

## FUNDING PROBLEMS MAY DELAY RESEARCH AT LBL'S ADVANCED LIGHT SOURCE

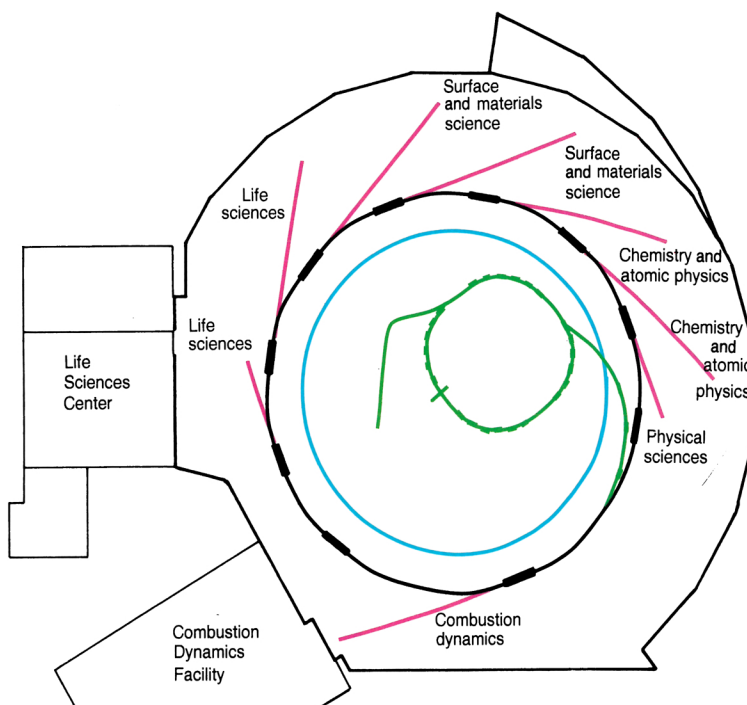
With a pair of next-generation facilities now under construction in the US—the Advanced Light Source at Lawrence Berkeley Lab and the Advanced Photon Source at Argonne National Lab—one could say the outlook for synchrotron research has never been brighter. And yet, even as the Federal government continues to spend large sums of money on new light sources, a shortage of outside funding may significantly delay the research program at the ALS.

Like the previous generation of light sources, the ALS and APS were planned with the expectation that users would bring in outside funding—that is, support from Federal and industrial sources—to help build their own beam lines and experimental stations. Their construction budgets were planned to cover primarily the storage rings and supporting structures.

Despite careful planning, funding for ALS beam lines has fallen far short of expectations. To date only five of a possible 34 beam lines have been funded by users; an additional two beam lines and three insertion devices will be built out of the construction budget provided by the US Department of Energy. The original plan called for half of the straight-section beam lines to be in place when the ALS starts up in spring 1993, according to Louis Ianniello of the DOE's basic energy sciences division. But given that a typical beam line takes at least a year to construct, it seems unlikely that the goal will be met.

Meanwhile construction on the facility itself continues apace: The external buildings are complete, the 50-MeV linac and 1.5-GeV booster synchrotron are now being commissioned, and the ALS storage ring is being installed.

Still four years to completion, the Advanced Photon Source has received some early pledges from industrial users: So far about one-tenth of the outside money needed for beam-line



**The Advanced Light Source**, now under construction at Berkeley, will eventually accommodate 34 beam lines—10 straight-section sites and 24 bending-magnet sites. The red lines indicate the eight straight-section sites that have been allocated to research teams. The linac and booster ring, in green, are now being commissioned. The ALS is built around the building that once housed Berkeley's 184-inch cyclotron, shown in blue.

construction has been secured. Though one cannot of course predict how the APS will fare in the future, it is altogether possible that the attention now focused on beam-line funding at the ALS will benefit APS users, as well as those at the existing light sources.

### At the ALS

A national user facility of DOE, the ALS is one of the so-called third generation synchrotrons now being built in the US and abroad (see

PHYSICS TODAY, April, page 17). Once completed the ALS will be a 1.5-GeV, 400-mA electron storage ring producing vacuum ultraviolet and soft-x-ray (10 eV to 1 keV) light beams that are up to two orders of magnitude brighter than existing xuv sources.

Although an ALS review panel has already allocated half of the 34 beam lines to research teams, funding exists for only three of the ten straight-section beam lines—considered the premier spots on the storage ring because they will accommodate inser-

tion devices—and four of the 24 bending-magnet beam lines (see figure). Of the three funded straight-section sites, two of the beam lines and three of the insertion devices are being paid for out of the construction budget; IBM, the only major industrial user to date, has agreed to build the third straight-section beam line.

Funding for the bending-magnet lines is coming from a variety of sources, including Lawrence Berkeley Lab, ALS project funds and the research teams themselves. Two of the bending-magnet lines are being moved across the San Francisco Bay from the Stanford Synchrotron Research Laboratory.

To fully outfit the ALS with insertion devices, beam lines and experimental stations, an additional \$70 to \$100 million is needed beyond the \$100 million construction budget, says Alfred Schlachter, the scientific program coordinator for the ALS. Regrettably, much of that money is not yet in hand.

The problem, as those in the synchrotron radiation community see it, is not a lack of users but a lack of users with money. In the face of a recession, industrial users seem reluctant to invest in new synchrotron radiation research, while many of those who have applied for government grants have seen their proposals turned down or delayed. "We've gotten wonderful reviews of our proposals but little money so far," says Dennis Lindle (University of Nevada, Las Vegas) who chairs the ALS users executive committee.

"The generally poor track record of previous projects is one of the factors that has slowed the rate of investment [by industry] in beam lines," says Jay Marx, director of the ALS. He points with some pride to the fact that his facility has consistently met construction deadlines within budget, and he confidently expects it to stay on schedule, unlike the light sources of the previous generation, which for one reason or another required several years after completion before they could perform as promised.

For now industrial users seem to be taking a "wait and see attitude," Lindle says. But once the ALS is fully commissioned, he predicts "they'll be knocking down Berkeley's door."

As one would expect, obtaining beam-line funding has been declared the number-one priority by ALS staff and users. Last spring a 20-page brochure calling attention to industrial applications for synchrotron radiation was mailed to thousands of researchers in industry, and the ALS has sponsored an on-going series of

workshops on research applications.

### At the APS

Also a DOE-supported national user facility, the Advanced Photon Source at Argonne is to be a 7-GeV, 100-mA synchrotron providing hard x rays, in the range from 1 to 100 keV. Construction is still in the early stages, with some external structures now being erected; the linac is to be installed next spring.

The \$456 million that DOE has pledged for construction of the APS includes \$60 million to build the insertion devices and front-end components for half of the 68 beam lines, says David Moncton, associate lab director for the APS. This should lower the cost to users by about \$2.5 million per sector (a sector being one insertion-device beam line and one bend-magnet beam line). Without that support the typical user might have to invest at least \$5 million for a complete beam line with insertion device. "Our goal is to have half of the facility equipped with beam lines by late 1995," says Moncton. "I think we'll easily meet that objective."

The APS has so far received "fairly firm commitments" from industrial users for \$25 million, says Moncton, about a tenth of the \$240 million needed beyond the construction budget. Moncton interprets these early pledges as a sign that the APS will not encounter the funding problems of the ALS. He points out that the two facilities are intrinsically different machines, intended to serve different segments of the synchrotron radiation community. Historically, x-ray technology has been more common than xuv technology, and users of hard x-ray synchrotron radiation—including those who will use the APS—therefore outnumber those using soft x rays.

A 15-member review panel chaired by Charles Townes was assembled by DOE Secretary James Watkins in September to assess the department's research priorities. The panel endorsed continuation of the APS on the "current baseline of cost and schedule." Of course, this in itself does not ensure future funding of the APS—it is Congress, after all, that has the final say on budgets.

### Changing funding climate

The situation at the ALS has led many within the synchrotron radiation community to believe that the government's and industry's priorities for funding synchrotron-based research have changed.

The previous generation of synchrotron radiation sources—including the

Cornell High Energy Synchrotron Source, the National Synchrotron Light Source at Brookhaven, the Stanford Synchrotron Radiation Laboratory and the Synchrotron Radiation Center at the University of Wisconsin—were built for just a fraction of what their newer counterparts cost. But when it came to building beam lines, both industry and government agencies were far more generous than they are today.

To illustrate: When the NSLS—now the country's largest synchrotron radiation facility—was built in the late 1970s, it was given a "small" construction budget of about \$50 million (a figure that included an initial \$24 million plus a later expansion), but research teams were able to find funding for and build more than 85 beam lines, for a total cost amounting to two and a half times the construction budget.

The lesson was drawn from the NSLS that future projects should have a better balance between how much was spent to build the facilities and how much was contributed by users. The ALS and APS were therefore given larger construction budgets than their predecessors. But what now troubles some about the current approach is that users may have been shortchanged in the process.

### Coherent strategy needed

"It'd be difficult for the synchrotron community to stand up and say that we're underfunded," says Moncton. What the synchrotron radiation community needs, he says, is to "cobble together a strategy for funding that is broader-based and reflects all of the research areas." Toward this end the Department of Energy held a workshop in October to outline what its users require in terms of beam lines and experimental support, at both the planned and the existing light sources it operates.

The 360-member Structural Biology Synchrotron Users Organization, also known as BioSync, has already explored this issue in some depth. A BioSync report released this summer states that "a threefold growth in synchrotron needs is projected through the year 2000," including at least 29 new experimental stations for research in crystallography, x-ray spectroscopy, scattering from non-crystalline materials and nonmedical imaging.

Officials at the various funding agencies say they appreciate the situation, but given their restricted budgets they cannot be as generous as they would like. "It would have been desirable to have all kinds of funding

for beam lines," says Ianniello of DOE. "But we don't have the money." Eventually, he hopes to see the ALS and the APS fully commissioned and outfitted with beam lines. "It just may take a little longer than we had hoped."

Adriaan de Graaf, deputy director of the NSF's materials research division, says that the current situation faced by synchrotron radiation users is "not more of a problem than that faced by any other group" trying to get funding. "We have funded beam-line construction in the past, and this will remain an important aspect of our support," de Graaf says, adding that a committee within NSF is now preparing guidelines to handle the "complex, multidisciplinary beam-line proposals" being submitted.

Another important issue, says Denis McWhan, chairman of the NSLS, is where the money to operate and maintain the synchrotron facilities will come from, once the ALS and APS are completed. At the NSLS users are responsible for operating and improving the beam lines, while DOE supports the operation and improvement of the uv and x-ray rings. "It would be unfortunate if we were unable to keep up our end of the bargain," says McWhan.

One idea that has been suggested by the Federal government to cover operating expenses is for users' fees to be paid on top of any investment users had already made in instrumentation. At present beam time at the national facilities is free, provided that research results are published in scientific and technical journals. (See the box on users' fees in *PHYSICS TODAY*, April, page 19).

### Impact on current light sources

Some thought is also being given to what impact the ALS and APS will have on research programs at the synchrotron sources in operation. "The ALS and APS will certainly take some of our users," says Ednor Rowe, associate director for accelerator development at the SRC at Wisconsin. "But they're quite specialized. Our expectation is that new uses for synchrotron radiation will keep popping up." He points to the case of x-ray lithography. "Four years ago it was just a gleam in the eye of a few people here. Now roughly one-fourth of the floor is devoted to it."

Even now the existing light sources are being upgraded. At the SSRL, for example, a dedicated 3-GeV injector was completed in September, with normal operation scheduled to begin in February; prior to that it had relied on an electron beam from the 2-mile

linac shared with the Stanford Linear Collider, a situation that resulted in only two months of beam time per year for the SSRL. Similarly, the number of beam lines at CHESS was recently doubled, and a bio-containment facility was added.

Arthur Bienenstock, director of the SSRL, says he's "looking forward to [the ALS and APS] taking some of the load. There's a large portion of the community whose needs we've never been able to meet fully."

—JEAN KUMAGAI

## OHIO STATE WITHDRAWS FROM MOUNT GRAHAM TELESCOPE PROJECT

To the dismay of the other participants in the Columbus Telescope Project, one of the three telescopes slated for the Mount Graham Observatory in Arizona, Ohio State University has withdrawn from the project, jeopardizing its future. Immediately upon receiving news of Ohio State's decision in early September, the Arcetri Astrophysical Observatory in Florence, Italy—a partner in the project with the University of Arizona—issued a press release expressing regret about the university's action.

Arcetri, a research organization of the Italian government, said the decision "has severe economic and scientific implications for the other partners and does not take into sufficient account the legal and moral commitments previously taken by Ohio State University and by its former president, Edward H. Jennings." Franco Pacini, the director of the Arcetri Observatory, said the decision was "detrimental to the prospects of collaboration in astronomy between European and American institutions and could result in a serious credibility gap for Ohio State in possible future international projects." The Arcetri astronomers were especially irritated that they learned of the decision from Arizona rather than Ohio State.

Ohio State officials have defended their action as financially necessary, given cuts in the university's budget imposed by the state legislature, and they have drawn a parallel between their withdrawal from Columbus and the University of Chicago's decision to pull out in November 1988. But Peter A. Strittmatter, the director of the University of Arizona's Steward Observatory, rejects the comparison. Strittmatter points out that Chicago made its decision and informed its partners in an orderly way and at a suitable time—not when the project was in an advanced phase and substantial investments already had been made. According to Strittmatter and Pacini, \$6–8 million have been spent on the project so far—about \$2 million by the Italian partner. The total cost of the project is estimated to

be \$60 million in 1989 dollars.

Neither Arizona nor Arcetri—nor the astronomers at Ohio State itself—had any warning that Ohio might withdraw from Columbus. Eugene R. Capriotti, head of Ohio's astronomy department, and C. William Kern, dean of the college of mathematical and physical sciences, have resigned their administrative positions in protest against the decision.

The Columbus telescope is a binocular instrument that is to be equipped with the first of the eight-meter honeycomb mirrors to be built by Roger Angel's team at the Steward Observatory; it will have an effective light-gathering area of 11.8 meters. (See the article by Buddy Martin, John M. Hill and Angel in *PHYSICS TODAY*, March 1991, page 22.) By comparison with the other two instruments being built for Mount Graham—a 1.8-m highly maneuverable optical telescope cosponsored by Arizona and the Vatican, and a 10-m submillimeter radiotelescope that is being built as a collaboration of Arizona and the Max Planck Institute for Radioastronomy—the Columbus project is at a relatively early stage. Nevertheless, Ohio State's withdrawal leaves Arizona and Arcetri in an awkward position, scrambling to find a new cosponsor when most major decisions concerning the project already have been made. Arizona is expected to claim that Ohio State owes the project several million dollars.

The frustration felt by Arizona astronomers is of course enormously heightened because of the long struggle they have been going through to get the Mount Graham Observatory built at all (see *PHYSICS TODAY*, November 1990, page 75). Faced with opposition from environmentalists and Native Americans, who have claimed that construction of the observatory would endanger the red squirrel and sacred Indian sites, the University of Arizona has prepared ground for the observatory in fits and starts, as complex litigation has worked its way through the courts.

—WILLIAM SWEET ■