ELASTIC SCATTERING OF 12.4 MeV TENSOR POLARIZED DEUTERONS

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ABSTRACT

Measurements of differential cross section, vector analysing power iT_{11} and the tensor analysing powers $T_{20}(\theta)$ and $T_{22}(\theta)$ were made for the elastic scattering of 12.4 MeV deuterons from 10 different target nuclei in the mass range A = 9 - 94. The data were then fitted with an Optical Model potential which included T_R and T_L tensor interactions.

ANALYSIS

The data were analysed using the computer codes SNOOPY 2 [1] and DD.[2]. First the code SNOOPY 2 was used to fit the differential cross section and vector analysing power data. Various initial parameter sets were taken from the literature. Eventually the potentials for all 10 targets were considered as a whole. It was found that a common value for the real radius parameter could be used for all targets, and that the real volume integrals followed the usual $A^{\frac{1}{3}}$ dependence.

In the next stage of the analysis a T_R tensor potential was introduced. As the code SNOOPY 2 did not include the off diagonal matrix elements needed for the exact treatment of the T_R potential, the DD. code was now used. Folding Model calculations of the T_R potential strengths were taken from the formulae of Ramirez and Thompson [3]. Good fits to the differential cross section and vector polarization for most data sets were contrasted with the poor fits to nearly all the tensor data. The fits to the ^{64}Ni and ^{65}Cu tensor data reproduced the general trends in the data, while the fits to the ^{90}Zr data were particularly poor (see fig 1). The addition of a T_R tensor potential improved the fit to the small angle T_{22} data for all targets, but no other significant improvements could be found. A small short range repulsive T_L potential

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strength, ≈ $1/20$ of the T_R potential produced strong effects in the tensor analysing powers. Small effects were also apparent in the cross section and vector polarization calculations which required readjustment of the central potential parameters. The T_L potential produced significant improvements to the ^{90}Zr fits (fig 1). Comparing the T_L and T_R matrix elements [4] (diagonal only), one can see that :

$$\langle LJ|T_L|LJ\rangle = -\frac{1}{\sqrt{6}}(2l-1)(2l+3)\langle LJ|T_R|LJ\rangle \qquad (1)$$

To ensure a small T_L interaction the potential must be short range so that at the nuclear surface where larger l values are dominant, there is little strength from the radial form factor. Stamp [5] found a small T_L potential from second order (l.s) interactions. This predicted T_L potential was of opposite sign to that found in the current analysis. One explanation could be that the T_L term is trying to compensate for deficiencies in the T_R form factor. This was derived from Folding Model calculations which do not account for changes in the deuteron d-state probability as the deuteron comes within the influence of the nuclear and coulomb fields of the target nucleus.

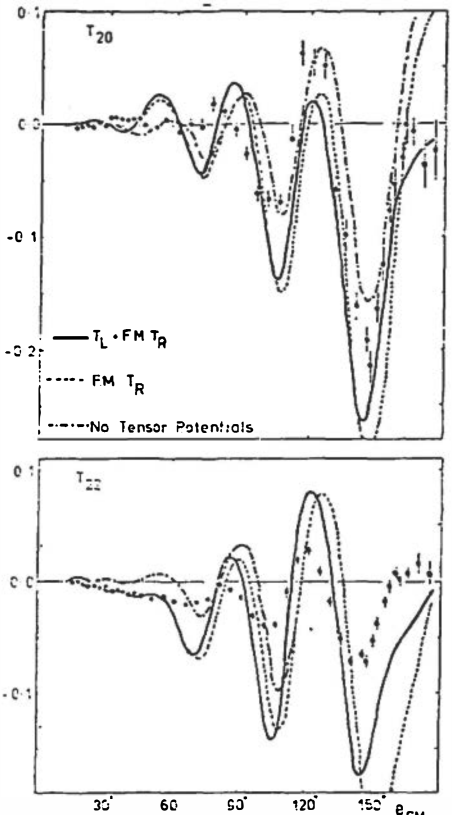

Fig 1. Fits to the ^{90}Zr Tensor data.

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