X-Ray Ring Upgrades

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Beamlines X1A and X1B

Beamline X1A completed installation of a second new room temperature microscope (STXM IV) on the outboard branch beamline for user operations (development supported by DOE facilities Initiative), began use of a solid-state segmented detector developed in collaboration with BNL Instrumentation Division and made considerable upgrades to their data analysis software.

In early FY2001, X1B commissioned their Sawatzky (U. Groningen) endstation, which was installed in June 2000. A dispersive detector based on a Si:xx multilayer was installed and commissioned in June 2001. The X1B beamline upgrade project, consisting of the overhaul of the grating chamber and control system, plus refurbishment of the mirror motions (mechanical, encoders, controls) and recalibration of the slits, is half-completed. The X1B beamline was shut down during May and June 2001 for realignment of the mirrors (their positions and angles had never been optimized) followed by the necessary realignment of the rest of the beamline to match the new angle of the beam from the mirrors. The control system was changed to a combination of SPEC running under EPICS and LabView. Eventually, the entire beamline will be run by SPEC/EPICS. In addition, the new grating chamber was received from Physical Sciences Laboratory and one (1200 lines/mm) of the four gratings (300, 600, 1200, and 1600 lines/mm) was received from J-Y/Horiba. Two of the other three gratings arrived in November 2001, and the grating chamber was installed in December 2001. Commissioning of the entirely upgraded X1B beamline is scheduled for January 2002.

Beamline X2B

X2B now has all aspects of their beamline controlled through a XMT computer supporting automated, unattended, sequential scans of multiple specimens at multiple x-ray energies and beam shapes.

Beamlines X3A1 and X3A2

The refurbishing of the X3A1 and X3A2 monochromators, begun last year with a complete re-wiring of the mechanism, was continued during the current year. First, the monochromator assembly for the X3A1 beam, which showed unreliable operation of one important axis, was repaired. The entire X3A1 mechanism was completely disassembled, cleaned, re-lubricated and reassembled. The oil/grease lubricant, used by the manufacturer, was replaced by a lubricant specifically made for the very low humidity environment in which the mechanism must operate, and also capable of tolerating the high level of scattered radiation in the tank.

The second effort involved improving the cooling of both the X3A1 and X3A2 monochromators, which is crucial for maintaining beam stability. The X3A1 monochromator has a long path for removal of heat from the crystals and poor conduction between the crystals and the cooled substrate, so that any impediment to cooling of the substrate quickly affects the monochromator crystals. Furthermore, to prevent pumping vibrations from affecting beam stability, the cooling circuit is a gravity-fed system. The water supply tank was raised and the return tank lowered, so that the total drop across the crystal mounts was substantially increased. The plumbing of the external cooling system was altered to reduce the water path significantly, and two-stage cooling of both the NSLS supplied water and the secondary cooling circuit, was implemented.

The most important change in cooling was achieved by mechanical overhaul of the X3A1 monochromator. A severe restriction in the water path within the unit was diagnosed and removed, causing a larger amount of water to pass through the crystal mount. As a result of these changes, the previously encountered thermal stability problems have been alleviated significantly, with a corresponding increase in data quality.

Beamline X5A

Beamline X5A installed a new power supply for the D4 tagger magnet to accommodate X6.

Beamline X7A and X7B

Beamline X7A improvements include a new Ge(111) CCM (purchased by Woodward from Ohio State University) and electronics repair and upgrade for a solid-state detector setup. Sample environment upgrades include control of a new Displex for PSD measurement mode, exploratory work on a new type of high temperature mirror furnace up to 200K (collaboration with Trudy Kriven, University of Illinois, Champaign) and diamond-anvil cell work up to 150 kbar requiring a new alignment setup in the chi circle.

Beamline X7B has upgraded the mar345 detector to make fuller use of the image plate. They can now collect 1.1Å data with less than 1 minute per image and 0.85Å resolution data in less than 2 minutes per image.

Beamline X8A

Beamline X8A improvements consisted of software upgrades for beamline control and data acquisition.

Beamlines X9A and X9B

The X9A beamline entered full commissioning phase October 1, 2000 with all components working. This phase was completed by January 1, 2001. Users are routinely using the beamline to good effect.

Beamline X9B increased the stability of their monochromator.

Beamlines X10A and X10C

X10A installed video cameras and a web-based control system that enables them to remotely perform simple experiments from their home office in Clinton, NJ via a private network. This also improves data acquisition procedures for local experimenters because the cameras provide better control over the experiment in progress. It also aids in helping supply General User support when they are having operational problems with the beamline. A Bonse-Hart camera for ultra-small angle scattering was also installed and successfully tested.

Beamline X10C commissioned a high count rate solid-state detector. 12 out of 30 elements have been implemented.

Beamline X11B

Work continues on X11B to make this line operational, with major focus on installation and testing of a new monochromator, and upgrades to water cooling lines. It is hoped that the X11B line will be ready for testing and commissioning in FY2002.

Beamlines X12A and X12B

An in-vacuum monochromator has been added to the X12A beamline to allow tests with monochromatic light as easily as with white light.

At beamline X12B, they have created user workspace in an adjacent laboratory, added a hotswap disk system and additional tape backups and provided the first installment of remote monitoring tools (software and hardware). Extensive planning was carried out for a major beamline upgrade in FY2002. The FY2002 upgrades will include replacement of the first mirror with a collimating mirror producing near parallel white beam, replacement of the two-crystal monochromator with a channel-cut monochromator of the Siddons design, replacement of the focusing mirror with a rhodium coated, sagittal-focusing mirror, complete overhaul of the beamline infrastructure including vacuum systems and services, and introduction of sufficient local computing on two workstations.

Beamlines X14A and X14B

Beamline X14A installed an Axis 2400 camera server. This server transmits real-time video signals from four cameras at the beamline to Oak Ridge National Laboratory for remote collaboration. A high temperature powder diffraction furnace, which can heat capillary samples up to 1200K, has been designed and is being manufactured. It will be installed and tested on the beamline in FY2002.

At beamline X14B, filter holders have been redesigned to improve ozone abatement. Scanning stage fixtures have been simplified to cover most of the range of samples that are run.

Beamline X15B

Beamline X15B has obtained beryl crystal from which new monochromator crystal plates will be cut and have modified the beamline geometry to prevent radiation damage to the beryl crystals. They have installed secondary loadlock on the main UHV chamber, adding evaporator capabilities, replaced several vacuum viewports that had been damaged by long-term exposure to low energy radiation and upgraded the main chamber vacuum system with a new roughing pump. They have also upgraded the UPS system for PCs and beamline controls.

Beamline X16C

Beamline X16C made modifications to their Microdiffraction Endstation.

Beamlines X17B1and X17C

A column downstream of the X17B1 hutch has been removed and a bridge has been installed in its place, in preparation for the construction of two new hutches to accommodate the current PRT members of X17B1. Conceptual design of the two new hutches has been made and has passed the beamline review and ALARA review. BNL plant engineering has prepared and issued a bidding package and a contractor is being selected for the engineering design and construction of the two hutches. A new sagittal-focusing monochromator was installed, providing 1000 times more intensity at 67 keV, compared to the old Laue-Bragg monochromator, without loss of energy resolution.

Beamline X17C developed some IDL programs to improve experiments, such as oscillating the sample during data collection and 'grid_scan' for automatically collecting spectra at different locations of a sample at one pressure.

Beamline X18A

At X18A, the capability to do EXAFS experiments was added by constructing a detector mounting system, which can be quickly attached to the diffractometer support table for easy alignment.

Beamline X19C

Beamline X19C acquired a new temperature controller.

Beamline X20A

At beamline X20A, the hutch was extended by ~9 ft to incorporate Kirkpatrick-Baez mirrors for microdiffraction (to replace currently used tapered capillary). New hutch electrical outlets were installed, the beamline control station was relocated and the safety system was reworked. In FY2002 the new optics will be installed on the microdiffraction endstation, along with a new virtual source slit assembly at the front of the hutch. At that time, the microdiffraction endstation will permanently occupy the back half of the hutch. A standard diffraction endstation or superconducting magnet endstation will occupy the front half. A CD-R drive was added to the beamline computer to allow users to burn their data onto CDs. The CAMAC crate controller was upgraded from GPIB-CAMAC to a SCSI-CAMAC type.

Beamlines X20B and X20C

Beamline X20B is installing and testing a new motor control system. Once it is demonstrated, it will be moved to X20C. New control systems will later be installed, as funding permits, on X20A and B. A CD-R drive was installed on the beamline computer to provide the capability for burning users' data onto CDs. The X20B hutch's electrical system was replaced.

The X20C hutch was extended to permanently house instrumentation for time-resolved diffraction. A new linear detector, controller, and LabView data acquisition software were installed. The monochromator crystal housing was adapted to improve cooling and temperature relay was installed to protect the multilayers. In FY2002, the crystal mounts will be converted from 4-pt to 3-pt to avoid crystal strain.

Beamline X21

At beamline X21, a vertical diffractometer was modified to use it for resonant inelastic scattering. This allows the study of polarization dependent inelastic spectra.

Beamlines X22A and X22B

Beamline X22A modified its beamline windows to facilitate two modes of operation, one at 10 keV, the other at 30 keV (nominal), with different mirror settings.

At X22B, a new Langmuir trough has been obtained for experiments. Ancillary equipment such as pumps and chillers, were also obtained. A new position sensitive x-ray detector has been given a permanent installation including its electronics and gas manifold.

Beamline X23A2

Beamline X23A2 improvements include upgrades to new Keithley 428 amplifiers and a new high energy Lyttle Detector. They intend to install computer driven exit slits

Beamline X24A

Beamline X24A has completed a beamline electrical power distribution system upgrade. This included improvements to both electrical capacity and distribution points. This was funded by the DOE Scientific Facilities Initiative.

Beamline X25

In FY2001, X25 made infrastructure upgrades on behalf of all users, particularly structural biology. The layout of the control area was revamped, with new furniture and electronics racks. A dual-headed SGI Octane computer station was installed, primarily for computational purposes. A walk-in cold box enclosure was installed in the general purpose laboratory just downstream of X25. Upgrades were made to the Brandeis CCD detector and the Nonius CAD-4 diffractometer. In FY2002, delivery of a new 31.5 cm square CCD detector and four-circle diffractometer, from Area Detector Systems Corp., is expected. A new cryogenically cooled monochromator, which is rated to handle the higher power expected from the proposed new wiggler for X25, is also under development.

Beamline X26A

In FY2001, the X26A PRT installed a new computer control system that replaced the aging VAX workstations. This new system is PC-based, running NT4, and integrates with our existing CAMAC electronics (CAMAC Crate, E500 controllers, Real Time Clock, etc.) through a VME crate running EPICS. They also have incorporated simultaneous micro-diffraction analysis of materials using both a Bruker Smart 1000 CCD diffractometer and Fuji Image Plate scanning system. In FY2002, they have two major upgrades planned for the beamline. The first is the purchase and installation of a new Canberra 9 element LEGe hard x-ray advanced array detector. With their continued advances in microbeam XAS, such a detector array will provide them with the improved spectral resolution and high energy rate capabilities they require to improve the quality of the absorption spectra their users collect. Funds have been allocated for this purchase and they expect delivery within the next six months. During the December 2001 shutdown, they are installing a new monochromator system for the beamline that should provide improved energy resolution for XAS analysis, better thermal stability, and greatly increase their functioning energy range. The system adds water-cooling to the crystals, replaces their translation stage driven sine bar with a 20:1 Huber rotational stage for improved angular resolution, and adds a unique translation system within the tank that will allow horizontal translation between either Si(111) or Si(311) channel-cut crystals. Operators can choose which crystal they wish to use depending on their energy and resolution requirements.

Beamline X26C

X26C purchased a second Silicon Graphics Octane stereographic workstation in FY2001. One older sgi Octane workstation was upgraded by adding disks and dual head display. Four Kingston hotswap disks were purchased adding 240 GB of disk storage space. The CAMAC motor control system was replaced with a VME based Epics system. An extensive remote monitoring software toolkit was deployed. In-hutch slits, a beam intensity monitor, and attenuators were added. Beamline infrastructure and user amenities were improved. A new focusing mirror system is being installed during the December 2001 shutdown.

Beamline X27C

Beamline X27C purchased a MAR CCD x-ray detector system in August 2000.based on an award from NSF (Materials Research Instrumentation Grant) and a SUNYSB matching fund (50%), This detector has met the stringent requirements of certain time-resolved and in-situ experiments (include the study of structure-function relationship in skeletal muscles, deformation of synthetic and biological fibers, flow-induced crystallization and rheology/x-ray investigation of complex polymeric fluid systems, etc.) with high spatial resolution and high through-put rate (high detection efficiency and fast read-out time). Currently, this detector has been made available to the user community for over one year of service. A Fuji BAS imaging plate scanner was purchased in June 2000 to replace the old one after 6 years of service. This equipment is one of the most used detection systems at X27C for beam alignment and the study of anisotropic materials. The current pixel resolution can be chosen from 50, 100 m or 200 mm. The dynamic range of the imaging plate is larger than 10^5 with an excellent linear response by each pixel. The use of imaging plates has provided a great flexibility to the x-ray detection in X27C. For example, two imaging plates can be used for simultaneous detection of 2D SAXS and WAXD patterns. The WAXD imaging plate has a central opening of about 2 cm in diameter, allowing the passage of the SAXS image