

# The role of the N-N Tensor force and nuclear structure in intermediate energy nucleon-nucleus elastic scattering.

E.S. Cunningham<sup>(1)</sup>, J.S. Al-Khalili<sup>(1)</sup>, R.C. Johnson<sup>(1)</sup>

<sup>(1)</sup>Department of Physics, University of Surrey, Guildford, Surrey, GU2 7XH, UK

## Abstract

With the next generation of radioactive beam facilities currently under construction there is a vital need for nuclear reaction theory calculations to make predictions of observables relevant to the proposed experiments. In order to do this for exotic nuclear species, it is timely to re-examine the microscopic foundation of the nucleon optical model when the target nucleus has non-zero spin.

Inclusion of terms in the optical potential which depend on the spin operator,  $I$ , of the target nucleus, were first proposed by Feshbach over 50 years ago [1]. Initially many attempts were made to describe these spin-spin interactions using a central or so called 'spherical spin-spin term' with the operator,  $\sigma \cdot I$ . Later works also included a second-rank 'tensor spin-spin term' with the operator,  $S_{12} = 3(\sigma \cdot \hat{r})(I \cdot \hat{r}) - \sigma \cdot I$ . The effects of these terms have since been the subject of much theoretical and experimental interest, but it was not until the work of McAbee [2] that a generalised spin-spin tensor was proposed.

In this work a model has been developed for determining spin-spin terms in the nucleon-nucleus optical potential. These terms are constructed by folding a realistic effective nucleon-nucleon interaction, which includes both direct and exchange parts, over the nuclear wavefunction. We have in mind data from IUCF on the elastic scattering of protons from  $^{10}\text{B}$  ( $I = 3$ ), which includes measurements of the polarisation transfer coefficient  $D_{NN}$ , known to be particularly sensitive to spin-spin terms. For our purposes, the target is assumed to have a simple two valence-particle structure, with the angular momenta of the two valence particles coupling to give the total spin of the nucleus. The resulting spin-spin tensors are evaluated within the Distorted Wave Born Approximation. The effect on spin observables of the spin-spin potentials derived from different terms in the NN interaction will be presented and their sensitivity to the presumed nuclear structure will be discussed.

## References:

[1] H. Feshbach, Ann. Rev. Nucl. Sci. 8 (1958) 49

[2] T. L. McAbee, W. J. Thompson, H. Ohnishi, Nucl. Phys. A509 (1990) 39