TEVATRON I PROGRESS

John Peoples and Don Young

After many parlous adventures, the Tevatron I project staff has revised the basic design of the Antiproton Source by adopting an all-stochastic cooling scheme. The revised design was scrutinized by several outside review committees, all of which have enthusiastically endorsed the changes. While this was taking place, the Tevatron Construction Group completed the engineering design of the Experimental Hall at B0 that will house the Collider Detector Facility. From the bids that were received on June 8, the Laboratory selected the low bidder to build the massive Experimental Hall. Construction is expected to begin during July and will continue into the fall of 1984. By the spring of 1983, the construction should be sufficiently advanced to permit commissioning of the Energy Saver with beam.

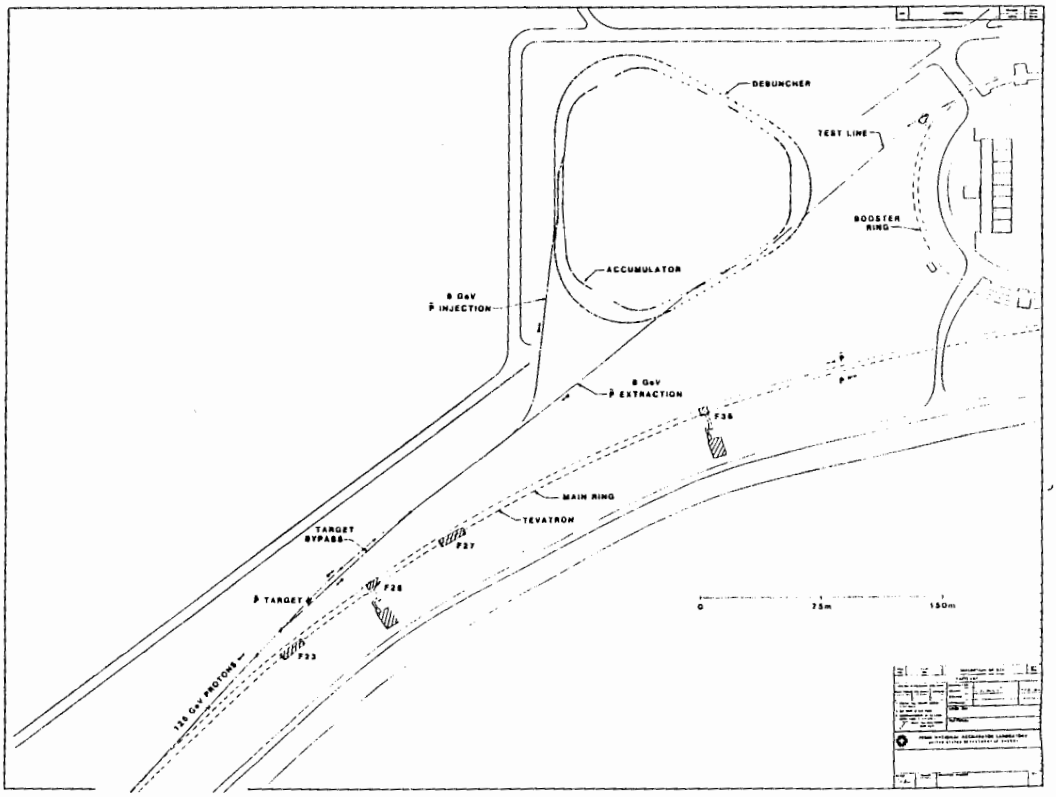
The Tevatron I project will enable experimenters to observe proton-antiproton collisions in the Energy Saver at the B0 and D0 experimental areas. The center-of-mass energy of 2 Tev will be the highest available in the world until at least the early 1990s.

The revised Antiproton Source design will use stochastic cooling, a technique which was invented by Simon van der Meer of CERN. The method is based on sensing deviations of a sample of particles in the circulating beam from the ideal orbit in one location and then partially correcting the deviations in another location. In the case of betatron cooling, a circulating beam induces in a pickup electrode a voltage proportional to the average position of the particles passing through the pickup at that moment. This voltage is amplified and then applied to a kicker in order to reduce deviations of the average positions of the particles. After many turns, the beam width is gradually reduced. Stochastic cooling was first used to cool proton beams in the ISR at CERN more than a decade ago. The method is the basis for the very successful Antiproton Accumulator now being used to supply antiprotons to the CERN Collider program. Stochastic cooling has also been demonstrated experimentally at Fermilab on our small cooling ring (see **Fermilab Report**, April 1980 and June 1980).

The Fermilab Antiproton Source is designed to accumulate 10^{11} antiprotons per hour, which is sufficient to provide the necessary antiprotons for luminosity of $10^{30}cm^{-2}sec^{-1}$ in a little more than 1-1/2 hours. Since the luminosity lifetime of the antiproton is in excess of 24 hours, we expect to exceed the design luminosity once the full potential of the Antiproton Source is reached.

The sequence of operations that must be performed is as follows: Protons are accelerated to 125 GeV in the Main Ring in

2 seconds, extracted at F17, and focused on a target as shown in the layout below. The 8-GeV antiprotons produced are focused by a lithium lens developed at the Institute for Nuclear Physics



General plan of the Antiproton Source

at Novosibirsk and transported to the debuncher, a storage ring approximately the size the Booster. In the debuncher, the antiprotons are rotated in longitudinal phase space to reduce their momentum spread and given their first cooling in transverse phase space. They are then transferred to the accumulator, a second storage ring where they are stacked and cooled. The accumulator is designed around stochastic cooling systems to cool newly injected antiprotons (the "tail") into the stack (the "core") and also to cool them in transverse phase space. After a large enough beam has been accumulated, its dense core is extracted, taken to the Main Ring and accelerated there and in the Tevatron. Detectors are planned for the B0 and D0 straight sections.

We plan to complete the engineering design of the Accumulator and Debuncher ring enclosures, the target station, and the beam-transport enclosures in the fall of 1982. The construction of the enclosures will begin early in 1983. The design of the magnets for the rings has advanced to the point where prototype magnets will be started in the fall.

The work described here was carried out by a collaboration of the University of Wisconsin, Argonne National Laboratory, Lawrence Berkeley Laboratory, Novosibirsk, and Fermilab. Our collaborators have been particularly active in the increased understanding and design work of stochastic cooling systems. We are all working to bring protons and antiprotons into collision by 1986 or earlier.

People at Fermilab will see more and more of Tevatron I in the coming year. Tevatron I will move particle physics into a new energy range and we all expect important new results. We believe Tevatron I will be the jewel of particle physics in the United States.