UNIVERSITY OF CALIFORNIA
Radiation Laboratory
Berkeley, California
Contract No. W-7405-eng-48

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February 14, 1955

Printed for the U.S. Atomic Energy Commission
ROTATION OF POLARIZATION VECTOR AND DEPOLARIZATION IN P-P SCATTERING

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It has been pointed out by Wolfenstein\(^1\) that triple scattering experiments can give information beyond that obtainable with simple double scattering polarization measurements. The difference between these varieties of experiments can be stated as follows: in a typical double scattering experiment a polarized beam is incident on a hydrogen target and the intensities of the scattered protons in various directions are measured, whereas in a triple scattering experiment the change in the state of polarization caused by the scattering on hydrogen is measured.

The two simplest independent cases are those in which the triple scattering experiments are performed as indicated schematically in Figs. 1 and 2. In the configuration represented by Fig. 1 all the scattering processes occur in the same plane and, in an oversimplified scheme, one measures the probability of flipping the spin in the collision occurring at target 2. Targets 1 and 3 act as a polarizer and analyzer, respectively. The asymmetry \(a_{3n}\) observed after the scattering on target 3 is connected with a coefficient \(D\) (for depolarization) defined by Wolfenstein as

\[
e_{3n} = \frac{P_3 |P_2 + DP_1|}{1 + P_1 P_2},
\]

where \(P_1\) is the polarization generated by scattering an unpolarized beam on target 1.

Figure 2 represents the triple scattering experiment in which the second scattering plane is perpendicular to the first. The scattering on target 2 rotates the spin in a complicated way and by analysing the polarization by scattering on target 3 we find the component of the spin \(P_2\) in the direction \(n_3\) perpendicular to the plane \(w\). The asymmetry after the scattering on target 3 is given by

\[
e_{3s} = P_1 P_3 R
\]

which defines \(R\) (for Rotation).

* The contents of this letter were presented at the 1954 Winter Meeting of the Am. Phys. Soc. (Berkeley December, 1954)

\(^{1}\) L. Wolfenstein, Phys. Rev. 96, 1654 (1954)
This work was performed under the auspices of the Atomic Energy Commission.

\( \text{pol} \)

A known reaction is the reaction of the direction of the beam and of the scattered beam. Solutions would involve multiply matched experimental directions. Other independent tests of the polarization perpendicular to the direction of incidence, and (b) the direction of analyte of the polarized light, have been made.

The two varieties of these scattering experiments discussed here have in common the property that (a) the beam incident on the second target is polarized.

The computer machine has been initialized.

The information obtained from our investigation should be sufficient to determine

\( 3, 5 \)
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Fig. 1 Scale drawing of targets and counters for measurement of the depolarization parameter D. Target 1, a beryllium target inside the cyclotron, is not shown in this figure.

Fig. 2 Perspective drawing showing the orientations of the successive scattering planes in the triple scattering experiment to measure the rotation parameter R. The positions of targets 1, 2, and 3 are indicated by spheres 1, 2, and 3. The plane of scattering at target 2 (indicated v') is perpendicular to the plane of scattering at target 1 (v). The plane of scattering at target 3 (v'') is perpendicular to the plane v'. The figure is not to scale.

Fig. 3 Depolarization factor D plotted against center-of-mass scattering angle θ for proton-proton scattering at 310 Mev.

Fig. 4 Rotation factor R plotted against center-of-mass scattering angle θ for proton-proton scattering at 310 Mev.