COSY-11 test run with a deuterium cluster target

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In view of planned measurements of near threshold strangeness production in proton-deuteron scattering, the COSY-11 collaboration performed a test run with the COSY internal proton beam scattered on a deuterium cluster target. The main aim of this run was to check the capability of the COSY-11 apparatus for a clean identification of the reaction products including deuterons and helium-3 and for measuring the elastic p-d scattering which is foreseen for luminosity monitoring. Additionally, we studied the feasibility of measuring the near-threshold production of the Ξ^- hyperon in the $pd \to dK^+K^+\Xi^-$ reaction by setting the beam momentum to 3.41 GeV/c which is only 0.04 GeV/c above the reaction threshold.

In the COSY-11 experiment [1] the particle identification proceeds via the determination of the invariant mass from the time of flight information and from the momentum measurement [2]. The invariant mass spectrum obtained in the test run is shown in fig. 1. The proton and deuteron peaks are well separated from each other and appear on a relatively small background. By setting a proper threshold on the energy loss in a scintillation hodoscope the helium-3 can be extracted in a clean way from the whole body of events as shown by the lower histogram in the fig. 1.

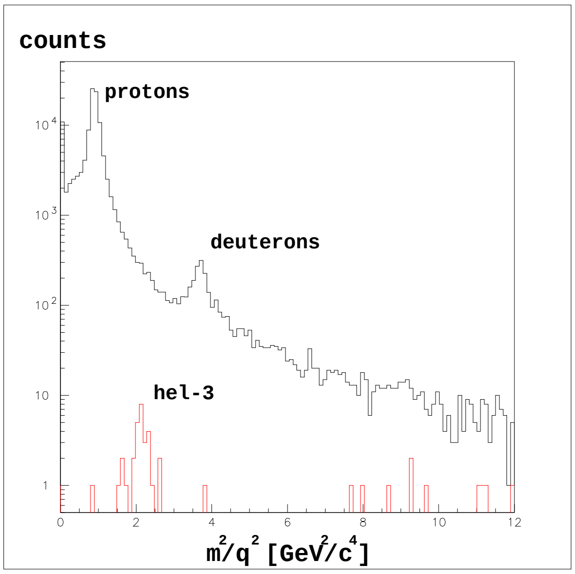

Figure 1: Invariant mass squared divided by particle charge squared as obtained from the measured momentum and the time of flight.

In the test run the elastically scattered protons were measured in coincidence with the recoil deuterons. The proton momenta and scattering angles were determined by tracing their trajectories in the magnetic field of the COSY-11 dipole magnet back to the target place. The scattering angles of the deuterons were measured by a silicon-pad detector mounted in the target region. The elastically scattered events follow exactly the kinematical expectation and are well separated from the quasielastic $d(p,pp)n$ reactions as shown in fig.2. Data for normalization purposes are scarce in literature.

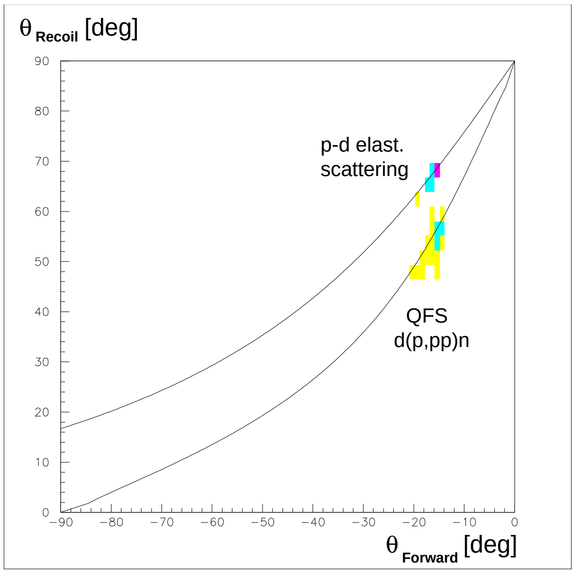

Figure 2: Scattering angle of the recoil particle measured in the silicon-pad detector versus scattering angle in the forward direction determined from reconstruction of particle track in the magnetic field of the COSY-11 dipole magnet.

For an identification of the Ξ^- production in the $pd \to dK^+K^+\Xi^-$ reaction we preselected events with three registered tracks of positively charged particles. A clean identification of particles in such events was achieved, however, no events with one dueteron and two kaon tracks were found. From this we conclude, i) that the cross section for the Ξ^- production is small (with the upper limit of the order of 1 nb), and ii) that the experimental background is very low giving a good chance for a successful measurement with higher luminosity and increased detector acceptance.

References:

[1] S. Brauksipe et al., Nucl. Instr. and Meth. **A376**(1996)397.

[2] J. T. Balewski et al., Phys. Lett. **B388**(1996)859.