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1.33 Spin Transfer in the Excitation of 1^+ States in ^{12}C at 80 MeV

K. Hosono, T. Noro, M. Ieiri+, T. Ichihara+, M. Nakamura+,
Y. Takeuchi+ and M. Yosoi+

Research Center for Nuclear Physics, Osaka University
Ibaraki, Osaka 567, Japan
+ Department of Physics, Kyoto University, Kyoto 606, Japan

Unnatural parity transitions in inelastic proton scattering are expected to be particularly sensitive to the spin-dependent part of the effective nucleon-nucleon (NN) interaction. Measurements of differential cross sections, analyzing powers and polarization-transfer observables for the inelastic proton scattering are currently being used to test the effective NN interaction. We have measured differential cross sections (σ), analyzing powers (A), polarizations (P) and spin-flip probabilities (S) in the excitation of the 15.11 MeV, 1^+ (T=1) and the 12.71 MeV, 1^+ (T=0) states in ^{12}C at 80 MeV. An aim of this experiment is to show that these observables demonstrate a sensitivity to the spin dependent amplitudes of the effective NN interaction.

The experiment has been carried out with 80 MeV polarized protons at RCNP. For the measurements of σ and A, we have used the high resolution spectrograph RAIDEN. For P and S, the polarization spectrograph[1] (DUMAS) has been used. The beam polarization was about 85% during these measurements. Systematic checks of the data obtained with DUMAS are possible from the $0^+ \to 0^+$ transition data. We have made simultaneous analysis of the 7.66 MeV, 0^+ state in ^{12}C. Figs. 1 and 2 show the angular distributions of cross sections (σ), analyzing powers (A), polarizations (P), spin-flip probabilities (S) and P-A leading to the 15.11 MeV and 12.71 MeV states, respectively. Microscopic DWBA calculations were carried out using the code DWBA74[2]. The M3Y interaction and the Cohen-Kurath wave function[3] were used in the calculations. Optical parameter sets for the entrance channel at 80 MeV and for the exit channel at 65 MeV were those derived by Ieiri et al.[4]. The results are shown as solid curves in figures. The dashed-dot curves are the calculations using M3Y tensor components alone. The similar results were obtained in the calculations using a density dependent interaction of 100 MeV[5] and are shown as dotted curves in Figs. 1 and 2.

For the 15.11 MeV, T=1 state shown in Fig. 1, the calculations can well describe the shape of the cross section over the measured angular range. On the other hand, though the calculations can reproduce A, P, S and A-P at the forward angles (momentum

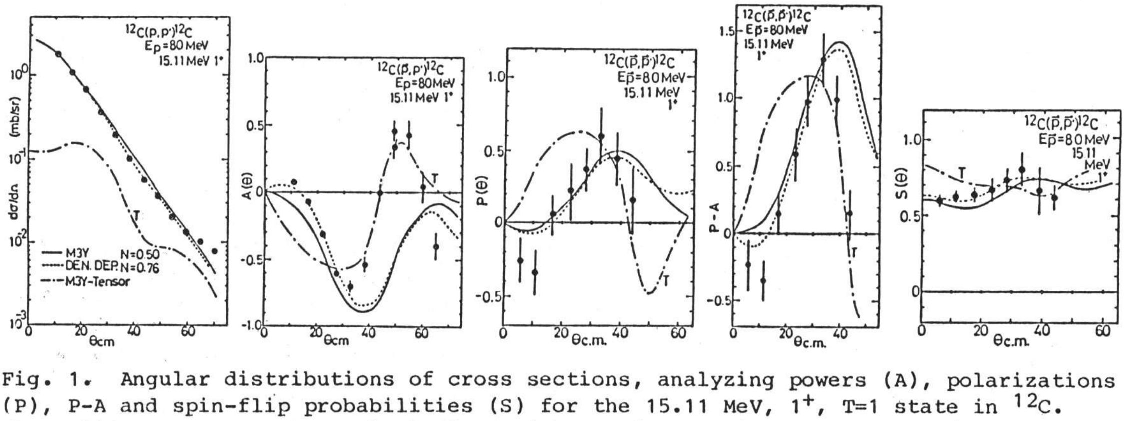

Fig. 1. Angular distributions of cross sections, analyzing powers (A), polarizations (P), P-A and spin-flip probabilities (S) for the 15.11 MeV, 1^+, T=1 state in ^{12}C. The solid curves are DWBA calculations with M3Y interaction. The dashed-dot curves are the calculations using M3Y tensor component alone. The dotted curves are the calculations using a density dependent interaction. N is normalization factor ($N=\sigma_{exp.}/\sigma_{cal.}$).

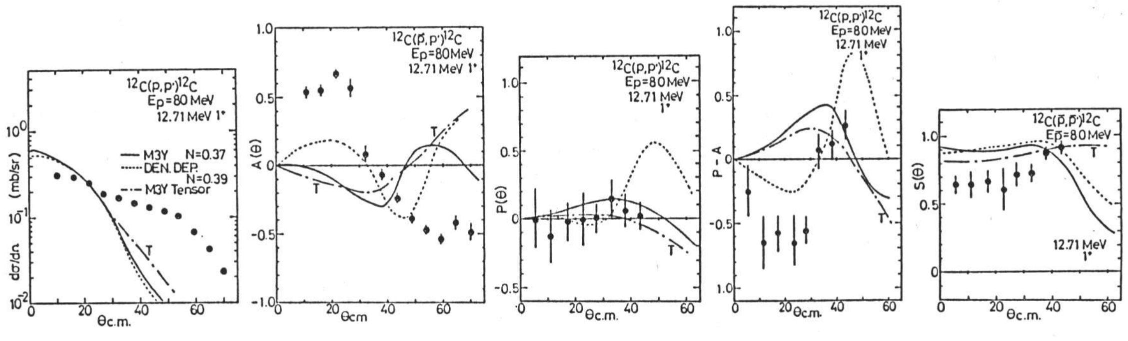

Fig. 2. Angular distributions of cross sections, analyzing powers (A), polarizations (P), P-A and spin-flip probabilities (S) for the 12.71 MeV, 1^+, T=0 state. See also the caption for Fig. 1.

transfer ≤250 MeV/c), they can not reproduce these data at backward angles (>250 MeV/c). In the large momentum transfer region, the comparisons between the data and the calculations show that contribution from the tensor force seems to dominate. The analyzing powers leading to this state are very stable in the wide energy region (65-200 MeV) and so complicated reaction mechanism may not be considered at 80 MeV. It is noted that the difference between the data and calculations suggests a remarkable sensitivity to the tensor component of the interaction in the large momentum transfer region for the T=1 state, and it may be related to the various effects within the nuclear medium. Fig. 3 shows the angular distributions of (P-A) times the differential cross section. The calculations for the T=1 state using M3Y tensor component alone can reproduce the absolute values.

For the 12.71 MeV, 1^+, T=0 state, the calculated cross section is dominated by the tensor-exchange amplitudes. Unfortunately σ, A, P, S and A-P as shown in Fig. 2 can not be described by the calculations. This may be due to ambiguities in isoscalar interaction and isospin mixing effect[6] with T=1 state.

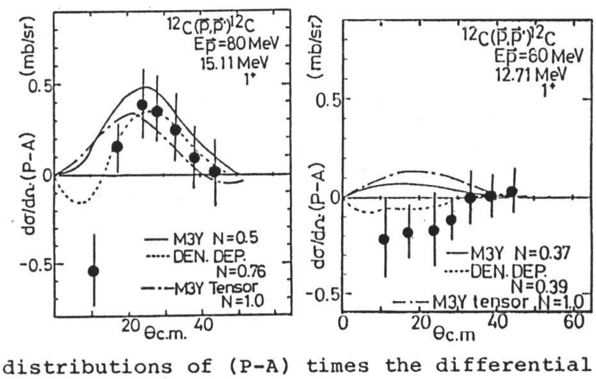

Fig. 3. Angular distributions of (P-A) times the differential cross section. N is normalization factor. See also the caption for Fig. 1.

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