POLARIZATION IN SCATTERING OF POLARIZED PROTONS ON POLARIZED PROTON TARGET AT 950 MeV

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Many parameters of pp scattering close to the energy 1 GeV have been measured in recent years: the total cross sections σ_{tot}, $\Delta\sigma_l$, and $\Delta\sigma_T$, the differential cross section for elastic scattering, $d\sigma/d\Omega$, polarization parameter P, Wolfenstein parameters D, A, and R and polarization correlations A_{oonn}, A_{ookk} and A_{oosk}. This experimental information, however, does not eliminate the ambiquity in the reconstruction of the amplitude for elastic pp scattering at an energy of 1 GeV. A study of the number of solutions of phase-shift analysis has led to the conclusion that under the assumtions of phase--shift analysis there are only two solutions, which are equal on the basis of statistical criteria and which lead to only slight differences in terms of observables which depend on the components of the first- and second-rank polarization tensors (e. g., P_{oono}, D_{iojo}, and A_{ooij}). On the other hand, the predictions of these solutions are substantially different in terms of angular dependence on the components of the third-rank tensors.

In an effort to select one of the solutions, we have measured the parameter $M_{s'okn}$ at a proton energy of 950 MeV at angles $\Theta = 70°$, 90° and 110° in the c. m. frame.

In the scattering of longitudinally polarized protons with a polarization P_B by vertically polarized protons with a polarization P_T, the final polarization $\langle\vec{\sigma}\rangle$ is

$$\langle\vec{\sigma}\rangle = \{(P + K_{noon}P_T)\,\vec{n} + (D_{s'oko} + M_{s'okn}P_T)\,P_B\vec{s}' + (D_{k'oko} + M_{k'okn}P_T)\,P_B\vec{k}'\}/(1 + PP_T)\,.$$

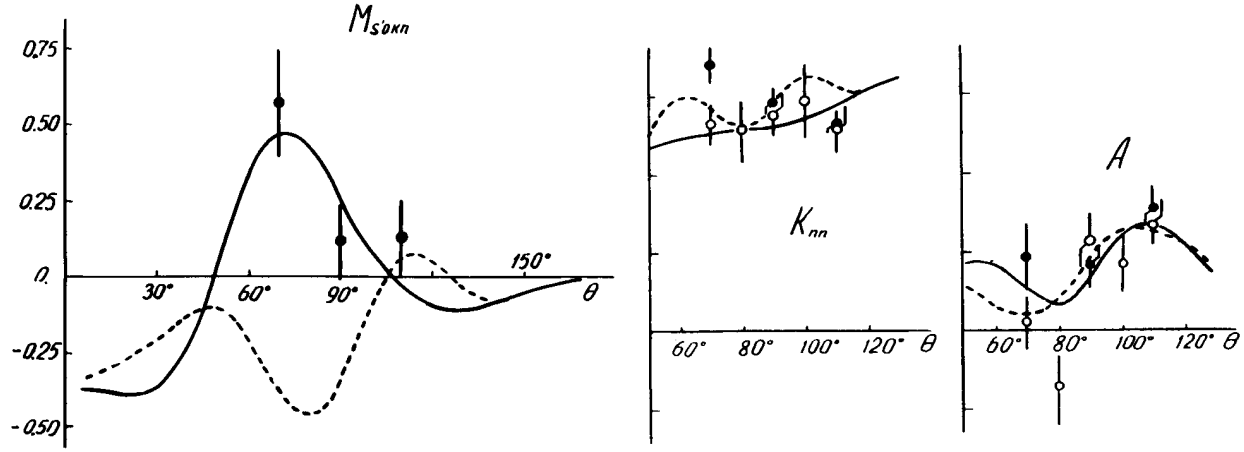

Fig. Values of parameters $M_{s'okn}$, K_{nn}, $A = D_{s'oko}$. ● — present study, ○ — results of other works. Solid line — first solution from PSA [1], dashed line — second solution from PSA [1]

where $\vec{n}$, $\vec{s}'$, $\vec{k}'$ is the orthonormal basis for scattering in the laboratory frame of reference; $\vec{n} = [\vec{k} \times \vec{k}']$, $\vec{s}' = [\vec{n} \times \vec{k}']$; $\vec{k}'$ and $\vec{k}'$ are unit vectors along the momenta of incident and scattered protons; $\vec{P} = n\vec{P}$ is the polarization in the scattering of unpolarized protons; $K_{noon} = K_{nn'}$, $D_{s'oko} = A$ and $D_{k'oko} = A'$ are Wolfenstein parameters; and $M_{s'okn}$ and $M_{k'okn}$ are components of the third-rank tensor.

Final proton polarization was measured in the second analyzing scattering on a carbon target. From the azimutal distribution of the protons scattered by the analyzer target were determined the left-right ε and up-down δ asymmetries:

$$\varepsilon = A_{pC}\{P\ (1 + \alpha) + K_{nn}P_T\}/(1 + PP_T + \alpha),$$

$$\delta = A_{pC}P_B\{A\ (1 + \alpha) + M_{s'kn}P_T\}/(1 + PP_T + \alpha).$$

The measurements were carried out on a vertically polarized «frozen spin» target. Maximum polarization was $P_T = 0.84 \pm 0.02$. The polarization of the beam was $P_B = 0.30 \pm 0.01$ and was directed either parallel or antiparallel to the momentum of incident protons.

Figure shows the values found for parameters K_{nn}, A, and $M_{s'okn}$, along with their statistical errors. The systematic errors in the parameter values stem from the uncertainty of the scattering angle, $\Delta\Theta \leqslant 5°$ c. m., and the uncertainties in the values of the polarizations P_B and P_T, analyzing power. An additional error arises in the determination of A and $M_{s'okn}$ for the angles $\Theta = 70°$ and 110° because of the precession of the proton spin in the magnetic field of the polarized proton target; this error is about 5° and its contribution in the total error does not exeed 0.03. The values predicted for the parameter $M_{s'okn}$ by the first phase-shift solution [1] differ from those predicted by the second solution more than three standard deviations. It can therefore be suggested that the first solution is more likely [2].

REFERENCES

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