STATUS OF THE TEVATRON II PROJECT

Tom Kirk

The first phase of the Tevatron II project has now been operational for approximately three months. During this period, the slow-extracted beam from the Tevatron and the completely reworked beam switchyard, plus many of the Tevatron primary-target systems, have been brought into operation. Most important, the Tevatron high-energy physics program has started.

The second phase of Tevatron II will involve construction and commissioning of the new secondary beam lines. These consist of the Wide Band Photon Beam in the Proton Area, the Muon and Prompt Neutrino Beams in the Neutrino Area, and the Meson Area MW Pion and MP Polarized Proton Beams. Many of the components that will be needed for construction of these beams have already been started and plans for the associated civil-construction projects are far advanced. In some cases, the work is already underway. Next spring and summer will be a period of intense activity for the Tevatron II Project; a great deal of civil construction will take place that will ultimately house the new beam facilities. Large experimental halls needed for the experiments to be done in these beams will also be constructed in this period.

The rapid and successful operation of the facilities associated with the superconducting Tevatron accelerator, and its associated extraction and switchyard systems bode well for the success of the entire fixed-target physics program. So far, the goals of the project and the fixed-target program have been met in a very pleasing way. Of course, not **everything** has proceeded smoothly. This is the first superconducting accelerator in the world, and it was always expected that there would be an extended period of commissioning, during which the many novel Tevatron systems could be proved. The expectation certainly came to pass and has produced a certain amount of frustration and impatience among the first users. Already, however, a smoother and more satisfactory operation of the program is in place, and if we look back and compare the duty factor for operation of the present superconducting accelerator with that of its predecessor, the improvement obtained has been well worth the period of adjustment.

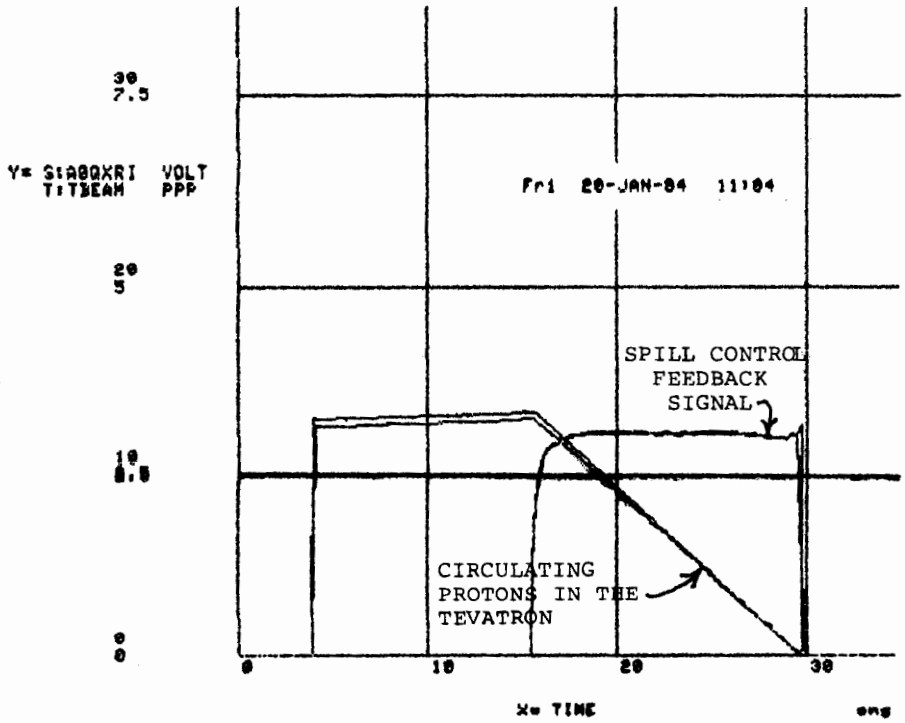
In the immediate future, the energy of the accelerator will be raised from its present 400 GeV to 700 GeV or greater. At this time, the Tevatron will come fully into its potential, not only in providing a superior spill and duty factor for fixed-target physics, but in increasing the energy by a factor of 2 over the old Main-Ring capability. Experimenters in all three of the operating areas are looking forward to initial operation at the higher energy with a great deal of anticipation and with high hopes for rapid success. It is the feeling of the people who operate the accelerator that these hopes will be justified and

that it will soon be operating routinely in the full Tevatron mode.

Extraction

The first area to be completed in the Tevatron II project was the slow resonant-extraction system for extracting beam from the superconducting accelerator and directing it into the Switchyard. Critical to the extraction success was the development of greatly improved wire septa for splitting off the beam that leaves the accelerator from the beam that continues circulating (and doing this in a controlled manner that minimizes losses in the process).

In the graph below, the result of careful work and planning for the slow-extraction system is seen. The beam from the superconducting accelerator is extracted smoothly and uniformly over a



Slow beam extraction from the superconducting Tevatron accelerator. The traces show two successive cycles of the accelerator. One pair shows beam being spilled uniformly over a 15-second period. The second pair shows the feedback signal that controls the beam spill rate.

15-second period! What cannot be seen from this figure is the modulation of the beam intensity at higher frequencies, such as 60, 180, and 360 Hz, etc. In the initial operating stages, various frequency modulations on the intensity of the beam spill were seen. This modulation is a normal consequence of starting up a new system. Over a period of two months, most of the modulation was removed through various technical means. The spill is now quite smooth and satisfactory to all the experimental areas.

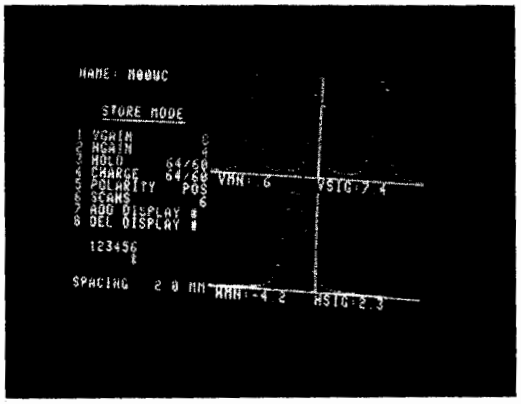
Switchyard

Once the beam leaves the accelerator, it passes into the Tevatron switchyard area where electrostatic splits divide the beam into multiple primary beams that continue on to production targets for the various experiments. The largest project in the Tevatron switchyard was the superconducting right bend to the Proton Area. This project, completed during the long 1983 accelerator shutdown, has two strings of superconducting Energy-Saver dipoles that take the beam split off to the Proton Area by the electrostatic and magnetic septa and bend it sharply to the East.

After passing through the superconducting right bend, the Proton primary beam is again split into three parts. The three primary beams in the Proton Area are subsequently targeted independently for the P-East, P-Center, and P-West beams. In Phase Two of the Tevatron, the P-East beam will pass through yet another electrostatic split, allowing photon beams to be used simultaneously in the Tagged Photon Laboratory and in the new Wide Band Neutral Beam. The primary beam transport for all parts of the Proton Lab are now complete except for the two-way split to the Wide Band target. The Wide Band split will be installed during the summer 1984 shutdown.

The primary beam to the Meson Area passes through the superconducting left bend which was installed prior to the Tevatron II Project. Once through the left bend, the Meson primary beam is split into three parts, as in the Proton area (see top of next page). The three primary beams pass through the old Meson target box and are focused on new targets in the former Meson Detector Building, henceforth to be known as the Meson Target Building.

Work in the Neutrino switchyard area has been relatively low key so far, but there will soon be a significant increase in activity with the installation of an electrostatic split and a superconducting bend that will split off primary beam to the new muon-production target. Construction of components for the muon split is presently underway and the equipment will be installed during the summer of 1984.



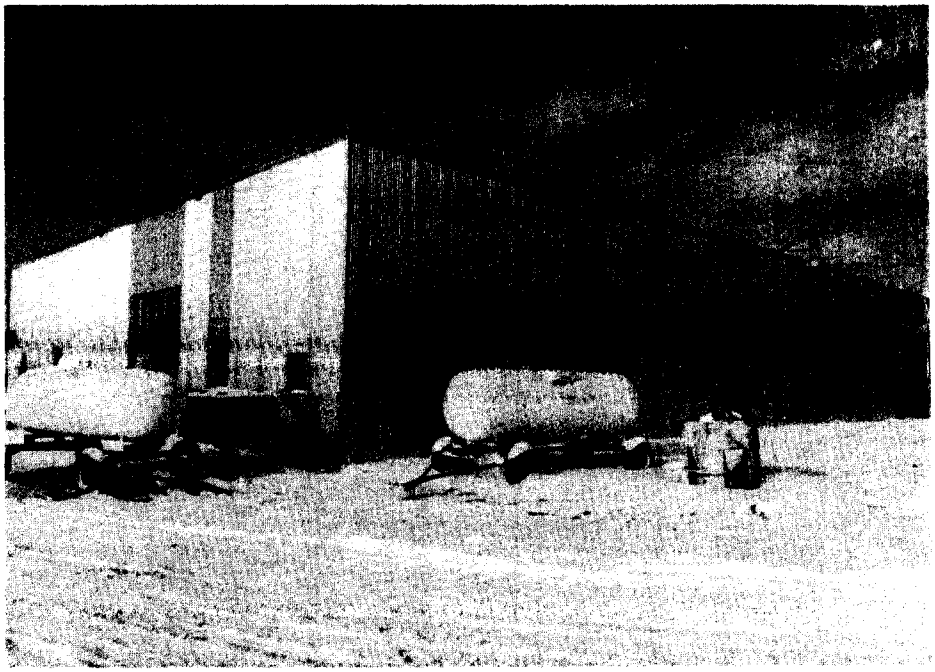
Primary beam SWIC traces after the Meson triple split septa. The beams are clearly separated in the vertical direction, but have not yet been bent apart horizontally by the Lambertson septum magnets.

Current Activities

Currently, the areas of maximum activity in the Tevatron II project involve construction of new experimental halls for the Phase II physics program (experiments in the new particle beams). Lab F, the first of these laboratories, has been under construction since July; it will be complete about March 1 (next page). At that time, experiment E745 will begin to install their equipment, the largest part of which consists of a large heavy-liquid bubble chamber with holographic optics. The bubble chamber and its associated spectrometer will later be used for E636, an experiment to study production of tau leptons and other phenomena in the Prompt Neutrino Beam.

Two new experimental halls will start construction in February and March. These are the new Muon Laboratory and the Wide Band Experimental Hall. Both of these buildings are major structures that will each house two experiments in tandem. Construction of these buildings is hoped to be complete by the Fall of 1984 in order to allow installation of experimental apparatus to be used in testing and shakedown runs in the spring of 1985 for E640, E665, and E687.

Two more large experimental halls are planned for construction in the Meson Area. These experimental laboratories (MP and MW) will house, respectively, the polarized-proton experiment E704 and a new multiparticle hadron spectrometer to accommodate E672 and E706. The design phase of these buildings has begun and it is expected that the construction will commence early in fall of 1984,



A view of the new Lab F experimental hall in the Neutrino Area. This structure will be complete in March 1984.

In parallel with design and construction of the experimental halls, there has been a large amount of design effort for civil structures that will house the secondary-beam elements. In particular, there are eighteen small quadrupole enclosures needed for the new Muon Beam and two extended tunnel enclosures in the Wide Band Beam. Two long surface tunnel enclosures are also needed to house beam-line components in the M-West and Polarized Proton Beams in the Meson Area.

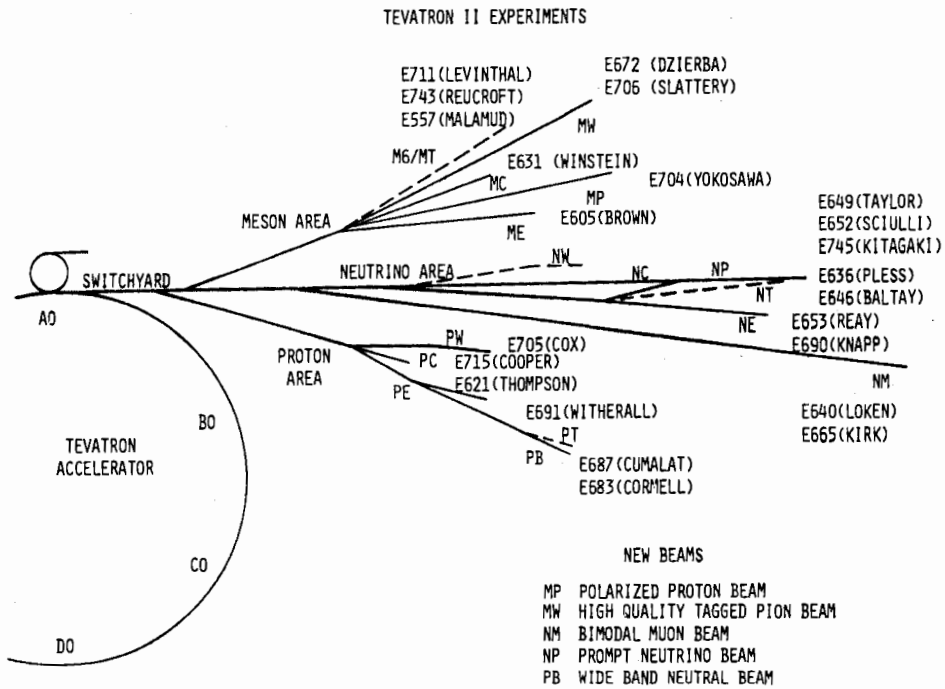
In parallel with the civil facilities being designed and constructed to house the new beams and experiments, a strong coordinated effort is going ahead to construct magnets, beam dumps, controls, and other technical components that will go into these facilities.

Physics!

When it all comes together in 1985, the TeV II physics program will be fully deployed and Fermilab will resume its role as peerless world leader for fixed-target physics through the

80's and into the 90's. In the diagram that follows, the current array of approved fixed-target experiments for the Fermilab program is shown in reference to the site topology. From hyperons to muons, from neutrinos to antiprotons, from pions to photons, the Fermilab community can look forward to a rich and productive decade of physics ahead.

And it's starting NOW!



WEEK	Avg/pulse for MEP (x 10^{12})	Scheduled MEP Hours	Actual MEP Hours	Number of Quenches	Quench Recovery Time	Total Systems Downtime [1]	Total TEV Downtime [1]	CHL Downtime	Total Non-overlap Downtime [2]
10/3 - 10/9/83	3.29	96.0	55.55	15	8.00	60.83	31.39	0.88	55.15
10/10 - 10/16	2.72	96.0	16.58	7	4.74	182.70	76.51	0.00	125.23
10/17 - 10/23	0.88	168.0	28.86	1	0.40	181.80	108.65	0.00	138.77
10/24 - 10/30	0.00	169.0	0.00	0	0.00	157.50	155.80	0.00	169.00
10/31 - 11/6	3.76	168.0	79.63	29	13.32	93.65	73.77	0.00	85.33
11/7 - 11/13	3.77	96.0	75.22	18	12.18	41.25	28.12	0.00	37.14
11/14 - 11/20	3.53	96.0	54.05	16	9.20	63.31	29.41	0.00	56.31
11/21 - 11/27	5.08	128.0	75.73	25	12.09	83.93	57.94	1.30	70.92
11/28 - 12/4	4.82	96.0	51.98	31	15.21	74.47	57.76	0.00	60.05
12/5 - 12/11	3.51	88.0	10.02	36	13.87	117.90	74.29	4.27	98.94
12/12 - 12/18	4.60	143.25	92.69	17	11.28	67.62	41.55	0.00	53.90
12/19 - 12/25	3.51	72.0	38.08	6	1.94	36.73	24.51	0.00	49.08
12/26 - 1/1/84	3.24	132.0	51.38	8	3.94	87.04	55.61	8.92	69.82
1/2 - 1/8	4.65	106.0	62.29	20	21.68	68.73	49.55	7.78	57.47
1/9 - 1/15	6.64	132.0	94.22	13	6.69	43.53	30.48	0.00	30.40
1/16 - 1/22	7.41	137.0	83.35	7	2.73	61.21	24.99	21.15	50.79
1/23 - 1/29	7.91	144.0	114.39	7	2.18	37.24	16.93	0.00	31.90
1/30 - 2/5	5.39	136.0	60.91	4	1.84	85.93	29.89	3.85	72.70

1) Does not have overlap of simultaneous downtimes subtracted out. Does not include tuning time.

2) Does have overlapping downtimes subtracted out. In cases where this is larger than total systems downtime, it means there were conflicting amounts of tuning time between my two sources.

WEEK	Cryogenic Downtime	TEV/Total Downtime (%) [3]	Quench/Total Downtime (%) [4]	Quench/TEV Downtime (%) [5]
10/3 - 10/9/83	11.75	51.5	13.1	25.5
10/10 - 10/16	13.07	41.9	2.6	6.2
10/17 - 10/23	0.00	59.8	0.2	0.4
10/24 - 10/30	0.00	98.9	0.0	0.0
10/31 - 11/6	1.84	78.8	14.2	18.0
11/7 - 11/13	2.43	68.2	29.5	43.3
11/14 - 11/20	5.77	46.4	14.5	31.3
11/21 - 11/27	10.04	69.0	14.4	20.9
11/28 - 12/4	12.94	77.6	20.4	26.3
12/5 - 12/11	35.34	63.0	11.8	18.7
12/12 - 12/18	8.03	61.4	16.7	27.1
12/19 - 12/25	8.72	66.7	5.3	7.9
12/26 - 1/1/84	15.55	63.9	4.5	7.1
1/2 - 1/8	12.21	72.1	31.5	43.8
1/9 - 1/15	9.93	70.0	15.4	21.9
1/16 - 1/22	5.40	40.8	4.5	10.9
1/23 - 1/29	3.32	45.5	5.8	12.9
1/30 - 2/5	14.91	34.8	2.1	6.2

3) Column 7 divided by column 6 (on previous page).

4) Column 5 divided by column 6 (on previous page).

5) Column 5 divided by column 7 (on previous page).