JULY 1995 NSLS NEWSLETTER

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IMPORTANT UPCOMING DATES

August 17, 1995

Town Meeting

August 18, 1995

UEC Meeting

August 21-25, 1995

17th International FEL Conference

September 22, 1995

Deadline for submissions, November Newsletter

September 28 - 30, 1995

Micro Bunches Workshop

October 2, 1995

Deadline for General User proposals

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APPOINTMENT OF NEW NSLS CHAIRMAN

Denis McWhan
Acting NSLS Chairman
BNL Associate Director for BES Programs

Over a dozen candidates applied for the position of NSLS Chairman and the search committee worked hard to develop a short list to forward to Dr. N.P. Samios, Director of BNL. We are pleased to announce that Professor Michael Hart has accepted our offer and that he will begin his term as NSLS Chairman in September 1995.

Mike is well known in the synchrotron community for his contributions to x-ray physics beginning with the development of monolithic multiple Bragg reflection devices such as the x-ray interferometer and the Bonse-Hart small-angle scattering camera and his pioneering work on x-ray polarization phenomena. Most recently, he and Lonny Berman have co-authored several seminal papers in the area of high heat load optics for insertion device beamlines at second- and third-generation synchrotron sources. His research and his leadership in the physics community have been recognized by his being elected a Fellow of the Royal Society and appointed Commander of the British Empire. He and U. Bonse shared the Warren Award for Diffraction Physics and he was awarded the Charles Vernon Boys Prize of the Institute of Physics. We look forward to Mike leading the NSLS into the 21st century.

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FROM THE NEW CHAIRMAN...

Michael Hart, Incoming NSLS Chairman

The March Newsletter provided a succinct perspective of the NSLS. It described very significant achievements during Denis McWhan's tenure as Chairman in source performance, infrastructure, and science results, and also gave a complete job description by Jean Jordan-Sweet for the incoming NSLS Chairman!

After a decade of operations and during the commissioning period of the two new third-generation sources in the United States, it is not surprising that future means and methods are up for discussion - especially as funding agencies are developing and refining their policies, methods, and objectives for the support of basic and applied science and technology. I am very encouraged by the discussions which have already been started about supplementing the PRT method of access by Confederations built around common scientific interests. Confederations can enhance the intellectual capital and ingenuity pool and provide economies of scale in financial and technical terms, too. They will also encourage future exploitation of the world class high flux sources which we have at the NSLS. As has been pointed out many times before, the great majority of experiments are not source-brightness limited...

I look forward to working with old friends and making new ones this September.

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X-Ray Photon Correlation Spectroscopy at the NSLS

Steve Dierker
Department of Physics
University of Michigan

Photon Correlation Spectroscopy (PCS) probes the low frequency dynamics of a material by analyzing the temporal correlations among photons scattered by the material. It is based on the fact that interference between coherent photons scattered by random structures in a material result in a random speckle pattern, familiar to anyone who has been in a laser laboratory, modulating the scattered intensity. As the spatial structure fluctuates in time, the speckle pattern, which is equivalent to the instantaneous diffraction limited structure factor, fluctuates and one can relate the time autocorrelations of the speckle pattern to the usual dynamic structure factor of the material.

Although any real photon source is only partially coherent, the observation of speckle only requires photons with a degree of coherence defined by the scattering conditions. Indeed, the first observations of speckle were made by Exner in 1877 with a white light source. However, it took almost a century and the advent of visible lasers in the early 1960's before visible light sources with sufficient coherence and intensity were available for speckle and PCS to become practical techniques. Since then, visible PCS has proven to be an indispensable technique for studying the long wavelength hydrodynamics of fluids, including simple liquids, liquid mixtures, colloids, liquid crystals, and polymers, and has provided some of the most stringent tests of fundamental concepts such as scaling, universality, and dynamic critical phenomena.

Since visible PCS is such a powerful and well developed probe, why would anyone want to use coherent x-rays in PCS measurements? The answer is that visible PCS cannot probe the short wavelength dynamics of materials and is also unable to study opaque materials, such as most solids.

The new field of X-ray PCS (XPCS) offers an unprecedented opportunity to extend the range of length scales over which a material's low frequency (10^-3 Hz to 10^6 Hz) dynamics can be probed down to interatomic spacings. While we have many techniques for studying phenomena at either longer length scales or higher energies, XPCS, as shown in Figure 1, offers the promise of being able to study a previously inaccessible window in wave vector and energy space.

Examples of important problems in the low frequency dynamics of condensed matter systems for which XPCS should be uniquely suited include:

- The dynamic structure factor of liquids on intermolecular length scales, probing theories of nonequilibrium statistical mechanics, including simple and colloidal liquids, liquid crystals, and

polymers.

- The dynamics of moving domain walls in incommensurate systems, including ferroelectrics, charge density wave (CDW) systems, magnetic systems, adsorbates on surfaces, and surface roughening.
- The internal conformational dynamics and reptation of polymer molecules.
- The temperature dependence of the dynamics of short range density fluctuations in liquids undergoing a glass transition.
- Equilibrium critical fluctuations in systems undergoing an order-disorder transition, including binary metallic alloys and polymer blends.

Much of the pioneering development of XPCS has been done over the last six years at the NSLS, primarily on beamline X25. Just as with visible PCS, it was the very low flux of coherent x-rays available with previous sources which, until recently, precluded its application as a practical technique. The critical development which has now made XPCS feasible is the use of synchrotron insertion devices, which have a significantly higher brightness, B, than bending magnet sources and the coherent flux is given by B (lambda)^2 (DELTAlambda/lambda). At the NSLS, the brightest sources in the hard x-ray range have been the wiggler beamline X25 and beamline X21. Since X21 and X25 have identical wigglers and X21 has been dedicated to inelastic x-ray scattering, most of the coherent x-ray scattering measurements at the NSLS have been done on X25. In the near future, the Prototype Small Gap Undulator recently installed on X13 may be available for XPCS measurements.

The degree of coherence of an x-ray beam can be specified by its transverse and longitudinal coherence lengths. The parameters for X25 and X13 are listed in Table I below. The transverse coherence length of a source of horizontal and vertical size, (sigma)h and (sigma)v, is given by *l*h = [lambda/2(sigma)h]R and *l*v = [lambda/2(sigma)v]R, where lambda is the wavelength and R is the distance from the source. A laterally coherent beam is usually prepared by passing the x-rays through a pinhole with a diameter equal to *l*h. This means that much of the available coherent flux in the vertical direction is not utilized. This loss, (~ x 50), together with window and filter losses (~ x 2), accounts for the difference between theoretical and measured coherent flux in Table I.

Table I: Coherence properties of the X25 wiggler and the X13 Prototype Small Gap Undulator. Brightness units are ph/sec/0.1%bw/250 mA/mrad^2. The Si (220) numbers for X13 were determined for an energy of 3.25 keV. Coherent fluxes for X25 all measured with 5mm diameter pinhole. See text.

Beamline	X25	X13
Energy	8 keV	3.0 keV
Wavelength	1.5 Å	4.1 Å
σ_h	414 μm	414 μm
σ_v	8.6 μm	8.6 μm
R	28 m	25 m
l_h	5 μm	12 μm
l_v	244 μm	595 μm
Brightness	2.6×10^{16}	1.3×10^{17}
Si (111) Monochromator ($\Delta E/E = 1.4 \times 10^{-4}$)		
l_{coh}	0.93 μm	2.6 μm
Theor. Coh. Flux	8.4×10^{7} ph/sec	3.1×10^{9} ph/sec
Meas. Coh. Flux	4×10^{5} ph/sec	?
Si (220) Monochromator ($\Delta E/E = 5.9 \times 10^{-5}$)		
l_{coh}	2.5 μm	6.9 μm
Theor. Coh. Flux	3.4×10^{7} ph/sec	1.3×10^{9} ph/sec
Meas. Coh. Flux	2×10^{5} ph/sec	?
W/B_4C Multilayer Monochromator ($\Delta E/E = 1.5 \times 10^{-2}$)		
l_{coh}	100 Å	270 Å
Theor. Coh. Flux	8.8×10^{7} ph/sec	3.3×10^{11} ph/sec
Meas. Coh. Flux	4×10^{7} ph/sec	?

Better utilization of the vertical coherence length is a major challenge to workers in the field. While one could use anisotropic pinholes or slits to collimate the x-ray beam, the flux/speckle is unchanged since the size of the speckles is given by lambdaL/d, where L is the distance from sample to detector and d is the illuminated sample size. A better approach is to vertically focus the x-ray beam, damagnifying it by a factor of (lambda)v/(lambda)h. Asymmetrically cut crystals have been used [1] for this purpose, but they are plagued by an inherent chromatic aberration that degrades the beam brilliance and results in a

maximum net gain of only ~ 20%. A factor of 5 gain in coherent flux has been demonstrated on X25 by Berman [2] by using a bent Silicon crystal to focus, and efforts are underway to perfect this approach.

The longitudinal coherence length, *l*coh, is given by lambda[lambda/(DELTA lambda)], and can thus be increased by using a higher resolution monochromator, albeit at the expense of coherent flux. Several possibilities are listed in Table I above. In order to see speckle, the maximum path length difference incurred by the scattered photons, PLD, must be less than *l*coh. In a Bragg geometry, PLD depends on the scattering angle and the absorption length, delta, through the relation PLD = 2(delta)sin^2theta. In a Laue geometry, PLD is given by 2 h sin(theta) tan(theta), where h is the sample thickness.

The first observation of speckle using coherent x-rays was made by Sutton, *et al.*,[3] on X25. They observed Fraunhofer diffraction of 8 keV x-rays passing through a circular pinhole aperture. They also observed [4] a static speckle pattern modulating the (001) Bragg peak in Cu3Au, a result of randomly arranged antiphase domains. They later studied [4] the time dependent changes in the speckle intensity due to nonequilibrium domain growth following a quench from the disordered to the ordered phase of Cu3Au. A CCD area detector was used in some of their work.

Although the reduced brilliance of bending magnets makes them unsuitable for most XPCS measurements, a bending magnet was used by Cai, *et al.*, [5] on beamline X6B, to study the static speckle patterns from gold-coated films of symmetric diblock copolymer films. Their measurements benefitted from the high reflectivity at grazing incidence of the gold coated films and from the use of a CCD area detector.

Pindak, *et al.*,[6] have attempted to use coherent x-rays on X25 to study the dynamics of moving CDWs in the one-dimensional conductor, K0.3MoO3. So far, they have observed speckle modulating the CDW superlattice peak in K0.3MoO3 and observed changes in the speckle pattern when the sample was field cooled. Since CDW's are a displacive phenomena, the intensity of the CDW superlattice peaks scales with q2 and only for 2theta values > 30 degrees are they strong enough to study. This makes the experiment even harder, as a Si(220) monochromator is required in order to produce the longer *l*coh, which results in a weaker coherent intensity.

An experiment carried out at the NSLS over the last year on X25 has been successful at demonstrating the ability of XPCS to make equilibrium dynamic measurements on a highly disordered material. In this experiment, Dierker, *et al.*,[7] used coherent x-rays to measure the Brownian motion of gold colloid particles diffusing in the viscous liquid glycerol. At first glance, this experiment's prospects for success might seem small, since the scattering typical of highly disordered materials, such as liquids or glasses, is notoriously weak. One can show [8] that the fractional detected count rate (P/P0) scattered into the solid angle subtended by a speckle, for an incident x-ray beam of cross-sectional area Ai and power P0 (ph/sec) incident on an uncorrelated liquid of atoms of charge Z, is P/P0 ~ 3 x 10^-28 Z /(lambda Ai). For the case of liquid Au, Z = 79, and taking lambda = 1.55 Angstroms at 8 keV, Ai ~ 20 micron^2, and P0~ 4 x 10^7 ph/sec at X25 with DELTAE/E = 1.5 %, one expects the impracticably small count rate of P ~ 3 x 10^-4 cps.

To overcome this, Dierker and co-workers [7] used the fact that for a liquid of Np gold particles, each with na atoms, such that Np na = Ntot, the average scattering in the forward direction is the sum of the coherent scattering from Np particles, i.e., P/P0 is proportional to Np na^2 = Ntot na, instead of Ntot. The q dependence of the scattering will just be that of the particle form factor for a sphere of radius, Rp,

since in the dilute gas limit at low q, the structure factor will be unity. For a Au particle with Rp = 200 Angstroms, na ~ 2 x 10^6, giving a sufficiently large P ~ 600 ph/sec. Using this approach, they were able to use XPCS to measure the diffusion coefficient for Brownian motion of gold colloid particles dispersed in glycerol over the range 1 x 10^-3 Angstrom^-1 < q < 1 x 10^-2 Angstrom^-1. This extends far beyond the upper q range of visible light scattering, for which qmax ~ 4 x 10^-3 Angstrom^-1. In addition, since the colloids studied had a gold volume fraction of ~ 1%, they were completely opaque to visible light, and thus could not be studied with visible PCS. Using a two crystal W/B4C multilayer monochromator on X25, the requirement that PLD < *l*coh is satisfied up to q = 3.2 x 10^-2 Angstrom^-1.

The Au colloid particles form a dilute gas having diffusively relaxing concentration fluctuations with a corresponding diffusion coefficient given by D = kbT/(6 pie eta Rp), where eta is the viscosity, and a relaxation time at wavevector q of tau = 1/(D q^2). The dynamic correlation function, g(t), is defined as,

$$g(t) = \frac{\langle n(t)n(0)\rangle}{\langle n(0)\rangle^2}$$

where [] represents a time average in both the numerator and denominator and n(t) is the detected photon count at time t. g(t) should have a maximum value of 2 at t = 0, decaying to 1 at infinite time. Spatial averaging of the speckles by the detector can reduce the t = 0 intercept of g(t).

A dramatic increase in collection efficiency was obtained by using a custom built CCD detector to measure the scattering from ~ 10^5 pixels simultaneously. Since the dynamics only depend on the magnitude of q, we can average the autocorrelation functions measured in all of the pixels in a band of q values. This is equivalent to performing an ensemble average over the pixels as well as a time average for each pixel and reduces the time needed to measure the correlation functions with good statistics by the number of pixels averaged over. With ~ 10^4 pixels in a radial band of width 10% in the average q of the band, the reduction is substantial.

Dierker, *et al.*[7] recorded 1920 images at the rate of one image per second for 32 minutes, of the intensity in a 400 x 400 pixel region on the CCD (Figure 2). The time autocorrelation function of each pixel was then calculated and the ensemble average of the correlation functions calculated. The results for two separate 90 degree arcs corresponding to q's of 3.3 x 10^-3 Angstrom^-1 and 5.5 x 10^-3 Angstrom^-1, with widths of 10% of their average q's and containing 1750 and 5000 pixels, respectively, are shown in Figure 3 along with fits of single exponential relaxations and their characteristic decay times. The large signal to noise ratio of the data can leave no doubt that they correspond to dynamic x-ray scattering from equilibrium colloid concentration fluctuations. The results are in good agreement with expectations based on the viscosity of glycerol. A deviation of the relaxation rates from a precise q^2 dependence was observed. This may be an indication of the onset of non-hydrodynamic effects at large wavevector. This possibility, as well as non-linear relaxation effects predicted by mode coupling theories near the glass transition, are currently being studied.

The results of the gold colloid experiment unequivocally demonstrate the feasibility of the XPCS technique at the NSLS. Its success was due to several factors:

(a)Use of a colloidal sample gave a great increase in scattering intensity.
(b) The measurements could be made at relatively low q, which relaxed the constraints on *l*coh and

permitted the use of a multilayer monochromator and a greatly increased coherent flux.
(c) The dynamics only depend on the magnitude of q, and thus a CCD could be used to ensemble average the correlation functions in a band of q, for a tremendous increase in collection efficiency.

What is the future for XPCS measurements at the NSLS? The work reviewed here clearly shows that XPCS is a feasible technique at the NSLS and can be expected to have wide application to certain classes of systems, especially complex fluids and surfaces, for which at least (b) and (c) above can be taken advantage of. This is particularly true given several significant forthcoming enhancements:

Optimization of the use of an area detector for making ensemble measurements of g(tau): x 10^1 - 10^2.

- Beamline optics which utilize the full coherent output of the undulator in both the vertical and horizontal directions: x 10.
- Introduction of undulator sources such as the Prototype Small Gap Undulator: x 102.

Plans to increase the ring current and lower the emittance will also help. All together, these will enhance the data collection efficiency by 10^4 to 10^5, relative to the gold colloid experiment. With these enhancements, XPCS studies of even atomic liquids will be very feasible at the NSLS, and XPCS will realize its full potential as a unique and important new technique.

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A User's Perspective

Paul Zschack
ORNL / Oak Ridge Institute for Science and Education
NSLS Users' Executive Committee Chairman

On behalf of all users of the NSLS, I'd like to express thanks to Denis McWhan for his capable piloting of the Light Source during the last five years. We have all enjoyed the reliable, productive operations provided by the NSLS during his tenure as chairman. Fortunately, we will not lose his guidance and attention since as BNL Associate Lab Director for BES programs Denis will remain closely involved in Light Source activities.

I'd also like to extend a warm welcome to Michael Hart, the next NSLS Department Chairman. Although I share the apprehension of the user community regarding the uncertainties in future funding and support, Michael will bring the vision and energy necessary to plot a new course for the Light Source to keep the facility at the forefront of synchrotron radiation research. As the next generation synchrotron facilities are coming on-line, the future role of the NSLS has to be defined. Most observers agree that the NSLS will remain an important, vital facility that provides reliable, convenient, and cost-effective access to synchrotron radiation. However, as some current NSLS Users move their programs elsewhere, and others struggle with financial support, new research markets are required to compensate for this erosion to the user-base. The challenge is for BNL management to move together with the Users to assure continued productivity of the NSLS in the next decade or two.

The NSLS has recently proposed formation of PRT Confederations as a means to achieve savings through economies of scale, and some users have already expressed to me their enthusiasm for these appropriately administered, market-driven "super PRT" arrangements. In principle, this confederation concept has significant merit and deserves further consideration. I applaud this pro-active philosophy, and encourage the NSLS to explore these types of alternatives with the Users.

To help guide the NSLS on the implementation of such confederations, and offer other specific recommendations, the UEC has sanctioned a study panel to evaluate the current PRT, General User and NSLS roles and current user needs on both the UV and X-Ray floors. Gerry Lamble, who has agreed to head this group, will entertain input from all users. If you have detailed ideas, or simply general areas where the NSLS infrastructure can help facilitate your programs, now is the time to be heard.

Hopefully, together we can arrive at a plan to strengthen the beamlines, extend the user-friendliness of the facility, and maintain the NSLS as an attractive place to perform research. One last bit of business resulting from the User Meeting are the results of the SPIG and at-large UEC elections. Also, the User Association voted to create a new special interest group for biology. The biology representative will be chosen through a special e-mail election organized by Steve Ginell, the Scattering representative. Finally, in executive session, the UEC selected Peter Stephens to be the Chair-Elect and Sue Wirick to serve as

Secretary. I welcome the newly elected UEC members and officers, and solicit input from the User community to help guide us in the year ahead.

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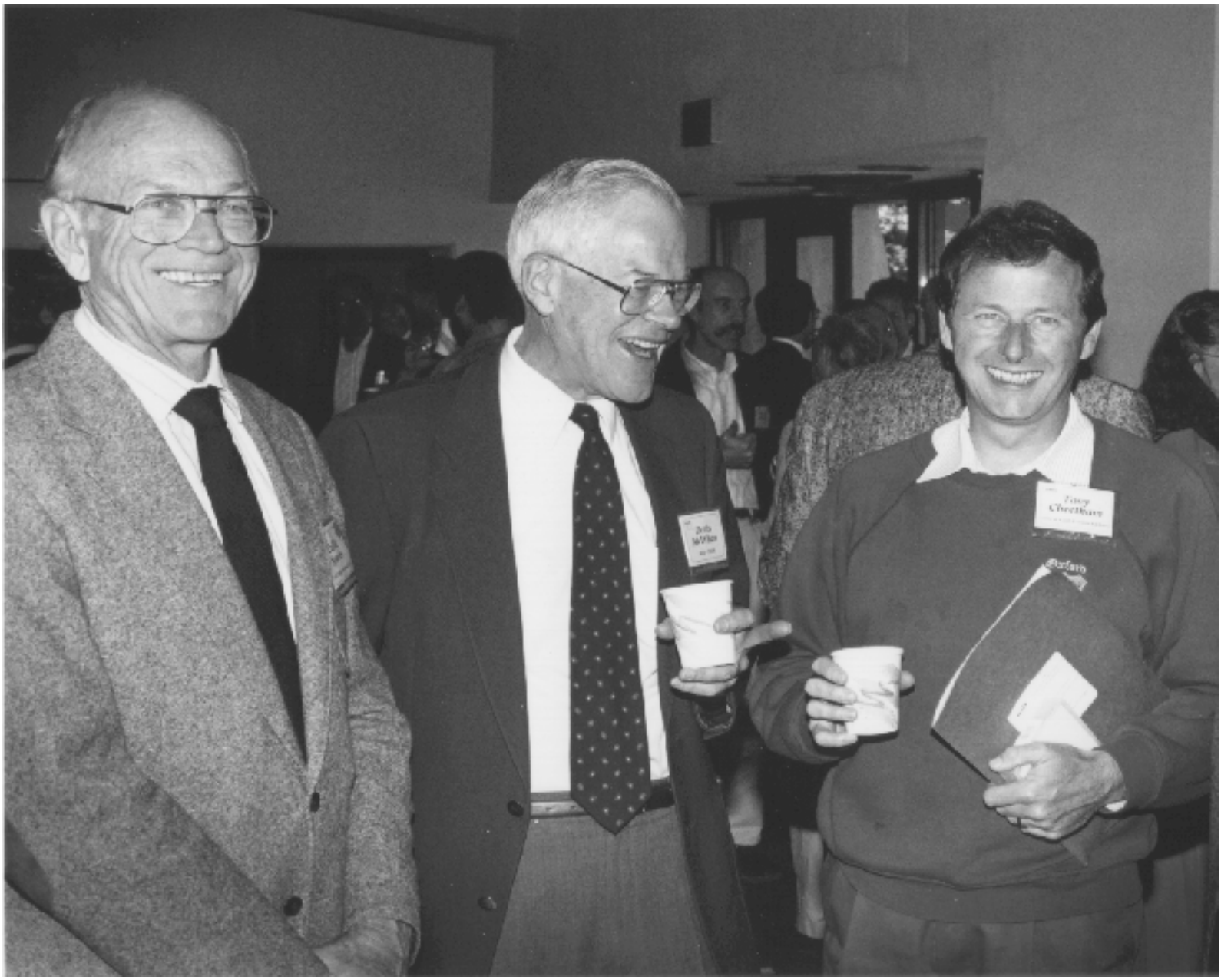
The 1995 NSLS Annual Users' Meeting

Paul Zschack
ORNL / Oak Ridge Institute for Science and Education
NSLS Users' Executive Committee Chairman

The NSLS held its 14th Annual Users' Meeting May 9-10, 1995 at Brookhaven National Laboratory. Associated with the 1995 Meeting, five parallel workshops were held on May 8th, and a satellite workshop on EXAFS was well attended on May 7th. The workshop and scientific programs emphasized scientific productivity and recognition of the NSLS as a mature user facility.

Following opening remarks by BNL Deputy Lab Director Marty Blume, Cullie Sparks (ORNL) gave the inaugural NSLS Distinguished User Presentation. This was a thoroughly enjoyable retrospective talk that served to remind all users that the reliable operations we currently enjoy did not come easily. Through a series of anecdotes, the efforts of many individuals were acknowledged as important for the evolution of the NSLS as a user-friendly facility.

From left to right: Cully Sparks (Oak Ridge National Laboratory), Denis McWhan (NSLS Acting Chairman), and Tony Cheetham (University of California @ Santa Barbara).



William Oosterhuis from the U.S. DOE next offered cautiously encouraging words regarding the outlook for future funding, and was particularly optimistic about the favorable reception which the "Facilities Initiative" has received.

NSLS Acting Chairman Denis McWhan gave a report on the state of the facility. Even though the next generation synchrotron sources are coming on line, the NSLS continues to be a vibrant, growing facility with planning for a Phase 3 upgrade and creation of PRT confederations. New beamline commissioning and PRT reorganizations indicate that the NSLS is continually adapting to accommodate the changing needs of the user community.

The morning session ended with the Keynote Address, given by Robert Galvin, Chairman of the Executive Board of Motorola Inc., and Chairman of the Secretary of Energy Advisory Board Task Force on Alternative Futures for the DOE National Laboratories. Mr. Galvin provided timely insight on the role of Government in the creative process, and most eloquently described his vision for the eventual privatization of the National Laboratories. This is one step beyond the Task Force recommendation for corporatization of the National Laboratory facilities, and introduced users to provocative, challenging new concepts in scientific organization and administration.

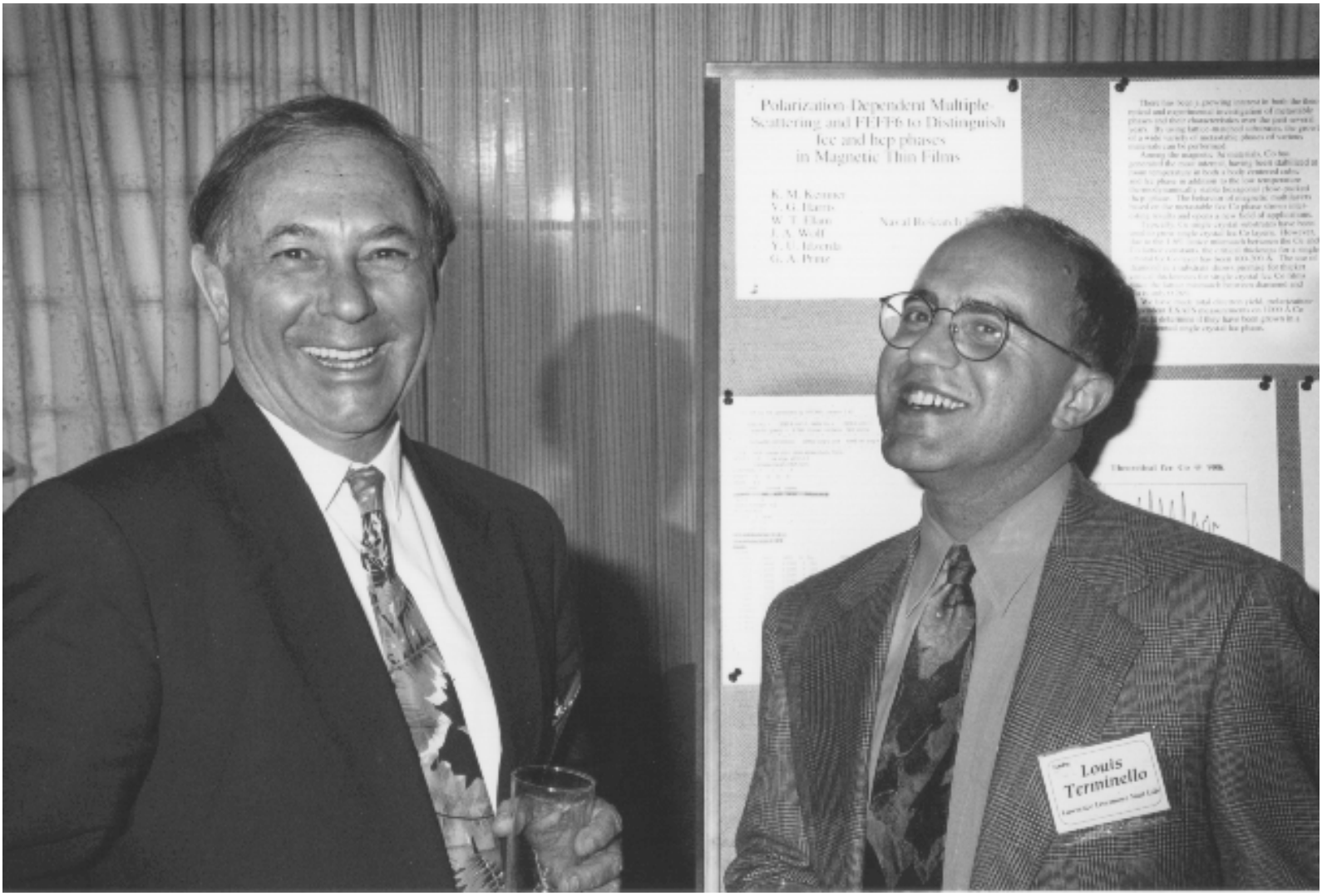
The traditional barbecue lunch provided the venue for Special Interest Group (SPIG) meetings and the User

Executive Committee elections. Elected to serve 2 year terms were Doon Gibbs (BNL - Physics), Peter Stephens (SUNY @ Stony Brook) and Kim Mohanty (EXXON). In addition, recognizing a significantly growing research area, the User Association voted to create another special interest group for biology.

After lunch, the scientific program began with Joel Berendzen (LANL) showing a wonderfully produced video demonstration of the crystallography of carbonmonoxy myoglobin. Steve Dierker (U. of Michigan) next provided exciting new results using coherent radiation to study complex fluids. Certainly, protein crystallography and speckle techniques will continue to be important programs at the NSLS and at other synchrotron facilities.

The NSLS continues to work toward improved performance, as evident from the work on new insertion device concepts. Sam Krinsky (NSLS) detailed the commissioning of the Elliptical Polarized Wiggler, and operations to 100 Hz with no significant adverse impact on operations. With the exciting prospects of easily using circularly polarized light, the EPW holds great promise. Similarly, Peter Stefan (NSLS) discussed the exceptional performance of the Prototype Small Gap Undulator, and noted only minimal compromise on lifetime.

Martin Blume (Deputy Director, Brookhaven National Laboratory) and Louis Terminello (Lawrence Livermore National Laboratory, Chairman of the SSRL Users' Executive Committee).



From left to right: Xiaodong Zhang and Janos Kirz (SUNY @ Stony Brook), with Christopher Buckley (King's College, London).

The conference poster session, with 80 contributions, was held Tuesday afternoon concurrent with a cocktail reception. The wide diversity of contributions again documents the importance of research done at the NSLS in many scientific disciplines. This year, the conference banquet was held at the Port Jefferson Country Club where the wonderful view and exceptional food were enjoyed by all. In a short after-dinner presentation, the Users' Association and the NSLS staff acknowledged the five years of leadership Denis McWhan has given as Chairman of the NSLS.

The meeting resumed Wednesday morning when Eric Isaacs (AT&T Bell Labs) demonstrated use of inelastic x-ray scattering in probing electronic structure in condensed matter systems. Unlike electron probes, x-rays provide good access to momentum transfer, and give a more complete picture of the dynamic structure factor. Myron Salamon (U. of Illinois) next explained x-ray resonant magnetic scattering measurements used to detect the induced spin structure in a Dy-Lu alloy film. The growth during the last several years in magnetic scattering studies using x-rays is remarkable. In another important area, Geraldine Lamble (NSLS) presented several examples of applications of XAFS techniques to study environmental problems.

The next two talks demonstrated continued success on the UV floor. First, John Gland (U. of Michigan) talked about the kinetics of organic reactions on metal surfaces using fluorescence yield measurements with ultra-soft x-rays. The morning session concluded when Eric Jensen (Brandeis U.) discussed advances in high-resolution photoemission techniques. Milli-electron volt resolution photoemission will become even more widely utilized in the next few years.

Attendees of the 1995 Annual Users' Meeting examining the display of one of the 24 exhibitors.

The lunch break on the second day was an opportunity to acknowledge the Structural Biology building addition to the NSLS. Roland Hirsch from the DOE Office of Health & Environmental Research was joined by BNL Laboratory Director Nicholas Samios, Denis McWhan and BNL Biology Department Chairman William Studier for a ceremonial ribbon cutting. The dedication ceremonies, held indoors at Berkner Hall due to poor weather conditions, were attended by over 300 meeting registrants and NSLS staff which indicates the importance of structural biology programs in the future.

The final session began with Mike Toney (IBM Almaden) presenting an interesting talk on near surface structures in rubbed polymer films. Although there is technological relevance (for example, to flat panel displays), there is also fundamental interest in this behavior. Brenda Laster (BNL - Medical) presented an application of synchrotron radiation to cancer radiotherapy using an enhancement due to Auger electrons, and its potential for diagnostic imaging of malignant breast disease. Her enthusiasm for this work underscores the potential impact of such medical applications. Finally, Mike Regan (Harvard U.) concluded the scientific program with a discussion of reflectivity measurements to understand the surface and near-surface layering structure of liquid metals.

The business of the Meeting was concluded when the UEC, in executive session, selected Peter Stephens (SUNY at Stony Brook) the UEC Chair-Elect and Chair of the Organizing Committee for the 1996 Annual Users' Meeting. Planning for next year's meeting is already underway.

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NSLS Users' Meeting Workshops

- Medical/Biological Applications Using Synchrotron Radiation
- Advances in the Characterization of Buried Interfaces Using Synchrotron Radiation
- Recent Advances in the Application of Synchrotron Radiation to Catalysis
- The Future of X-Ray Absorption Spectroscopies
- Synchrotron Infrared Science
- Powder Diffraction Using Synchrotron Radiation

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NSLS PARTICIPATES IN BNL's TAKE OUR DAUGHTERS TO WORK DAY

On April 27, BNL invited its staff to bring their daughters, aged 9 to 15 years, to hear about the many and varied careers represented on site. After a morning of career talks and demonstrations by BNL women, the girls were taken on a round of tours to several BNL departments. The NSLS hosted five such groups, with Eva Rothman, Linda Feierabend, and Eileen Pinkston (User Administration) and Eva Bozoki (Physicist) giving a short introduction about the NSLS and their jobs and answering questions. Who knows - some of those girls could be our future beamline scientists and Users!

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Facility Update

Mike Kelly
NSLS Building Manager

Hazardous Waste Disposal Area Moved

The Hazardous Waste Disposal Area been moved from Room 1-150 to a Haz-Stor container, outside the west roll-up doors and adjacent to the NSLS gas cylinder storage. Please take the time to complete the proper paperwork. Proper disposal of waste chemicals is everyone s responsibility; if you have any questions whatsoever, please contact an OP CO on pager 0824.

Laboratories and Set-Up Space

There are four set-up rooms, each divided in half with electricity and closed-loop cooling for chambers. Set-up space can be reserved by contacting me via voice mail (516-282-3476) or e-mail (kelly1@bnl.gov). The normal time allocation is three weeks.
For newly-arriving General Users, lab space will be allocated to you by your beamline contact person. There are also several general labs to handle conflicts when other labs are not available. Please contact the lab steward to arrange for usage:

- Lab 1-117, General Lab, Steward: Mike Kelly
- Lab 1-146, General Lab, Steward: Lars Furenlid
- Lab 1-162, General Lab, Steward: Alex Darovsky
- Lab 1-161, Structural Biology, Steward: Bob Sweet

Weekly X-Ray Users Meeting Moved

The regular Wednesday X-Ray Users Meeting has been moved from the Seminar Room to Conference Room C, which is room 1-165 on the x-ray experimental floor. The weekly VUV Users' Meeting will continue to be held in Conference Room A on Thursdays.

Construction Update

On April 10, 1995 the Structural Biology Addition was opened to the NSLS users. At present, the lab users are moving their equipment into their prospective labs. The coldboxes have arrived and their assembly begins on June 14, 1995.
The bid package for the completion of the X1-X4 addition is currently in Contracts and Procurement. We hope to have this job started by early summer.
The NSLS roof, a source of trouble for many years, is being replaced in the region from X1 to X18. When this section is completed in July 1995, the NSLS will have been 100% re-roofed.

Dedication of the NSLS Structural Biology addition on May 10, 1995: Roland Hirsch from the DOE Office of Health and Environmental Research (far right) was joined by BNL Laboratory Director Nicholas Samios, Denis McWhan (BNL Associate Director for Basic Energy Sciences/Acting NSLS Chair) and William Studier (BNL Biology Department Chairman) for a ceremonial ribbon cutting.

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JULY 1995 NSLS NEWSLETTER

NSLS Lobby Information Center

Eva Rothman
NSLS User Administrator

As many users will attest, the intense round-the-clock nature of research at a synchrotron can make the facility seem like a home away from home. The NSLS lobby has undergone some changes over the past year to make it a more comfortable, interesting, and useful place in which to spend time. The furniture has been rearranged into two conversation groupings, the area rugs have been replaced, and the stairwell door has been moved and painted in order to be more visible. The small display easel has been replaced by six double-sided panels, now posted with NSLS projects and highlights as well as the traditional beamline features.

Last spring, two touch-screen terminals with a computerized directory of staff and users were installed. The directory is running live off the existing User Database - that is, new users appear in the system shortly after they register. You can search by last name, by beamline, or by institution, and the directory then provides contact information such as telephone numbers, fax, e-mail, primary beamline, and on-site office location (if applicable). An NSLS map dynamically displays a dot at the location of their primary beamline or office. Both a BNL site telephone and an outside pay phone are available in the lobby. Everyone - users, staff, visitors, vendors - is encouraged to use the directory and send me their comments and suggestions. If any of your contact information has changed, please let User Administration know so that it can be kept up to date!

The latest addition to the lobby was the installation of a 3-by-3 array of television screens. The system currently uses a combination of video, laser disk, and optical disk to present segments on BNL and NSLS highlights and safety topics. The black plywood box which contained the NSLS overview has been retired and transferred to disk, and the updated version can also be viewed on the TV wall. The NSLS Safety video, which is shown in the lobby after regular working hours, is now presented on the TV wall to make it easier for a group of users to view at one time. Any of the programs can be played at any time, with full control over volume and display options. Because the system is computer-driven it is easy to design and update the programs, and the combination of video and computer graphics results in interesting presentations. According to Denny Klein, who has been overseeing the project, the NSLS will continue to update and change the topical segments; additional segments, such as special tours and beamline features, are also planned for the future.

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JULY 1995 NSLS NEWSLETTER

What is a Human?

William Thomlinson
NSLS Associate Chairman
User Programs and ES&H

When thinking of synchrotron research involving humans, one immediately conjures up images of the angiography program or perhaps radiotherapy. At the NSLS we have taken all the necessary steps to ensure compliance with the regulations covering human studies. However, we have learned recently (and admittedly late in the game) that legal requirements to protect human subjects apply to a very broad range of research. In addition to the traditional biomedical studies in which humans are actively involved, regulations cover research that uses bodily materials such as cells, blood, urine, tissues, organs, hair, nail clippings, etc. The key question for determining the regulations which may apply is whether or not such materials can be traced back to specific individuals, even though the experimenter may not have collected them. If an experiment will involve such materials, the Principal Investigator must fill out and sign an NSLS Human Materials Study Form. If materials can be traced back to specific individuals, the Principal Investigator must also attach a copy of their home institution's Institutional Review Board approval for the research. If the materials cannot be traced back to specific individuals, the Principal Investigator must acknowledge this on the form.

The form for this approval is very short and consists of only a few questions. It has been developed with the cooperation of the BNL Legal Counsel to ensure that it will meet the regulatory requirements. We will be introducing this form in several ways, the details of which are still to be decided. It will appear in some form during the General User Proposal Process and will definitely be made a part of the Safety Approval Form process. By these means we hope to be able to identify all such experiments well before the work is to start. If an experiment fits one of these categories and no Human Materials Study Form has been completed, the experiment will not be allowed to proceed at the NSLS.

We will have to depend on the beamline personnel to be aware of these requirements and to assist the users and NSLS in maintaining compliance. Clearly it will be best to do the necessary approval process early, not after arrival at the NSLS. The Local Contacts can really help in seeing that this is the norm. Of course, we will have to allow some time for this process to be fully implemented. Fortunately it is not a very large number of experiments that will be affected, but it is important for the entire community to be aware of our needs.

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JULY 1995 NSLS NEWSLETTER

X-Ray Ring High Current Update

Lonny Berman, NSLS Beam Line Support/R&D Section
Chairman, NSLS X-Ray Thermal Limits Task Force

The NSLS X-Ray Thermal Limits Task Force, consisting of Norman Fewell, Donald Lynch, Paul Montanez, James Safranek, Peter Stefan, and myself, has concluded thermal and stress calculations for X-Ray Ring and front end components that are, or can be, illuminated by synchrotron radiation, in order to determine the current limits under which they can operate reliably. Most of these calculations were reviewed by an external panel of experts in January. Concerning increasing the machine current above the existing 250 mA limit during normal operations (at the present 2.584 GeV machine energy), the Task Force determined that the primary obstacle is the design of the first water-cooled white beam beryllium windows on the beamlines. There are approximately 40 such windows in use. Of these, four could not be operated reliably at 300 mA. Four viable substitutes were located among the spares held by the NSLS and the PRTs, and these were installed during the May shutdown. Upon commissioning of various machine interlocks that are required for high current operations, and leak-checking of some of the beryllium windows, normal operations at 300 mA will begin by the end of June.

Achievement of operations at 350 mA or higher requires the replacement of approximately 30 beryllium windows. A new beryllium window design, which will sustain such currents, is now underway, and it is expected that the first batch of new windows will be ready in one year. In addition, calculations by the Task Force revealed that the water-cooled copper crotches in the storage ring chambers will function reliably at 350 mA, but perhaps not at 438 mA, the nominal storage ring current limit at 2.584 GeV (which is equivalent to 500 mA at 2.5 GeV). There are approximately 30 crotches in the ring. Further calculations are underway to better determine their current limit.

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JULY 1995 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, October 2, 1995 for scheduling January through April 1996

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 new proposals and for beam time requests against existing proposals. Follow the instructions on the proposal information sheet. All information must be typed or printed legibly. Be sure all of the required sections are completed and submitted at the same time. MAIL OR FAX ONE COPY of the proposal form, Safety Approval Form, and any attachments to the NSLS User Administration Office. Only one copy is required - do not mail a hard copy or fax a second if you have already faxed one.

Proposal Deadline

The complete proposal package must be received by the User Administration Office on or before 5:00 pm Eastern Time Monday, October 2 in order to be considered for the January - April cycle. The fax machine is always extremely busy on the deadline date; please do not rely on faxing the proposal successfully on October 2. We encourage submitting new proposals by mail 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 by contacting the General User Program Coordinator. Office hours are Monday through Friday, 8:00 am to 5:00 pm Eastern Time.

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NSLS USERS' ORGANIZATION MEMBERSHIP

May 1995 through May 1996

Users' Executive Committee

Chair

Paul Zschack (ORNL)

Vice-Chair

Peter Stephens (SUNY@ Stony Brook)

Past Chair

Jean Jordan-Sweet (IBM)

Secretary

Sue Wirick (SUNY @ Stony Brook)

General Members

- Kim Mohanty (Exxon)
- Doon Gibbs (BNL-Physics)
- Kevin Smith (Boston University)
- Dan Fischer (NIST)

Ex-Officio

Eva Rothman (NSLS)

Special Interest Group (SPIG) Represeantatives

Atomic/Molecular Science

David Hanson (SUNY@Stony Brook)

Biology

(to be determined)

Energy-Dispersive Diffraction

Syed Qadri (NRL)

Exafs

Simon Bare (Dow)

Imaging

Sue Wirick (SUNY @ Stony Brook)

Nuclear Physics Craig Thorn (BNL-Phyics)

Scattering

Steven Ginell (ANL)

Stuent/Post-Doc

Johnson (BNL-Chemistry)

Time Resolved Spectroscopy

Jon Levin (U. of Tennessee)

Topography

Michael Dudley (SUNY @ Stony Brook)

UV Photoemission/Surface Science

Boris Sinkovic (NYU)

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JULY 1995 NSLS NEWSLETTER

17th International Free Electron Laser Conference and Users' Workshop

New York Marriott Marquis, New York, New York
August 21-25, 1995
Hosted by Brookhaven National Laboratory

The 17th International FEL Conference will cover the science and technology of Free Electron Lasers. Oral and poster sessions on the theory, experiment and facility aspects of FELs will include:

- FEL Prize Talk and New Lasing
- High Power FELs
- Storage Ring Based FELs
- FEL Technology
- Electron Beam Physics and Technology
- New Directions
- Long Wavelength FELs
- FEL Facility Challenges
- Short Wavelength FELs

The 2nd International FEL Users' Workshop will be held in parallel with the FEL Conference. One of the objectives of the workshop and its scheduling is to facilitate interaction between the user community and the operators of FEL facilities. Four invited oral sessions and two poster sessions will be organized around the following topic areas:

- Applications in Biology
- Solid State Physics
- Biomedical Applications
- Chemical Physics

About 300 abstracts have been submitted to the Conference and Workshop. The anticipated participation is expected to be about 300 as well.

For information please contact the FEL '95 Conference Secretary:

Judith Thompson
Brookhaven National Lab.
Building 725B
P.O. Box 5000

Upton, New York 11973-5000

Telephone: (516) 282-2145
FAX: (516) 282-4745
FEL95@BNLLS1.BNL.GOV

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The Second Announcement for the Conference and Workshop, including registration forms, is available also on the World Wide Web: http://www.nsls.bnl.gov/Intro/News/News.html

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JULY 1995 NSLS NEWSLETTER

MICRO BUNCHES: A Workshop on the Production, Measurement & Applications of Short Bunches of Electrons and Positrons in Linacs & Storage Rings

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Topics of Interest for the Workshop Include:

- Production of Short Bunches
- Impedance, Collective Effects and Feedback
- Diagnostics and Measurements
- Uses in Factories, FELS, Colliders and Coherent Emission

Sponsored by the NSLS at Brookhaven National Laboratory
September 28-30, 1995

The workshop format includes both invited and contributed papers and working papers.

Registration and information are via the World Wide Web" or by contacting Toni Hoffman / Kathy Loverro at (516) 282-5257 or FAX (516) 282-3029.

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JULY 1995 NSLS NEWSLETTER

NSLS Forms Available on the World Wide Web

The General User Proposal form, Safety Approval Form, and Faculty/Student Funding Application have been made available as PostScript files on the NSLS Home Page. Depending on your PostScript viewer, you can display and/or print them out at your end. Getting these forms from the Web should save you a trip to the User Administration Office or from using a fuzzy faxed version - and it will ensure you have the most up-to-date version. Template files are being investigated, but it is more likely that an electronic submission method similar to the abstracts will be implemented as part of the new proposal database this year.

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LABORATORY TENURE AWARDED TO NSLS BEAMLINE SCIENTIST

Congratulations to Steve Hulbert, a member of the NSLS Beamline R&D/Support group, who last spring was chosen to join BNLÕs tenured staff. Since his arrival in 1983, Steve has made significant contributions to synchrotron instrumentation in the areas of optics design, experiment control and data acquisition, and spectroscopic techniques. Accomplishments include design and development of the U13 wiggler, development of the extended-range grasshopper monochromator, and critical contributions to the development of Auger photoelectron coincidence spectroscopy. Steve has been Spokesperson for beamline U13UA for some time and is now involved in the upgrades of beamlines U5U and U7A.

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END-OF-RUN SUMMARY

Please fill out and turn in your end-of-run summary to the User Administration Office; the NSLS needs feedback on how well we are answering user needs during your experimental runs. Comments, both positive and negative, and suggestions are encouraged! The form is available from the User Administration Office, the NSLS Lobby, or the NSLS Home Page.

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