2.2 A Prototype Hadron Jet Experiment at the Tevatron

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We consider an adaptation of Experiment #557, a 400-GeV study of hadron jets using the Fermilab multiparticle spectrometer (MPS) in the M6W beam line. To cover a solid angle comparable to that of E-557, the separation distances from the target to the calorimeter and to the magnet are scaled as $(s)^{1/2}$ only 1.4 for 800-GeV incident particles. Further instrumentation to detect wide-angle particles is desirable. Lengthening the geometry allows a longer open space for a particle identification system such as a Cherenkov ring-imaging system. Another Cherenkov counter could be installed to aid in the mass identification of the forward particles.

The present E-557 calorimeter covers the polar angular range from ~35° to ~125° in the c.m.s., with essentially the full azimuthal angular range, with the downstream calorimeter covering most of the remaining forward polar angles. The magnet aperture matches the calorimeter aperture.

The expected rates for an 800-hour run, assuming a 10-second spill at 1×10^6 particles per second, 1 spill per minute, and a 45 cm H_2 target are as quoted by C. Halliwell in the 1980 Fermilab Users' Meeting. The table below shows the minimum values of $1/2\ (p_T^{\text{jet 1}} + p_T^{\text{jet 2}})$ to achieve the rates indicated for several incident proton beam energies.

Number of Events Above a Given p_T for Different Beam Energies.

Number of Events Having $p_T > p_{T\ min}$	$p_{T\ min}$ for 200 GeV	$p_{T\ min}$ for 400 GeV	$p_{T\ min}$ for 800 GeV
10^6	3.6 GeV/c	4.5 GeV/c	6.0 GeV/c
10^5	4.2 GeV/c	5.4 GeV/c	7.4 GeV/c
10^4	4.9 GeV/c	6.4 GeV/c	8.8 GeV/c
10^3	5.6 GeV/c	7.3 GeV/c	10.2 GeV/c
10^2	6.2 GeV	8.0 GeV/c	11.6 GeV/c

The table shows that, for example, at the Tevatron the range of p_T accessible at the 10^3 event level is increased from $p_T > 7.3$ GeV for 400 GeV to $p_T > 10.2$ GeV/c at 800 GeV. At fixed p_T the event rates increase by more than an order of magnitude.

Another improvement resulting from higher incident energy is the accuracy of the reconstructed jet direction to represent the scattered quark direction. Monte Carlo studies indicate that at

800 GeV the accuracy improves by about a factor of 2 as compared to 400 GeV. In addition, the Monte Carlo simulations show improvements in the separation of the scattered quark jets from the beam and target jets.