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January 28, 1981

Letter of Intent

To: Fermilab Physics Advisory Committee
From: Chicago-Princeton Collaboration (Exp. 326)
Subject: Dimuon Physics with the Tevatron

This group is currently engaged in a detailed study of the production of massive muon pairs by pions on nucleons. Our present experiment (E-326), which uses a large spectrometer in the high intensity pion beam in Proton-West, is expected to yield high-statistics dimuon data over a wide kinematic region. This will enable us to extend the $M_{\mu\mu}$, p_T, x_F, and $\cos\theta^*$ distributions and so determine the various structure functions of the pion. Thus, a thorough study can be made both of the scaling expected from the naive Drell-Yan model and of the scale breaking correction predicted by several higher order QCD corrections.

At the time of this writing a major data-taking run of E-326 is in progress. We are learning, at first hand, both the advantages and the problems of having a large acceptance spectrometer placed in a high-intensity beam. We find that our detector performs well at intensities in excess of 10^9 225-GeV negative pions per beam pulse, giving an invariant mass resolution $\sigma/M_{\mu\mu} = 6\%$. We are particularly interested in the $M_{\mu\mu}$ mass ranges 3 - 10 GeV/c^2 (especially at high dimuon p_T) and $\gtrsim$11 GeV/c^2. In the latter range we expect to increase by more than an order of magnitude the present world sample (mainly NA3 at the CERN SPS).

The purpose of this letter is to express the obvious physics interests in extending these dimuon studies into the kinematic regions which will be opened up by the Tevatron. Primary protons of 800-1000 GeV will produce high intensity meson beams of hitherto unavailable energies (e.g. 600 GeV), thus allowing the individual $\sqrt{s}$ and $M_{\mu\mu}$ dependences to be separately determined. An increase in incoming beam energy or intensity (or both) will, of course, result in further extensions of the p_T, $M_{\mu\mu}$, and x_F distributions.

Our detector, a large magnetized iron spectrometer, has the advantage of being fairly insensitive to the energy of the incident beam, and hence is particularly suited for a study of dimuon physics as a function of $\sqrt{s}$. In other words the E-326 configuration needs no upgrading for Tevatron physics. In fact, it is already a Tevatron experiment and we are eagerly awaiting the first beam!

As soon as the data we are now taking are analyzed, the results known, and the full power and limitations of the apparatus are understood, we will submit a more detailed proposal.

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