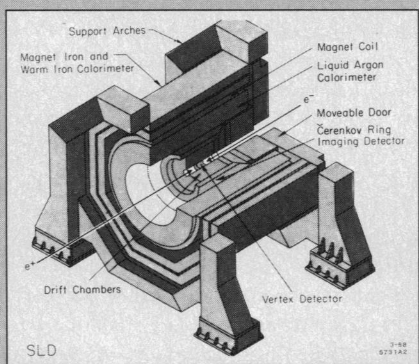
Morale Plummets as SLAC Fails to Get Its Z^0s

While SLAC's faculty love to speculate about their plans to build a B factory and an advanced linear collider somewhere down the road, they'd just as soon not talk about their present physics program—the Stanford Linear Collider Large Detector (SLD) project. Set to begin trial operation in April, the SLD, SLAC's second-generation Z^0 particle detector was to be the culmination of its Linear Collider program, but it faces an uncertain future. So uncertain that a spokeswoman, instead of eagerly promoting the project, recommended that *Science* should call back in a year if it wanted to do an article on SLD.

A long series of setbacks in the Linear Collider program during the past 2 years has cast a pall of doubt over the SLD. Combined with the continuing success of the European competition—CERN's LEP machine—these disappointments have produced a clear erosion of morale at SLAC, according to several SLAC physicists, each of whom spoke only on a promise of anonymity. "It's been a long time since we've done the physics that we've wanted to do," says one. "Whenever nature conspires not to shine on us, it is very discouraging." Says another, SLAC has a "tremendous morale problem."

Not everyone exudes gloom: "I wouldn't say a huge number of people are discouraged," says Martin Breidenbach, co-leader of the SLD collaboration. But even Breidenbach admits that "a huge number are nervous." And the recent layoff of 66 physicists and technicians, prompted by a $9-million cut in the SLAC budget, has hardly soothed nerves.



The SLD. *Will it see enough Z^0s to do any physics?*

SLAC's latest round of difficulties began soon after the linear collider detected it's first Z^0 particle in April 1989. At that time, SLAC director Burton Richter was predicting the lab would have a Z^0 factory (*Science*, 19 May 1989, p. 771). But his enthusiasm was short lived. By the time SLAC had seen 500 Z^0s in October, LEP, the massive circular collider at the European Laboratory for Particle Physics (CERN), had detected 11,000, permitting CERN physicists to study the critical particle in much more detail.

While SLAC physicists knew that LEP would eventually overwhelm them, they had hoped to squeeze out a lot more physics before LEP began operation. But instead of pulling off a big scoop, the linear collider program, which had finally looked like it was on the right track after many troubles, became mired in another long chain of mechanical failures, disappointments, and delays. "You fix one thing, and nobody knows if there are going to be 20 more things down the road," is how one senior physicist describes the ongoing frustrations.

As a result, the aging accelerator simply hasn't been made to produce the high luminosity necessary for the experiments that SLAC physicists wanted to do. The October 1989 California earthquake and a rare winter freeze last December further delayed progress. By last November, when SLAC's first Z^0 detector, the Mark II, finished operation, it had seen only 818 Z^0s—less than a tenth the amount projected.

That's where the SLD was supposed to come in. According to projections, the new detector is to see 100,000 Z^0s over the next couple of years. Simultaneously, the collider must achieve 40% polarization of the electron and positron beams, giving it an experimental capability not possessed by CERN's LEP. In other words, if everything goes perfectly, SLAC will perform some moderately interesting, if not ground-breaking experiments—among others, a precision measurement of Weinberg angle, which describes the quantum mechanical "mixing" between the Z^0 and the photon.

But there are real questions as to whether the SLD will ever perform as projected. While some people remain optimistic, many others—particularly those who experienced Mark II's problems—are very pessimistic. "The future of the SLD? I can tell you that: none," pronounces one SLAC physicist. Alan Honma of the University of Victoria, who has been collaborating with SLAC physicists, estimates that official projections of nearly 100,000 Z^0s are about 10 times too high. One Mark II veteran says merely, "No one knows the answer, [but]...everyone appreciates the enormity of the challenge."

Worrying the pessimists is the fact that, while the SLD itself should help double the luminosity, further luminosity improvements will have to come from the same cantankerous collider that gave Mark II so much trouble. Moreover, rather than overhauling one system, SLAC scientists must improve scores of different ones. And no one knows whether the polarization will work as hoped.

And there's another kind of danger lurking on the horizon. "Everyone's worried that the SLC program will fail [so] badly...that the DOE will reduce our funding," says Morris Swartz, an experimentalist working on polarization.

Few want to think about the possibility of total failure. For the SLAC experimentalists who have waited for data that never came from Mark II, this would mean several more years without data—until the B factory, if approved, starts producing results (see accompanying article). "That would be a very, very difficult time," winces a Mark II veteran now working on the SLD project.

Indeed, most SLD collaborators from other universities have hedged their bets by lining up other projects, and one group—SLD's Canadian collaborators—has completely pulled out. So have some of SLAC's graduate students, who were unwilling to bet on whether SLD will see enough Z^0 particles to give them thesis topics. Those who have stayed are picking topics that require only small amounts of data. The SLAC experimentalists, however, don't have such options. "I don't think anyone is even considering that," says Nobel laureate Richard Taylor.

And despite all of SLAC's recent problems, a surprising number of physicists remain guardedly enthusiastic. Accelerator physicists—those who tinker with the collider mechanics, rather than performing experiments—point out that as a research project into designing linear colliders, the program has succeeded spectacularly: it proved for the first time that linear colliders can work, and attracted attention from many countries who now want to build their own. And SLAC's physicists are making every possible effort to improve the machine. "I think we can do it," Breidenbach says, explaining that people shouldn't write off SLD prematurely. "It's not over until it's over," he says. ■ ROBERT LANGRETH