Elastic n-p Charge-Exchange Scattering at 8 GeV/c.

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Summary. — The differential cross-section for elastic charge-exchange scattering of neutrons on protons has been measured at 8 GeV/c over forward laboratory scattering angles (0÷90) mrad (square of four-momentum transfer 0 < −t < 0.5 (GeV/c)²). The method utilized acoustic spark chambers and about 1900 elastic-scattering events were analysed. A value of \((d\sigma/dt)_{lab} = (20 \pm 6) \text{ mb/sr}\) and \((d\sigma/dt = (0.93 \pm 0.28) \text{ mb/(GeV/c)²})\) was obtained for the forward differential cross-section and an estimated \((0.06 \pm 0.03) \text{ mb}\) for the elastic charge exchange cross-section. Both cross-sections show the decreased values expected from Pomeranchuk's second theorem (1) when compared with results at lower energies (2). Further comparison shows that the narrow forward peak in the distribution of \(d\sigma/dt\) previously observed for −t < 0.05, is still present at 8 GeV/c, varying in shape only slowly, if at all, with energy. For −t > 0.1 however, energy dependence is apparent. The results also suggest that the interaction is spin-dependent and/or that the real parts of the scattering amplitudes in the isospin states 0 and 1 are different. Comparisons with

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the theoretical predictions show good agreement with the value of forward cross-section given by the Regge pole approach of Ahmadzadeh (3). The model of Ringland and Phillips (4) for single-pion exchange with absorption agrees with our results for \(-t<0.01\) but a predicted secondary peak at \(-t\sim0.08\) is not observed.

1. Introduction.

Measurements of the differential cross-section for n-p elastic charge-exchange scattering have been made at several energies (2) up to 3.67 GeV/c (*). Two main features are apparent in these results, namely that the forward cross-section decreases with increasing energy and that the angular distribution at all energies is sharply peaked forward. Palevsky et al. (4) suggested that at 2.83 and 3.67 GeV/c the narrow peak implied that the n-p interaction contained components of range \(\sim2\) fermi compared with an apparent range for the p-p interaction of \(\sim1\) fermi.

The decrease in forward cross-section may be expected on the basis of Pomeranchuk's second theorem (5), in that a lower limit of the forward cross-section may be estimated from the difference of the n-p and p-p cross-sections. Many attempts have been made (7-13) to explain the narrow forward peaks particularly following the results of Palevsky et al., but a solution is not yet apparent.

In order to extend the experimental data to higher energies and thus test the predictions of the theoretical work, the present experiment was performed at the 8 GeV/c proton synchrotron of the Rutherford High-Energy Laboratory.

(*) A few events were observed at 25 GeV/c by Steinriesser et al. (5).


