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Before the shutdown of the Argonne Zero Gradient Synchrotron (ZGS) in October 1979, our group extended our previous measurements[1] of the 6 GeV/c P-P elastic scattering rates with beam and target polarizations normal to the scattering plane. The experimental technique has been described in the previous publications, but some improvements were made as shown in Fig. 1. Additional momentum resolution was added in the recoil arm and the solid angle was increased by the use of two element hodoscopes. Beam intensity was increased by a factor of 3 and additional shielding was installed. Along with the usual statistical uncertainty and errors in measurement of the target polarization, we have added in quadrature a term due to a systematic difference between target and beam asymmetries (A_T and A_B). Figure 2 shows the results plotted against $P_\perp^2$. This may be an appropriate variable since our recent data[2] at 11.75 GeV/c seems to indicate that A_{nn} may depend solely on $P_\perp^2$.

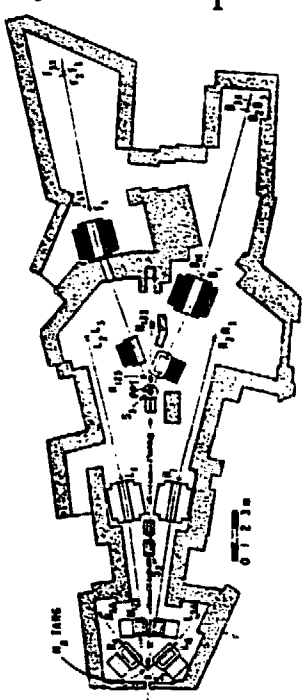

Fig. 1 (Left): Layout of Experiment.

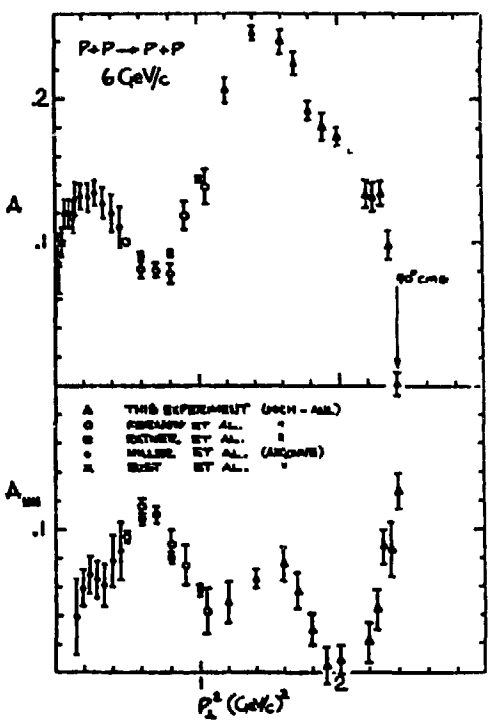

Fig. 2 (Right): A and A_{nn} Plotted as a Function of $P_\perp^2$.

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Since the range of the variables usually used to parameterize the data (-t or $P_\perp^2$) changes drastically with energy, one of us (LGR) thought it might be interesting to compare the data at different energies as a function of $\theta_{cm} = \mathrm{Sin}^{-1} P_\perp/P_{cm}$. This energy-dependent presentation might then give us some intimation of what can be expected at unmeasured energies. An extensive angular range has been measured at three energies: 3 GeV/c,[3] 6 GeV/c,[4] and 11.75 GeV/c.[5] We will consider 3 GeV/c as the beginning of the high energy range. We will first show the asymmetry parameter A and then the spin-correlation parameter A_{nn}.

In Fig. 3, note first the 3 GeV/c distribution. Then compare this to the 6 GeV/c data and we see that the forward peak moves to smaller angles and that a peak has developed in the plateau region. Only a small flat remains before the approach to zero at 90°. With the 11.75 GeV/c data, we again see a forward movement of the peaks and the development of another long plateau with perhaps the suggestion of another peak emerging. Unfortunately, at higher energies, no full angular distributions are available, but we can follow the further migration of the forward peaks as shown by the 17.5 GeV/c data.[6] We'll start another composite (Fig. 4) with the 17.5 GeV/c data. Note the scale change from 90° to 30° cm. As we add the higher energies,[7] we again see the forward movement of the first peak and the development of a sizable negative dip. This trend continues to the highest measured energy of 300 GeV/c. There are a few points

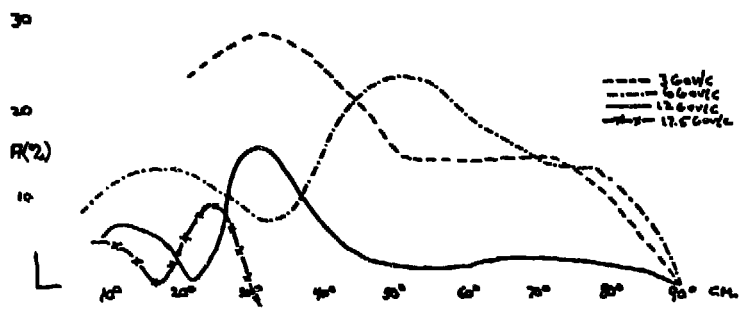

Fig. 3. A from 3 GeV/c to 17.5 GeV/c Plotted Against θ_{cm}

at larger angles than shown here, but the errors are very large. In general, these trends for A seem to be consistent. However, when we look at the spin correlation parameter A_{nn}, we see some surprising behavior.

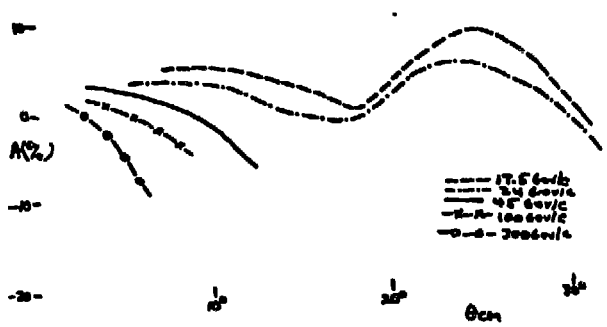

Fig. 4. A from 17.5 GeV/c to 300 GeV/c Plotted Against θ_{cm}

Measurements at 2, 3, and 4 GeV/c[8] behave typically like the 3 GeV/c plot (Fig. 5). At 6 GeV/c[1] there appears to be another oscillation, but the general behavior is the same, and as with A the amplitude decreases with energy. When we go to the 11.75 GeV/c[5] data, we see a surprisingly different behavior. The amplitude becomes even larger in places than the 6 and 3 GeV/c data. It appears that the interaction mechanism has changed dramatically between 6 and 11.75 GeV/c. As noted before, $P_\perp^2$ is a relevant parameter that changes with energy while the c.m. angular range is constant. 11.75 GeV/c and 43° has the same $P_\perp^2$ as 6 GeV/c and 90°. The sharp rise in A_{nn} is probably linked with the much higher $P_\perp^2$ and, consequently, with a smaller impact parameter. The scattering

might indeed be taking place from constituents of the proton with dimensions of the order of 0.3 F.[5]

The data also points out how small a region of transverse momentum and energy space has been explored and leaves plenty of room for speculators, theorists, and experimenters to provide further input.

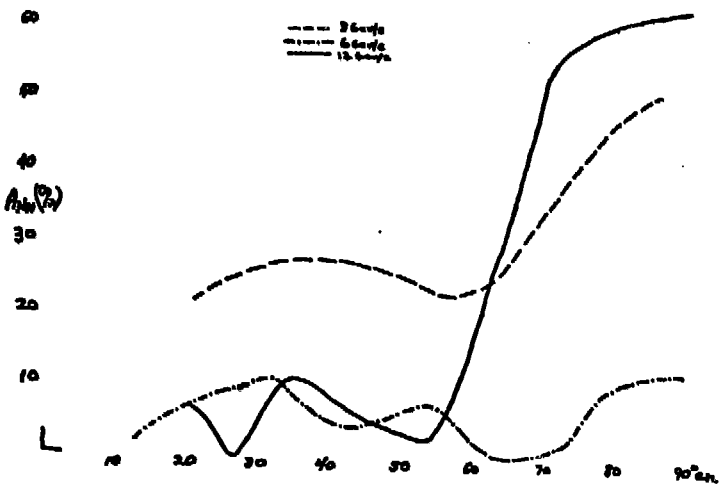

Fig. 5. A_{nn} from 3 GeV/c to 11.75 GeV/c Plotted Against Θ_{cm}

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