciences. In response to questions regarding the budget negotiation process, he agreed that it is every citizen's right to make their elected representatives aware of decisions which adversely effect their interests.

Barbara Illman (University of Wisconsin, USDA/FS Forest Products Lab) next described part of her research program at beamlines X26A and X27. With the microprobe at X26A, she and collaborators are employing new, non-destructive synchrotron techniques for detecting iron and manganese oxidation

states in wood to study biochemical mechanisms of fungal decay. She and Betsy Dowd (NSLS) work at X27 to develop novel synchrotron techniques for element mapping in 3-dimensional images of preservative-treated wood.

Left to right: John Parise (SUNY at Stony Brook), current NSLS User Executive Committee Chairman; Carl Zimba (NIST); and Joel Brock (Cornell U.), former UEC Chairman, between User Meeting sessions.

In the time remaining in the morning session the users had an opportunity to thank representatives from NSLS staff and BNL Plant Engineering who worked to repair power cables responsible for a shutdown in December 1997. The repair to the NSLS were so well managed that most users did not know there had been a major power failure until the User Meeting. (See July NSLS Newsletter for details about the power failure.)

The Scientific Highlight speech was given directly after lunch. Nobelist James Watson, President of the Cold Spring Harbor Laboratory, presented a retrospective of his life's work "From the Double Helix to the Human Genome Project". This was followed by a presentation by Wayne Hendrickson of Columbia University/HHMI. In collaboration with researchers from Dana-Farber Cancer Institute, SmithKline Beecham Pharmaceuticals, and Tulane University Medical Center, they were able to obtain small crystals of the HIV-1 gp120 envelope glycoprotein in complex with the CD4 receptor and a neutralizing human antibody. The crystals were needles of only 30-40 microns in cross-section, and required the intense synchrotron radiation on NSLS beamline X4A for data collection. They were able to solve the structure at 2.5 Å resolution. The structure reveals the details of the CD4-gp120 interface, a conserved binding site for the chemokine receptor, evidence for a conformational change upon CD4 binding, the nature of a CD4-induced antibody epitope, and specific mechanisms for immune evasion. The results provide a framework for understanding the complex biology of HIV entry into cells and should guide efforts at intervention.

Ian Robinson of the Physics Department, University of Illinois, Urbana spoke about grazing X-rays and electrochemical interfaces. The examples presented included the electrochemical oxidation of copper, specifically at the Cu(111) surface. Structural studies of the native oxide formed in air show an epitaxial film of Cu_2O (cuprite) which gradually thickens over several hours following electropolishing. Both hexagonal orientations of the interface form simultaneously with equal proportions. The situation is very

different in acidic solution, where the oxidation and reduction can be driven by an external potential. There, only one epitaxial orientation of the film is found to grow thick; the other orientation forms, but always remains a single monolayer in thickness.

Peter D. Johnson of the BNL Physics Deptartment gave a talk on recent advances in High Resolution Photoemission applied to the study of low dimensional oxides, in particular the High Tc superconducting materials. New developments in instrumentation now allow the energy and angular distributions of the photoelectrons to be measured in parallel, and with much higher energy resolution than in earlier studies.

The Keynote Address was delivered by Dr. Ernest J. Moniz, Under Secretary of Energy at the US Department of Energy. Given the recent history of BNL, his opinions were of interest to an audience beyond the Users of the NSLS and the numbers of people in the auditorium swelled during his presentation. Dr. Moniz began by commenting that BNL is regarded as amongst the best of the research laboratories in the country and that the new BNL management team lead by Dr. John Marburger is "hitting the ground running". He also emphasized that the recent Birgeneau report, which emphasized the growing importance of the four DOE synchrotrons in the nation's research programs, praised the NSLS for the number of users served and its education and outreach to new users.

Left to right, NSLS Annual Users' Meeting Organizing Committee:

John Hill (BNL Physics)

Harald Ade (NCSU)

Nancye Wright (NSLS)

Elaine DiMasi (BNL Physics)

Linda Feierabend (NSLS) and

John Parise (SUNY at Stony Brook)

Other important parts of the meeting included the reception the evening before the meeting, poster sessions, a barbeque luncheon outdoor under a tent and an equipment exhibit attended by 17 vendors. All were held in Berkner Hall and all were popular with the users. The election of three new members to the User Executive Committee took place during the Annual Meeting: John Hill (BNL Physics Department), Carol Hirschmugl (U. of Wisconsin), and Lisa Kelly (U. of Maryland) were elected as general members, and the UEC chose Barbara Illman to be its Vice-Chair (Chair-Elect). The Annual Meeting was capped off that evening by a banquet at the Port Jefferson Country Club which overlooks the Long Island Sound.

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November 1998 NSLS Newsletter

Electronic Safety Approval Forms

Andrew Ackerman

Experiment Review Coordinator (ERC)

Our new Electronic Safety Approval Form web page is up and working. After October 1, 1998 all Safety Approval Forms must be submitted via the new system. We want to move towards complete dependence on web-based submission of this information but understand that this is new, so will work out whatever is needed to keep experiments running until we have all had time to adjust. You can get to it from the NSLS home page (under "User Info") or go directly to http://www.nsls.bnl.gov/Safety/safhome.htm. You will find several pages of fields where you can enter the information previously collected on the paper form.

We have long needed a well-organized database filled with the information we collect with our existing Safety Approval Forms. Such a database streamlines data collection and processing and allows easy access to the system for whatever reports we want. Only the record keeping is changing; the fundamental goals of the program are the same. We want to evaluate and control the risks presented by experiments. We want to plan activities and include consideration for potential hazards to personnel and the facility. The forms, and now the web page, are our best way to collect and organize the information we need. Using the web and developing this database is in everyone's best interests. Please help out by giving complete information and by giving accurate, concise descriptions of your work in the "Task and Hazards Analysis" section. Several fields are marked as required and must be completed for your form to be reviewed.

Operations Coordinators will still be posting paper forms at the beamlines and enabling lines as always and we still want this information submitted at least a week in advance of the start of your experiment. When you call the Operations Coordinator to have your beamline enabled, they will check the system to see that your experiment has been reviewed and then print the information we want posted at the beamlines. You can also print out copies of your form and, if you remember the serial number assigned to your experiment, you will be able to query the system and check your form's status at any time. There are other good features and we will add and change the page as we see what everyone wants. We expect to have ample input from the user community as the system grows and hope that you will be patient as we all get better at using it.

These SAFETY APPROVAL FORM Policies Are Still In Effect

1. Your SAF is valid for one year from date of approval.

2. Submit your SAF at LEAST one week before your expected start date.

3. General Users: Don't submit a SAF with your proposal - submit your SAF once you have bene notified of your beam time allocation. Also, do not submit a new SAF for each cycle unless the experiment or beam line has changed.

4. Complete all required fields (use "none" or "not applicable" if necessary) or your form can not be reviewed.

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November 1998 NSLS Newsletter

FOCUS ON.....NSLS Utilities Group

Ron Beauman, Utilities Engineer

Marty Woodle, Mechanical Section Head

Water, water everywhere,

Nor any drop to drink,

`Cause all this lovely water,

keeps the Light Source in the pink.

Apologies to Samuel Taylor Coleridge

INTRODUCTION

The Light Source is a 24 hour, 7 day a week facility whose operation requires seven critical systems to operate continuously:

- Electrical Systems Vacuum Systems
- Magnet Power Supply Systems RF Systems
- Computer/Control Systems Water Systems
- Compressed Air systems
- Vacuum Systems
- RF Systems
- Water Systems

An interruption to any of these systems will result in a machine shutdown. The Utilities group is concerned with the operations of the Water and Compressed Air Systems. Within the water system there are six individual subsystems: Chilled Water, Condenser Water and four process water systems, each of which must operate continuously.

The four process systems directly effect the accelerators and beamline equipment and may be considered the "lifeblood" of the NSLS. It is these water systems that provide the necessary cooling to maintain not just operations, but stable operations.

In 1992, a study [1] established the relationship between photon beam stability and vacuum chamber water temperature. Since that time the Utilities Group has been striving with significant success to improve reliability and stability of these vital systems. The table below summarizes the areas served by the four process water systems.

TABLE 1: PROCESS WATER SYSTEMS	
SYSTEM	COOLS WHAT
Aluminum	VUV and X-Ray vacuum chambers
High Press. Copper	Magnets, RF cavity skin, front end components and crotches, buss bars, LINAC pump stations
Low Press. Copper	Power supplies, RF transmitters, RF cavity mushrooms
Experimental	User community, Cryogenic system compressors

CAPACITY and CONTROL

The process systems must dispose of the heat generated by from the machine and experiments. Multiple heat exchangers accomplish this by transferring the heat to two independent chilled water systems and ultimately to the atmosphere. One chilled water system, the NSLS in-house, utilizes four chillers and several roof mounted cooling towers. It originally was the only chilled water system. In 1994 BNL completed a project started in 1990 to connect the Central Chilled Water Facility (CCWF) to our water systems. The NSLS utility engineer, Ron Beauman, championed the concept and design of retaining most of our original chilled water system capability providing the increased operational reliability that two systems allow us. This design philosophy has greatly benefited the NSLS users by allowing the Light Source to remain operational during major problems with both the CCWF and the NSLS in-house chilled water systems. With a few weather related limitations, the NSLS can operate using either or both chilled water systems.

In addition to our increased capacity, sophisticated controls have been added to our process systems improving both our pressure (flow) and temperature stability. These controls consist of:

- PID Controllers
- Improved Control Valves
- Improved Instrumentation

Figures 1 and 2 show typical temperature variations over a day before and after the implementation of the new control systems. The stability in the HP Copper, LP Copper, AL, and Experimental systems have all improved with the most notable improvement achieved in the AL and Experimental systems. The AL system has been established as having the most direct effect on beam stability [1, 2].

THE UTILITIES GROUP

The Utilities Group is part of the Mechanical Section headed by Marty Woodle. The group takes care of the process water systems and provides coordination services as well as technical guidance for work by Plant Engineering on the chilled water, condenser water, A/C, compressed air and instrumentation systems.

Ron Beauman is the Utilities engineer responsible for the design, maintenance and modifications to our utility systems. Tom White is leadman with Lenny Santangelo and Mike Schwartz NSLS utility technicians. Joe Pagano and Bob Bellando, Plant Engineering A/C Engineers whom the Light Source partially fund, complete the group. In addition, the group is fortunate to be able to call on the electrical expertise of Joe Sheehan from the Electrical Group and Norm Besemer of the Electricians as well as Pete Gross from the Design Group.

From left to right: Mike Schwartz, Ron Beauman, Marty Woodle and Lenny Santangelo. Absent from photo: Tom White, Joe Pagano, and Bob Bellando.

CURRENT AND RECENT WORK

The NSLS has recently completed the installation of upgraded deionizer subsystems for the Aluminum (AL), High Pressure Copper (HPC) and Low Pressure Copper (LPC) Systems.

At the Source Development Laboratory, the two utility systems are nearing operational status. These systems will provide cooling for the LINAC, magnets and electronic racks.

NEAR FUTURE WORK

Most beamline personnel have received Michael Hart's memorandum outlining our intentions to assure that components that are controlled and maintained by users are connected only to the Experimental System. This will be of benefit to all users by resulting in even more stable process water systems. During the upcoming winter shutdown, we will continue our system maintenance and improvements by rebuilding the expansion tank subsystems on all process water systems. We also will be implementing the connection of extensive new instrumentation to a sophisticated centralized control computer which will allow us to better understand, diagnose and control our "lifeblood" systems.

If you need advice on how or where to connect your equipment to our utility systems, your starting point should be to contact Ron Beauman at x7418 or beep him at 0498 (voice pager).

[1] E. D. Johnson, A-M. Fauchet, X. Zhang, "Correlation of Photon Beam Motion with Vacuum Chamber

Cooling on the NSLS X-Ray Ring", *Rev. Sci. Instrum*., **63** (1), 513, (January 1992).

[2] S. Kramer, R. Beauman and T. White, "VUV Ring Water Temperature Tolerance Study", VUV RING STUDY NOTE, UVSTUDY-1, 9/2/94

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November 1998 NSLS Newsletter

X-RAY RING STATUS

Roger Klaffky

X-Ray Ring Manager

There have been reliable X-Ray Ring operations since the last status report in the July 1998 NSLS Newsletter. The new all-copper RF2 cavity installed during the Spring 98 shutdown has performed according to expectation during 2.584 and 2.8 GeV operations periods. The major task for the upcoming December 1998 shutdown will be replacing the existing RF1 cavity with the second all-copper cavity. This cavity was delayed in shipping because several small port joints required rewelding to make them leak tight. Cross-sections of a test weld were inspected and approved by the manufacturer and BNL engineers prior to the repair. The cavity will arrive at BNL during the week of September 21. It will be moved to the RF Test Area where frequency calibration and mode-damping measurements will take place, as well as high power testing. During the shutdown the same installation sequence used for the RF2 cavity will be followed, except that the X5 tagging cave and associated water manifolds will be disassembled to provide sufficient room for the installation. The space between the RF1 and RF2 cavities has been increased by more than one foot to allow for the future installation of a second IVUN (In-Vacuum Undulator). This change requires that a new hole be drilled through the 1.5 foot thick tunnel wall for the RF coaxial power cable. Holes will also be drilled through the tunnel roof to provide additional support for the RF lift rails.

The new Oxford Instruments X17 superconducting wiggler installation planned for this shutdown has been delayed for at least 5 months due to problems encountered during acceptance tests at BNL. Two specific issues were identified as the new wiggler was being prepared for cold tests. The first problem was a leak between the helium and nitrogen vessels in the wiggler. The other defect was an electrical short which has not yet been completely isolated. Both of these discoveries were cause for rejection. After consultation with the manufacturer, a series of electrical checks was performed in an attempt to pinpoint the electrical short and to determine if the two defects were related. At that point all agreed that repairs on site at BNL were not feasible and arrangements were made to ship the wiggler back to the UK for further evaluation and repair. At this point, under the most optimistic scenario, the wiggler will not be returned to BNL until the end of January 1999. Therefore, it is unlikely that the wiggler will be ready by the Spring 99 shutdown. Oxford expects that the repairs will be completed by May 1999 at the latest. A December 1999 installation is now the most likely outcome.

In addition to the RF1 cavity installation, there will be a number of other upgrades taking place during the December 1998 shutdown. The NSLS water system expansion tanks will all be replaced. A pressure control will be installed in the experimental water system to maintain a constant supply pressure to user beamlines. Additional experimental water taps will continue to be installed on the X-ray shield wall to provide additional capacity to users. Plumbing will be installed to permit a future move of the X5 magnet power supply and target room cooling from the low pressure copper system to the experimental water system. Electrical work

includes moving the last 208 V power panel inside the ring to an accessible location. To enable operation of the ring at 2.8 GeV with the low emittance lattice, cables (500 MCM) will be run to the sextupole magnets. In the future these cables, together with new sextupole power supplies, will make it possible to boost the sextupole magnet currents to the levels required for 2.8 GeV low emittance operation. Electrical interlock work will include the installation of fast valve interface boxes on all of the remaining X-ray front ends, and rendering the fast valves on several beamlines operational. The Phase I user beamline equipment interlocks will be upgraded with the installation of connectors to allow easy decoupling of the equipment interlocks from the NSLS personnel protection interlocks. This will facilitate the monthly beamline personnel protection interlock tests.

There was steady progress during X-ray studies periods toward implementing the low emittance lattice at 2.584 GeV. Low emittance response matrices were measured and tested for local and global feedback and for orbit corrections. Main magnet and QD trim magnet ramps were established as well. After the insertion device prefill tests were modified to incorporate the correct trim responses, operations with the low emittance lattice began September 27 during 2.584 GeV operation.

The other anticipated upgrade in X-ray operations, a boost in the maximum allowable operating current to 440 mA at 2.584 GeV or to 300 mA at 2.8 GeV, awaits the completion of heat loading tests of the X-ray ring crotches. An electron beam welder facility at the BNL Central Shops will be used for these tests. A prototype copper piece (which simulates the geometry of a crotch) was fabricated and set up in the welder, in order to make sure that the electron beam can be tailored to deliver the proper power load to the target. This test was successful. Preparations are now being made to accommodate an actual crotch in the welder, for testing. It is envisioned that about 4 weeks of welder time will be required in order to attain an appropriate number of power load cycles. Because this amount of time cannot be used contiguously (since the welder cannot be tied up for a 4-week run), the testing will likely span a 3 month period. This is expected to begin around November 1. By late January or early February the testing should be completed and the results analyzed, to determine the long-term prospects for reliable operation of the X-ray crotches at the above currents and energies.

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November 1998 NSLS Newsletter

VUV RING STATUS

Stephen L. Kramer

VUV Ring Manager

The VUV Ring has been operating very reliably since the vacuum accident in March. The lifetime has been lower than the record level set last November, due to higher vacuum pressure. In August the vertical emittance of the beam was increased, in order to increase the beam lifetime. In September the users agreed to return to the 5-hour fill pattern overnight, instead of the 3-hour fills that have been standard since the January shutdown. The 5-hour fills were the standard before the shutdown, but the more frequent fills, which were added to help compensate for the reduced lifetime and integrated current, have made a detailed comparison of the radiation improvement of the new shielding difficult. Users will be able to request the more frequent fill pattern overnight if the higher integrated flux is necessary for their experiment.

Several changes have been made in the RF system to improve the stability of the beam at high currents. One of these uses a novel idea of damping the first major higher order resonance of the RF cavity, by feeding back power using a damping antenna to couple this power into the cavity 180 degrees out of phase with the beam induced signal. This has already shown some improvement in the stability of the beam for symmetric bunch patterns. However, the high power amplifier for the 52 MHZ cavity started to suffer from reduced efficiency in July, making it difficult to maintain the high currents in the VUV Ring. It was decided to replace the amplifier tube during the September maintenance period. This should allow the ring to store high currents more reliably.

One of the sextupole power supplies was replaced in August. This power supply was more sensitive to AC power line transients during the power transfers from the Superconducting Magnetic Energy Storage (SMES) device. When this supply "glitched" the beam would develop the well know head-tail instability, losing a major portion of the stored beam. The new power supply and beam have now run without problems for several power transfers since this change was made. Hopefully this was the last weak link in the electrical systems and the advantage of the SMES on the VUV Ring operations will be a clear asset during the electrical storms and other power line fluctuations.

With three infrared beamlines now operational and a fourth being commissioned, considerable effort was expended to track down a disturbing vibration signal at around 59.5 Hz, seen by these beamlines. Since this frequency was so close to the 60 Hz AC ripple in magnet power supplies, it was felt that electron beam motion was the cause. However, the measurements showed that the electron beam had a small 60.0 Hz motion but the photon beam signal was 59.5 Hz. Accelerometer measurements showed a significant 59.5 Hz vibration, which remained after all NSLS water pumps and compressors were turned off. The search for the source of this vibration will continue, but attempts to decouple the beamline components from this vibration will be made.

The planning is well underway to install more of improved radiation shielding during the December 1998 shutdown. This will replace shielding in the transport line and the beamlines between U9 to U16. The remaining part of the ring (U6 to U9) will be scheduled for the summer shutdown of 1999. This improvement in shielding will make it possible to reconsider the Top Off Method of Injection as a operating standard for early 2000. Studies on this method of injecting will continue and discussion with the users will begin again in early 1999.

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1999 NSLS Annual Users'

Meeting and Workshops

May 24 - 26, 1999

The 1999 NSLS Annual Users' Meeting and associated Workshops will provide a scientific forum in the areas of physics, chemistry, biology, materials science, geology, and medicine. New research opportunities and significant accomplishments will be presented in both invited talks and contributed posters.

Workshops

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

Uses of "milli beams" (10-50 micron spot size)

Chi-Chang Kao, NSLS

Interesting Insertion Devices (PSGU, IVUN, EPW, Super Bends, etc.)

Jerry Hastings, NSLS

Advances in Detectors for Synchrotron Radiation

Daniel Fischer, NIST

Complex Materials (complex oxides, high T_c superconductors, etc.)

Peter Johnson, BNL Physics Department

Infrared Spectromicroscopy

Gwyn Williams, NSLS

Techniques and Opportunities in the 2-3 keV Photon Energy Range

Ogranizer to be announced

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 on May 25. The location will be announced at a later date.

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 at www.nsls.bnl.gov under "News". The deadline to submit an application for poster session submission is **April 23, 1999.**

Registration

Complete registration, housing, and transportation information will be sent to those returning the attached response card before **February 15, 1999**. Individuals registering on or before **May 3, 1999** with full payment will receive a discount on the Users' Meeting registration fee. Mail your response card early! Don't miss out on this year's meeting!!

If you would like more information on the 1999 NSLS Annual Users' Meeting**,** Please send e-mail to LSUSRMTG@BNL.GOV

Planning Committee Members

Paul Stevens, Exxon R&D Chairman

Mark Chance, AECOM Program Chair

Steven Hulbert, NSLS Workshops

Sue Wirick, SUNY @ Stony Brook Poster Session

Linda Feierabend, NSLS Meeting Coordinator

Nancye Wright, NSLS Equipment Exhibit

Eva Rothman, NSLS User Administrator

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November 1998 NSLS Newsletter

NEW SYSTEM FOR PURCHASE REQUISITIONS AT BNL

For Fiscal Year 1998, beginning October 1, BNL is discontinuing the use of the paper Work Copy form for purchasing items. The new "People Soft" web-based submission system is on line, and is to be used for all purchase requisitions. The paper forms are being phased out. NOTE: ILRs and Shipping Memos are NOT affected at this time.

Users now have two options if they want to purchase something through BNL:

- 1. For a limited time, NSLS will data enter your purchase requisitions for you. Complete the paper form as before and send/take to Room 2-177 "Data Entry".
- 2. Use the new system yourself. It is accessible at **http://www.fsd.bnl.gov/** under "Web Requisitions". Be sure to read the notes at the bottom of the logon screen.

An overview of the system, general instructions, and a link to the system are available at

http://www.nsls.bnl.gov/Intro/Guide/purchase.htm

This page is also accessible from the NSLS Home Page under "News", and also under "User Info" - "Services and Amenities" - "Fiscal Services/User Accounts"

NEED HELP? Contact NSLS Staff Susan White-DePace at x7959 swd@bnl.gov

or Jim Desmond x4837 desmond@bnl.gov

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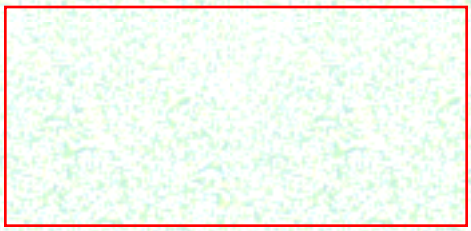
Identification and Tagging of Equipment

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 below).



These 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 have any questions or need assistance please call Donna Buckley at extension 3599.

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November 1998 NSLS Newsletter

CALL FOR GENERAL USER PROPOSALS

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

Monday, February 1, 1999

for scheduling May - August 1999

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 to us.***

Proposal Deadline

The complete proposal package must be received by the User Administration Office on or before 5:00 pm Eastern Time Monday, February 1 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 February 1. 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.

Additional Information and Forms

Blank proposal forms and instructions, a guide to the NSLS beamlines, and more information about the General User Program are available on the World Wide Web at **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 am to 5:00 pm Eastern Time. Contact information is on the back page of this Newsletter.

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 scheduling cycle. Submit PX Forms only for those 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).

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Important Upcoming Dates	
Sept. 8 - Oct. 30, 1998	NSLS Activity Report Abstract Submissions
Nov. 13, 1998, 10 am	NSLS Town Meeting and UEC Meeting
January 22, 1999	Deadline for submissions, March Newsletter
February 1, 1999	Deadline for General User Proposals (May - Aug. `99)

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