



HIGH-ENERGY PHYSICS

Plans for Next Big Collider Reach Critical Mass at Snowmass

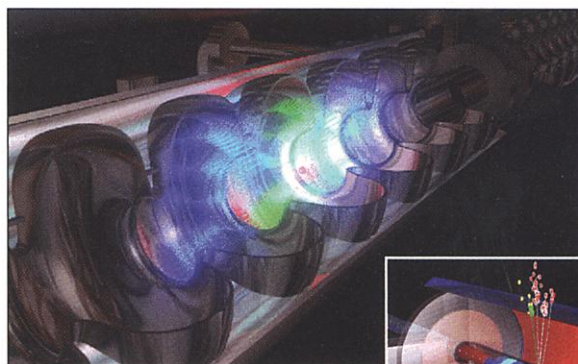
SNOWMASS VILLAGE, COLORADO—High-energy physicists from around the world would like to build a multibillion-dollar linear collider as the next big accelerator project. The unexpected consensus appeared in an unofficial statement cobbled together at the end of a 3-week summit.* But how such a machine would be funded and where it would be built are yet to be determined.

"There are fundamental questions ... that cannot be answered without a physics program at a Linear Collider overlapping that of the Large Hadron Collider," reads the statement, which refers to a machine being built at CERN, the European particle physics laboratory near Geneva. "We therefore strongly recommend the expeditious construction of a Linear Collider as the next major international High Energy Physics project." Conference attendees were surprised by the broad agreement represented by the document. "I thought we'd never get to a consensus," says Mike Barnett, a physicist at Lawrence Berkeley National Laboratory in Berkeley, California, who helped craft the statement. "It took off suddenly."

Such a linear collider would take electrons and their anti-matter twins, positrons, and smash them together. Because electrons and positrons are fundamental particles—indivisible "leptons"—their collisions are much less complicated than collisions between composite bodies like protons, which are made up of three quarks. This simplicity, along with scientists' ability to manipulate the electrons' polarization, gives electron-positron colliders the ability to make much more precise measurements than composite, or hadron, colliders like the Tevatron at Fermi National Accelerator Laboratory in Batavia, Illinois, and the Large Hadron Collider, which is scheduled to go online in

2006. The sacrifice is that they operate at lower energies—a handicap in searching for massive particles.

But in the past few years, particle physicists have become convinced that the Higgs boson, a long-sought particle responsible for objects' mass, should have a mass-energy less than 200 giga electron volts (GeV), within reach of a new electron-positron collider. The leading designs are the German Tera Electron Volt Superconducting Linear Accelerator (TESLA) and the American Next Linear Collider, either of which would accelerate the particles for tens of kilometers before smashing them together with as much as 500 GeV of energy. This should enable



Linear thinking. Planned collider would smash electrons into positrons.

physicists to make precise measurements of the Higgs boson, as well as possible "supersymmetric" particles that some scientists believe will be found in the next few years.

Faced with this prospect, the community decided to back the collider rather than scramble for funding of other potential facilities such as a neutrino factory, which would produce the nearly massless particle in great numbers, or a muon collider, which would slam heavier versions of the electron and positron into each other. "We really wanted to avoid where this becomes a food fight and everyone says, 'My area should be the one that's funded,'" says Steven Ritz, a

physicist at NASA's Goddard Space Flight Center in Greenbelt, Maryland, who works in high-energy astrophysics.

Of course, agreement among physicists won't pay for the new machine. An estimated price tag of at least \$6 billion makes it extremely unlikely that one country will be willing to finance the facility. But the opportunity to host it is believed to be a major attraction.

Physicists from Europe, Japan, and the United States each want their own country to win the honor. Talk in the hallways pegged Hamburg, Germany, and Batavia, Illinois, as the leading contenders for the site of the accelerator, to the chagrin of Japanese scientists. But these differences are unlikely to be serious stumbling blocks. "It's more important to get a machine built than to get it built in the U.S.," says Ken Bloom, a physicist at the University of Michigan, Ann Arbor.

A bigger issue for U.S. scientists is whether their government will be a reliable partner. The U.S. withdrawal from the International Thermonuclear Experimental Reactor is still an open wound (*Science*, 9 October 1998, p. 209), and a White House budget official who addressed the conference gave little indication that money would be forthcoming. "Given that the overall funding profile of physical sciences is slipping down, large expenditures are going to be difficult," says Mike Holand of the Office of Management and Budget. Given the current budget situation, he said, some politicians are more likely to ask the opposite question, namely: "What would be the impact on society if the funding for high-energy physics were zeroed out?"

Luciano Maiani, director-general of CERN, said that such an attitude would be "very unfriendly to science." But some participants suggested that they should learn from their colleagues in the life sciences, who have managed to win big increases for the U.S. National Institutes of Health while funding stagnates for most of the physical sciences, by explaining the benefits to society from their work. "We're no longer the favorite son of science," says Princeton physicist Kirk McDonald. "We're just used to acting that way."

—CHARLES SEIFE

* Snowmass Summer Workshop, "The Future of Particle Physics," 30 June to 21 July.