THE TEVATRON II PROJECT: A STATUS UPDATE

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A year has flown swiftly by since the last artricle in these pages devoted to the status of the Tevatron II Construction Project. The highlight of last year's article was the extraction, splitting, and transport of 400-GeV slow-spill beam from the newly commissioned superconducting accelerator to the Meson, Neutrino, and Proton Areas. The next step ahead at that time was the long awaited step "from it's present 400 GeV to 700 GeV or greater." The machine, as we all know, actually accelerated beam to 800 GeV where it ran very successfully and productively until mid-July 1984. Here we trace the highlights of the past year as they occured in the TeV II Project.

Extraction and Switchyard

The final piece of the TeV II-provided primary beam extraction system was the 1.5 ms fast spill for neutrino physics. A successful test of this very tricky maneuver was completed in March 1984. It appears that fast primary proton beam bursts up to 2.5×10^{12} protons per pulse can be successfully extracted during and after the slow beam spill and transmitted, without appreciable losses, to the neutrino production target.

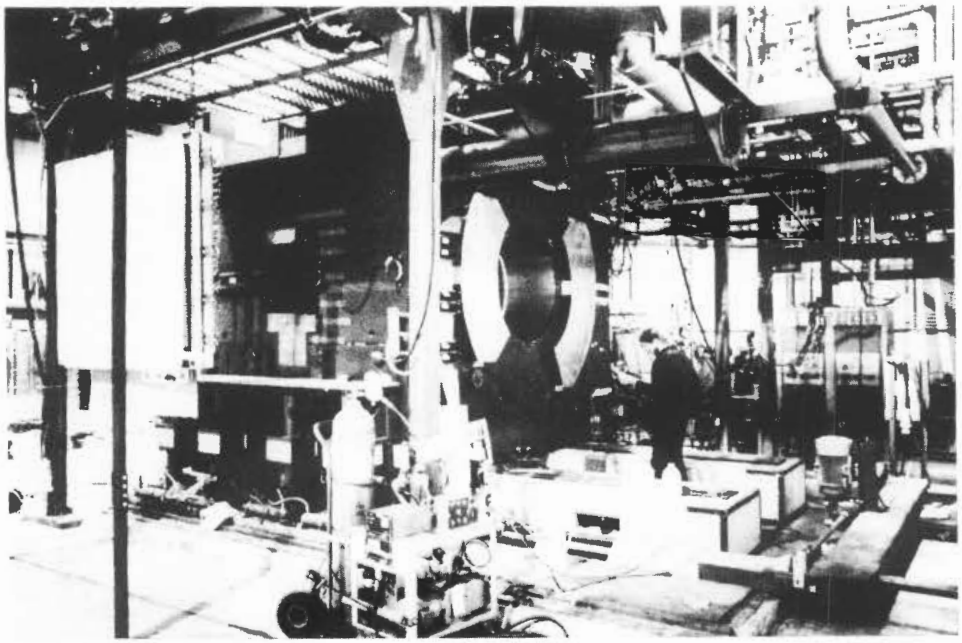
It is presently planned to deliver three such pulses per machine cycle to neutrino users in the present 800-GeV physics run. This rate could be increased if the total accelerated beam per cycle (proton economics) permits. The fast extraction, long worried about because of a greatly increased danger of quenching the machine, is a success and will permit a fruitful neutrino run for the four experiments presently sitting in the beam. These experiments consist of E-632 in the 15-Ft Bubble Chamber, E-745 in the new Tohoku Bubble Chamber, E-733 in Lab C, and E-744 in Lab E. All these detectors have been significantly improved for the first Tevatron neutrino beam run.

Worthy of note is the way the slow beam spill for the rest of the physics program repeated its beautiful 400 GeV duty factor and trouble-free performance at 800 GeV during the spring and summer. Successful runs were accomplished for experiments in the Meson and Proton expereimental areas (E-605, E-615, E-557/672A, and E-400). Test beams were also provided in the M Bottom, N West and N Test beam lines for groups ranging from CDF and D0 of the colliding beam program, to E-665, E-731, and E-691 in the final target program. Demand for test beam use last year was even more spirited, and beam time certainly more hotly debated, than among the regularly scheduled experiments.

The fact that the Tevatron Switchyard operated so smoothly, and delivered the apportioned beam fractions on demand to the many slow-spill targets, redounds to the credit of the Switchyard Group in the Accelerator Division. Their careful planning and sound conceptual designs made possible the reliable operation. The run at 800 GeV, getting underway this month, has had some rocky problems, but the Tev II switchyard does not seem to be a significant contributor. It just goes on working, adding the multi-pulse fast spill for the neutrino target to the prior eight slow spill beams, and pumping out the beam!

Civil Construction

A very large part of the TeV II Project activity this past year has been in civil construction. In this period alone, one major new laboratory building was completed (Lab F), two were constructed and beneficially occupied (Muon and Wide Band), and a third begun (M West Experimental Hall). The members of E-745 were anxiously awaiting the completion of Lab F last March so that they could install and commission the new Japanese-built Tohoku Bubble Chamber, shown below, with its high-resolution holographic optics. Tests of the operation of the bubble chamber and its brand-new, superconducting magnet coils will begin in the

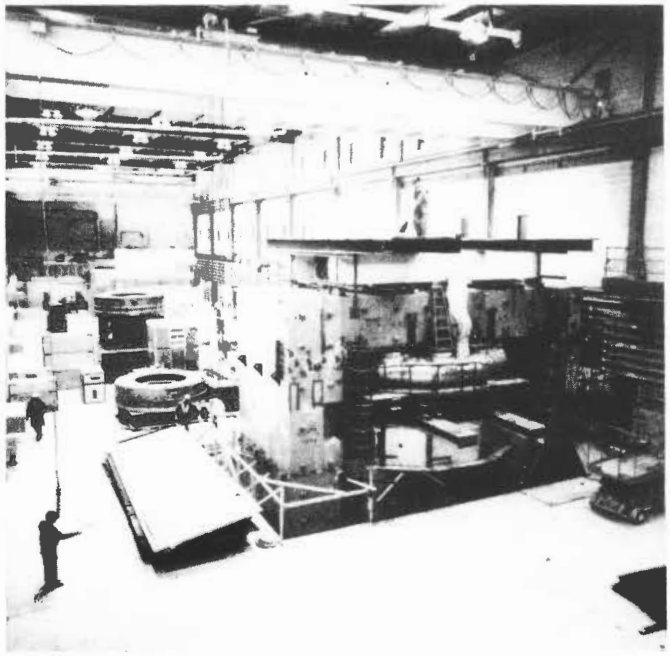


The Tohoku Holographic Bubble Chamber in Lab F coming into operation. (Fermilab photograph 85-42-8)

immediate future after safety reviews are complete. The Lab F Building, a TeV II Project item that houses the bubble chamber and its associated electronic detectors and support equipment, was custom designed for this detector system and seems to be serving its mission successfully.

The largest laboratory building in the TeV II Project, and by acclamation the most beautiful, is the new Muon Lab, north of Wilson Road. This striking concrete structure will provide a new architectural landmark for Fermilab. We owe its inspiring design to our polymath Director Emeritus Robert R. Wilson, whose artistic talents were lent to the building at its birth on the drafting boards of the Fermilab Tevatron Construction Group. Its strong horizontal lines and crisp angles reprise the architecture in the Wilson Hall footprint area, and bring to mind echoes of the prairie style practised by Frank Lloyd Wright.

Just as beautiful to the experimenters of E-665 are the carefully planned technical amenities. The heart of the experiment is a pair of large superconducting magnets, the CERN-built Vertex Streamer Chamber Magnet and the University of Chicago Cyclotron, both shown below. Even as this article goes to press,



The Chicago Cyclotron Magnet is shown with the unassembled pieces of the Vertex Streamer Chamber Magnet in the background. (Fermilab photograph 85-22-3)

the CVM has been assembled and stands ready to receive a streamer chamber provided by the Max Planck Institute at Munich. The pace of installation of E-665 in the Muon Lab is increasing rapidly as the last few workmen from the construction crews finish their painting and wiring. We look forward to a successful test run for E-665 this summer.

Not far away, in the Proton Area, the new Wide Band Experimental Hall and Service Building is reaching completion as this is written. As with the other new laboratories, the Wide Band Hall has been custom designed for the needs of the two Tevatron photon experiments that will be installed there (E-683 and E-687). These groups, hardened veterans of the traditional porta-kamp life at Fermilab, may not yet be accustomed to such amenities as computer floors, engineered air-conditioning and bathrooms, but they are very eager to learn. Repeating the Muon Lab pattern, the anxious experimenters and supporting Fermilab staff members will flood into the building this month as the contractor's people complete their jobs. They are racing to complete parts of the E-687 so that a test run to check out the apparatus (and maybe do some physics) can take place starting in late spring. The Laboratory as a whole, and TeV II in particular, are pushing hard to realize this goal.

Much less apparent to experimenters, but of vital interest, are the beamline-tunnel civil construction projects and magnetic beam transports that bring primary and secondary beams to the experiments. In TeV II the past year, a great deal of work of this nature has taken place in the Muon Beam, and in the Wide Band Beam as well. A total of more than $5 million has been spent by TeV II on building the thirty-odd beam enclosures for these two beams alone. Even in sub-zero winter temperatures, the intrepid contractor personnel have persisted in the digging and placement of the enclosures. Such determination matches the "can-do" spirit that has, all along, characterized the Fermilab attitude toward providing new TeV II facilities.

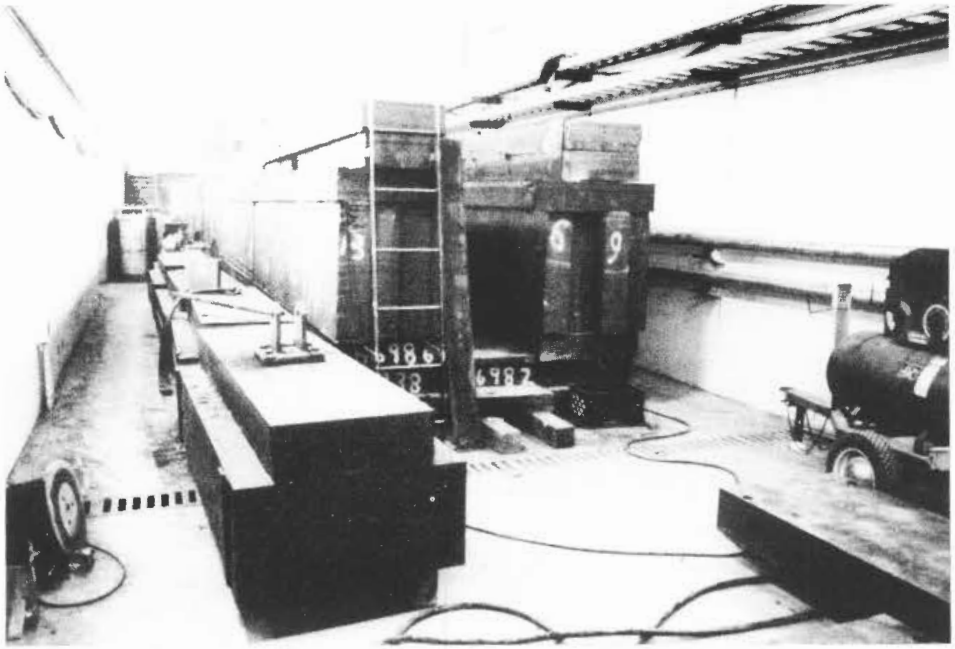
Finally, the last civil construction phase of the TeV II Project is now starting to roll. This is the construction of the M West Experimental Hall (E-706 and E-672) and the M Polarized Experimental Hall (E-704). The earthmoving was begun in January for M West, and will begin in March for M Polarized. Later in the spring, the beam enclosures for these experiments will be started. All these projects will be completed by this time next year, and will be ready for beam in summer 1986.

Technical Systems

During the past year, a less visible but equally important part of TeV II has gone on in the primary beam transport and target areas. This is the installation of target stations and beam dumps for the M West and Wide Band beams. Because targeting and dumping intense machine energy proton beams generates significant

amounts of radiation, and produces high residual radioactivity, the primary beam targets and magnetic dumps are shrouded in massive steel and concrete vaults.

The most recently completed of these, the Wide Band Target Pile, is shown below. In service, dump magnets are placed along



The thick steel target pile and beam dump ready to receive the Wide Band Beam target-sweeping dipole magnets. (Fermilab photograph 85-63-5)

the central channel and the whole pile closed with steel plugs, shown laying on the side. A long, water-cooled aluminum core intercepts the central proton beam and carries away the kinetic energy of the beam. The steel contains and absorbs the slow and fast neutrons genertated by the primaries. Outside the pile, residual radiation levels are safe for people a few minutes after the beam goes off.

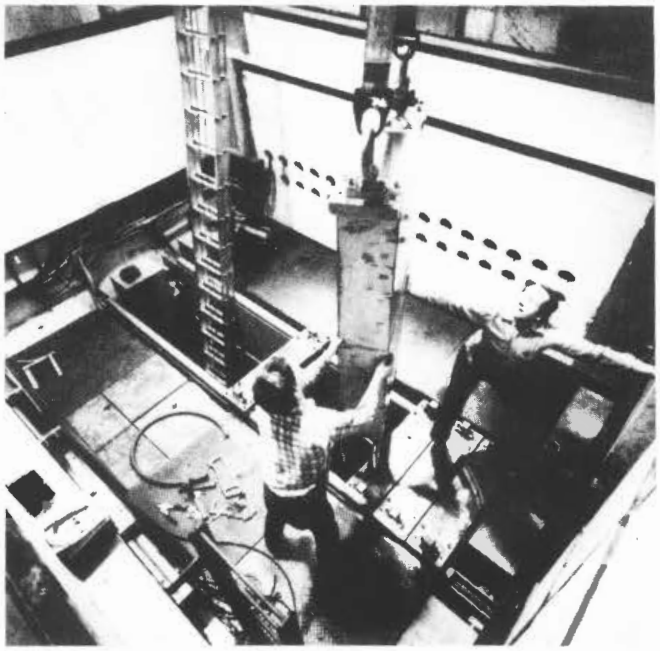
Work is just begining on the Muon target and dump system. Due to the unusual characteristics of this type of beam, three seperate dump piles will be needed. Also, to limit multiple scattering of the desired beam muons, a large beryllium-metal absorber is used for hadron removal in the third of the three dumps. Next summer, the Polarized Proton beam dumps will be fabricated for later installation. The polarized beam dump will

represent the last technical area to be completed for the TeV II Project.

Physics

The purpose, of course, for digging all this dirt, pouring all the concrete, welding all the steel, and stringing all the wires is to prepare new facilities for HEP experiments and, ultimately, to foster the physics of the Tevatron fixed-target physics program. In this regard, it was very exciting to attend the Division of Particles and Fields Meeting last November in Santa Fe, New Mexico, and hear, from members of the first Tevatron generation, their first physics results! At this meeting, the first really convincing evidence for hadron jets in a fixed target hadron experiment (E-609), and a beautiful new experiment (E-715), which laid to rest the serious challenge to the "standard model" presented by prior data on the sigma hyperon beta decay asymmetry, were among the many highlights. In the new experiment, a total of 80,000 beta decays were recorded, several hundred times the total from all previous experiments.

Well, theorists can maybe breathe easier for a little while, but the standard model will be in for many more challenges, and the data storehouse of physics subject to a new motherlode of data, as the TeV II experimental program moves into high gear over the next two years. These should be rewarding times to be a high-energy physicist at Fermilab!



John Spencer and George Biallas intserting the fifth of 14 filler modules in the antiproton target hall vault. (Fermilab photograph 85-60-9)