HIGH-ENERGY PHYSICS

Global Team Keeps Low Profile As It Works on Next Collider

MENLO PARK, CALIFORNIA—The 150-meter-long array of wires and tubes set up in the hallway of a weathered concrete building at the Stanford Linear Accelerator Center (SLAC) looks like a modest physics experiment. But it's actually a central part of Director Burton Richter's multibillion-dollar dream: a 25-kilometer-long Next Linear Collider (NLC) to be designed, built, and operated by an international team of scientists and financed by governments around the world.

The jumble of equipment is the latest technology test bed for the NLC, and scientists hope to have the experiment up and running by early next year. But don't expect much fanfare: Richter and other supporters are approaching this project in a very different way from previous big-physics projects. They are quietly building an international coalition to tackle the tough technical problems up front, drawing on money from many countries to keep costs low. In the current fiscal climate, it may be the only reasonable way to tackle such a huge project.

If built, the NLC would also be a gigantic leap forward in the field of accelerator physics. SLAC is home to the Stanford Linear Collider (SLC), a 4-kilometer-long machine that focuses narrow beams of electrons and positrons and smashes them together. Richter and his international collaborators want to build on the lab's experience by creating a collider 10 times more powerful. That higher energy, along with brighter synchrotron radiation, will allow researchers to explore the behavior and mass of several elementary particles, says physicist Bjorn Wiik, director of the DESY facility in Hamburg, which is a partner in the effort. And proponents argue that it would complement Europe's planned Large Hadron Collider, which will deliver higher energy but less focused collisions.

Although there are daunting technical challenges confronting the project, NLC's supporters expect their toughest fights will be over funding, not physics. Two years ago Congress killed the $11 billion Superconducting Super Collider, a proton-smashing machine already under construction in Texas, after mounting complaints about mismanagement, cost overruns, and a dearth of international contributions. Early this year, the Clinton Administration abandoned plans for a $2.7 billion Advanced Neutron Source. And now the Department of Energy (DOE) is increasing pressure on labs like SLAC, which recently won a hard-fought contest to build a B-meson factory (*Science*, 15 October 1993, p. 328), to reduce costs. "You would have a tough time going to Congress today to propose a large new facility," says James Decker, DOE deputy director for energy research.

As a result, the workload has been parceled out to an international lineup of researchers, fueled with money from the United States, Japan, and Europe. Dividing up the work keeps expenditures by any one country under the radar of budget-conscious politicians. "We've been very careful to keep government officials informed informally," Richter explains. "They are perfectly happy with the [preliminary] R&D, but no government has said anything about funding [the NLC itself]."

The multinational team's first step was a prototype focus test beam, built at SLAC between 1991 and 1993 with the help of Russian magnets, Japanese hardware, and French and German diagnostic instruments. The prototype achieved a cross section of 60 nanometers—much smaller than the SLC's current 500 nanometers and enough to prove the basic technology, says David Burke, who is leading the new collider effort at SLAC, which spent $16 million on the test beam. The final test beam must achieve a cross section of 5 nanometers.

The next step is to decide what kind of accelerator will work best. That effort includes a test of two competing magnet technologies. One approach, the $20 million test accelerator SLAC plans to start operating early next year, employs conventional, room-temperature magnets similar to those used on the current Stanford machine. Meanwhile, DESY scientists are working on a soccer-field-sized prototype using superconducting magnets, which they hope to complete early in 1997. That approach, while more difficult technically, could substantially reduce operating costs by using less electricity.

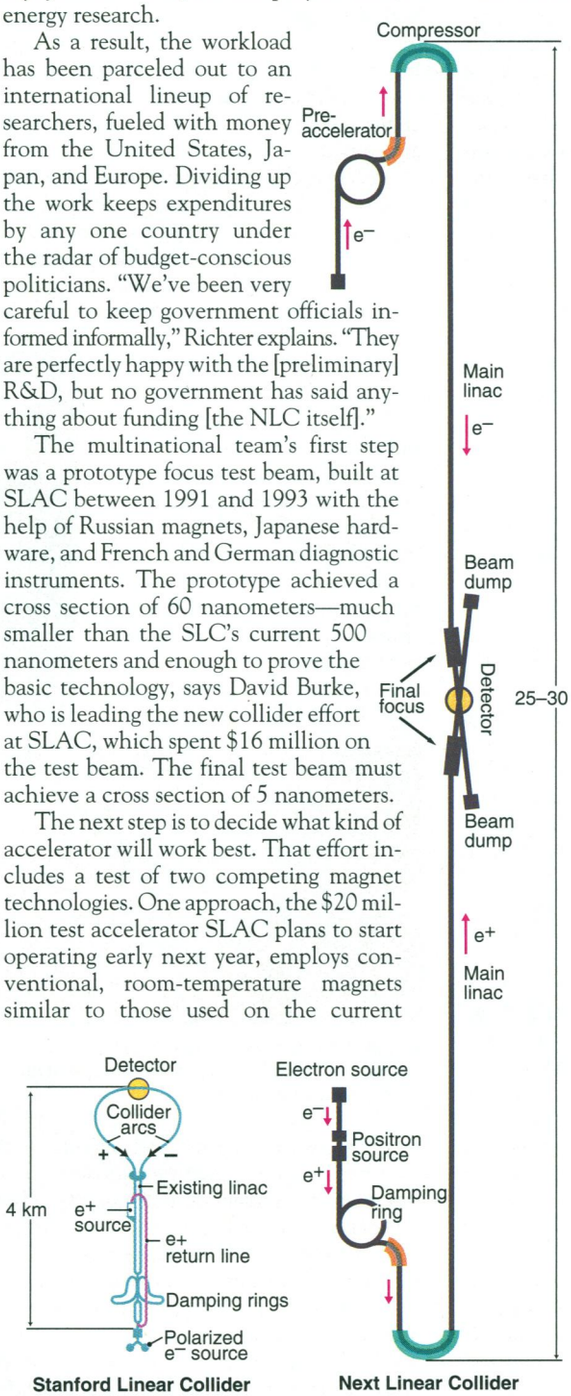
Not all the international partners are expected to play an equal role in the project. The Burka Institute in Novosibirsk, Russia, contributed magnets to the SLAC test beam, but funding problems cut short further contributions. "Their contribution is now more in theory than in hardware," says Richter. Japan, meanwhile, is supplying finely machined metal to build parts of the test accelerator at SLAC.

Once a decision is made between the two technologies, Richter estimates it would take 3 more years to complete a design and 5 to 6 years to build it—if funding can be found and an inevitable fight among U.S., European, and Japanese politicians over the site can be resolved. Richter is coy about the cost: "Let's just say it is in the billion-dollar class," he says, although others have put the price at between $2 billion and $3 billion.

Such numbers make a thoroughly international project the best alternative, say NLC advocates, and Richter already has plans for how such a collaboration might work. He envisions a nonprofit organization, modeled on the European Synchrotron Radiation Facility in Grenoble, France, in which governments get a voice in proportion to their contributions, and the host country is responsible for utilities, infrastructure, and the nearby university. "It's a lot easier than something like CERN," says Richter about the European High-Energy Physics lab in Geneva, which is run directly by officials from member governments.

Decker says it is too early to spell out such details for the NLC, but that it is important to keep moving ahead with the technology. "No matter how bleak the budget picture is, one has to think about the future," he says. Richter is confident that he will see his dream become reality. He's even scoped out a site—just outside the gates of his center.

–Andrew Lawler



SOURCE: SLAC

Scaling up. The proposed Next Linear Collider would dwarf Stanford's current electron-positron facility.