# 2. JET EXPERIMENTS AT TEVATRON II

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## 2.1 Introduction

The existence of 1 TeV/c beams will open a new "frontier" for the use of high $p_T$ jets as tools for studying hadronic structure and interactions. The jets that have been studied at Fermilab and the SPS thus far have been in the 3-5 GeV/c range which is essentially the threshold for high $p_T$ phenomena,[1-4] whereas jets in the 10-12 GeV/c range will be studied at the Tevatron. The opening of this "frontier" is perhaps analogous to the production of jets at SPEAR compared to those produced at PETRA. At SPEAR, jets were observed as essentially a threshold phenomena at 3-3.5 GeV/c. While at PETRA, the observation of jets has lead to the discovery of gluon jets and to the use of jets as invaluable tools for testing QCD.

The uniqueness of the Tevatron lies in the fact that several incident beams are available, and, as discussed above, each of these beam particles: protons, mesons, leptons, and photons probe the structure of hadrons and test the predictions of QCD in many different ways.[5] These tests and measurements cannot be done at the ISR in the multitude of methods available at the Tevatron, nor can such measurements be done at the SPS at such large $p_T$ where the jets are perhaps more bias free.

As an example of this last point we show in Fig. 2.1a. a typical 4-jet event produced at 400 GeV/c with two high $p_T$ jets of 4 GeV/c transverse momentum at 90° in the center of mass. As a comparison, we show a typical 10 GeV/c jet event produced in an 800 GeV/c interaction in Fig. 2.1b. It's fairly clear that collimated jets of 10 GeV/c transverse momentum will be easier to measure experimentally.

In this section we discuss several high $p_T$ jet experiments for various beams and final states, typical detector arrangements, expected rates and backgrounds, and pertinent advantages, disadvantages, and special problems with each. The experiments we have considered are the following:

1. $\begin{pmatrix}\pi\\K\\p\end{pmatrix}$ p → jet + jet + X

2. $\begin{pmatrix}\pi\\K\\p\end{pmatrix}$ p → $\gamma$ + jet + X

3. $\begin{pmatrix}\pi\\K\\p\end{pmatrix}$ p → $J/\psi^{ee}_{\mu\mu}$ + jet + X

4. $p\uparrow p\uparrow \rightarrow$ jet + jet + X

5. $\gamma p \rightarrow$ jet + jet + X

6. $pA \rightarrow$ jet + jet + X.

This list does not exhaust the possible uses of jets at the Tevatron, nor does the discussion of these experiments in this section present a complete study of the experiments. It should, however, serve as a starting point and guide for such experiments.

## References


1. W. Selove et al., Results from a Two-Arm Calorimeter-Array Jet Experiment, International Conf. on High Energy Physics, Tokyo, 1978, p. 165.

2. C. Bromberg et al., Jet Production in High Energy Hadron-Proton Collisions, CALT-68-738.

3. R. Williams et al., Results from Fermilab E-236 on High $p_T$ Events from p-p Collisions, to be published in the Proc. of the XXth International Conf. on High Energy Physics, Madison, July, 1980.

4. K. P. Pretzl, Preliminary Large $p_T$ Cross Sections Measured with a $2\pi$ Calorimeter Trigger, to be published in the Proc. of the XXth International Conf. on High Energy Physics, Madison, July 1980.

5. For a discussion of lepton beam interactions, see E. Berger et al., in the proceedings of this workshop. We have limited our discussions to $\gamma$, $\pi$, K, and p beams.

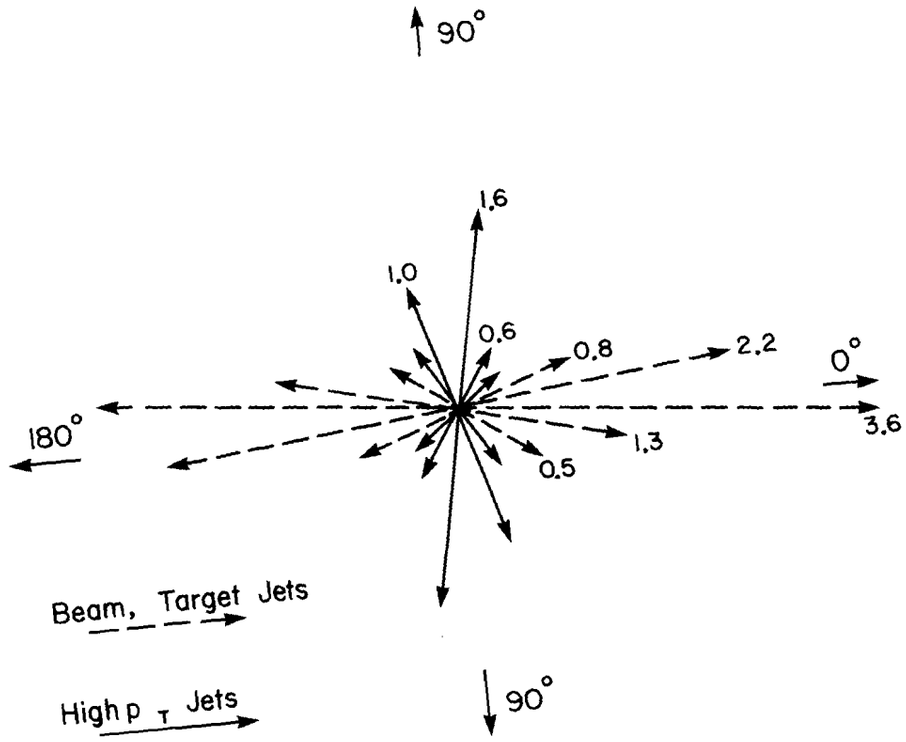


Fig. 2.1(a). Typical 4 GeV/c jet event at $(s)^{1/2} = 27$.

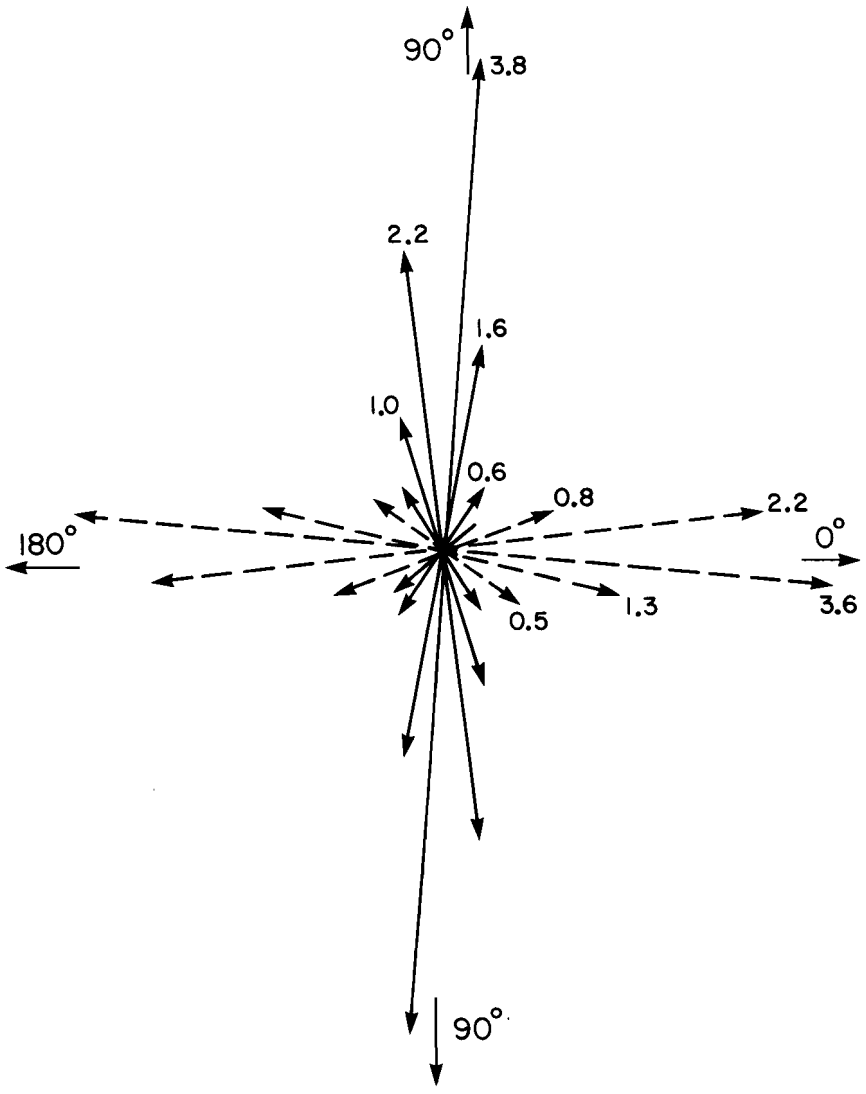


Fig. 2.1(b). Typical 10 GeV/c jet event at $(s)^{1/2} = 39$.