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What locates neutron driplines ?

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The neutron dripline is one of the fundamentals of atomic nuclei, and nuclear physics must be able to depict its location and origin. The neutron dripline has now been known up to Na isotopes experimentally. The mean potential provides us with a natural account of the dripline as the uppermost bound orbit, which seems to work for the majority of light nuclei and explain the appearance of neutron halo. However, the dripline of F-Ne-Na isotopes changes as Z, and the general understanding of this trend seemed to be missing. We explored an alternative underlying picture of the dripline, starting from nuclear forces and including full of correlations. This aim was materialized by performing large-scale shell-model calculations using EEdf1 effective interaction derived in an ab initio way from the chiral EFT interaction [1]. It was presented that the dripline mechanism beyond oxygen isotopes differs from the above-mentioned traditional one. The quadrupole deformation produces binding energies and shifts driplines. This contribution is saturated at a certain common neutron number for different isotope chains, contrary to experimental fact. It is demonstrated that on top of this effect, the monopole interaction drives the dripline further away to different extents depending on Z. This monopole-quadrupole interplay indeed explains the variation of the dripline location from F to Na isotopes. This talk will present a pedagogical sketch of this mechanism [2] as the second dripline mechanism after the traditional one based on the single-particle picture. Some related features of exotic Na and Mg isotopes are discussed if time permits, as further relevance to direct reactions in exotic nuclei.

[1] N.Tsunoda,T.Otsuka,K.Takayanagi et al., Nature, 587, 66 (2020).
[2] T.Otsuka, Physics, 4, 258-285 (2022).

Topic

Theory

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