An Update on the Advanced Photon Source at Argonne National Laboratory

The Source

AUGUST 1994 NUMBER 7

Secretary O'Leary Lauds APS at MHATT-CAT MOU Ceremony

ANL photograph 17269K #6

June 2, 1994 — With Secretary of Energy Hazel O'Leary (at right) as honored guest, representatives of the Howard Univer-sity-University of Michigan-AT&T Bell Laboratories Collaborative Ac-cess Team (MHATT-CAT, also known as the Center for Real-Time X-ray Studies) signed their Memorandum of Understanding at Howard University in Washing-ton, D.C.

Researchers with MHATT-CAT will build two 60-meter-long beamlines at APS sector 7. These beamlines will be instrumented for X-ray scattering and spectroscopy and will be capable of carrying out four experiments at a time. MHATT-CAT will study the precise positions of atoms in materials and learn how atomic positions shift as a material grows, flexes, relaxes, ages, develops defects, or otherwise responds to changes in temperature, pressure, and other factors in its environment. They will also study ultrafast chemical reactions as they occur and learn how atoms and molecules form chemical compounds.

A significant part of the funding for MHATT-CAT's beamlines comes from a $9.2 million grant to Howard University from the Department of Energy (DOE). The grant resulted from open competition among institutions and is the largest DOE has ever made to an historically black college or university.

Speaking at the ceremony, Secretary O'Leary characterized the APS as "a world-class facility where world-class scientists will work with world-class students." She noted that "the partnership we celebrate is an opportunity, using the power of the national labs, industry, and educational communities… to work on the cutting edge of science.

"In the real world… the questions people will ask are: What is an Advanced Photon Source, and what does it do for me? I think it is very important that we are all able to communicate that answer. I would answer that it is an advanced x-ray source that brings value into the industrial sector because it affords the opportunity to take a better look at the structure of materials… With this wonderful machine, we can now, for instance, begin to look at the structure of ceramics, which can be used in airplanes and automobiles. We can understand why a structure fails and determine how to make that a better, sounder structure, thereby making a safer, higher quality automobile or airplane. . . We will be able to produce a product that is of high quality at a reasonable cost, and we will become very competitive internationally. That's what this opportunity and its application are all about in the real world." ❍

A number of APS CATS signed Memorandums of Understand during the spring and summer of 1994 . See pages 2 & 3 for a complete listing.

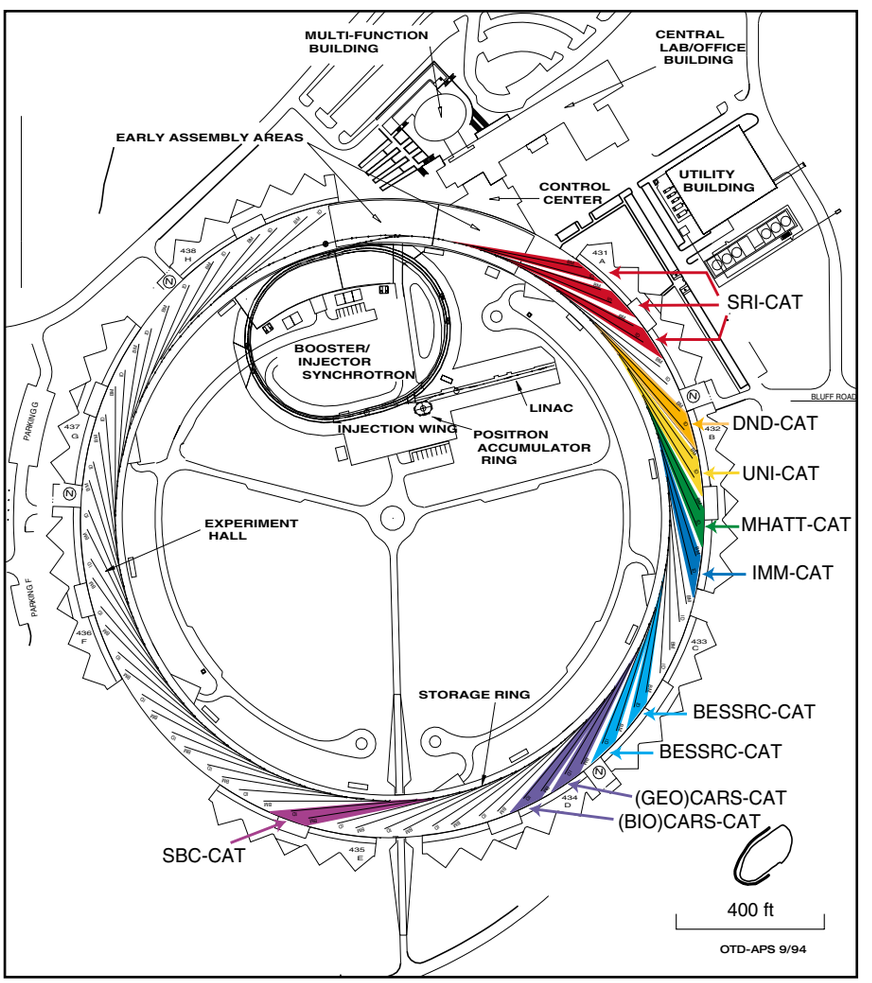
SBC-CAT (Sector 19) — MOU signed March 24, 1994 — The Structural Biology Center Collaborative Access Team (SBC-CAT) will construct a forefront facility for studying the structure of biological molecules and for developing and testing improved detection devices and other instruments. Researchers will determine the precise positions of the atoms that make up viruses, proteins, enzymes and other large biological molecules important to human health. Experiments that today take weeks or months to carry out will be conducted in a single afternoon. Research at the Center is expected to produce new biotechnology products from renewable resources, such as plants, instead of from petroleum.

The Structural Biology Center, with two beamlines, will attract some 250 biological and medical researchers each year from industry, universities, and federal laboratories. The Center is funded by the DOE's Office of Health and Environmental Research (OHER). Over the next three years, OHER has budgeted $15 million for construction and $6 million for research, operations, and support activities. ❍

CARS-CAT (Sectors 13 & 14) and UNI-CAT (Sector 6) — MOUs signed April 27, 1994 — Two APS CATs, the Consortium for Advanced Radiation Sources Collaborative Access Team (CARS-CAT) and the University-National Laboratory-Industry Collaborative Access Team (UNI-CAT), signed their Memorandums of Understanding in the Springfield office of Illinois House Minority Leader Lee Daniels (R-46), who has been instrumental in obtaining State funds for the APS User Residence Facility and for beamline construction by CAT affiliates from Illinois.

The University of Chicago leads CARS-CAT, which includes Northern Illinois University, Southern Illinois University, and a large group of scientists from across the U.S. CARS-CAT signed separate MOUs for its BioCARS and GeoCARS sectors (13 and 14, respectively). With 140 members, CARS is currently the largest group of scientists scheduled to use the APS. CARS will focus on research in biology, geophysics, soil science, and environmental science. Later, CARS expects to sign an agreement to study chemistry and materials science at the APS.

The University of Illinois-Urbana leads UNI-CAT. Other UNI-CAT members are Oak Ridge National Laboratory and UOP Research Center. UNI-CAT research will concentrate on materials science and crystal structures. Other research is planned in physics, chemistry, biology, chemical engineering, polymers, and geology. ❍



Planview of the APS showing sectors (beamline pairs) assigned to Collaborative Access Teams with signed Memorandums of Understanding.

SRI-CAT (Sectors 1, 2, & 3) — MOU signed April 29, 1994 — The Synchrotron Radiation Instrumentation Collaborative Access Team (SRI-CAT) will occupy the first three sectors in the APS experiment hall. They will develop new instruments and equipment for X-ray research. Organizations participating in SRI-CAT are Argonne, Cornell University, Exxon, Lawrence Berkeley Laboratory, the National Institute of Standards and Technology, Purdue University, Stanford Synchrotron Radiation Laboratory, and the University of Houston.

SRI-CAT research will include inelastic scattering for the study of solids and liquids by probing atomic motions and the energy states of electrons. Nuclear-resonant scattering with precisely tuned energies will permit almost instantaneous observations of chemical reactions as they take place, with the potential for discovery of new catalysts. The CAT will build a powerful new device for studying the electronic and magnetic structures of materials, work that will advance techniques used to study thin films and multilayed materials, which are expected to be at the forefront of the next generation of information-storage media. A microfocusing optics and techniques beamline will use new, powerful lenses to focus X-ray beams to four millionths of an inch (1,000 angstroms). These lenses will map the positions of trace elements, crystal strains, and chemical states in materials, and make three-dimensional images of objects. ❍

IMM-CAT (Sector 8) — MOU signed May 19, 1994 — The IBM-MIT-McGill Collaborative Access Team (IMM-CAT) will build a total of 6 experimental stations, capable of supporting 4 experiments at a time, at 2 APS beamlines. Experiments carried out will cover a broad range of applied and basic research in materials science, physics, and chemistry, emphasizing processes and phenomena, such as growth of thin films, that take place over time. They will also study interfaces where layers of magnetic materials meet. This will help in the engineering of materials with more desirable magnetic properties, which could lead to improved magnetic heads for reading data on information storage disks. Research into the structure of thin-film polymers could lead to the design of improved coatings, such as those used for lubricants in magnetic disk drives and for orienting liquid-crystal films in flat-panel displays. The researchers expect to explore thin-film growth on time scales of a few billionths of a second as individual atoms settle from a vapor onto a surface or are attracted by electrical forces from a liquid solution to collect on a surface. ❍

BESSRC-CAT (Sectors 11 & 12) — MOU signed July 6, 1994 — The Basic Energy Sciences Synchrotron Radiation Center Collaborative Access Team (BESSRC-CAT) comprises scientists in Argonne's Materials Sciences, Chemistry, Physics, and Geosciences divisions, and collaborators from Northern Illinois University. This CAT will build and operate 4 beamlines at the APS with 10 experimental stations capable of performing 5 simultaneous experiments. The research carried out by BESSRC-CAT will advance basic knowledge of chemistry, physics, materials science, and the geosciences.

Many practical applications of BESSRC-CAT investigations are anticipated. New chemicals and industrial processes could result from studies of the structure of long-chained molecules, ultra-fast chemical reactions that take place in billionths of a second, and the arrangements of atoms and molecules in catalysts and other economically important materials. Studies of the magnetic structure of thin films and other materials could lead to improved data-storage media for computers. New telecommunications technologies may grow out of studies of molecules that convert light into electrical energy, while research into geophysical processes could lead to a better understanding of how nature forms deposits of oil, natural gas, and mineral ores. In the area of basic research, the CAT will studythe inner electronic structure of atoms and small molecules. ❍

Busy, busy, busy . . . . . .

ANL photograph 16854K #5

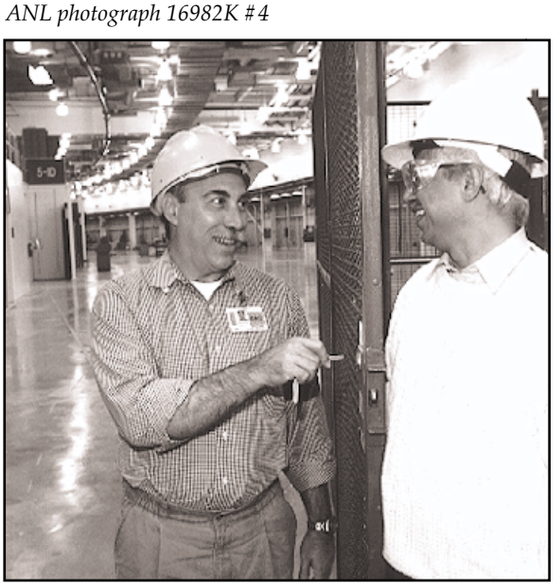
April 11, 1994 — Argonne Director Alan Schriesheim (left) presents the first royalty payment from licensing of the Experimental Physics and Industrial Control System (EPICS) software (see *The Source*, Number 6). This suite of software tools, developed by the Accelerator Systems Division (ASD) Controls & Computing (CTL) Group in cooperation with the AT-8 Group at Los Alamos National Laboratory, is now being used by industry as well as DOE and overseas labs. The APS accelerator control system was completely developed using EPICS.

Acceptingis Martin Kraimer (ASD-CTL), while APS ALD David Moncton (3rd from left), ASD Division Director John Galayda and C&C Group Leader Bill McDowell (foreground), and a significant sample of the CTL Group look on. ❍

April 22, 1994 — Andy Kelly (ASD-MAG), shown here with laminations for a storage ring quadrupole magnet, received a 1994 Argonne Director's Award at ceremonies held in conjunction with the annual State of the Laboratory address. Kelly was cited for "his extraordinary efforts in organizing and supervising the APS rigging crew, [and] in effecting moves of equipment and personnel to new facilities at the construction site, [all of] which were handled exceptionally well and completed days ahead of schedule." The award was presented to Kelly at formal ceremonies honoring all 1994 winners. ❍

ANL photograph 16950K #5

ANL photograph 16982K #4



April 28, 1994 — Experimental Facilities Division Director Gopal Shenoy (right) presents Joe Georgopoulous (left), Director of the Dow-Northwestern-DuPont Collaborative Access Team (DND-CAT), with the keys to the CAT's shiny new, 1994 CAT cage located at sector four in the APS experiment hall. DND-CAT was the first to sign a Memorandum of Understand-ing with the APS, and became the first CAT to take up residence at the facility. The cage provides temporary housing while DND-CAT's lab/office module is being constructed. ❍

May 5, 1994 — Six members of the Accelerator Systems Division earned the second annual Department of Energy (DOE) Pollution Prevention Award for Zero Generation, presented at the 10th annual DOE Pollution Prevention Conference, held in Denver. The award recognizes the development of a process, used by APS to clean storage ring vacuum chambers, that completely eliminates a potentially major source of hazardous waste, and saves more than $500,000 per year in disposal costs. The process was selected from entries submitted by the entire national laboratory system.

ANL photograph 1727

Contaminants such as machine oil evaporating from the inside surface of aluminum APS vacuum chambers would be a severe detriment to efficient storage ring operations. Chamber sections were originally to be dipped in 15-ft-long tanks of sodium hydroxide — caustic lye — to remove surface contamination. This procedure would have produced 3,000 gallons of hazardous waste per month. In addition, given disposal fees, training, protective equipment and compliance costs, the process could have cost the laboratory $600,000 per year.

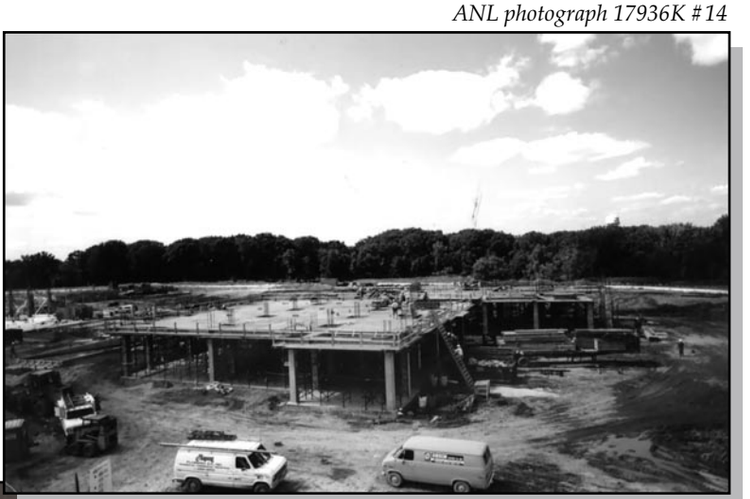
Using the new process, the chambers are dipped in a bath of alkaline detergent and subjected to high-frequency sound waves. The detergent solution is non-hazardous and can be handled by the Argonne waste-water treatment plant. In effect, waste can be poured down the sink. The process is also being adopted to clean other metals used in the APS, such as stainless steel and copper.

The winners were, from left, Dean Wyncott (ASD-VAC), Mike McDowell (ASD-VAC), Robert Ferry (ASD-ME), and John Noonan (ASD-VAC), along with James Lang (ASD-ESH) and Richard Rosenberg (ASD-VAC), both not pictured. Hardhatted Jeff Warren (ASD-VAC) is shown dipping a chamber in the "green" cleaning solution. ❍

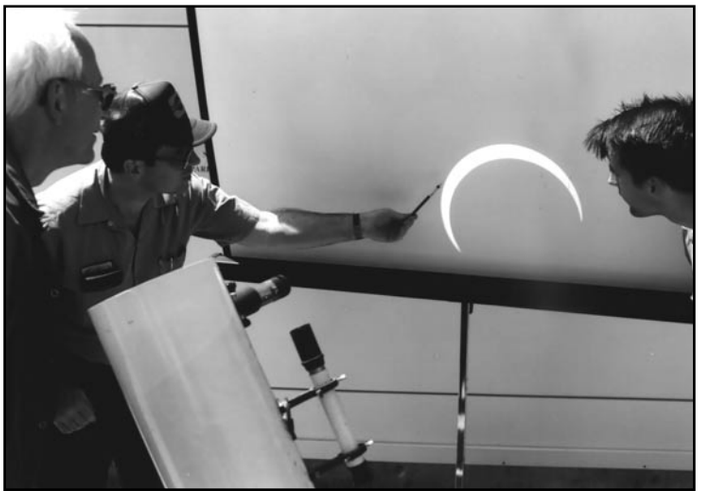
ANL photograph 17936K #14

May 9, 1994 — Ground-breaking ceremonies signaled the start of construction for the 178,000 sq-ft APS central lab/office building (CLO, shown in an artist's rendering below), which includes a 6-level office building, a 4-level laboratory wing, and a lecture hall/meeting facility. The contract for final design and construction of the CLO was awarded to Perini Building Co., Inc., of Chicago.

By August 31 (photo at right), concrete pours for the laboratory wing were well along, as can be seen in this view from the roof of the APS utility building. ❍



ANL photograph 15905K

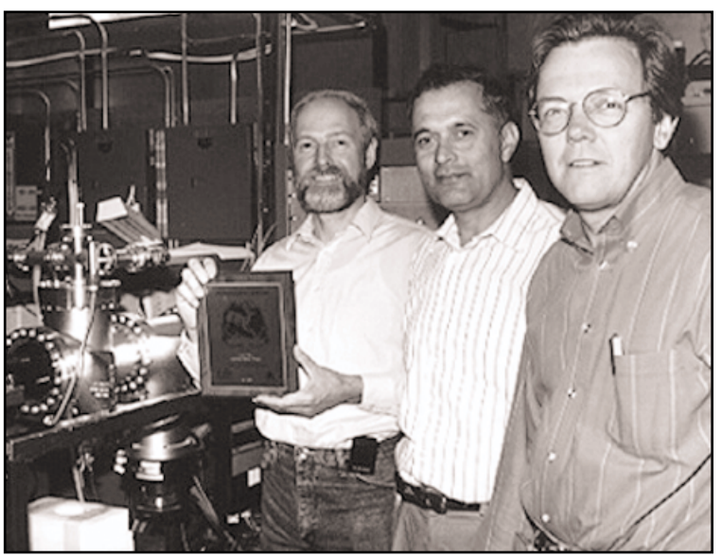


ANL photograph 17113K #11A

May 10, 1994 — An annular solar eclipse brought first light of a sort to the APS. Dick Prien (left, ASD-VAC) brought his 6-in. reflector telescope to the facility and used it to project an image of the event first on a screen set up outside of the Control Center and then on the white outer wall of the building itself. Included in the appreciative audience were Tony Lynch (with pencil) and Pete Fuesz (both ASD-VAC), who moved in close for a better look at the sun spots that were clearly visible in the image. ❍

ANL photograph 172144 #11

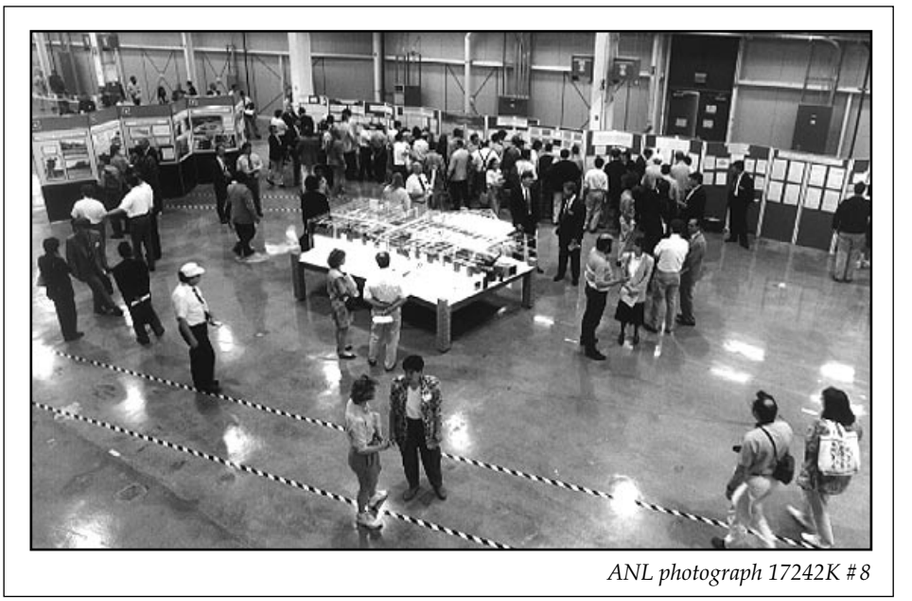
May 18, 1994 — Jozef Maj (left), of the ASD Mechanical Engineering Group, was presented with a Pacesetter Award for fabricating a titanium-vapor deposition system used to apply UHV-clean coatings of a few angstroms to APS radio-frequency-cavity couplers. With Maj in the photo are Sushil Sharma (ASD-ME, second from right) and Keith Primdahl (ASD-ME). ❍



ANL photograph 17186K #19A

May 21, 1994 — Bob Ferry (ASD-ME) explains the finer points of APS storage ring installation to visitors at the Argonne open house. APS personnel from all organizational groups worked on preparing exhibits, animations, and videos, and conducted tours for the event. By unofficial estimate, more than 6,000 people availed themselves of the opportunity to explore the APS facility, beginning in the Early Assembly Area of the experiment hall, where they saw the magnet measurement and the storage ring girder assembly areas, and then on to the experiment hall at Sector 2, where they viewed exhibits and peered into the storage ring tunnel. ❍

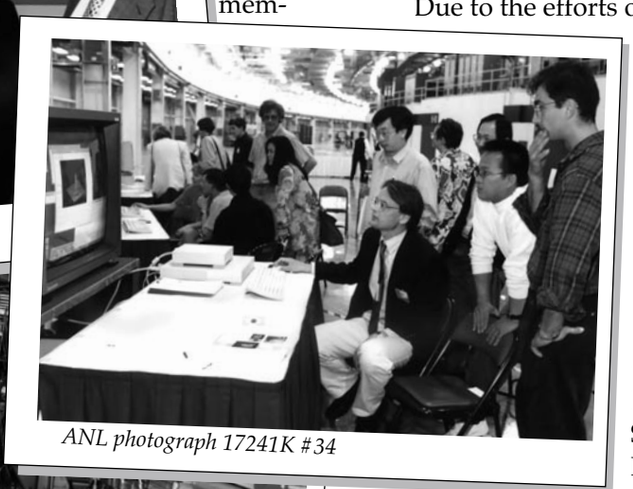
May 25 & 26, 1994 — The 6th Annual APS Users Meeting began with a report on Project status from APS ALD David Moncton. Other invited speakers provided a look at experiments now taking place at the European Synchrotron Radiation Facility, and discussions of topics ranging from radiation shielding for beamlines, to personnel safety and equipment protection issues, to preliminary and final design reviews, lab/office module build-outs, and user access. Four overview talks focused on synchrotron science: polarization analysis, microfocusing, anomalous scattering, and coherent X-ray scattering. On the afternoon of day two, participants chose among three mini-workshops: Microfocusing Technology and Applications, Coherent X-ray Scattering, or CAT Optical Designs.



ANL photograph 17242K #8

Attendees found time to work in an APSUO business meeting, the election of six new members to the APSUO Steering Committee, and a tour of the APS technical buildings followed by a reception and graduate student/post-doctoral-appointee poster session in the experiment hall. This poster session enabled participants to see results of the research done by future APS users and potential CAT employees. (The actuality of *using* the facility made clear the progress achieved by the Project. Eighteen months ago at the 5th Users Meeting, the experiment hall was by and large exposed to the rainstorm that coincided with a facility tour.) The first day ended with a dinner at Comiskey Park, where the Chicago White Sox obliged with a victory over the Minnesota Twins.

ANL photograph 17240K #5



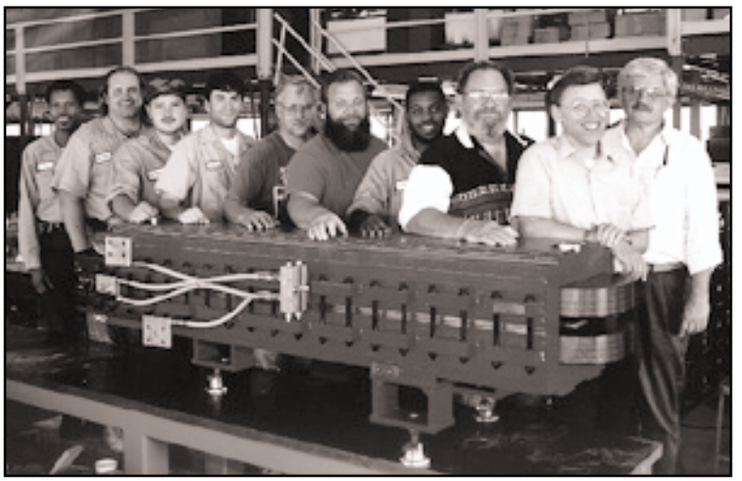
ANL photograph 17241K #34

ANL photograph 17241K #18

Due to the efforts of the Accelerator Systems Division Controls & Computing Group, the meeting was transmitted to workstations around the world via MBONE teleconferencing. Watching at least some of the meeting were viewers from most DOE labs, the Navy, NASA, the N.I.H., 10 U.S. universities, and interested parties in Norway, the U.K., It-aly, Finland, Ger-many, Switzerland (CERN), the Nether-lands, France, Spain, and Australia. ❍

— S. Barr (XFD-USR) & M. Knott (ASD-ADM) contributed to this item

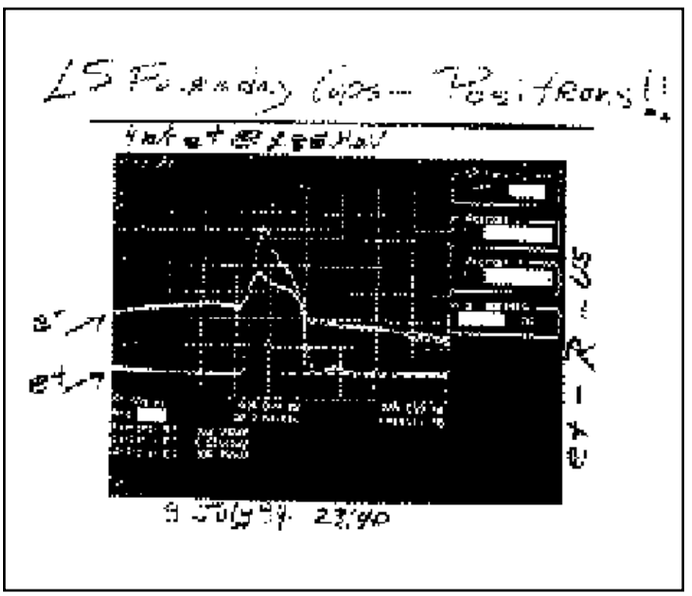
Upper left: *Emil Trakhtenberg (XFD-ID) discourses on insertion-device vacuum chambers.* ***At right****, Roger Dejus (XFD-ID) demonstrates a graphical user interface for spectral calculations.* ***Lower left:*** *A look at a completed storage ring sector was a high point of the facility tour.*



ANL photograph 17415K #4

June 30, 1994 — The team responsible for design and fabrication of the high-energy transport dipole magnets bid farewell to the sixth and final production unit of same. These dipoles are components of the transfer line between the booster and the storage ring. Team members are (l. to r., all ASD-VAC unless otherwise indicated) Kevin Bond, Mike Johnson, Mike Bosek, Ed Russell, Ric Putnam, Steve Hanuska (ASD-DDR), Lester Hawk, Jack Jagger, Ken Thompson, andTony Gorski. ❍

July 9, 1994 — At 11:40 p.m. on July 9, 1994, the linac accelerated the first beam of positrons at the APS, marking a major technical accomplishment in construction of the facility. The 4-mA positrons reached an energy of 285 MeV. On July 16th the linac achieved the design positron current of 8 mA. By July 31, the linac was accelerating positrons to 420 MeV and electrons to 630 MeV. ❍



ANL photograph18044K #9

July 28 — Robert Smither (XFD-OP) was presented with a 1994 University of Chicago Award for Distinguished Performance, the highest honor that can be given by the University to an Argonne employee. The award was given to Smither by Hugo Sonnenschein, President of The University of Chicago.

In the course of a 38-year career at Argonne, Smither has compiled an outstanding record of achievements in areas such as bent-crystal spectrometers and germanium detectors for gamma-ray analysis, and variable-focal-length lenses for imaging applications.

The results of his work on methods for cooling first-optical elements to be used in the APS and other third-generation light sources will be instrumental in the success of these facilities. This work includes using liquid metal as a coolant, developing the pumps that will deliver the coolants, design of the optics channels through which the coolant will flow, and contributions to the design of tilted two-crystal monochromators. Concurrently, he has continued the design, fabrication, and testing of crystal diffraction lenses with novel geometries (shown in the photo) to be used in a wide range of applications. ❍

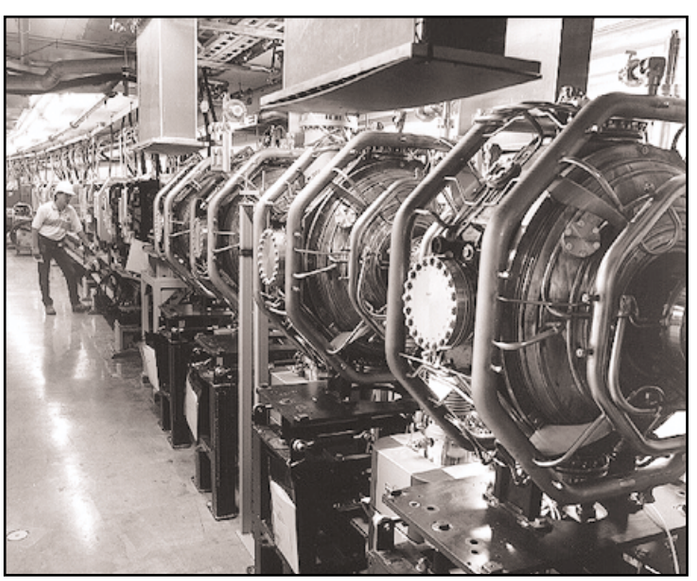
August 9, 1994 — The first APS Undulator A insertion device (ID) was delivered by the manufacturer, STI Optronics, to the Insertion Device Group of the APS Experimental Facilities Division. The device was installed at the magnetic measurement facility in Bldg. 362, where comprehensive acceptance tests were immediately begun. By August 31, field-quality testing was complete and the device was formally accepted. The ID is shown on the measuring bench, with Jenny O'Brien (XFD-ID) at the controls. ❍

ANL photograph 17818K

August 9, 1994 — The first boxes of photon shutter components for APS beamline front-end sections arrived at the experiment hall, ready for installation. The APS front ends, which will run from the storage ring to beam ports in the storage ring ratchet wall, are designed to confine the photon beam as it leaves an insertion device or bending magnet on its way to the experiment hall. The current APS insertion device front-end designs (which are much more complex than the bending magnet front-end designs) meet the specifications for operations at an unprecedented 100-mA storage ring current and 7-GeV synchrotron energy. The next issue of *The Source* will carry a detailed look at these crucial and complex links between light source and user. ❍

— T. Kuzay (XFD-EC) contributed to this item

ANL photograph 17759 #5



ANL photograph17772K #7

August 10, 1994 — Four copper radio frequency (rf) cavities are shown installed at the end of sector 40, the storage ring (SR) straight section located just upstream from the high-energy transfer line. These single-cell cavities were designed by the Rf Systems Group of the Accelerator Systems Division. A total of 16 such cavities located in the SR lattice will compensate for energy loss (in the form of synchrotron radiation) as the stored positron beam orbits the ring. By adding up to 10 MeV of energy to a positron every time it passes the cavities, the rf system replaces up to 2 MW of power emitted as synchrotron radiation in the storage ring. The other three sets of cavities will be installed in the 36th through 38th straights. The cavities are driven by high-power klystron/modulators located in the Rf Building above the SR. Each is capable of generating 1 MW of rf power that is transferred to the cavities via rf waveguides penetrating down through the SR enclosure roof. ❍

ANL photograph 17774 #7

August 10, 1994 — Progress on laboratory/office module (LOM) #431 (foreground) and #432,(at left, just beyond the rectangular truck-lock structure that separates the two LOMs). These white-clad structures will provide work space for APS users, and allow them immediate access to their beamlines on the experiment hall floor.

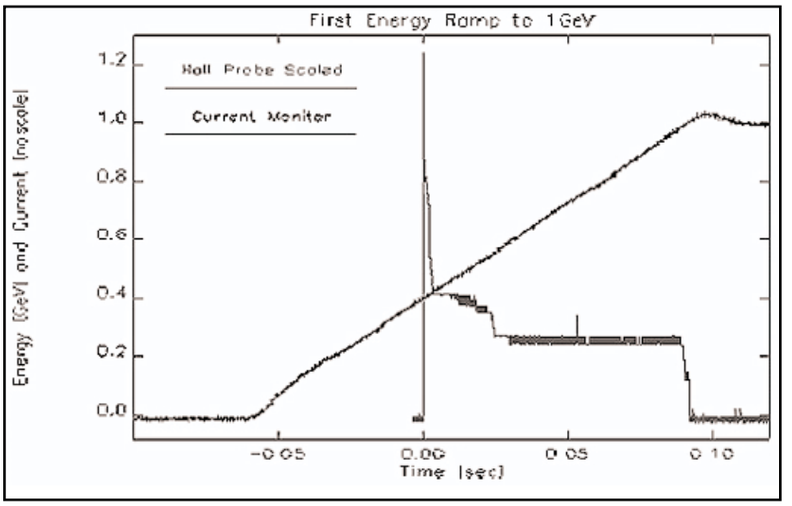
Notice to Proceed has now been given to the Wil-Freds company, contractor for LOM construction, to build the fifth lab office module, #433. This exceeds the original scope of 4 (of an eventual 8) modules proposed in the original APS Project Plan, at no increase in the total estimated cost of the facility. ❍

ANL photograph 17869K

August 24, 1994 — Filled with pride and a celebratory luncheon, the ASD Vacuum Science and Technology Group assembled in Bldg. 382 with the 235th and final completed APS storage ring vacuum chamber. Following extrusion by Taber Metals in Russellville, Arkansas, these positron pathways were assembled with loving care at the APS vacuum-chamber production facility (Bldg. 382), where the work that is carried out is recognized as the state of the art for this technology. With storage ring chambers completed, the group is gearing up to begin work on APS insertion-device chambers and other equally intriguing projects.

The group, beginning **front row, left:** Sharon Morelli, Michael Nole, Jay Michalowski, Robert Ferry, John Noonan, George Goeppner, Robert Wilson, Wayne Michalek, Mary Gorick (PFS), Robert Wehrle, and Audrey Salzbrunn. **Second row:** Neil Cortez, Dean Peters, Tim Roberts, John Gonczy, Dean Walters, Greg Rhodes, Michael McDowell, Bill Ferrell, and Val Svirtun. **Third row:** John Gecan, John Attig, Neil Sarkar, Richard Rosenberg, Steven Downey, Anthony Lynch, Fred Lopez, Mark Martens, and Bob Sommers. **Fourth row:** Donald Croupat, Ron Kmak, Glenn Moonier, Dan Vanlannen, Joseph Gagliano, Wade Muranyi, Richard Prien, John Crandall, and Jeff Warren. ❍

August 21, 1994



First beam ramped to 1+ GeV in the APS Booster Synchrotron

From the APS Accelerator Logbook:

1.0 Operators
Linac: L.Erwin, J. Scapino; PAR: N. Sereno; Booster: S. Milton; Other: G. Decker, Y. Chung, F. Lopez, J. Carwardine, E. Crosbie, L. Emery, M. Borland, A. Nassiri, J. Bridges, etc...

2.0 Plan

· Booster Ramping Studies with Beam

3.0 Booster Operations Summary

· From Linac/PAR:400 MeV, ~(1.5nC -> 2.0nC)/pulse

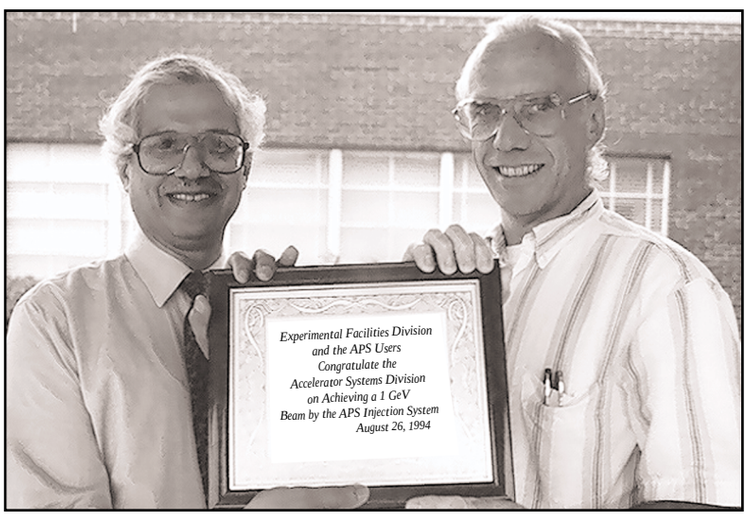
3.1 1+ GeV Beam!

· Magnet Ramping Table Tune-up

Three hours were spent at the beginning of the shift tuning up the ramp tables. This was done by observing the Bdot signals on a scope and modifying the tables until the region of interest was as flat as possible. Both quadrupoles and the dipole supplies were tuned up. We did not tune up the sextupole supplies. Only when we were satisfied did we open the triple stop and allow beam into the booster.

· **1+ GeV Beam**

Using "rshift" and "rslope" the ramp tables were adjusted. At 20:02 beam was observed reaching the end of the ramp cycle (Fig. 1). The magnet currents at this time placed the beam just a tad above 1 GeV. The ramp tables had a flattop programmed in to prevent increasing the energy further. This flattop lasts for 100 msec, enough for an-other 1.3 or so GeV… It would have been only a matter of maintaining the slope and shortening the flattop period in order to go up to ~2.3 GeV. We can't do everything in one night. . .



ANL photograph 17945 #2

August 26, 1994 — The first GeV is the hardest GeV, and so a spur-of-the-moment all-Project milestone party took place under the trees next to the ANL lodging facility. Experimental Facilities Division Director Gopal Shenoy (left) further commemorated the occasion by presenting a congratulatory certificate to Accelerator Division Director John Galayda. The inscription reads: *"Experimental Facilities Division and the APS Users Congratulate the Accelerator Systems Division on Achieving a 1 GeV Beam by the APS Injection System August 26, 1994."* ❍

The photographs in this and all future issues of *The Source* will be available as GIF files on the World Wide Web Advanced Photon Source Mosaic Home Page under "The Source." They are also available as PICT files by contacting the editor as indicated below.

The Source is a vehicle for enhancing communications within the APS Project on matters of technical accomplishments and progress, ES&H, research programs, and management news. Address story suggestions and/or comments to FENNER@ANLAPS or Rm. G-218, Bldg. 360.

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Lightning Over the APS — June 13, 1994

ANL photograph 17354K #30A