Measurement of the analysing power in $\vec{p}d$ elastic scattering at small angles*

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The ANKE collaboration has performed the experiment using a transversely polarised proton beam incident on an unpolarised hydrogen or deuterium cluster jet target [1]. Six beam energies of $T_p = 0.796$, 1.6, 1.8, 1.965, 2.157 and 2.368 GeV were used. Even though the main goal of the experiment was to study *pp* and *pn* scattering spin observables, it was also possible to extract the analysing power for pd elastic scattering. This report will summarise the preliminary results of the *pd* analysing power at the aforementioned energies in the scattering range from 4 to 28 degrees in the center-of-mass.

The scattered deuterons were detected at the ANKE spectrometer using the Silicon Tracking Telescopes (STT). The two STTs were placed inside the vacuum chamber, to the left and right of the beam close to the unpolarised deuterium cluster target. Each STT consists of three layers of double-sided silicon strip detectors. These layers of 70 μm, 300 μm, and 5000 μm thickness were placed 2.8, 4.6 and 6.2 cm away from the target, covering laboratory angles $75^\circ < \theta_{lab} < 140^\circ$.

In order to calculate the analysing power, we had to measure the polarisation of the beam and the asymmetry of the scattered deuterons. Cycles of 180 s or 300 s duration were used, with the last 20 s being reserved for the measurement of the beam polarisation with the EDDA detector. The $7\mu m$ diameter carbon fibre target was moved in the beam at the end of the every cycle. The polarimeter consists of 29 pairs of half-rings, and thanks to the known effective analysing powers of the rings, it was possible to measure the polarisation via every ring. The weighted averages over time and polar angle were taken as the final values of the polarisation. The systematic uncertainty of the polarisation measurement was estimated to be 3% [2] and it dominates the uncertainty of the final *pd* analysing power.

The elastic deuterons were registered in the STTs, measuring the total kinetic energy as well as polar angle. However, greater precision is achieved in the angle of the stopped particles by deducing it from the energy measured in the telescope rather than from a direct angular measurement [3]. The elastic deuterons were identified through the missing mass evaluation in the $pd \to dX$ reaction. The clear proton peak is seen when one deuteron is detected in the STT (Fig. 1).

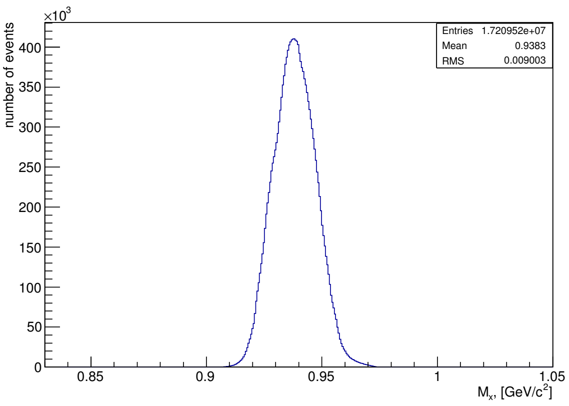

Fig. 1: Missing mass spectra obtained for $pd \to dX$ at the beam energy T_p=1.8 GeV.

The so-called cross-ratio method [4] allows one to eliminate first-order systematic errors, for that reason the polarisation of the beam was reversed every successive cycle.

Forming the geometrical means of the yields to the left $L = \sqrt{L_1 L_2}$ and to the right $R = \sqrt{R_1 R_2}$ with respect to the beam polarisation direction, the asymmetry is calculated as

$$\varepsilon(\theta) = \frac{L(\theta) - R(\theta)}{L(\theta) + R(\theta)} \tag{1}$$

in each θ scattering angle interval. Finally, the analysing power A_y is calculated as

$$A_y(\theta) = \frac{\varepsilon(\theta)}{P\langle cos\phi\rangle} \tag{2}$$

In our geometry $\langle cos\phi\rangle \approx 0.966$, where ϕ is the azimuthal angle.

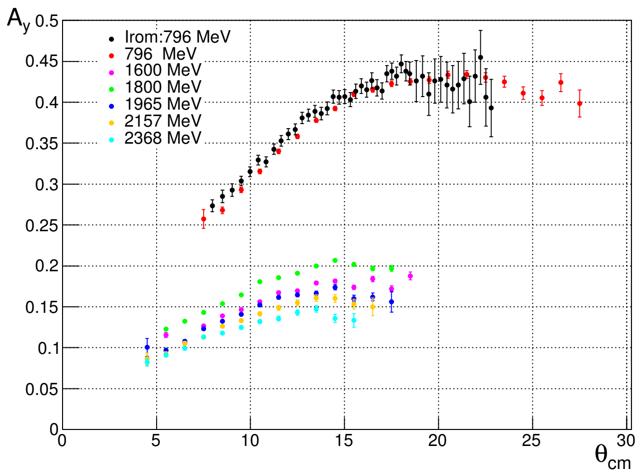

Fig. 2: *pd* elastic scattering analysing power A_y (preliminary) results, along with the existing experimental data from SATURN at 796 MeV [5]. ANKE results include statistical errors only

The results of the measurements of A_y at all six energies are shown on the Fig. 2. Our measurements at 796 MeV agree with SATURN measurements [5] within the systematic error bars. The results at five other energies can be used for the polarimetry at various polarised experiments, as well as could be useful input for the model calculations [6].

References:

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