ANALYZING POWER MEASUREMENTS IN HIGH-\(p^2\) p-p ELASTIC SCATTERING*

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ABSTRACT

The analyzing power in 28 GeV/c proton-proton elastic scattering was measured at \(p^2 = 5.95\) 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 \(p^2\).

Previous measurements\(^1\) of the analyzing power, \(A\), in \(p + p \rightarrow p + p\) suggested a rise in \(A\) at large-\(p^2\), but the statistical uncertainty in the highest point at \(p^2 = 5.95\) (GeV/c)\(^2\) made it impossible to determine the magnitude of the increase. In an effort to clarify this situation, we made new measurements of \(A\) at \(p^2 = 5.95\) and \(6.56\) (GeV/c)\(^2\).

An unpolarized beam of typically \(5 \times 10^{10}\) 28 GeV/c protons from the AGS at Brookhaven National Laboratory was incident upon the University of Michigan polarized proton target. This target contains irradiated ammonia beads cooled to 0.5 K by a \(^3\)He-\(^4\)He evaporation refrigerator, in a 2.5 T magnetic field. The polarizing transitions are driven by a 70 GHz microwave system. The polarization of the hydrogen protons is measured with a 107 MHz NMR system, and is typically \(P_T = 45\%\) with beam and 60\% without beam.

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Elastic proton events were detected in the double-arm forward-backward spectrometer shown in Fig. 1 consisting of six magnets and six scintillation counter hodoscopes with a $P^2_\perp$ acceptance of about 1 (GeV/c)$^2$.

![Fig. 1. Double-arm forward-backward spectrometer.](image)

The analyzing power for these measurements is obtained, following the Basel convention, from

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

where $\mathcal{N}(\uparrow)$ and $\mathcal{N}(\downarrow)$ are the numbers of events with the target polarization up and down, respectively. The new values for $A$ are:

<table>
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<tr>
<th>$P^2_\perp$ [GeV/c]$^2$</th>
<th>$A$ [%]</th>
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<tbody>
<tr>
<td>5.95</td>
<td>16 ± 5.7</td>
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<tr>
<td>6.56</td>
<td>51 ± 17</td>
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The point at $P^2_\perp = 5.95$ (GeV/c)$^2$ includes our earlier data. These points are plotted in Fig. 2 along with earlier data from the AGS$^1,2$ and CERN.$^3$ Notice the sharp increase in $A$ near $P^2_\perp = 6$ (GeV/c)$^2$, which was totally unexpected.
Fig. 2. Analyzing power for proton-proton elastic scattering as a function of $P^2$. 

REFERENCES