An SLC Beginning

Construction of an innovative accelerator moves along

Joe Faust/SLAC Beam Line

U. S. Energy Secretary Donald Hodel moves the first earth for SLC, while Stanford board chairman William Kimball applauds, and SLAC director W. K. H. Panofsky aids with body English.

By DIETRICK E. THOMSEN

On Oct. 31, 1983, ground was formally broken at the Stanford Linear Accelerator Center (SLAC) in Menlo Park, Calif., for the Stanford Linear Collider (SLC), the United States' first major new particle accelerator project in several years. Donald Hodel, the U.S. secretary of energy, threw the first shovel of dirt with more than usual vigor to the evident delight of William Kimball, chairman of Stanford University's board of trustees, and Wolfgang K. H. Panofsky, SLAC's director.

In spite of the day chosen for the groundbreaking, the project has not been spooked. It is rolling along well. In fact, many of its components were well on their way to completion before the project itself was even authorized, and this momentum has continued since the dirt flew on Allhallows Eve. On Jan. 8 SLC (pronounced "slick") passed a major technical and administrative milestone, the passage of a partial beam one-third of the way down the existing linear accelerator, which will be incorporated into SLC. According to John Rees, SLC project director, the Trilling Committee, which advises the Department of Energy on such things, expected success at this stage before it would consider recommending authorization of a second detector for SLC. One detector is already under construction. Authorization of the second detector would be agreement to the last piece of the original plan and would indicate that SLC's builders have given their colleagues confidence that they can build the apparatus.

Such confidence is especially necessary in this case. SLC is unique in the world. Nothing like it has ever been built before. It will take beams of electrons and positrons from the existing SLAC linear accelerator, send them around oppositely curving arms and collide the positrons head-on with the electrons. At the collision point the particles will have 50 billion electron-volts (50 GeV) of energy each, so that each collision will make available 100 GeV for the creation of new phenomena. The newly discovered Z particles are a particular subject to be studied, but the physicists hope to find currently unknown things as well (SN: 7/30/83, p. 71).

Undertakings of this kind usually start out as research and development projects. Physicists want to know that the components work, particularly the innovative ones, before going on to heavy construction. In SLC's case there are many innovative ones. SLC's R&D project got started upwards of three years ago. One of the major things it has produced is a damping ring.

In order to be most efficient at colliding with each other, the bunches of electrons and positrons that are accelerated in SLC have to be very narrow and tightly bunched. They come out of their sources much too ragged, especially the positron bunches. The damping ring is designed to equalize the momenta of the individual particles and so bring the bunches together geometrically. SLC will have two damping rings. The achievement recently completed amounted to taking a beam of one-fifth the final planned intensity or 2.4×10^{10} (24 billion) particles per pulse into the damping ring, around it, back into the linear accelerator and a third of the way down the linear accelerator itself.

The beam requirements for SLC, which are generally more stringent than those for the linear accelerator itself, necessitated a new electron gun added to the two or three the linear accelerator already has. This was financed as an improvement to the linear accelerator. The gun shoots electrons into the linear accelerator. Some of the electron bunches will be accelerated all the way to the collision point. Others will be struck against targets about two-thirds of the way down the linear accelerator to make positrons. A return line to be constructed will bring the positrons back to the beginning of the linear accelerator, where they will be sent around a damping ring and then be on their way to the collision point.

To raise the linear accelerator from its present maximum energy of 35 GeV to 50 requires new klystrons, the giant microwave tubes that generate the radio waves that accelerate the particles. (Only one other accelerator in the world, LEP, now under construction at the CERN laboratory in Geneva, is planned to have electron-positron collisions in this energy range.) The klystrons have to operate at a power level of 50 megawatts, and designing 50 MW klystrons is pushing the art.

Klystron work is another major achievement of the SLC R&D project. After trying several, they now have one that runs at 50 MW with an acceptable rate of faults. Faults are anything that prevents the klystron from firing when it should, and as these klystrons have to fire 180 times a second to move the particle pulses along, high fault rates can be a problem. By spring the SLC managers hope to have a final design and to begin the manufacture of the 250 they need. If for some reason the 50 MW klystrons prove infeasible, they can fall back on the XK5 35 MW tubes they now have, but the project would require twice as many of them, and the XK5s cost more apiece than half what a 50 MW klystron would cost. Thus, Rees says, it is a financial as well as technical advantage to make the 50 MW klystrons work.

Progress on all these fronts led to the authorization of construction at the beginning of fiscal year 1984. The SLC managers were allowed to hire an architectural firm before the final authorization and so they had plans for the tunnels to house the curving arms ready by the time the appropriation of money came through. On the basis of those plans, bids had been solicited and received. The money became available on Oct. 3, 1983, the first business day of fiscal 1984. The contract was signed the same day.

The successful bid provided a pleasant surprise. Planners had estimated a little more than $14 million for the tunnels. The bid was for $7,950,000. Rees explains that heavy construction in the United States is more or less in the doldrums lately. Firms find that it pays them to keep their equipment and staff working even at cut rates. If they work fast enough, they can still make money this way. "Their interest coincides with ours," Rees says. In spite of a very rainy season in California, two entrances from the ground to the tunnels are ready, and tunneling is about to begin. □