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Asymmetry in Inclusive $\pi^{\pm}$, p Production at 22 GeV, BNL E925 [a]

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Preliminary results from Experiment E925 on inclusive pion asymmetries from a 22 GeV/c polarized proton beam on a carbon target show significant asymmetries for $\pi^{\pm}$ production similar to those observed earlier at the ZGS and Fermilab with beams of 12 and 200 GeV respectively. This experiment demonstrates the viability of using the analyzing power in inclusive pion production for high energy beam polarimetry at RHIC. Inclusive proton asymmetries are consistent with zero.

Experiment E925 seeks to measure the analyzing power in inclusive pion production from a polarized proton beam at 22 GeV, RHIC injection energy, and to compare the analyzing power from hydrogen to carbon as the latter will be used in the design of the beam polarimeter at RHIC [4]. These preliminary results are from a run in November 1997 with a carbon target.

The apparatus, Figure 1, consists of two spectrometers. The first is a pair of identical pp elastic scattering measurements of the left-right asymmetry with a kinematic acceptance of -t = -0.15 ± 0.05 GeV^2/c^2. The recoil arms are de-

[a] Work Performed Under the Auspices of the U.S. Department of Energy

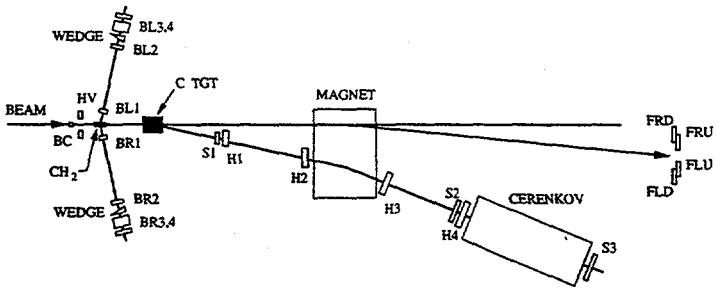

Figure 1: A layout of the elastic scattering and the pion spectrometers (not to scale).

signed to stop the elastic protons. An aluminum wedge, placed in front of the third scintillator, removes the angle/energy dependence. Exiting pions are vetoed by the fourth scintillator. Elastic candidates are selected by a coincidence between the two arms and cuts are made on the time and energy distributions. Data were collected with CH2 and carbon targets for background subtraction. Raw asymmetries were normalized to the effective analyzing power $A_N = 0.04 \pm 0.004$ to provide an average measurement of the beam polarization over the run at 30% ± 6%.

The pion spectrometer consisted of four tracking hodoscopes, 6 mm overlapping elements for effective 2 mm bins, positioned upstream and downstream of the analyzing magnet (p_t kick of 1 GeV/c). The trigger consists of a coincidence of three trigger counters and a majority of 3/4 of the tracking hodoscopes. A threshold Cerenkov counter, filled with carbon dioxide at two atmospheres, to count pions and veto protons, is employed in the trigger only when positive particles are in the spectrometer, otherwise its output is latched and used in the data analysis. The online DAQs, pentium-based PCs that read a CAMAC crate, are capable of about 100 triggers per spill with approximately 50 % dead time.

A polarized proton beam of 2-5· 10^7 particles over a 1.5 sec long spill and a 1x2 mm spot, impinges on both spectrometer targets simultaneously. The beam polarization reverses on alternate spills. Intensity monitors are ion chambers and two up/down telescopes set at 16 degrees with respect to the scattering plane or nearly 90 degrees in the CMS rendering them insensitive to asymmetries due to the vertical beam polarization.

Data were collected with alternate magnet settings for positive or negative particles entering the spectrometer. Reconstructed tracks using the hodoscopes were cut on quality, point back to the target, and the Cerenkov counter ADC and TDC distributions. Figure 2(a) shows the preliminary measurement of the analyzing power of pions and protons plotted against X_f. Each point is

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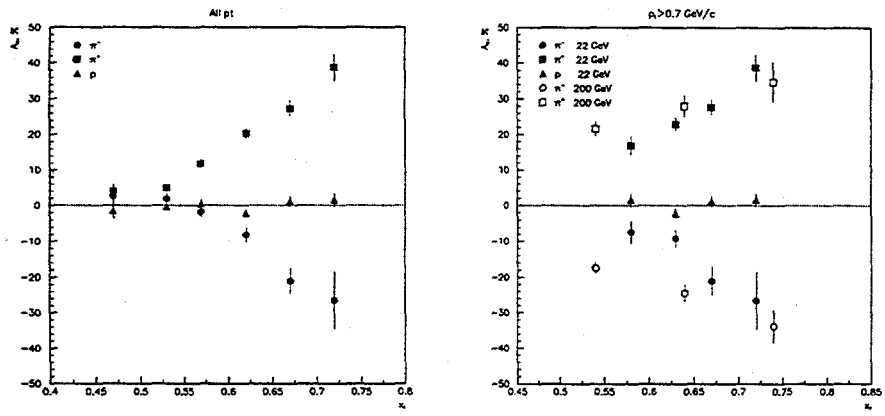

Figure 2: a) Inclusive asymmetries in pion and proton production from a 22 GeV/c polarized beam and a carbon target versus X_f. b)Comparison of inclusive asymmetries in pion production from this experiment with data at 200 GeV/c from a hydrogen target. The error bars are statistical only.

integrated over a limited p_t range that varied between 0.1 to 0.3 GeV/c. The mirror asymmetries for positive and negative pions are quite large. The pion data are similar to those measured at Fermilab [1] at 200 GeV/c albeit with a hydrogen target. Similar data on positive pion production were also seen at the ZGS [2] at 12 GeV/c. The data with a cut on p_t larger than 0.7 GeV/c allows a comparison to the Fermilab data, Figure 2(b). Note that the two experiments have different acceptances in p_t for the respective X_f points.

It has been postulated [3] that the use of nuclear targets will appreciably dilute the observed asymmetries due to multiple small p_t interactions, thus a lower effective asymmetry. Previous experience from Lambda polarization [5] produced from beryllium and hydrogen targets indicate a 15 % effect. The ZGS experiment[2] see little difference in production from hydrogen and deuterium targets. A run with a liquid hydrogen target is scheduled in Spring of 1999.

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