Manifestation of α-clustering in ^{10}Be via α-knockout reaction

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Despite the remarkable successes achieved by the cluster models, the physical observables that are directly related to the cluster degree of freedom is not available until very recent studies of α-transfer reactions and α-knockout reactions [1, 2].

For the first time, we introduce the microscopic structure models into the theoretical frameworks for α-knock out reactions to probe the α-clusters in ^{10}Be nucleus [3]. In this work, we integrate the THSR wave function and the distorted wave impulse approximation (DWIA) framework, and make the first calculation for the ^{10}Be(p,pα)^{6}He reaction. The α-cluster reduced width amplitude is extracted from the microscopic wave function of ^{10}Be via an approximated approach [4]. Optical potentials are determined by folding the density distributions of ^{10}Be. The triple differential cross sections (TDX) is predicted for the ^{10}Be(p,pα)^{6}He knockout reaction at 250 MeV, as shown in Fig. 1. We further construct artificial states with extreme shell-model like or gas like states for the target nucleus ^{10}Be. The differences between structures of these states are discussed by comparing the density distributions in the intrinsic frame. We find strong dependence of the TDX observable on the α-clustering structure by calculation of corresponding α-knock out reactions, as shown in Fig. 1.

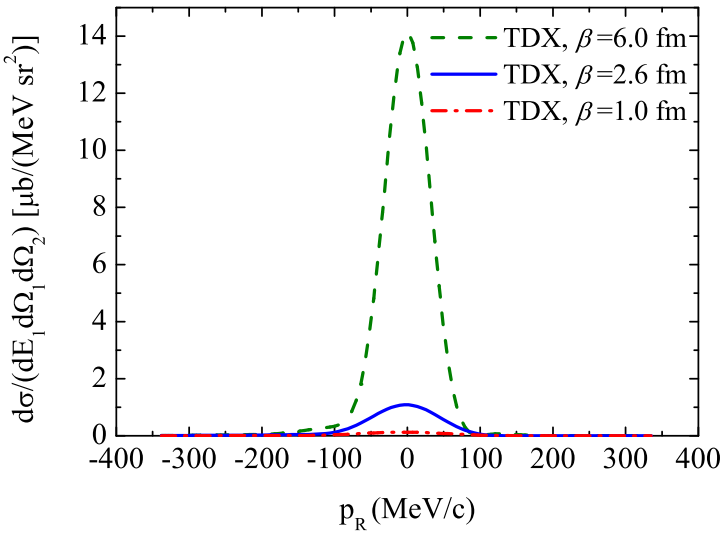

Figure 1: The TDX of the ^{10}Be(p,$p\alpha$)^{6}He reaction at 250 MeV. Kinetic energy of incident proton is fixed at 180 MeV and its emission angle is set to $(\theta_1, \phi_1) = (60.9°, 0°)$. Emission angle ϕ_2 for daughter nuclei is fixed at 180° and θ_2 is varied around 51°. P_R is the recoiled momentum.

With this new framework, we relate directly the microscopic description of α-clustering structure to the reaction observables in the (p,pα) knockout reaction, and provide reliable manifestation of the α-clustering in the ^{10}Be nucleus.

References

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