Analyzing power of $\vec{p}d \to {}^3\mathrm{H}\pi^+$ and $\vec{p}d \to {}^3\mathrm{He}\pi^0$ at $T_p = 353$ MeV measured at ANKE-COSY*

V. Shmakova[1,2], S. Dymov[2,3] for the ANKE collaboration

The study of coherent pion production on very light nuclei $p + A \to (A+1)\pi$ in the Δ-resonance region is important for the understanding of the structure of the nuclei and the properties of the πN and ΔN interactions. The good results obtained with microscopic models with explicit Δ-excitation in the two-nucleon sector calls for tests of the models to be made in the three-nucleon case, where production of the Δ may involve 3N forces. The phenomenological approach using impulse approximation with $pp \to d\pi^+$ amplitudes as input was successful near the reaction threshold but only partial progress has been achieved at higher energies [1]. The new high quality ANKE results, which supplement data available from other laboratories, will present further challenges for theory.

The proton analyzing power (A_y) has been extracted for the $\vec{p}d \to {}^3\mathrm{H}\pi^+$ and $\vec{p}d \to {}^3\mathrm{He}\pi^0$ reactions as byproducts of the April 2009 study of $pn \to \{pp\}_s\pi^-$ process. A polarized proton beam with kinetic energy 353 MeV was incident onto the cluster deuterium target.

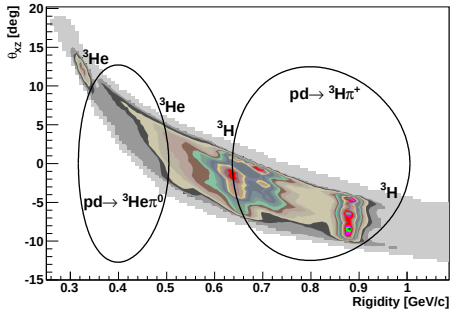

Fig. 1: Acceptance of the ANKE forward detector. Kinematical loci for the processes under study are shown.

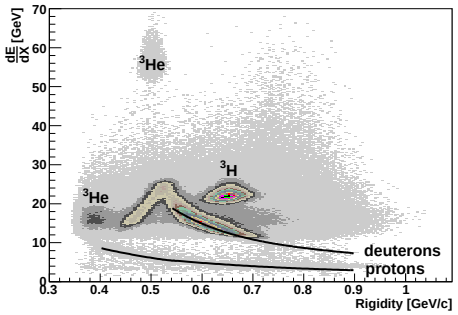

Fig. 2: Distribution of the energy losses in the first layer of the hodoscope versus particle rigidity, as obtained with the high dE/dx trigger.

The final ^{3}He and ^{3}H were detected in the ANKE Forward Detector (FD). As shown in Fig. 1, the FD acceptance covered the forward and backward c.m. angles of the ejected nuclei to give the four kinematical branches of the reactions studied. The criterium for particle identification (see Fig. 2) was based on the energy loss information from the FD hodoscope. A dedicated trigger selecting events with high energy losses in the first layer of the hodoscope was used for the detection of three of the four branches.

The asymmetry measured is $\xi = (N\uparrow\eta - N\downarrow)/(N\uparrow\eta + N\downarrow)$, where $N\uparrow$ and $N\downarrow$ are the numbers of events with proton spin oriented up and down, respectively, and η is the ratio of the luminosities collected for the two beam spin states. This ratio was obtained by comparing the rates of ejectiles emitted at $\theta = 0^\circ$ or $\phi = \pm 90^\circ$, which do not depend on the beam polarisation. The vector analyzing power A_y is related to the experimental asymmetry ξ as $A_y = \xi/P\cos\phi$, where the value of polarization $P = 0.65$ was obtained from the analysis of $\vec{p}n \to d\pi^0$ reaction.

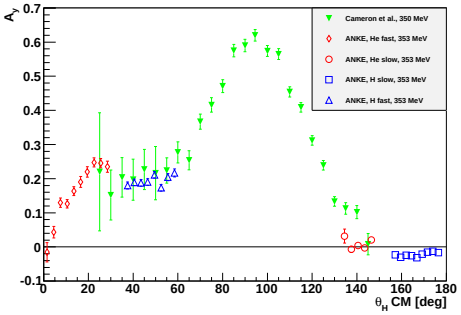

Fig. 3: Analyzing power of $\vec{p}d \to {}^3\mathrm{He}\pi^0$ at 350 MeV.

Isospin conservation ensures that the A_y for the ${}^3\mathrm{H}\pi^+$ and ${}^3\mathrm{He}\pi^0$ final states should be equal. The ANKE results for $\vec{p}d \to {}^3\mathrm{H}\pi^+$ and $\vec{p}d \to {}^3\mathrm{He}\pi^0$ are shown in Fig. 3 together with the TRIUMF data [2] for the π^0 case at 350 MeV. The results cover the previously unexplored angular ranges and improve on the precision of the TRIUMF data in the overlapping regions. Differential cross sections are currently being analyzed.

References:

[1] W.R. Falk, Physical Review C 50 (1994) 1574.
[2] J.M. Cameron *et al.*, Nucl. Phys. A 472 (1987) 718.

[1] IKP, Forschungzentrum Jülich, 52425 Jülich, Germany
[2] LNP, JINR, 141980 Dubna, Russia
[3] Phys. Inst. II, Universität Erlangen-Nürnberg, 91058 Erlangen, Germany

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