MEASUREMENT OF THE PARAMETER R_{pn} IN ELASTIC SCATTERING AT A PROTON ENERGY OF 605 MeV

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To eliminate the ambiguity in the phase analysis of nucleon-nucleon scattering at an energy of 630–650 MeV [1], Wolfenshtein's parameter R for *pn*-scattering at a 90° angle in the center-of-mass system was measured.

A polarized beam of protons was obtained by scattering a proton beam extracted from the JINR synchrocyclotron on a C-target (23 g·cm^{-2}) (Fig. 1). The energy of the polarized beam in this case was 605 ± 9 MeV, the polarization $P_1 = 0.43 \pm 0.03^{-2}$, and the polarization vector lay in the horizontal plane.

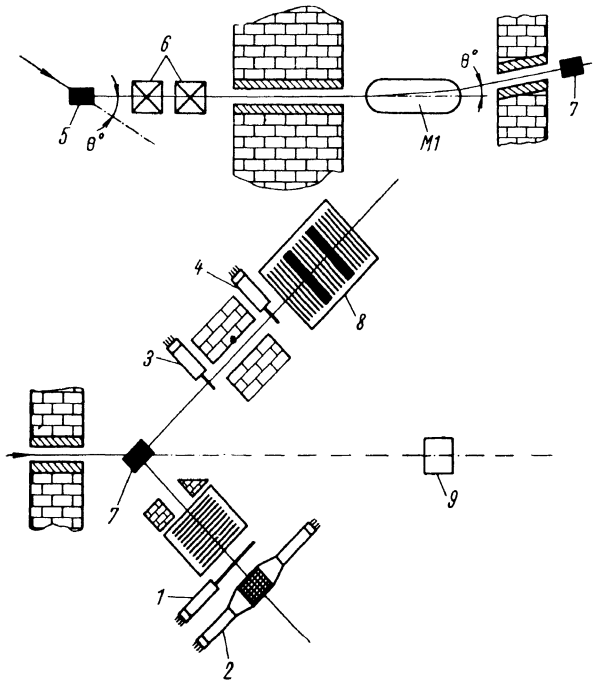

Fig. 1. Experimental layout:

1 – 4 – counters; *5, 7, 8* – first, second, and third scatterers; *6* – magnetic lenses; *9* – monitor.

The beam was cleared of neutrons by a 6° rotation in the vertical plane by means of an auxiliary magnet M_1.

In the second scattering CD_2- and CH_2-scatterers, each containing the same number of nuclei, produced different effects when placed in the beam. Cases of *pn*-scattering were determined by coincidence of the pulses from counters *3* and *4* with the pulse from counters *1* and *2* of the neutron detector.

Recoil protons escaping as a result of *pn*-collisions in the second scattering were analyzed in the third scattering on an Al-target (24 g·cm^{-2}), placed inside the spark chamber, which recorded the third scattering. This target was divided into two parts in order to reduce the influence of multiple Coulomb scattering.

A second spark chamber was placed in the "neutron" branch. The absence of a track in this chamber served as the main criterion in selecting *pn*-collision events.

The projections of the tracks on two mutually perpendicular planes were photographed. 4761 cases, satisfying the following criteria, were chosen for processing:

1) the entrance angle of the proton into the chamber does not exceed 3°;

2) the angle of the third scattering lies in the interval $4° < \theta > 30°$;

3) no track in the chamber of the neutron branch.

The calculations were made according to the maximum likelihood method. We determined the maximum for the expression

$$L = \Pi [1 + P_2 P_3(\theta_i) \cos \varphi_i - \\ - P_1 P_3(\theta_i) R \sin \varphi_i],$$

where P_3 (θ_i) is the analyzing power of the Al-target (third scattering); P_2 is the polarization in *pn*-scattering (second scattering); P_1 is the polarization of the beam after scattering by carbon (first scattering).

The maximum lies at the point of the most probable value of R and P_2.

In order to eliminate a possible error due to multiple scattering, the calculations were made for different minimum angles of the third scattering (4, 5, 6, and 7°). Accordingly, it was shown that within the error limits the results agree. An additional experiment, carried out for *pp*-collisions in a non-polarized beam of protons, made it possible to determine a pseudoasymmetry in the third scattering and to introduce a correction in the measured value of R and P_2. The values found with allowance for all corrections and errors of the experimental quantities P_1 and $P_3(\theta_i)$ were $R = 0.55 \pm 0.29$ and $P_2 = -0.13 \pm 0.12$.

REFERENCES

1. Kazarinov Yu.M., Kiselev V.S., JETP, 46, 797 (1963).
2. Kumekin Yu.P., et al. JETP, 46, 50 (1964).