MUON PAIR PRODUCTION IN 125 GEV/C ANTIPROTON-TUNGSTEN COLLISIONS

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We have measured the cross section for the reaction $\bar{p}N \to \mu^+\mu^- X$ at 125 GeV/c over the range $4<M<9$ GeV/c^2 with $x_F>0$ and find good agreement with QCD calculations using structure functions measured in deep inelastic scattering.

The Drell-Yan[1] model predicts the absolute cross section for muon pair production in hadron-hadron collisions once the structure functions of the interacting hadrons are known. First order QCD predicts large corrections to the Drell-Yan model that take the approximate form[2]

$$\sigma_{1st\ Order} \approx \left[1+(\alpha_s/2\pi)C_F(1+4\pi^2/3)\right] \sigma_{Drell\text{-}Yan}.$$

Theory and experiment are best compared using the reaction $\bar{p}N \to \mu^+\mu^- X$ since this process is dominated by the annihilation of the valence antiquarks of the antiproton with the valence quarks of the nucleon and the valence structure functions have been accurately measured by deep inelastic lepton scattering experiments[3]. Experiment E537 at Fermilab has measured the cross section for the production of high mass muon pairs using a tagged beam of 125 GeV/c antiprotons and pions incident on a tungsten target and a closed geometry magnetic spectrometer.

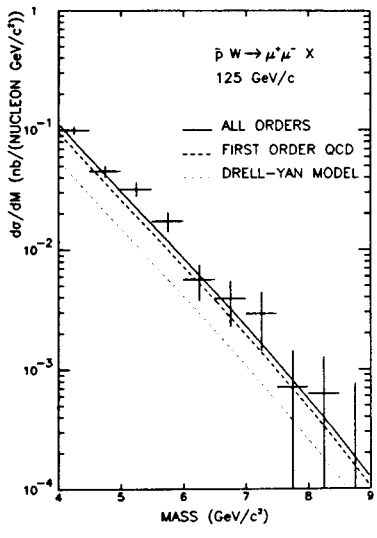

Fig.1 Cross Section for Muon Pair Production

Figure 1 shows the measured cross section as a function of mass. The dotted and dashed lines show the cross section predicted by the Drell-Yan model and first order QCD respectively using the nucleon structure function parameterizations of Duke and Owens[3] for both the antiproton and the tungsten target. The measured cross section is $K=2.45\pm0.10\pm0.20$ times larger than the predictions of the Drell-Yan model and between 1.24 and 1.41 times larger than the cross section predicted by first order QCD, depending on the value of Λ chosen. The solid curve shows the result when the vertex part of the QCD corrections is summed to all orders of α_s. The data gives a cross section between 1.17 and 0.95 times larger than this calculation, again depending on Λ. The shape of the mass distribution is well described by all three curves but it is clear that the corrections predicted by QCD are required to explain the magnitude of the cross section. The errors quoted for K represent the statistical(4%) and systematic errors(8%) in our experimental measurement. Additional systematic errors of up to 11% and 20% may arise from the the uncertainty in the A dependence of the cross section and normalization differences among the DIS experiments respectively.

1. S.D. Drell and T.M. Yan, Phys. Rev. Lett. 25, 316 (1970).
2. W. Stirling, Contribution to the Fermilab Drell-Yan Workshop, October 7-8, 1982.
3. D.W. Duke and J.F. Owens, Florida State Preprint, FSU/HEP/83-11-15.