From the desk of the Executive Director:

With this issue, we inaugurate a quarterly newsletter to help in the dissemination of information relevant to the Synchrotron Radiation Instrumentation Collaborative Access Team members. Because this is the first issue, it is difficult to determine where to start, in time, on news and status updates of the SRI CAT. However, although a considerable amount of work has preceded the Memorandum of Understanding (MOU) signing, I believe this is a good starting point. The SRI MOU signing took place on April 29, 1994 (after a snow-related postponement of the originally scheduled date of Feb. 25, 1994) at which time we were officially assigned Sectors 1, 2, and 3. As you may be aware, the MOU signing indicates that a Conceptual Design Report and Management Plan have been produced and approved by the APS and that sufficient financial support has been secured. We were fortunate to have Dr. Dick Deslattes (NIST) and Prof. Ralph Simmons (U of I), two of the SRI CAT Scientific Members, join us in the MOU ceremonies and give us their views and perspectives on the impact that the APS will have on their research interests.

In July, we submitted two additional documents to the APS for review, the Preliminary Design Report (PDR) and a draft copy of the SRI CAT Safety and Environmental Protection Policies and Practices Manual. The staff is already working on the Final Design Report, and we are aiming for a September/October submission date for this document. With these documents in place, construction in the Experiment Hall can commence. I'm sure I speak for all the members when I say we eagerly await the installation of the first beamline components on the Experiment Hall floor, expected to begin in October.

On a slightly different note, I would like to update everyone on an issue discussed at the first meeting of the SRI CAT Advisory Board held in February. As outlined in the Management Plan, the Advisory Board is assembled to provide guidance to the Executive Committee on all management, financial, scientific, and engineering activities of the CAT. The current members of the SRI CAT Advisory Board are B.W. Batterman (CHESS), Tuncer Kuzay, Gopal Shenoy (Chairman), and Sunhil Sinha (Exxon) (with one vacancy yet to be filled.) They made useful comments on a variety of issues. One of their important recommendations on the problem of fund raising by the X-ray Physics group will affect many of the SRI members directly and deserves comment here. Below is a quote from that report:

"The Board suggests that the Executive Committee should inform the (X-ray Physics) group of its (funding) problems and prepare a plan to convert the group's status from contributing developers to non-contributing scientific members. If such a step is not taken immediately, it will dissolve the enthusiasm of the contributing

In light of this, I ha
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hearing your comment
on what types of news
would find beneficial.

Dennis Mills - Executi
SRI CAT

Table of Co

From the Desk
Beamline Synopses
Calendar
Publications
New People
Members

You are reading the premier issue of the newsletter—soon to be a colle
no doubt. Here are the top six reasons to read this and subsequent issues:

6) keep up with beamline developments and progress.
5) get well acquainted with specific CAT activities (future newsletters will articles),
4) get a list of titles and authors of recent publications by CAT members,
3) peruse the calendar for upcoming meetings and workshops,
2) keep up with important environment, health and safety issues,
1) find out if you won the logo contest.

We need a logo for this newsletter. Please submit your entrees to Cher
Sept. 30, 1994. The winner will be serenaded by Bonita Meyer and receive a
shirt with the logo emblazened upon it. Hey, what could be better than tha

end components, 2) insertion-device diagnostics, and 3) high-energy x-ray scattering. The beamline will also be used for experiments pertinent to the scientific programs from the 1-BM beamline when there is a need of more brilliance or more flux. Other experiments involving novel optical devices developed by SRI-CAT members, for example, experiments involving microfocusing optics or multilayer mirrors may also be carried out.

Two insertion devices will be placed in tandem in the 1-ID straight section. The upstream device will be a standard APS Undulator A and the downstream device a standard APS Wiggler A. The IDs will not be used simultaneously. The first experiments on the 1-ID beamline will be diagnostic measurements of the x-ray beam produced by Undulator A. Hence, this will be the first insertion device installed and commissioned at the APS. The wiggler will be installed at a later date. The high-heat-load program will use both IDs to satisfy power and power-density requirements. Undulator A provides very high power densities with considerable overall power. Wiggler A has a much lower power density but has the highest overall power of any APS device.

The SRI CAT has taken a leading roll in the development of high-heat-load optics for use at the APS. The overall power and power densities from APS insertion devices require novel designs in many areas of synchrotron radiation instrumentation, for example, in the design of monochromators, mirrors, slits, windows, beam stops, and beam-position monitors. The development of components that can handle both high power and high power density is essential for optimal use of the APS at currently planned operating conditions. The APS will have a nominal positron beam energy of 7.0 GeV, a positron current of 100 mA, and insertion devices that are 2.5 m long. Continued development of high-heat-load components is imperative if the positron energy or current is to be increased, and/or if 5-m-long insertion devices are to be used. Several avenues for realizing high-heat-load monochromators are being actively pursued. Among the techniques under ods of bonding crystals are also under investigation. Experiments on optical components designed to handle high heat loads are currently being carried out at operational synchrotron facilities; these will continue on beamline 1-ID when the APS begins operations.

The APS/XFD Engineering and Construction Group will also use beamline 1-ID to test other high-heat-load components. Experimental results on the effectiveness of various cooling methods for high-heat-load front-end and FOE components will be critical in determining designs for future components. Testing of cooled-window designs is of particular interest.

Careful diagnostic measurements are necessary to fully characterize photon beams from insertion devices. The diagnostics fall into two basic categories, phase-space measurements and spectral flux and polarization measurements.

Phase-space measurements of the photon beam will be used to diagnose the performance of the undulators. These measurements provide a bridge to convert the results of spectral flux measurements into representations of spectral brilliance. The results will provide users with properties of the x-ray beam and will give feedback to the storage ring operators on the size and divergence of the positron beam. A novel experimental technique for this purpose has been developed. The two scanning slits that are typically used are replaced with a slit array and a high-resolution imaging system using a scintillation crystal. With the new arrangement, the measurement time has been reduced to approximately one second. Thus, the contamination of measurements due to positron-beam instability can be largely avoided.

Absolute spectral flux and polarization measurements of the beam produced by Undulator A will also be made under high power and high-power density conditions. A water-cooled pinhole and water-cooled slits will be used to scan over different portions of the photon beam. To measure the absolute flux, a Si(Li) energy-dispersive detector is used to measure the x-ray scattering from a well-defined volume of helium at can handle. The flux measu
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1-BM The bending magn
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after the monochromator. Sagittal focusing of the horizontally divergent bending magnet radiation combined with a vertically focusing cylindrical mirror is calculated to be 2.5 times more efficient than that achievable using a toroidal mirror.

Two scientific programs are to be carried out on this beamline: 1) time-resolved x-ray scattering studies (TS), and 2) polarization studies (PS) in the 5-keV to 100-keV region. TS entail the development of wide-bandpass optics, high-speed detectors, and a mechanical chopper. As part of the wide-bandpass-optics program, a curved-crystal monochromator for horizontal focusing and a layered, synthetic multilayer monochromator are being developed. The detector development is focused on three types of detectors: 1) CCD, 2) CdTe-based, and 3) hybrid pixel array detectors.

For PS, emphasis is given to a crystal optics design that yields: 1) a high degree of circular polarization, 2) rapid switching between left- and right-handed circular polarization states, and 3) tunability in a wide energy range. Phase plates are currently being designed and constructed that operate in both 5 keV to 11 keV and the 20 keV to 88 keV parts of the spectrum. Most of the experiments that use the polarization properties of synchrotron radiation, such as magnetic Compton scattering and magnetic circular dichroism, to name two, are generally flux-limited experiments. A Bragg transmission, thin-crystal phase plate is currently being developed for use at low energies. A highly collimated undulator beam can enhance the degree of circular polarization for certain energies; the calculated improvement at APS is from 90% for bending magnet source to 99% for Undulator A. However, many experiments can be successfully performed with a 90% degree (P_C=0.9) of circular polarization. If flux becomes a limiting factor, the experiment will be moved to an insertion-device beamline. The calculated flux of circularly polarized photons (P_C=0.95) at the center of 1-BM-C (for 8 keV) produced by a Bragg transmission phase plate is 4.5 x 10^8 photons/s/0.1%BW.

be a 5.5-cm-period device to provide 0.5-4 keV x-rays. Three beamline branches, 2-ID-B, 2-ID-C, and 2-ID-E, will be built to take advantage of these devices.

The FOE, station 2-ID-A, will contain four mirrors. The first mirror is the most important optical component in the beamline and will serve all three branches. The other three mirrors housed in 2-ID-A will deflect the beam to the various branch lines. The first mirror will be exposed directly to the undulator beam and will experience a high heat load. The anticipated maximum total power and peak heat flux incident on the mirror surface are 1.4 KW and 0.36 W/mm^2 for the 5.5-cm undulator, the device that will produce the greater power of the two insertion devices. The first mirror will separate the synchrotron beam from the high energy bremsstrahlung radiation and will reduce the total power and heat flux incident on the downstream optical components. It will also suppress high order undulator harmonics by using appropriate coating materials. All mechanical motion for the mirror alignment will be located outside the vacuum chamber.

2-ID-B branch

The 2-ID-B beamline branch is dedicated to high resolution imaging, coherence-based techniques, and beam diagnostics in the 0.5-4 keV range, including x-ray holography, scanning microscopy, and interferometry. Its chief aim is to deliver 0.5-4 keV photons to the experimental station with as little degradation of the spatial coherence of the undulator radiation as possible. The beamline optics will permit continuous adjustment of the degree of coherence. A multilayer spherical grating monochromator will provide a spectral resolution of 10^2-10^3 to experiments in the end station.

The 2-ID-B end station will be outfitted with a variety of instrumentation including a 0.5-4 keV scanning microscope using high resolution zone plate optics and a large-format backside-illuminated CCD camera. The latter will be used for x-ray Fourier transform holography, imaging microscopy, and

2-ID-C branch

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2-ID-E branch

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ments requiring high energy resolution and spectral purity. This aperture will also help reduce the total power incident on the monochromator, which is further reduced due to the high-energy cutoff of the first mirror in the FOE. The monochromator will function either with crystals or with multilayers. On the one hand, crystals will be used in experiments requiring high resolving power, such as microspectroscopy, microdiffraction, and interferometry. On the other hand, multilayers will be used for microanalysis and micro-Laue diffraction as well as to increase the flux density at the focus of a phase zone plate.

A scanning x-ray microprobe and an imaging microscope will be developed as the major instruments in the 2-ID-E station. Focusing for the microprobe will be accomplished with either a phase zone plate or with an elliptical mirror; a focal spot size approaching 0.1 µm is expected. The microprobe will be used for microspectroscopy, differential absorption contrast microscopy, microdiffraction, and microanalysis. The imaging microscope will be used for three-dimensional computed microtomography.

2-BM The Sector 2 bending magnet beamline will be used to test and develop high performance x-ray optics for the intermediate (0.5-4 keV) and high (4-40 keV) x-ray energy ranges and for development of hard x-ray lithography applications and techniques. Optics development for the lithography program will be closely coupled with development of high resolution x-ray optics for the 2-ID-branch E beamline, such as zone plates and other diffractive elements.

The 2-BM beamline will be equipped similarly to the 2-ID beamline. A long high-heat-load mirror will be used to reduce the total power and the power density incident on either a double-crystal or double-multilayer monochromator. Much of the instrumentation used at 2-ID-E will be also used at 2-BM because the two beamlines are similar and will cover the same energy range.

3-ID The objective of this beamline eV resolution and inelastic x-ray scattering (IXS) with eV to milli-eV resolution. The experimental stations and first optics enclosure are designed flexibly to incorporate further developments in x-ray optics. There will be four stations on the beamline: i) 3-ID-A, the FOE, ii) 3-ID-B, an extension of the FOE, iii) 3-ID-C , the inelastic x-ray scattering station, and iv) 3-ID-D, the nuclear resonant x-ray scattering station.

Monochromatization of x-rays to the micro-eV to nano-eV level is achieved by NRS. The energy bandpass achievable is related to the lifetime of the excited states of the Mossbauer nuclei. The challenge is to design and develop new optics and experimental techniques to tailor the energy, time, polarization, and focusing response of the optical components. These activities include the design and construction of high-energy-resolution crystal monochromators; nuclear monochromators in the form of thin films and multilayers; focusing devices such as circular or linear Mossbauer-Fresnel zone plates; and devices such as polarizer/analyzer crystal monochromators for synchrotron Mossbauer spectroscopy. The NRS program also requires the development of detectors with nanosecond time resolution, large dynamic range, and reasonable efficiency in the 8-30 keV range.

The IXS program is developing instrumentation to study inelastic x-ray scattering in the 5-25 keV range. Because cross sections for IXS are extremely small, very efficient x-ray optics are required to obtain useful spectra. Measurements will be made with two different optical arrangements, one with ≤10 meV overall resolution and another with 200 meV overall resolution. Energy analysis of scattered x-ray beam at the meV level is achieved by using backscattering Si or Ge analyzers. The x-rays are first monochromatized by a Si(111) high-heat-load, double-crystal monochromator. Then, in one operating mode, an in-line nested monochromator in the (+ + — —) configuration will be used to reduce the bandwidth to ~5-meV levels and Si (777) or (888) or a higher order reflection will be used for energy analysis. In another operating

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Address additions, chang
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Next Issue - November 1

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the source point and will closely resemble the high-heat-load monochromator for beamline 1-ID. Besides inclined crystals, we plan to use standard asymmetric crystals to spread out the beam footprint and to match the undulator beam divergence. Liquid gallium will be used for cooling. The energy range between 4 and 30 keV can be accessed by using Si (111) and Si (220) crystals because the scanning range for the monochromator is 0-30°.

The first optical component after the high-heat-load monochromator will be a double channel-cut, nested monochromator (+ + — —). This monochromator will be used for both the NRS and IXS programs. Its usefulness for the NRS program derives from the significant improvement in the signal-to-noise ratio for the detection of nuclear resonant photons that can be achieved with the nested optical arrangement. A bandwidth of 5 meV has recently been demonstrated. Its usefulness for the IXS program (for an overall resolution of ~10 meV) derives from the in-line nature of the optical layout instead of an awkward backscattering monochromator design and from the ability to scan the incident energy. Other IXS workers have chosen designs in which the energy is scanned by varying the temperature of an analyzer crystal with respect to a backscattering monochromator crystal.

After the high resolution monochromtor, there will be a mirror to provide two functions, 1) vertical focusing between 18 m and infinity, and 2) fixed horizontal focusing. There will be two grooves on the same mirror substrate that can be accessed by translating the tank transversely to the x-ray beam. The first groove will focus the beam horizontally into the meV hutch. The resolution achievable in IXS is directly related to the size of the focused beam at the sample; a spot size of less than 1 mm is needed. The second groove will be used to collimate the beam for subsequent vertical and horizontal diffraction with higher order Bragg crystals for the NRS program. The collimating mirror is expected to provide more than an order-of-magnitude gain in throughput. This is necessary for a specialized optic known as a polarizer/

under development for the inelastic scattering program are high-energy-resolution crystal monochromators; grooved, spherically-bent backscattering silicon analyzers for overall resolution below 10

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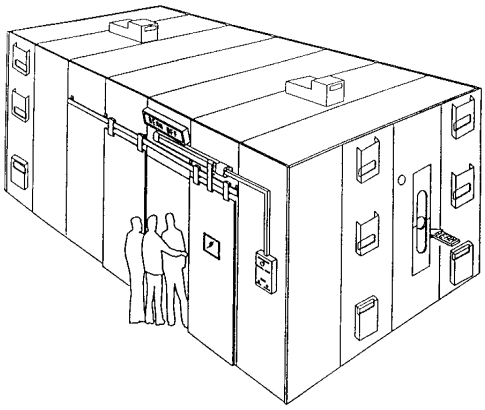
Albert T. Macrander a



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tion will be a general-purpose enclosure for experiments with m
sertion-device radiation.

The beam entrance to the station is approximately 56.6 m from
1-ID straight section and 16 m from the beam exit of the plan
station. The enclosure will have dimensions of 4 x 7 m with a h
mately 3.35 m. The interior clearance of 3 m is limited by the br
manual hoist. The construction is modular with standard self-sup
steel-lead-steel sandwich panels. The thickness of lead will be 1
and upstream walls, 12.5 mm for the downstream wall, and 6 m

The enclosure will have two sets of sliding doors, with each se
wide doors. One door will be pneumatically operated and used
into the station. The other doors will be manually operated and
stallation of large equipment. Detailed aspects of the enclosur
found on the APS Design Exchange.

Construction of the modular panels is currently underway, ar
should be ready for beneficial occupancy in October 1994. *Dea*

Dates to Remember

November 4, 1994	SRI CAT Meeting
October 1995	Synchrotron Radiation Instrumentation Meeting Argonne National Laborato
October 1995	Seventh Users Meeting for the APS Argonne National Laborato

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THEY'RE HERE !!!!!!!

Photon shutter components for beamline front-end sections wai to be unpacked on the APS floo

cant contributions to the project, such as a demonstration of coherent scattering (speckle) at grazing in keV x-rays and development of a new technique for fast phase space measurement of synchrotron ra

Jonathan Lang - **Postdoctoral Research Associate**

Jonathan Lang is a postdoc working with George Srajer on developing optics for production and anal synchrotron radiation. Jonathan got his Ph.D. from Iowa State University. In his thesis, he studied nea in rare-earth metal alloys using spin dependent x-ray absorption. Jonathan brings to the SRI CAT a co designing and implementing high-quality polarization-related instrumentation.

Harry Lipkin - Visiting Scientist

Prof. Harry Lipkin of the Weizmann Institute, Israel, is spending a summer here at Argonne to calcul multiphoton excitations and their implication in nuclear resonant scattering of synchrotron radiation.

William McHargue - Scientific Research Associate

William McHargue is a scientific research associate working with staff members of the SRI CAT Sector got his Bachelor of Applied Science in Electronics Engineering Technology from the ITT Technical Instit Prior to joining the APS, Bill was at the Indiana University Cyclotron Facility. Bill will be responsible for t maintenance of the Sector 1 bending magnet beamline.

Ralf Roehlsberger - Postdoctoral Research Associate

Dr. Ralf Roehlsberger recently graduated from Hamburg University, Germany. He has joined the x-ra develop μev-band pass, meV tunable x-ray spectroscopy using nuclear resonant scattering technique

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