Ab initio NCSM/RGM for three-body cluster systems and application to ^{4}He+n+n

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Ab initio approaches in nuclear physics describe nuclear systems considering its nucleons as the fundamental components of the system. Their aim is to be able to predict the system's properties from the fundamental inter-nucleon interactions.

The *ab initio* NCSM/RGM introduced in [1,2] is a promising technique that is able to describe both structure and reactions in light nuclear systems. This approach combines a microscopic cluster technique with the use of realistic inter-nucleon interactions and a consistent microscopic description of the nucleon clusters.

The method has been introduced in detail for two-body clusters and has been shown to work efficiently in different systems [1-4]. However, there are many interesting systems that have a three-body cluster configuration and therefore can not be properly studied within a binary-cluster approach.

In this work we introduce three-body cluster configurations into the method and provide, for the first time within an *ab initio* framework, the correct asymptotic behaviour for the three-cluster wave functions. The correct description of the asymptotic behaviour is particularly important for studying continuum states. For this reason, the three-cluster NCSM/RGM approach is suitable for the investigation of resonant states in two-nucleon halos or scattering states in reactions in which there are channels with three fragments.

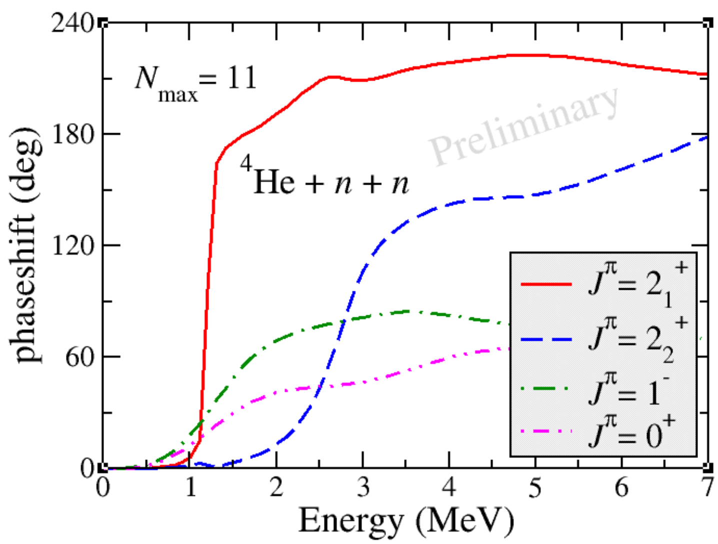

Figure 1: Preliminary diagonal phaseshifts for ^{4}He+n+n for different J^{π} channels.

We present the results obtained for ^{6}He within a ^{4}He(g.s.)+n+n basis. We find a bound state in the $J^\pi T = 0^+1$ channel, corresponding to the ^{6}He ground state. All other states are in the continuum. Among the calculated phaseshifts for different channels (see figure 1) we obtain the experimentally well-known 2^+_1 resonance as well as the second low-lying 2^+ resonance, recently measured at Ganil [5]. In addition, we predict broad 1^- and 0^+ low-lying resonances.

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