BIG PHYSICS

DOE Urged to Go Slow in Building Free Electron Lasers

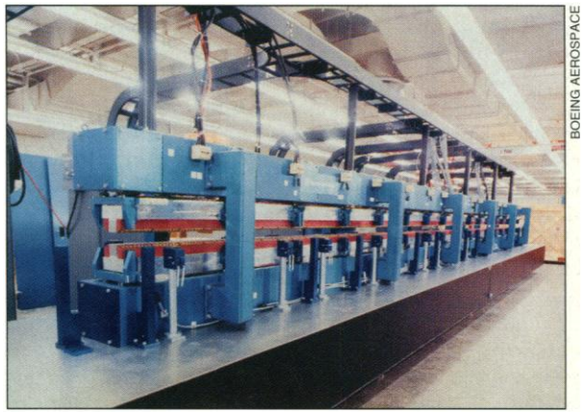
Last year, the Department of Energy (DOE) came under siege by physicists pleading for funds to build free electron lasers (FELs). For two decades, aficionados had been touting these machines—which generate light from an electron beam slaloming through a "wiggler" magnet—as a technology with a bright future. The reason: Unlike conventional lasers, which operate at a fixed frequency, FELs can be tuned to produce high-energy light at a range of wavelengths likely to be important for materials research, structural biology, medicine, and industrial processing. For years, those hopes were fueled by the Strategic Defense Initiative (SDI), which saw FELs as part of a potential anti-missile defense. But now, as physicists across the country are anxious to experiment on their own machines, SDI funding has stopped.

FELs are costly beasts, requiring powerful accelerators to produce the electron beams, and DOE was not convinced that a big government investment was warranted. So it turned to the National Research Council (NRC) for advice. NRC's response, delivered last month, has dismayed some members of the FEL community. A panel of 12 scientists, led by Donald Levy, a physical chemist at the University of Chicago, urged DOE to take a cautious approach, funding more research on the technology itself but building no more than a single new facility, which would be open to all investigators. "What we said," according to Levy, "is that in the far infrared you ought to build [a center]. In the visible, ultraviolet, and near infrared you shouldn't build one and probably never should build one" because there are competitive light sources. And "in the far ultraviolet and x-ray you shouldn't build a facility now," because the cost is prohibitive. Instead, "you should figure out how to build a better one [later]."

That advice has prompted some FEL advocates to charge that DOE stacked the deck by asking the NRC to look only at the potential value of FELs for basic science rather than for industrial and medical applications. And they argue that if DOE doesn't make a major commitment to the technology, the United States will risk losing leadership to the Japanese and Europeans, who have begun to invest heavily in FELs. Even though SDI has been disbanded, the Defense Department remains the major source of funding for FELs, through a medical research program funded by the Office of Naval Research (ONR). The ONR program does not pay for technology development, although the national weapons labs are spending a very small amount to continue FEL development.

But the NRC reviewers believe the state of the technology doesn't justify major new investments across the board. The only part of the spectrum where a new FEL research center could make a cost-effective contribution, the panel decided, is the far infrared (1000 to 10 micrometers), because here the technical challenge would be low, as would the cost—estimated at "several million dollars." (Long-wavelength devices are more tolerant of imprecision in manufacture than are systems that generate x-rays, for example.) The panel said this new laser center should be capable of producing very short (picosecond) pulses, and it should be a "user facility" open to proposals selected by merit. Although there are nine FELs in the United States now, the Levy panel says that none has picosecond capability, critical for analyzing time-dependent interactions at the molecular level. And none, according to Levy, is truly open to all comers; instead they are controlled by universities or government labs, where the management "occasionally allows people to come in."

In addition to backing one major user facility, the panel went out of its way to plead for "a balance between support for individual investigators and support for major research facilities." The major scientific questions in many areas "can best be attacked in the individual researcher's laboratory," says Levy. Several recommendations urge DOE to find ways of shrinking the cost and size of FELs so they can be squeezed into small labs.



BOEING AEROSPACE

Big wiggler. This laser magnet, built for Boeing under an SDI contract, is being shipped to Brookhaven.

This attitude bothers some FEL experts like John Adamski, who oversaw construction of the world's largest FEL "wiggler" magnet at Boeing Aerospace for the SDI program. Adamski sees the panel's approach as unduly "narrow" and "pessimistic." He adds, "Our field is in danger of collapse." Others say they are "disappointed" that accomplishments of their own centers were not mentioned. And physicist John Madey of Duke University, inventor of the FEL and director of a large medical FEL program at Duke funded by ONR, says of the report: "It's a puzzler." It seems to focus on "an unstated agenda" at DOE to fend off requests for major investment, he says, not on the broad potential of FELs.

Some of the biggest promoters of FEL technology are close to home. Indeed, one of DOE's own nuclear physics centers, the Continuous Electron Beam Accelerator Facility (CEBAF) in Newport News, Virginia, has an optimistic view of FELs. CEBAF is looking for funding to produce ultraviolet FEL light, a project that already has the backing of some impressive partners—including Xerox, DuPont, IBM, and AT&T, among others—who hope to conduct industrial processing experiments such as using laser light to alter material surfaces. The projects being considered at CEBAF are "really unique," says Leonard Brillson, a manager at Xerox's Wilson Center for Research and Technology in Rochester, New York. Like others in the field, he regrets that members of the Levy panel "intentionally confined themselves to the scientific aspects" of FEL use.

But the man who requested this report, former DOE basic energy sciences official Louis Ianiello, now retired, points out that science and energy research are what DOE is meant to support. "I was somewhat skeptical about spending a lot of money to build a new device that might be of only marginal interest" to scientists, he adds. Robert Marianelli, who now oversees this area for DOE, says that he thinks the Levy panel "did a good job." Although many proposals for new FELs were reasonable, he adds, "we can't support everything." DOE would like to see the field expand gradually, perhaps piggybacking on accelerators at the four major light sources DOE already supports.

After waiting 20 years for their chance, dedicated FEL experimenters aren't likely to fold their tents. Despite the cool scientific review, and despite DOE's reluctance to pick up the tab, DOE is likely to continue receiving appeals to fund FEL centers.

–Eliot Marshall