Sensitivity of Analyzing Power to Details of the Reaction Mechanism of Cluster Knockout

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Recently the analyzing power of the reaction ^{12}C(p,$p\alpha$)^{8}Be under quasifree kinematic conditions was investigated at an incident energy of 100 MeV. A distorted-wave impulse approximation (DWIA) theoretical expression formally shows a convolution of the two-body projectile-cluster matrix, on the one hand, with the the interaction of the light particles with the core of the target system, on the other hand. However, it is found that, to a remarkable extent the analyzing power angular distribution resembles free (p,α) scattering from ^{4}He. This behaviour of the analyzing power requires an unexpected degree of factorisation of the knockout cross section. Explicit DWIA calculations reveal that this outcome is, fortuitiously, true to a very good approximation. Clearly, the spin-orbit interaction in the distorted waves is simply too weak to retain the convoluted structure of the formal theoretical expression in this case.

Theoretical calculations predict that the same considerations as in the case of the (p,$p\alpha$) reaction on the target nucleus ^{12}C should also hold for ^{40}Ca at the same incident energy, but this is not found experimentally. It will be shown that, in the case of ^{40}Ca, the deviation of the analyzing power angular distribution from a simple trend is explained if the well-known anomalous large angle scattering effect of the outgoing α-particles with the heavy residual nucleus is taken into account.