ANALYSIS OF EXCLUSIVE INELASTIC BREAKUP OF HALO NUCLEI WITHIN THE CDCC FRAMEWORK

M. Rodríguez-Gallardo[*1,2], A. M. Moro[2], J. Gómez-Camacho[2,3],
M. Assiè[4], D. Lacroix[5], J. A. Scarpaci[4]
[1]IEM, CSIC, Serrano 123, 28006 Madrid, Spain
[2] Dpto. de FAMN, Universidad de Sevilla, Aptdo. 1065, 41048 Sevilla, Spain
[3]CNA, Av. Tomas A. Edison 7, 41092 Sevilla, Spain
[4]IPN, IN2P3/CNRS and Université Paris-Sud 11, 91406 Orsay, France
[5]GANIL, B.P. 5027, 14021 Caen, France
[*]mrodri@us.es, tlf.: 954559510
Nuclear Reactions

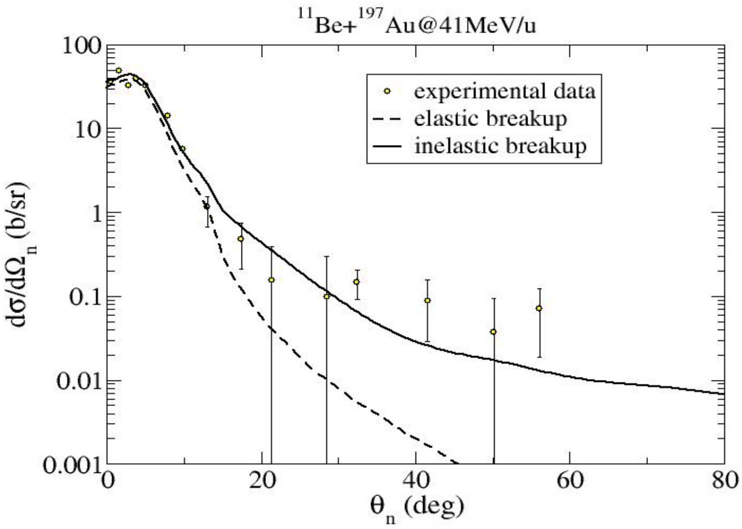
The *inelastic breakup* of a weakly-bound nucleus leads to the emission of one or several nucleons with specific characteristics. In the case of one-nucleon emission, such as the reactions induced by the one-neutron halo ^{11}Be, a three-body reaction picture is needed (core+n+target). Analogously, in the case of two-nucleon emission, such as the reactions induced by the two-neutron halo ^{6}He, a four-body picture will be needed (core+n+n+target). By inelastic breakup (named *incomplete fusion* by some authors) we refer to reactions where the projectile breaks up into their fragments and the particles involved (target, core, and valence nucleons) do not preserve their initial state necessarily, or one of the fragments is absorbed by the target. This includes the *elastic breakup*, the breakup with excitation of the core and/or the target, and the transfer of part of the projectile to the target. We do not include in this definition those processes in which the projectile is completely absorbed by the target. The latter will be referred to as *complete fusion*. By *elastic breakup* we refer to the process in which the projectile breaks up into their fragments, and these fragments as well as the target preserve their identity and remain in their initial states.

On one hand, a Time Dependent Schrödinger Equation method (TDSE) [1], within a three-body model, was applied to the measurements of the nucleus ^{11}Be on ^{197}Au, ^{48}Ti and ^{9}Be at 41 MeV/u [2]. This procedure allowed to understand the reaction mechanism leading to the emission of these nucleons and showed the particular links between the initial wave function and the observables. However its extension to four-body models has not been accomplished yet.

On the other hand, a powerful tool to study reactions induced by weakly-bound nuclei is the Continuum-Discretized Coupled-Channels (CDCC) framework [3], that was first developed for three-body problems and has been recently extended to four-body problems [4]. Within its standard formulation, CDCC only deals with breakup processes leading to the three (or four) constituents in the final state (leaving out, for instance, the transfer of one nucleon to the target). Moreover, only the ground state of the constituents is considered and, consistently, the fragment-target interactions are described by effective optical potentials. The imaginary part of these optical potentials produces a reduction of the flux that accounts for the non-elastic processes of the fragment-target subsystem. Because of the choice of the model space and the fragment-target effective interactions, the CDCC solution provides only the elastic cross section and the *elastic breakup* cross section. This formalism has been applied successfully to describe reactions induced by halo nuclei [5,6].

In this work, we propose a simple prescription to calculate the *inelastic breakup* observables within the CDCC formalism [7]. Unlike the usual procedure, the fragment-target interactions will be described by real potentials. This choice permits those configurations that would be removed otherwise from the outgoing flux, due to the presence of the imaginary interactions. We expect that with this choice, non-elastic breakup processes such as the inelastic excitation of the target or the core will appear in this model as part of the outgoing flux. In addition to these (real) fragment-target interactions we include a short-range imaginary component acting only on the projectile-target relative coordinate. As done in previous works, the absorption due to this imaginary potential will be associated with complete fusion.

Our first objective is to apply the 3-body CDCC calculations to the exclusive inelastic break-up where one nucleon is emitted and to compare it with the experimental data on ^{11}Be+^{197}Au, ^{48}Ti, and ^{9}Be at 41 MeV/u [2]. In a second step, 4-body CDCC calculations should allow to extract the dissociation probability as a function of the relative angle of the two neutrons emitted in the breakup of ^{6}He in order to compare with the data on ^{6}He+^{208}Pb at 40/u MeV from the recent experiment performed at GANIL [8], and to eventually extract the relative contributions of the di-neutron and cigar configurations.



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