Recent developments in Coulomb breakup calculations

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The development of radioactive ion beams in the 80's has allowed the study of nuclei far from stability. This technical breakthrough led to the discovery of halo nuclei [1]. These nuclei can be seen as a core to which one or two nucleons are loosely bound, and form a sort of halo around the core. Being short lived, these nuclei cannot be easily studied with the usual spectroscopic techniques. One usually resorts to indirect methods like Coulomb breakup. In this reaction, the halo dissociates from the core through interaction with a heavy target.

Coulomb breakup has also been proposed as an indirect technique to infer radiative capture cross sections at stellar energies [2]. The former can be seen as an exchange of virtual photons between the projectile and the target, which simulates the time-reversed reaction of the latter.

In both cases, an accurate reaction model coupled to a realistic description of the projectile is needed to extract reliable information from experimental data. Usually, the projectile is described as a two-body system: a structureless core to which a valence nucleon is loosely bound. The core-nucleon potential is adjusted to reproduce the binding energy of the projectile. The interaction with the target is simulated by optical potentials. Within this framework, the breakup comes down to the resolution of a three-body Schrödinger equation. Several theories have been developed or extended to solve that problem: perturbation expansion [3,4], coupled channels with a discretised continuum (CDCC) [5,6], and time-dependent model [7,8].

Recently, efforts have been made to improve these theories. To improve the projectile description, Summers *et al.* have developed a CDCC model in which the core is no longer spherical and inert, but can be deformed and excited [9]. With the aim of studying the dissociation of Borromean nuclei, other groups have extended the CDCC model to include three-body projectiles [10,11]. The semi-classical description of breakup reactions has also been improved by Baye *et al.* to include interferences between the different trajectories [12].

In this paper, I will present the aforementioned theories, and review their new developments. I will also describe some recent analyses of the mechanism of dissociation reactions, and their implication on the information extracted from the experiments. In particular, I will illustrate the use of Coulomb breakup of ^{8}B to infer the astrophysical S factor for the ^{7}Be$(p,\gamma)^8$B radiative capture [13,14].

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