Coupled-channel studies of the p+\(^{12}\)C scattering with microscopic spin-orbit interactions

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In light nuclear systems, it is well known that cluster structures appear in excited states. One of characteristic properties in cluster structures is a prominent extension of nuclear radius. In a nucleon scattering by a nucleus, for instance, excitation of the target nucleus to a cluster states leads to the extension of a range of a nucleon-nucleus potential and hence, some enhancement factors may be observed in an inelastic scattering going to a final cluster channel. In the present study, we perform microscopic coupled-channel calculations of the p+\(^{12}\)C scattering, and the inelastic scattering going to the Hoyle 0\(^{2+}\) state of \(^{12}\)C, which has a well developed 3\(\alpha\) structure, is analyzed. The central and spin-orbit parts of the nucleon-nucleus interactions are derived in the basis of the folding procedure, in which we employed the M3Y nucleon-nucleon interaction [1] and the \(^{12}\)C transition density obtained from the microscopic 3\(\alpha\) cluster model [2].

The differential cross section at \(E_{\text{lab}}=65\) MeV is shown in Fig.1. In this calculation, imaginary potentials are assumed to be the same form of the folding potential, and the strength of the potentials is optimized so as to reproduce the experimental data. As shown in Fig.1, the angular distributions are nicely reproduced by the present calculation. We found that the spin-orbit interaction gave a considerable effect on the cross section. In the present report, we will also discuss the asymmetry, \(A_{y}(\theta)\), for the excitation to the 3\(\alpha\) cluster states.
