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1.95 Polarized t and ^{3}He Elastic Scattering by Diffraction Model with Imaginary Spin-Orbit Interaction

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Recently the study of polarization phenomenon has recieved great interest specially for composite projectiles t, ^{3}He and in heavy ion collisions[1,2,3]. Polarization data in nuclear scattering and reactions provide informations not only about the spin dependence of the nuclear interaction but also they constitute a sensitive test of the theoretical model used.

Usually the analysis of the polarization data, in the scattering of composite particles, is done using the optical model potential, including spin-orbit interaction. The resutls from these analyses exhibit the well known ambiguities of the optical model potential parameters. Such ambiguities exist for both the central and the spin orbit parts of the potential[4].

In a double folding model[5] for t and ^{3}He elastic scattering it is found that the strength of the potential for both projectiles must be multiplied by a normalization factor without any explanation for this.

An alternative approach to this problem is the diffraction model. This is due to the fact that, the cross section and analysing power in nuclear collisions of strongly absorbed particles near and above the Coulomb barrier are associated with diffractive features.

In the present work, a diffraction model is used for the scattering of spin - ½ composite projectiles t and ^{3}He on spinless targets. The elastic scattering function S_l which changes in the relevant region of l-space (under conditions of strong absorption) allows to evaluate the partial wave summations in the scattering amplitudes.

In a previous work[6] the elastic scattering of t and ^{3}He projectiles on different nuclei has been studied with a diffraction model using the Ericson parametrization for S_l. The agreement between the experimental data and calculations for analysing powers was relatively satisfactory. But many authors have emphasized the fact that, in all polarization analysis the spin orbit interaction should be in general complex.

Therefore, in the present work, the diffraction model is used for the analysis of the elastic scattering of spin-½ projectiles. In the present approach the differential cross-section $\sigma(\theta)$ and the vector analysing power $A(\theta)$ are given in terms of the non-spin-flip and the spin flip amplitudes $g(\theta)$ and $h(\theta)$ as[9]

$$\sigma(\theta) = |g(\theta)|^2 + |h(\theta)|^2 \qquad (1)$$

and

$$A(\theta) = 2\mathrm{Im}(gh^*)\vec{n}/\sigma(\theta) \qquad (2)$$

where n is the normal to the scattering plane. To calculate $\sigma(\theta)$ and $A(\theta)$ a complex spin-dependent matrix element S_l^j was used [4].

For the elastic scattering of ^{3}H by ^{58}Ni and ^{68}Zn at 17 MeV and for ^{3}He by ^{26}Mg and ^{58}Ni at 33.1 and 33.7 MeV, a comparison of the calculated cross section ratio σ / σ_R and vector analysing power $A(\theta)$ with the experimental data are shown in Figs. 1 to 4. The agreement between both calculations and experimental data is good. It is clear that the use of complex spin-orbit S-matrix improves the polarization data much better than the real one. The values of the parameters obtained in that way seem to be consistent with those values obtained in Ref.[4].

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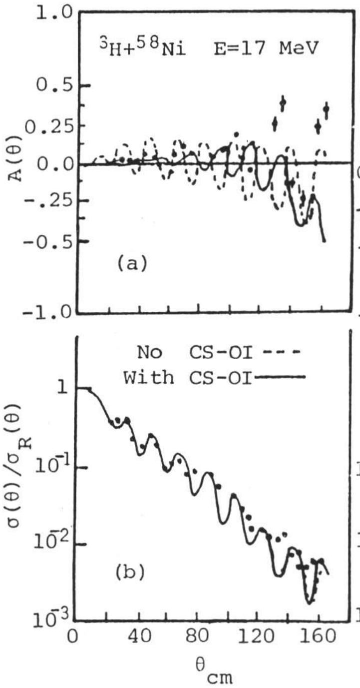


Fig. 1

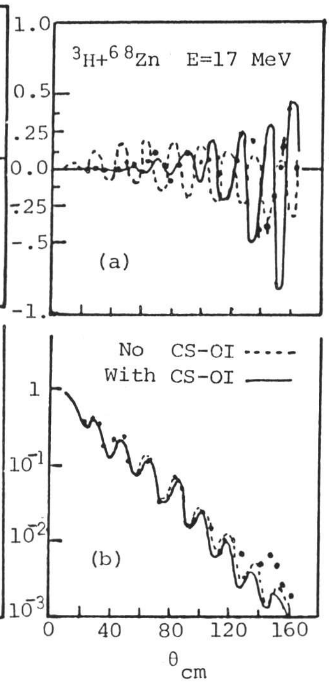
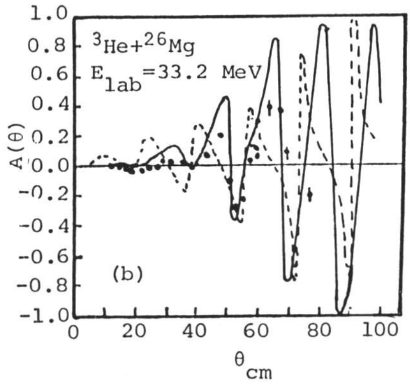
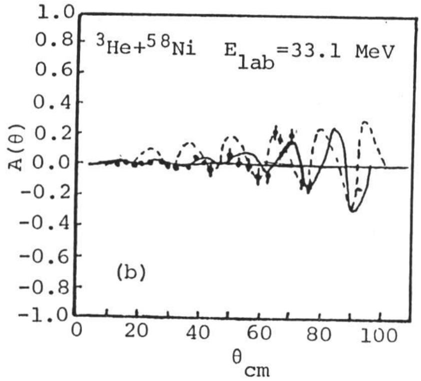
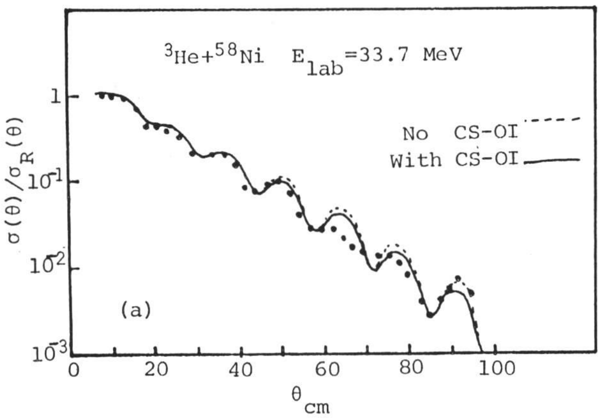


Fig. 2







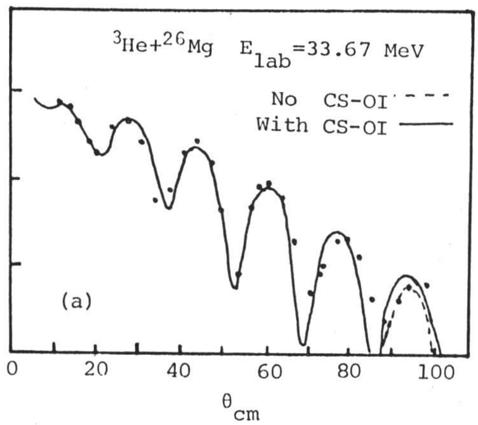


Fig. 3

Fig. 4

Figs. 1-4. σ/σ_R and $A(\theta)$ for ^3H on ^{58}Ni, ^{68}Zn at 17 MeV and for ^3He on ^{26}Mg, ^{58}Ni at 33.1 and 33.7 MeV.

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