separately, using the form (1). According to the idea of exchange degeneracy, the A_2 and ρ trajectories should be the same. Our results show that they are not, in agreement with a conclusion already reached from the previous experiments. In comparison with the ρ trajectory obtained from the charge-exchange data, the A_2 trajectory found above has a smaller intercept α_0 and a smaller slope α_1 at $t=0$.

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[7]The moments algorithms were developed while planning the experiment. They are described in the reports listed under Ref. 1 of the preceding Letter (Ref. 1) on charge-exchange scattering.

Polarization Measurements around the Secondary Dip in πp Elastic Scattering*

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Polarization in π^-p elastic scattering, with emphasis in the region around the secondary dip and also $\theta_{\text{c.m.}}=90°$, has been measured at 2.93 and 3.25 GeV/c. We observe an interesting sign change in this angular region.

Earlier polarization measurements[1,2] in πp elastic scattering up to $|t|\approx 2.0$ have shown the remarkable fact that, in this $|t|$ range, $P(\pi^+p) \approx -P(\pi^-p)$. In terms of t-channel quantum numbers, the above results are due to interference between $I=0$ and $I=1$ exchange; $(I=0)\mp(I=1)$ in $\pi^\pm p \to \pi^\pm p$ scattering.

What will happen beyond $|t|\approx 2.0$ is an interesting topic, particularly where a secondary dip exists near $|t|\approx 2.8$. The small cross section of the secondary dip[3] has made it difficult to measure polarization. Our program investigates polarization in π^-p scattering around the secondary dip and also around $\theta_{\text{c.m.}}=90°$ at 2.93 and 3.25 GeV/c, where cross sections are large enough for statistically meaningful measurements.

The experiment was carried out at the Argonne zero-gradient synchrotron with a polarized proton target. Some of the experimental details have been briefly described before.[4] We measured the trajectories of the beam particles incident on the polarized target by means of proportional-wire-chamber hodoscopes. Incident-beam intensities were typically 5×10^5 pions per pulse. An on-line computer recorded about 100 events per pulse on tape. Proportional-wire-chamber hodoscopes measured the θ and φ angles of both final-state particles. Events from π scattering off the free protons of the ethylene glycol target show up as peaks in the θ angular-correlation distribution of the two final-state particles. The background under the peaks was subtracted by using noncoplanar events to establish the shape of the θ correlation distribution.

Figure 1 shows the results of the polarization measurements at 2.93 and 3.25 GeV/c, together with differential-cross-section data[5,6] at 3.0 GeV/c. The errors are statistical and include the uncertainty in background subtraction. Because of uncertainty in the target polarization, which was about 0.85 during the experiment, there is an additional normalization error of ±5%.

The most interesting feature of the data is in the sign change near the position of secondary dip

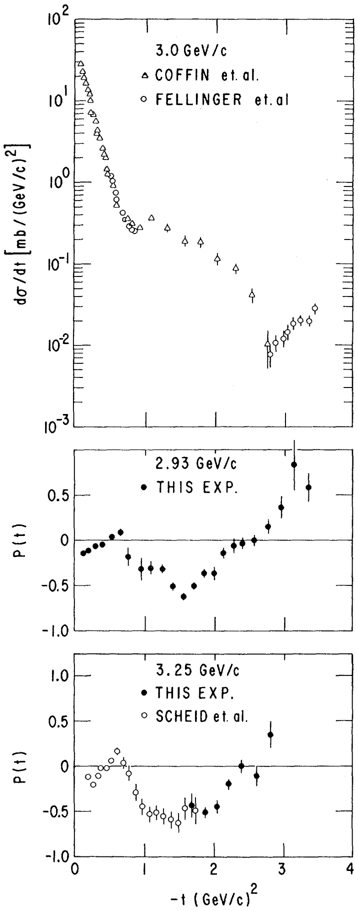

FIG. 1. Polarization in $\pi^- p$ elastic scattering at 2.93 and 3.25 GeV/c, together with some of the existing cross-section data at 3.0 GeV/c.

from negative to positive as $|t|$ increases. The nature of this dip differs from the one at $|t| \approx 0.6$, where the polarization has approximate double zeros. An exploratory attempt[7] was made to predict polarization at large $|t|$, but approximate quadratic zeros were expected at both first and second dips.

An earlier paper[8] pointed out that πp backward-scattering data satisfy a "derivative relationship" between the differential cross section and polarization. We observe a similar phenomenon in that as the sign of the cross-section slope changes, there is a sign change in polarization, as shown in Fig. 1. The reaction mechanism near the second dip may involve a simple exchange and is likely to be peripheral.

We have not measured $\pi^+ p$ polarization at the same momenta, but will examine some of the existing data at lower momenta.[9,10] Polarization results[9] in $\pi^+ p$ at 2.31 GeV/c indicate a sign

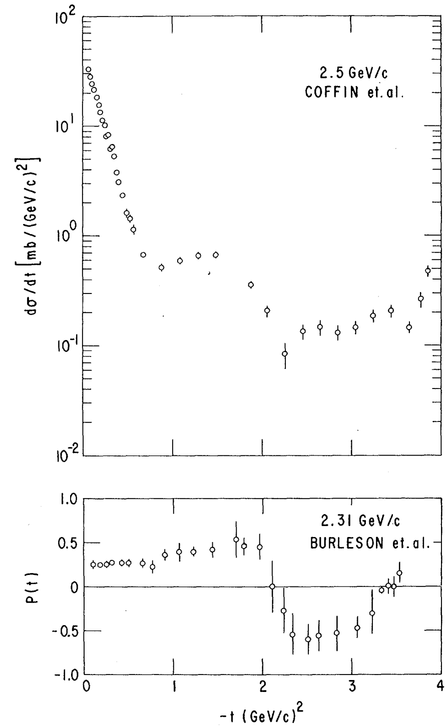

FIG. 2. Differential cross section in $\pi^+ p$ elastic scattering at 2.5 GeV/c and polarization at 2.31 GeV/c.

change at $|t| \approx 2.2$, where the secondary dip exists around this momentum,[5] from positive to negative as $|t|$ increases, as shown in Fig. 2. The behavior is opposite from the $\pi^- p$ polarization. Thus we observe a mirror symmetry between $\pi^+ p$ and $\pi^- p$, which continues up to $|t| \approx 3.2$, including the region of the secondary dip.

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