

Study of nucleon-nucleon elastic scattering in polarized experiments at Jülich COSY

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Motivation of the conducted experiments at ANKE-COSY [1] was absence of experimental data above 1 GeV at small angles (below 35°). From other hand NN interaction, which is fundamental to the whole of nuclear physics, needs precise elastic scattering data as input to a phase-shift analysis ([2] PSA). During the experiments the fast proton was detected in the ANKE forward detector (FD) and/or the slow recoil proton - in a silicon tracking telescope (STT). Obtained results:

- The differential cross section for pp-elastic scattering has been measured energy of 1.0 GeV and 1.6-2.8 GeV interval for CM angles in the range 12°–30°. A precision in the overall normalisation of typically 3% was achieved. It is shown that the data have a significant impact upon the results of a partial wave analysis. After extrapolating the differential cross sections to the forward direction, the results are broadly compatible with the predictions of forward dispersion relations. The proton analysing power in pp-elastic scattering has been measured at small angles at COSY-ANKE at energy 796 MeV 1.6-2.4 GeV interval using a polarised proton beam. The asymmetries obtained by detecting the fast proton in the ANKE forward detector or the slow recoil proton in a silicon tracking telescope are completely consistent [3].
- The charge exchange of vector polarised deuterons on a polarised hydrogen target has been studied in a high statistics experiment at the COSY-ANKE at a deuteron beam energy of $T_d = 726$ MeV. By selecting two fast protons at low relative energy E_{pp} , the measured analysing powers and spin correlations are sensitive to interference terms between specific neutron-proton charge-exchange amplitudes at a neutron kinetic energy of $T_n \approx \frac{1}{2} T_d = 363$ MeV. An impulse approximation calculation, which takes into account corrections due to the angular distribution in the diproton, describes reasonably the dependence of the data on both E_{pp} and the momentum transfer [4]. The vector and tensor analysing powers, A_y and A_{yy} , of the $pd \rightarrow n\{pp\}_s$ charge-exchange reaction have been measured at a beam energy of 600 MeV at the COSY-ANKE facility by using an unpolarised proton beam incident on an internal storage cell target filled with polarised deuterium gas. The low energy recoiling protons were measured in a pair of silicon tracking telescopes placed on either side of the target. Putting a cut of 3 MeV on the diproton excitation energy ensured that the two protons were dominantly in the 1S_0 state. By analysing events where both protons entered the same telescope, the charge-exchange reaction was measured for momentum transfers $q > 160$ MeV/c. These data provide a good continuation of the earlier results at $q < 140$ MeV/c obtained with a polarised deuteron beam. They are also consistent with impulse approximation predictions with little sign evident for any modifications due to multiple scatterings [5].

Literature:

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