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ANALYZING POWER MEASUREMENTS FOR p-p ELASTIC SCATTERING AT HIGH- P_{\perp}^2

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Résumé - Au Laboratoire National de Brookhaven (AGS), la mesure de la puissance d'analyse d'une diffusion élastique p-p de 28 GeV/c a été effectuée à $P_{\perp}^2 = 5,95$ et $6,56$ (GeV/c)² en utilisant une cible de protons polarisée et un faisceau de protons non-polarisé. Les résultats montrent que la puissance d'analyse, A, augmente rapidement avec P_{\perp}^2 .

Abstract - The analyzing power in 28 GeV/c proton-proton elastic scattering was measured at $P_{\perp}^2 = 5.95$ and 6.56 (GeV/c)² using a polarized proton target and an unpolarized proton beam at the Brookhaven National Laboratory AGS. Results indicate that the analyzing power, A, is rising sharply with P_{\perp}^2 .

Previous measurements¹ of the analyzing power, A, for proton-proton elastic scattering suggested a rise with transverse momentum above $P_{\perp}^2 \approx 3.5$ (GeV/c)². Such a rise was contrary to theoretical expectations, so to clarify the situation, we made further measurements at $P_{\perp}^2 = 5.95$ (GeV/c)², the maximum P_{\perp}^2 of the earlier measurements, and at $P_{\perp}^2 = 6.56$ (GeV/c)².

Measurements were made using an unpolarized 28 GeV/c proton beam from the Brookhaven Alternating Gradient Synchrotron, AGS, incident upon the University of Michigan polarized proton target. The target consists of target material cooled to 0.5°K by an evaporation refrigerator, in a 2.5 T magnetic field. Polarizing transitions are driven by a 70 GHz microwave system and the polarization of the free protons is measured with a 107 MHz NMR system. A high beam intensity, typically 5×10^{10} protons per pulse, was made possible by using irradiated ammonia as the target material and by using a ³He - ⁴He mixture as the circulating fluid in the refrigerator. The polarization of the target hydrogen proton, P_T , was typically 45% with beam and 60% without beam.

Elastic proton events were detected in a double-arm forward-backward spectrometer, shown in Fig. 1, consisting of six magnets and a six-fold eight-channel scintillation-counter hodoscope. The P_{\perp}^2 - acceptance for these measurements was about 1 (GeV/c)².

The analyzing power, following the Basel convention for our layout, is defined as

$$A = - \frac{1}{|P_T|} \frac{N(\uparrow) - N(\downarrow)}{N(\uparrow) + N(\downarrow)}$$

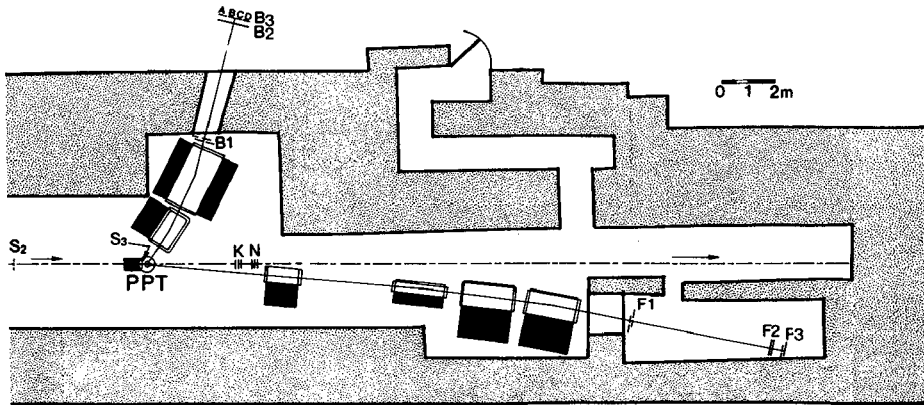


Figure 1. Layout of Experiment

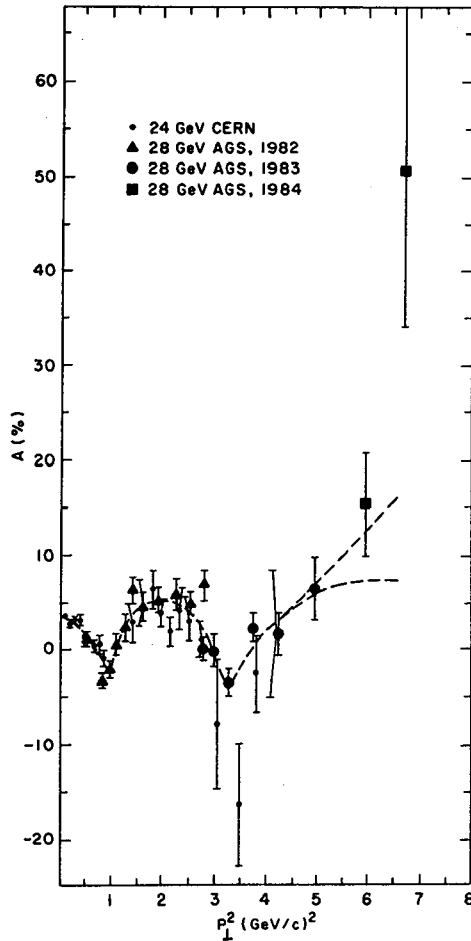


Figure 2. Analyzing Power for Proton-Proton Elastic Scattering as a Function of P_{\perp}^2

where $N(\uparrow)$ and $N(\downarrow)$ are the number of events with target polarization direction up and down, respectively. Accidental coincidences between the forward and backward arms were measured continuously and subtracted from the raw number of events. An estimate of the non-hydrogenous and non-elastic background events was obtained by substituting Teflon beads for the normal ammonia beads. The resulting background events were presumed to have an analyzing power of zero and were treated as a dilution of the proton-proton elastic analyzing power. The final values of A were:

P_{\perp}^2	θ_{cm}	A
5.95	42.9°	0.16 ± 0.057
6.56	45.6°	0.51 ± 0.17

The value at $P_{\perp}^2 = 5.95$ (GeV/c)² contains the data from our earlier run¹. These new values are plotted in Fig. 2 along with earlier measurements from the AGS^{1, 2} and CERN³. The sharp rise is not, as far as we know, described by any theory. Planning is now in progress for more measurements in order to reduce the statistical uncertainty of the 6.56 (GeV/c)² point and also to obtain data at even higher P_{\perp}^2 .

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