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Spectra, densities and reaction cross sections of drip-line nuclei with the Gamow Shell Model

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Nuclei far away from the valley of stability are actively studied at experimental and theoretical levels. Radioactive ion beam accelerators, which can generate nuclei of very large proton-to-neutron ratio, have indeed revealed unusual features. For example, standard nuclear magic numbers can disappear at drip-lines, while others can develop. Due to their small nucleon separation energies, nuclei at drip-lines can present halos in the asymptotic region and nuclear states can be unbound with respect to particle emission.

Models developed for well-bound nuclei are no longer sufficient to describe drip-line nuclei. In fact, drip-line nuclei are open quantum systems, whereas nuclei of the valley of stability are closed quantum systems. A nuclear model able to treat drip-line nuclei consistently is the Gamow Shell model (GSM). GSM is a configuration interaction model based on the use of the one-body Berggren basis. The Berggren basis contains bound, resonance and scattering states, so that continuum coupling is present at basis level. Inter-nucleon correlations are taken into account via the use of configuration mixing, so that both structure and reaction degrees of freedom are included in GSM. It is thus the tool of choice to study weakly bound and resonance nuclei.

We will present applications of GSM concerning light nuclei. In particular, GSM has been used in a no-core approach with realistic interactions, so that unbound systems bearing A=3-5 nucleons could be precisely studied. When the number of nucleons increase, it is more convenient to use the core + valence nucleon picture. An effective interaction has been fitted in this framework, where the statistical errors of fitted parameters have been assessed. Spectra, densities and correlation densities will be considered. GSM has also been extended to the study of reaction observables. Scattering and radiative capture cross sections of light nuclei involving nucleon and deuteron projectiles will be presented for that matter.

Abstract Type

Talk

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