

ANALYZING POWER MEASUREMENT IN INCLUSIVE π^0 PRODUCTION AT HIGH x_F

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ABSTRACT

A measurement of inclusive π^0 production has been performed with the new 185 GeV/c Fermilab polarized proton beam. First results for A_N in the x_F range between 0.2 and 0.8 and p_T -0.8 GeV/c are presented.

During the last weeks of the most recent fixed target run at Fermilab, our collaboration (E581/E704) has succeeded in commissioning tertiary tagged polarized proton and anti-proton beams of momentum around 185 GeV/c.¹ Along with the measurement of the beam polarization, the availability of a polarized beam enabled us to make simple parasitic measurements. Based on preceding inclusive π^- , π^+ and K_S production asymmetry measurements at lower energies² and the predictions that follow from the quark fragmentation model presented in Ref.3, a non-vanishing analyzing power is expected in inclusive π^0 production in the beam fragmentation region and at moderate values of transverse momentum, of about $((A_N(\pi^+) + A_N(\pi^-))/2) = 0.08$. We were also strongly motivated to provide E704 with a simpler polarization monitor than the more sophisticated absolute polarimeters based on Coulomb-Nuclear interference and the Primakoff effect.¹ The layout of the measurement consisted essentially of an electromagnetic calorimeter placed on one side of the beam axis, 50.5 m downstream of the target, with a surface of ~ 0.5 m². The calorimeter had two sequential sections; upstream 129 leadglass modules (2.5" x 2.5", 13X₀), downstream was a lead-scintillator sandwich ($\sim 20X_0$). The leadglass provided the necessary position resolution, whereas the Pb-scintillator part allowed the total absorption of the γ -energy from the observed $\pi^0 \rightarrow \gamma\gamma$ decay. The high- x_F π^0 trigger consisted of energy deposition in the leadglass of >30 GeV in anticoincidence with a charged particle veto counter upstream. We required the interaction to be originated by a

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beam proton, i.e. a particle with momentum and polarization tagged successfully, giving a coincidence in a beam telescope placed immediately upstream of the target, and giving no signal in two threshold beam Cherenkov counters. A vertical polarization was obtained through rotation of the tagged x-polarization by means of a Siberian snake, consisting of 12 dipoles. The polarity of the snake, and therefore the correlation between each beam ray and its polarization sign, was reversed every 10 Tevatron spills, in order to suppress systematic errors. Each beam particle track was reconstructed by means of four segmented hodoscopes placed at each end of the snake magnet system. The data acquisition was done with a PDP11/45. The calorimeter stability was monitored continuously with an LED-light source coupled to the modules via quartz-fiberoptics; before each accelerator spill LED-data as well as one pedestal measurement were acquired. A total of 285000 triggers were collected, for a beam flux of $1.16 \cdot 10^{10}$ protons. Half the data were obtained with a 4"x4"x4" plastic target, where for an average rate of 10^7 beam particles/Tevatron spill the trigger rate was typically 300, 7% of which reconstructed to a π^0 . The other half of the data were collected parasitically with a 7 mm scintillator target. The reconstructed mass resolution was typically ± 17 MeV/c². We have binned our data into 4 regions of x_p (see Fig.1). We have determined the analyzing power A_N for π^0 production from data acquired with beam polarization values between 30% and 55%, taking the average of the results obtained with the two snake polarities evaluated separately. The results are presented in Fig. 2. The average analyzing power we observe for $\langle x_p \rangle = 0.52$ and $\langle p_T \rangle = 0.79$ GeV/c is 0.10 ± 0.03 (0.13 ± 0.04 for the plastic target), for an average polarization of 44%, in excellent agreement with the predictions. Systematic effects on the result are

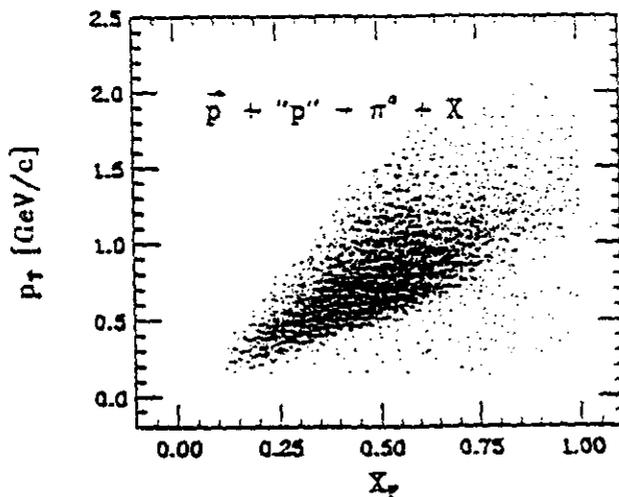


Fig.1: x_p - p_T distribution

negligible: their magnitude, which is determined as the contribution to the measured analyzing power that does not reverse sign under snake polarity reversal is 0.02 ± 0.03 . The analyzing power of the events constituting the background was also determined to be consistent with zero. The background underneath the π^0 peak was fitted and the measured asymmetry scaled accordingly. We were also able to perform a very short measurement with the polarized

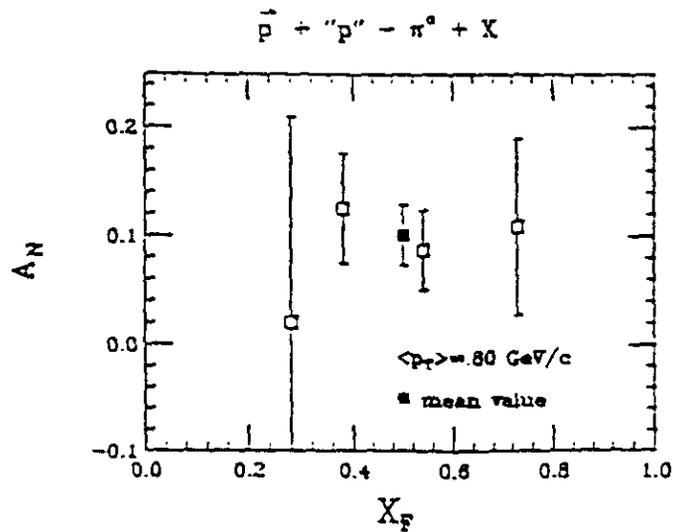


Fig.2: Analyzing power results vs. Feynman x

antiproton beam. We collected 4300 π^0 triggers for a beamflux of $8.5 \cdot 10^7$ antiprotons; We obtain $A_N = 0.26 \pm 0.19$. This result encourages us to extend these measurements to other mesons and hyperons in order to provide a complete picture of the mechanisms involved in these processes.

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