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1.43 Analyzing Power of (p,t) Excitation through One-Step and Two-Step Mechanisms

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The one-step and two-step transfer processes of the (p,t) reactions are accurately evaluated employing the realistic triton and deuteron wave functions and also the realistic finite-range interaction[1]. The triton wave function used here was obtained by Sasakawa et al.[2] solving the three-body Faddeev equation with Reid soft-core interaction. The same interaction was used for the reaction interaction.

For the unnatural parity transition, one-step transition is caused by the minor components D-state and S'-state of the triton wave function. Therefore the $\Delta s=1$ transfer amplitude is dominated, which provides non-zero analyzing power function ($A(\theta)$) for the reaction even without spin-orbit distortion.

The two-step sequential transfer process is evaluated with including the intermediate unbound-deuteron channels as well as the ground state deuteron channel. Each one-particle transfer step in the two-step process is found to be dominated by the symmetric S-state component of triton and deuteron wave function. The contribution from the singlet-deuteron channel, which is unbound, is about one-order of magnitude smaller than that from the ground triplet-deuteron channel. This fact indicates the failure of the closure approximation for the intermediate deuteron channels[3], hence the $\Delta s=1$ transfer component in the scattering amplitude does not vanish, since no longer the cancellation between the singlet- and triplet-deuteron channels occurs. Consequently the $A(\theta)$ of the two-step process is produced. The origins of the $A(\theta)$ are therefore completely different between one- and two-step processes. In the other paper contributed to this Symposium (II)[4] the relative importance of the contributions from the one-step process, two-step processes through the ground state deuteron channel and through the unbound-deuteron channels is examined.

$A(\theta)$ of both one- and two-step processes strongly depends on the j-shell structure of the nuclear wave function. Fig. 1.(a) shows the $A(\theta)$'s of one-step calculation for the four combinations of the pair pick-up from the p and f single particle states in the $^{208}Pb(p,t)^{206}Pb$ 3^+ reaction. The sign of $A(\theta)$ in the two-particle pick-up from the $[j_<,j_<]$ shells is different compared with other three two-particle pick-up cases in the forward angular region. Fig. 1.(b) shows the $A(\theta)$ of the two-step process. The sign of $A(\theta)$ of the two-step process is also quite sensitive to the change in j-shell configuration. Furthermore, we should like to notice that the signature of $A(\theta)$ produced by the j-shell difference is almost alternative when one-step and two-step processes are compared at the forward angles. Fig. 1.(c) shows the $A(\theta)$ predicted by the coherent sum of the one-step and two-step processes. The predominance of the two-step process determines the final results of $A(\theta)$.

In the other paper (II) we will show the fact that the present calculations are quite promising to correctly reproduce the experimental result measured for two 3^+ state transitions corresponding to the $[p_{1/2}^{-1},f_{5/2}^{-1}]$ and $[p_{1/2}^{-1},f_{7/2}^{-1}]$ configurations.

References

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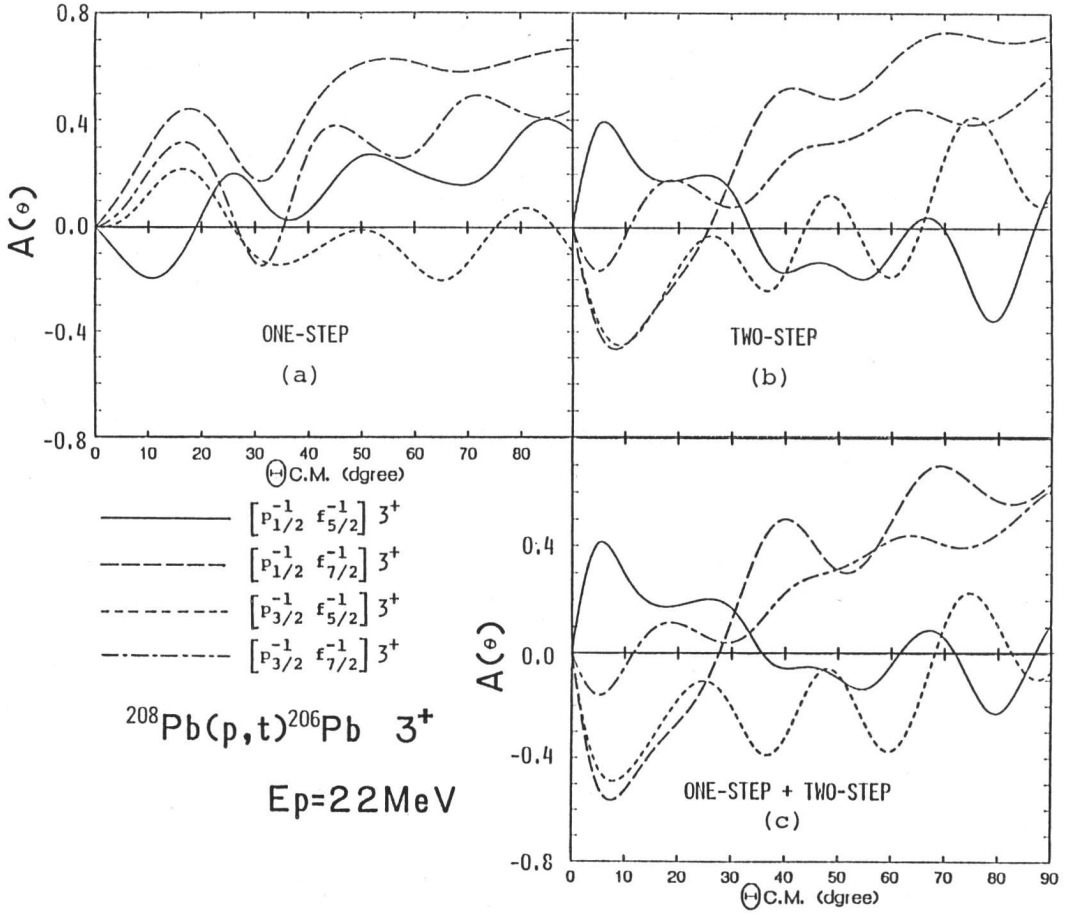

Fig. 1. Analyzing Power functions of $^{208}Pb(p,t)^{206}Pb$ leading to the four 3^+ state configurations. (a) shows the one-step process, (b) two-step process, here the contribution from the ground state deuteron intermediate channel is considered alone, and (c) the coherent sum of the two processes, respectively.