MATHEMATICAL SIMULATION AND OPTIMIZATION OF CARBON POLARIMETERS

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Mathematical simulation approach for analysis of carbon polarimeter operation at few GeV and preliminary results of focal plane polarimeter optimization are presented

An actuality of this problem is determined by the existence of a wide group of experiments (active and future) to use focal plane polarimeters for a measurement of recoil proton polarization. The most interesting region of transverse momentum corresponds to the $T_p = 1 - 5$ GeV recoil proton energies. Therefore there is a task to determine the possible construction of this polarimeters and to optimize it. Due to the interference of different channels of interaction it is a problem for M.-C. mathematical simulation. This task is possible to be resolved now basing on the new experimental data [1] and computing power increasing.

According to the traditional determination of analyzing power and figure of merit of polarimeter we have to generate a penetration of polarized proton through the thick sample of matter and, taking into account our device criteria of event selection, to calculate analyzing power $A(\theta)$ and figure of merit F^2as

$$A(\theta) \simeq \frac{\Sigma \cos\phi}{\Sigma \cos^2\phi} \tag{1}$$

and

$$F^2 = \int_{\theta_{min}}^{\theta_{max}} \frac{n(\theta)}{N_0} A^2(\theta) d\theta \tag{2}$$

where N_0 is a number of initial protons, θ and ϕ are the angles of detected particle scattering and θ_{min} and θ_{max} are determined by the polarimeter aperture. The mathematical simulation programme is based on the separation of proton-nucleus interaction to the elastic, quasielastic and inelastic channels of scattering using NA- and NN- scattering experimental data for cross sections and analyzing powers [2]. Secondary particle production, multiple scattering and energy losses, Fermi-motion for quasielastic and inelastic scattering, analyzing power attenuation $R_{pC} = A_{qe}/A_{pN}$ for the scattering on intranuclear

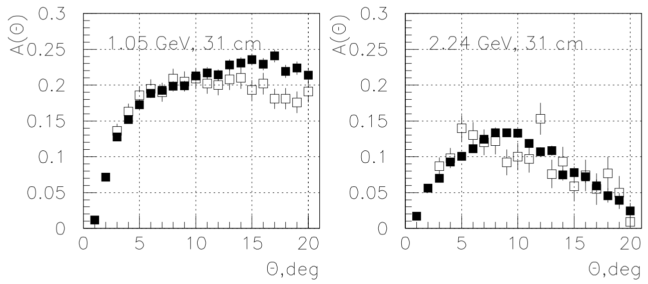

Figure 1: Comparison of the thick (31 cm) filter simulated analyzing power (closed squares) with the measured analyzing power of POMME polarimeter (open squares).

nucleons [3] and approximative fenomenological models for the inelastic channel analyzing power [4] (including resonant production) were additionally taken into account. The comparison of the final version results for a thick analyzing filter with POMME polarimeter data [5] was used to check the programme tuning (Fig.1).

Using preliminary completed programme at first it was shown that the one charge particle event selection of focal plane polarimeter corresponds to the two times higher figure of merit than the one for multiple charge particle detection. Then the preliminary analysis of the optimal thickness of carbon filter for this polarimeter was carried out. Fig.2 presents the dependence of the figure of merit on the filter thickness. One can state that there is the expressive maximum in this dependence and the decreasing of the optimal thickness of filter vs energy is observed. At the same time the maximal figure of merit decreases as $F^2_{max}(1GeV)/F^2_{max}(5GeV) \sim 25$.

Looking forward the programme can be developed by more careful description of inelastic channel and basing on the new experimental data on R-attenuation. In future we assume to use this software for the comparison of a different matter of analyzing target (carbon or polyethilen, as example) and to simulate the operation of deuteron polarimeters.

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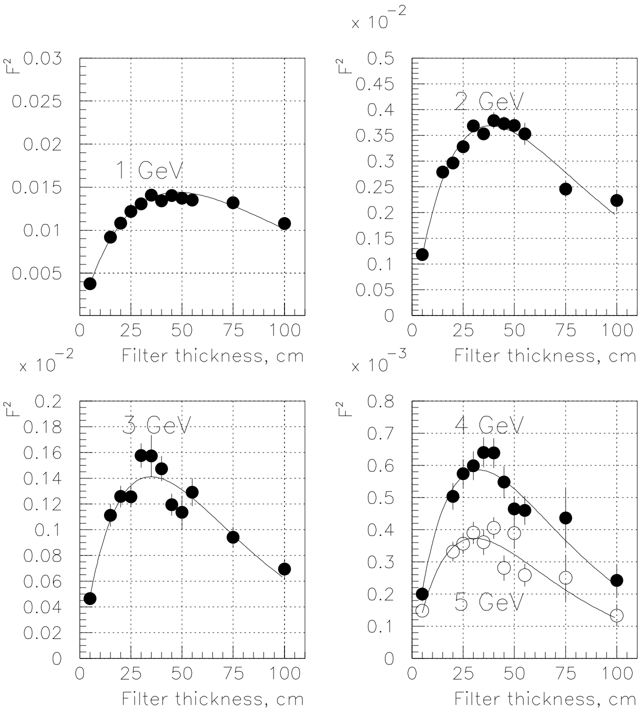

Figure 2: Focal plane polarimeter figure of merit (integrated from $\theta = 2^o$ to 20^o) dependence on analyzing filter thickness. One charge particle criterion of event selection is used

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