Spin Correlation Parameter C_{yy} of $p + {}^3$He Elastic Backward Scattering at Intermediate Energy

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For several decades considerable efforts have performed to investigate the structure of lightest nuclei (d, ^{3}He ^{4}He) at short distances between constituent nucleons. Significant progress was achieved both in theory and experiment, first of all because high quality data on spin dependent observables were obtained with both hadronic and electromagnetic probes. Large part of these investigations consists of studies of elastic backward (in the center of mass system) proton-nucleus scattering (EBS). This process involves large momentum transfer and therefore a belief exists that EBS can provide an access to high momentum components of the wave function of the lightest nuclei.

We measered the differential cross section and the spin correlation parameter C_{yy} of $p+{}^3$He EBS at $E_p = 200$, 300, and 400 MeV. The proton polarization was about 70%. Elastically scattered ^{3}He particles were measured by the Grand Raiden spectrometer at 0°. In order to stop the beam and integrate the current a Faraday cup was installed inside and near the exit of the first dipole magnet of the spectrometer. A spin exchange type polarized ^{3}He target was developed and the typical ^{3}He polarization was 12% throughout the experiment.

Figure 1 shows the present results. In this figure, the open circles show results of this work, and other symbols are values [2, 3, 4, 5] extrapolated to $\theta_{cm} = 180°$ by us. For the differential cross section, present results are consistent with previous data. For the spin correlation parameter C_{yy}, these are measured for the first time. These data were compared with theoretical predictions calculated by A.P. Kobushkin [6]. Present results of the spin correlation parameter C_{yy} will provide an impetus for more sophisticated theoretical models to be considered.
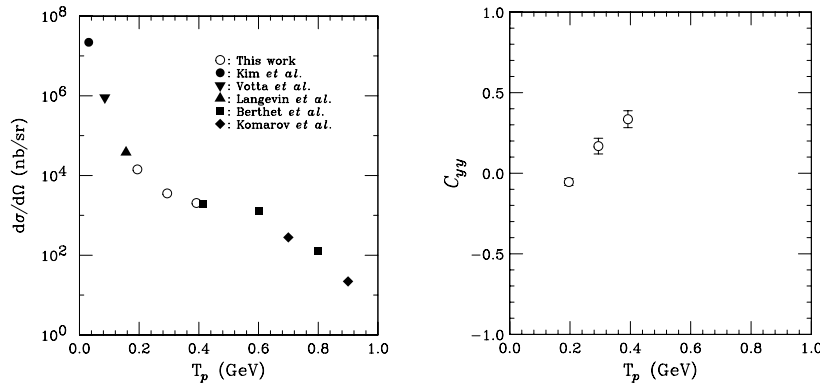

Figure 1: The left panel shows the differential cross section of the p^3He EBS. Open circles show results of this work, and other data [2, 3, 4, 5] are extrapolated to $\theta_{cm} = 180°$ by us. The right panel shows the spin correlation parameter C_{yy} of the p^3He EBS.

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