THE CONTRIBUTION OF THE PROCESSES OF ELASTIC, QUASIELASTIC AND INELASTIC INTERACTIONS INTO ANALYZING SCATTERING OF POLARIZED PROTON WITH ENERGY 700 - 1600 MEV ON CARBON

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The experiments on the spin rotation parameter measurements in the πp elastic scattering and on the measurements of the photo- and electroproduction of pions (at CEBAF, Mainz, Bonn) require to know the proton-carbon scattering analyzing power up to $T_p \sim 2$ GeV. In this work the pC analyzing power data were circumscribed as a superposition of the elastic, quasielastic and inelastic processes. Their contribution into total analyzing power is estimated. Our results cover the proton energy range $T_p = 0.7$–1.6 GeV and the angular range $\Theta_{pC}(\text{lab.}) = 5°$–$20°$. They are compared with new experimental data in the region $T_p = 0.9$–1.3 GeV, which were obtained at the ITEP accelerator.

The current and future experiments in which recoil proton polarization is required to measure are needed of reliable data on the the proton–carbon scattering analyzing power A_{pC}. This magnitude depends on the proton scattering angle and on the proton energy at the scattering point in the carbon analyzing target (carbon plate). Therefore the accurate knowledge of A_{pC} as a function of the angle and the energy, $A_{pC} = A(\theta, T_p)$, is necessary.

We summarized and reanalyzed the pC analyzing power data on the base of semi-empirical approach [1,2]: elastic (EL) channel with an energy loss less then 35 MeV; quasielastic (QE) scattering of incident protons on nucleons of the carbon nuclei, here the NN partial-wave analysis [3] was used; inelastic (IN) , with "large" energy losses, mainly with production of π mesons:

$$A_{pC}(\theta, T_p) = \frac{\sigma_{EL} \cdot A_{EL} + \sigma_{QE} \cdot A_{QE} + \sigma_{IN} \cdot A_{IN}}{\sigma_{EL} + \sigma_{QE} + \sigma_{IN}}, \tag{1}$$

where $A_i(\theta, T_p)$ and $\sigma_i(\theta, T_p)$ are the correspondent asymmetries and differential cross sections for each channel, they are expressed by the semiempirical formulas [1]. In [1,2] we demonstrated that there is a large enough discrepancy between our calculation for a thin block ($\sim 3-5$ cm) and a thick one ($\sim 20-30$ cm) especially in the angle region $\theta_{pC} = 12^\circ - 20^\circ$ [4].

So it was decided to carry out a new experiment at the ITEP accelerator to investigate the detailed behavior of $A(\theta, T_p)$ for several carbon thicknesses in the proton energy range 0.70–1.35 GeV. In this work we investigated the analyzing power for several separated thin carbon plates. In Fig.1 the experimental setup containing spark chambers with magnetostrictive data acquisition and four carbon blocks ($3+2+3+3$ cm) is presented.

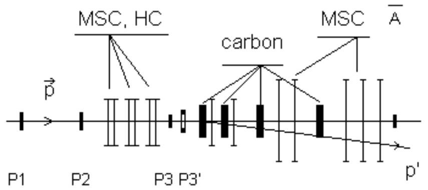

Figure 1. The experimental setup: *HC,MSC* - track chambers, $P1, P2, P3, P3', \bar{A}$ - scintillation counters.

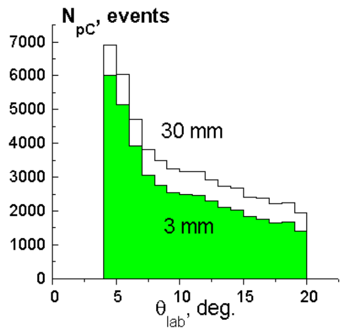

Figure 2. Number of events vs. laboratory angle for different cross radii.

The same data set was processed with different restrictions: 1) each of four thin carbon plates separately, the cross radius R between incident and scattered track is not more than 3 mm; 2) four carbon plates together as one thick block, $R < 3$ mm; 3) four carbon plates together, $R < 30$ mm. It appeared that the case 3) tended to be different from 1) and 2). In Fig.2. one can see that more relative fraction of increase is just for larger angles. Our supposition is that because of multiple Coulomb scattering there is the transition of events to the field of larger angles. Since the analyzing power and the cross section is more for less angles and the proton probability to scatter once more from a fixed angle θ on another one is the same for all angles ϕ, we have the effective increase of $A_{pC}(\theta, T_p)$ magnitude for $\theta_{lab} > 12^\circ$. Our preliminary conclusion is that the analyzing power increase at large angles with the carbon block increase is not connected with partial contribution of three channels, but is explained by the angular dependence distortion for pC

scattering because of multiple scattering. The next processing of all statistics will give more definite answer.

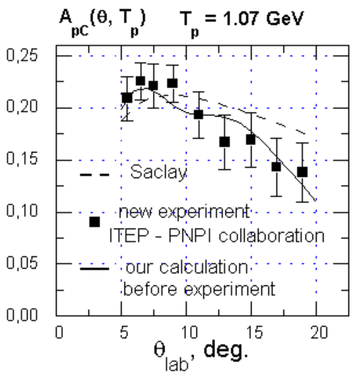

Figure 3. Comparison of our new experimental data at T_p = 1.07 GeV (3 cm) with our calculations *before* experiment $\leq$ 5 cm and interpolations of Saclay data $\sim$ 30 cm[4].

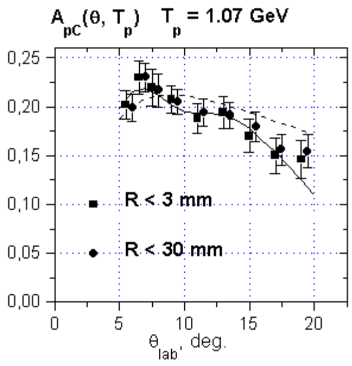

Figure 4. Our results for four carbon plates together (11 cm) for different cross radii compared with our and Saclay calculations, for convenience the points for $R < 30$ mm are shifted by 0.5°.

Fig.3 shows that our result for the first carbon plate (3 cm) generally corresponds to our calculation for the thin plate. Fig.4 demonstrates a slight tendency to the increase of A_{pC} in the range of larger angles. So analyzing power calibration results for the thick block have to be used carefully because they depend on both the carbon block thickness and data processing algorithm. Multiplate polarimeters with thin carbon blocks allow to reconstruct the interaction point exactly and they are free from the effect of the multiple scattering in the analyzer material. The calculations for thin plates can be used in this case.

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3. R.A.Arndt, I.I.Strakovsky, R.L.Workman, *Phys. Rev.* **C50** (1994) 2731.
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