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Four-body Continuum Effects in d+11Be Elastic Scattering

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The main goal of the Continuum Discretized Coupled Channel (CDCC) method is to solve the Schrödinger equation for reactions where the projectile presents a cluster structure, and a low dissociation energy. The CDCC method has been introduced forty years ago [1] to describe deuteron induced reactions. Owing to the low binding energy of the deuteron, it was shown that including continuum channels significantly improves the description of d+nucleus elastic cross sections [1, 2]. The simplest variant of CDCC describes scattering of a two-body nucleus with a structureless target, but extensions to three-body projectiles have been performed recently (see, for example, ref. [3]). The projectile continuum is approximated by a finite number of square-integrable states, up to a given truncation energy.

We present here a new development of the CDCC method, which aims at describing reactions where the projectile and the target have a low separation energy. This leads to four-body (or more) calculations. Since continuum states are included in both colliding nuclei, the number of channels can be extremely large. We solve the coupled-channel system by using the R-matrix method on a Lagrange mesh [4].

A first application is presented for d+11Be elastic scattering and breakup, which have been measured recently at Ecm=45.5 MeV [5]. The 2H and 11Be nuclei are defined by 2H=p+n and 11Be=10Be+n structures. We choose the Minnesota potential [6] as nucleon-nucleon interaction, and the Koning-Delaroche global potential [7] as nucleon-10Be optical potentials. We show that including continuum states of 2H and of 11Be is necessary to reproduce well the experimental data.

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Primary author: Dr DESCOUVEMONT, Pierre (Universite Libre de Bruxelles)

Presenter: Dr DESCOUVEMONT, Pierre (Universite Libre de Bruxelles)