Reaction mechanism in the (^{3}He,*t*) reaction at 140*A*MeV

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The (*p*,*n*) and (^{3}He,*t*) reactions at intermediate energies are good probes for extracting *B*(GT). However, the measured strength occasionally varies about 50% depending on the reactions. This difference is considered to be caused by a reaction mechanism of composite projectile. In order to understand this mechanism, the precise angular distributions of these reactions are helpful.

The experiment was carried out at RCNP, bombarding 140*A*MeV proton and ^{3}He beams on ^{116}Cd target. The (*p*,*n*) reaction was measured by NPOL3 [1] and the (^{3}He,*t*) and ^{3}He elastic scattering were by Grand Raiden. The beam was transported in achromatic mode to obtain a high angular resolution. Then, the obtained angular distributions are compared with the DWBA calculations for understanding the reaction mechanism.

The previous data for ^{116}Cd(^{3}He,*t*) at 150*A*MeV [2] differed remarkably from the one for ^{116}Cd(*p*,*n*) at 300MeV [3] where the distortion effect is expected to be suppressed best. Besides, the ^{116}Cd target used in the former experiment is doubted to be sufficiently enriched [3]. That is why (^{3}He,*t*) and (*p*,*n*) are measured with the single enriched ^{116}Cd in this experiment, for making clear the difference in the reaction mechanisms. In addition, the effect of the energy dependence of the effective interaction is reduced by using the same energy (140*A*MeV) beam.

The DWBA calculations for the angular distributions of (^{3}He,*t*) and (*p*,*n*) are done with TWOFNR [4]. As for the optical potential, the well established Global Potential [5] is adopted for (*p*,*n*). However in case of (^{3}He,*t*), the elastics scattering were measured only for ^{12}C, ^{28}Si, ^{58}Ni, ^{90}Zr and ^{208}Pb [6-7]. Therefore the optical potential of ^{116}Cd is deduced from the present data of ^{3}He elastic scattering for the first time. The t-matrix at 140MeV [8] is adopted for (*p*,*n*) and the same one folded with the ^{3}He and triton wave functions is for (^{3}He,*t*). The exchange effects are included by short range approximation only for the center part. The transition is assumed to occur between purely ν-$1d_{3/2}{}^{-1}$ and π-$1d_{5/2}{}^{+1}$.

The obtained angular distributions and calculations are shown in Figure 1.

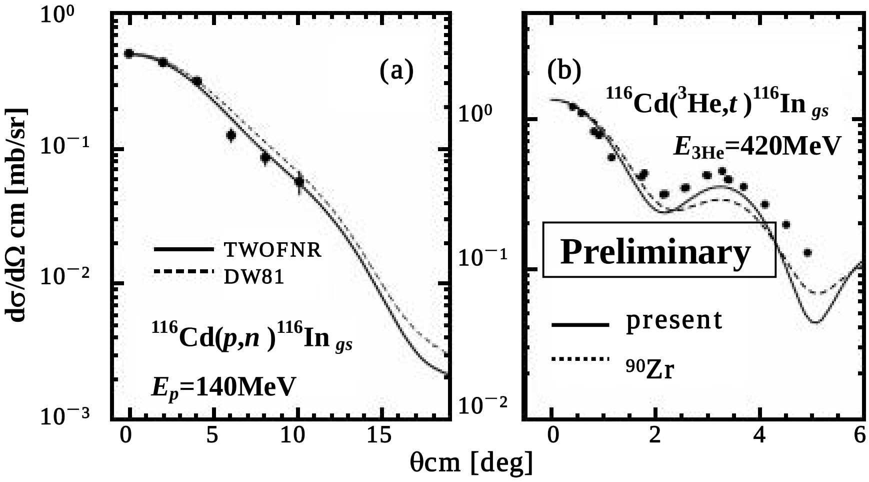

Figure 1 :
The measured angular distributions and the DWBA calculations (a) for (*p*,*n*) and (b) for (^{3}He,*t*).

(a) TWOFNR is compared with DW81 [9] which can treat the exchange effect exactly.

(b) The DWBA with the optical potential of ^{116}Cd (solid) and of ^{90}Zr (dashed) [7].

From Figure 1, it is clear that the short range approximation is reasonably good and the DWBA roughly agrees with experimental data. For better agreement and more detailed discussion, the coupling effects should be taken into account, e.g. by Fresco [10], and *B*(GT) should be deduced.

References

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