PHYSICS: International Team Releases Design, Cost for Next Great Particle Smasher

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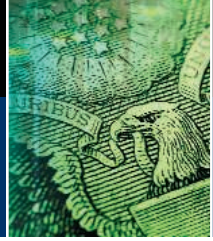

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PHYSICS

International Team Releases Design, Cost for Next Great Particle Smasher

An international team has released a preliminary design and cost estimate for the International Linear Collider (ILC), the hoped-for straight-shot particle smasher that many researchers say is the future of their field.

In Beijing this week, the ILC Global Design Effort (GDE) team reported that the "value" of the 35-kilometer-long machine would be $6.65 billion and 13,000 person-years of labor, plus or minus 30%. The value differs from a cost estimate because it does not account for inflation until the machine is completed—in 2016 at the earliest—or so-called contingency to cover potential cost overruns, which different countries handle in different ways, says Barry Barish of the California Institute of Technology in Pasadena, who leads the GDE.

Including such factors would, for example, likely double the amount entered in the ledgers of the U.S. government. So if the United States hosted the machine and bore half the expense, its contribution would total about $7.5 billion, Barish says.

The value estimate is roughly equal to the cost of the Large Hadron Collider (LHC), the 27-kilometer-long circular accelerator under construction at the European particle physics laboratory CERN near Geneva, Switzerland. The LHC cost 4.7 billion Swiss francs (about $3.8 billion), but that does not include the tunnel, which was dug for an earlier machine, or the older accelerators that will feed the LHC.

The LHC and ILC "are in the same ballpark, so I think it is doable," says Albrecht Wagner, chair of the board of directors for the German particle physics laboratory DESY in Hamburg. "But in the end, it's up to the politicians." Some researchers, however, say it is too early to name a price. "I'm afraid that the cost will increase," says Kaoru Yokoya, who leads ILC R&D at the KEK particle physics laboratory in Tsukuba, Japan. "A big increase will kill our project."

The ILC will probe in detail phenomena researchers expect to glimpse at the LHC, which is scheduled to be turned on in November. Many physicists expect the LHC to produce the long-sought Higgs boson and possibly a raft of new particles predicted by a theory called supersymmetry. But the LHC will smash protons into protons, and each proton is itself a tangle of particles called quarks and gluons. So the resulting collision will be too messy to reveal some key properties of the new particles. The ILC will collide electrons into their antimatter siblings, positrons, to make cleaner collisions that will allow physicists to nail down decay rates and other parameters needed to forge a complete theory.

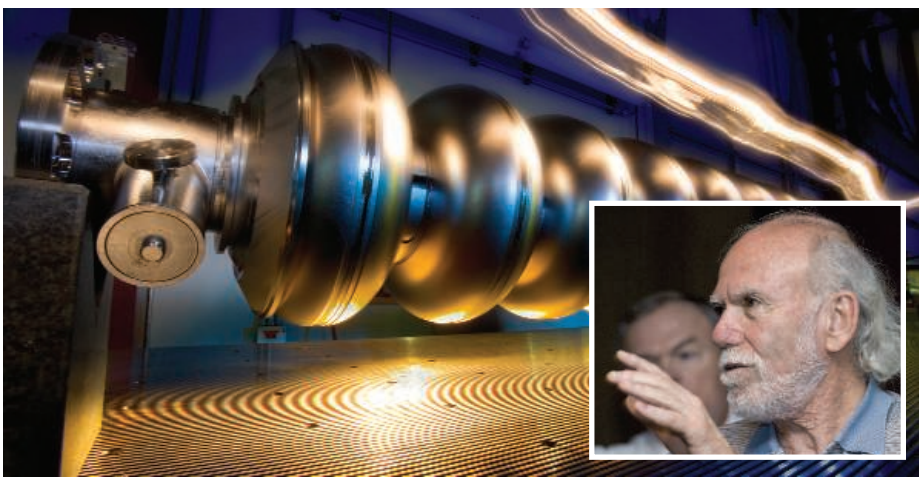
But first physicists must persuade governments to spring for the machine, and the value estimate is meant to help that process along. In particular, the estimate responds to a request from the U.S. Department of Energy (DOE) to know what the total cost would be. DOE has requested $60 million for ILC R&D in fiscal year 2008.

Over the past year, the GDE transformed a rough "baseline configuration" tacked together from 2 decades of R&D at various labs into a coherent "reference design," making changes that reduced the cost by about 25%. "They have done a good job without stretching the limits beyond reason," says Günther Geschonke, an accelerator physicist at CERN. "The design has evolved into a cost-conscious design."

The GDE made several changes to the basic layout of the machine. For example, the baseline configuration called for a 7-kilometer circular tunnel near each end of the collider to house accelerators known as cooling rings that would concentrate the electrons and positrons. The new design calls for one circular tunnel near the center that will house both rings. The baseline also split the beams in two to collide particles in the hearts of two detectors; in the new design, the beams collide at just one interaction point, and researchers will swap the gigantic detectors into and out of the line of fire. Now "there is no way to make it substantially less expensive without reducing the scientific scope of the project," Barish says.

The reference design and value estimate will undergo an international review this spring. That review is one key to keeping the project from repeating the story of the Superconducting Super Collider, the ill-fated accelerator in Waxahachie, Texas, that Congress killed, uncompleted, in 1993 after its budget exploded from $4 billion to $8 billion. A DOE representative will serve on the review team, says Robin Staffin, associate director for high-energy physics at DOE.

ILC researchers will now use the reference design as the starting point for a more detailed "engineering design." Meanwhile, physicists will lobby for an international framework between governments to fund the project. A decision about where to build the machine is still far off. "My guess is that the international framework will be in place in 2010 at the earliest," says Mitsuaki Nozaki, a particle physicist at KEK and Asian regional director of the GDE. "Until then, we cannot say anything about the final site." **–ADRIAN CHO**



Confident. Barry Barish says the price tag for the ILC and its 16,000 accelerating cavities will hold steady.

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