Benchmark comparison of reaction theories for nucleon knockout reaction

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Single nucleon knockout reaction is one of the promising reactions for the nucleon spectroscopy. A common reaction theory adopted to the knockout reaction analyses is the distorted wave impulse approximation (DWIA) framework. On the other hand, very recently, a new theory called the transfer-to-the-continuum model (TC) have been developed [1, 2]. In this study the benchmark comparison of these reaction theories have been made for the ^{15}C(p,pn)^{14}C at 420 MeV/u, in which the Faddeev/Alt-Grassberger-Sandhas (FAGS) calculation has been already published [3].

In Fig. 1(a), the longitudinal momentum distribution (LMD) of the reaction is given. As shown by the solid

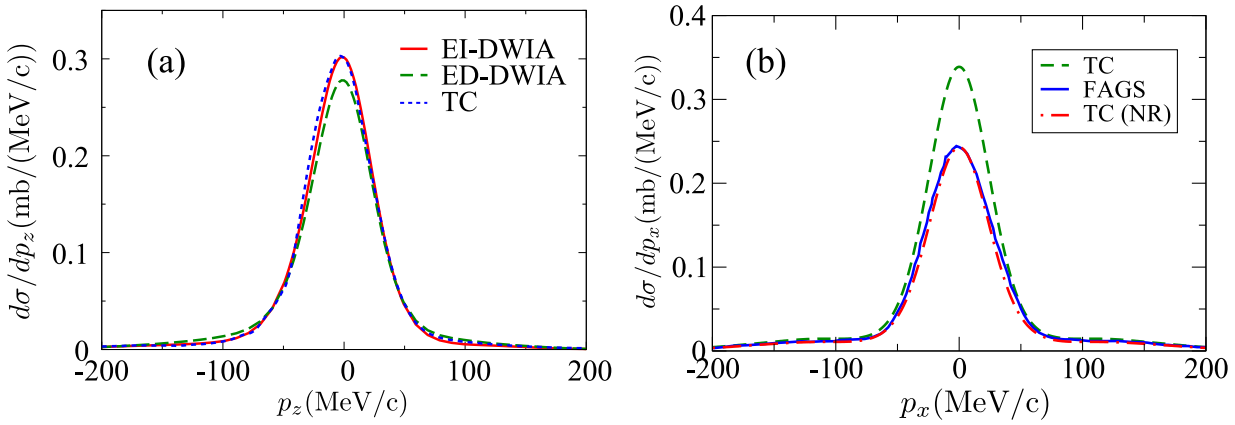

Figure 1: (a) The longitudinal momentum distribution (LMD) of the ^{15}C(p,pn)^{14}C at 420 MeV/u. The solid, dashed and dotted lines are, LMD of the Energy-independent (EI) DWIA, that of Energy-dependent (ED) DWIA, and that of TC, respectively. (b) The transverse momentum distribution (TMD) of the same reaction. The solid, dashed and dot-dashed lines are, the result of FAGS, that of TC with relativistic correction, and that of TC without relativistic correction, respectively.

and dotted lines, the results of both theories agree very well. Due to difficulties in TC, the energy dependence of the optical potentials for the emitted nucleons are neglected and fixed to 210 MeV. In contrast, it is easy to take the energy dependence of the optical potential into account in DWIA, one may estimate the ambiguity arising from the absence of its energy dependence. The dashed line in Fig. 1(a) shows the DWIA result including the energy dependence of the optical potential. It was found that the effect is miner, the LMD is reduced by 8.0% at the peak.

In Fig. 1(b), the transverse momentum distribution (TMD) of FAGS (solid) and TC (dot-dashed) are shown. In addition to them, the result of TC with relativistic correction for p-n collision is shown by the dashed line. It has been shown that once the consistent input are adopted, FAGS and TC agrees quite well as shown in the solid and dot-dashed lines, while the relativistic correction for p-n collision is essential, giving about 30% difference.

Through these benchmark comparison, DWIA, TC and FAGS give consistent results for knockout reaction calculations once the same input are adopted. See Ref. [4] for more detail.

References

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