Shape and energy spectra of Λ hypernuclei in the framework of Skyrme-Hartree-Fock model

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We combined the triaxially shape-constrained Skyrme Hartree-Fock (SHF) +BCS mean-field model and the density-dependent NSC89 $N\Lambda$ interaction to investigate the potential energy surface (PES) of the hypernuclei Λ hypernuclei ${}^{13}_{\Lambda}$C, ${}^{21}_{\Lambda}$Ne, ${}^{25,27}_{\Lambda}$Mg, and ${}^{27,29}_{\Lambda}$Si. We found that, in general, the addition of one Λ reduces slightly the quadrupole shape of a nuclear system. From ${}^{13}_{\Lambda}$C to ${}^{29}_{\Lambda}$Si the change of β due to the addition of a Λ decreases, because the stability of the respective core nuclei increases. The PES of ^{26}Mg and ^{26}Si have γ-soft patterns due to the competition between oblate and prolate energy minima, and the addition of a Λ does not change such patterns significantly.

The Angular momentum projection and particle number projection techniques techniques were used in this paper to restore the rotational symmetry and particle number conservation broken in the SHF calculation and BCS approximation, respectively. This made it possible to study the hypernuclear energy spectra in the lab-fixed reference frame. The related $E2$ transition probabilities were found to be slightly reduced by adding a Λ, due to the corresponding reduction of both the charge radius and the quadrupole deformation β. The latter change was shown to be the dominant one for all nuclei considered.

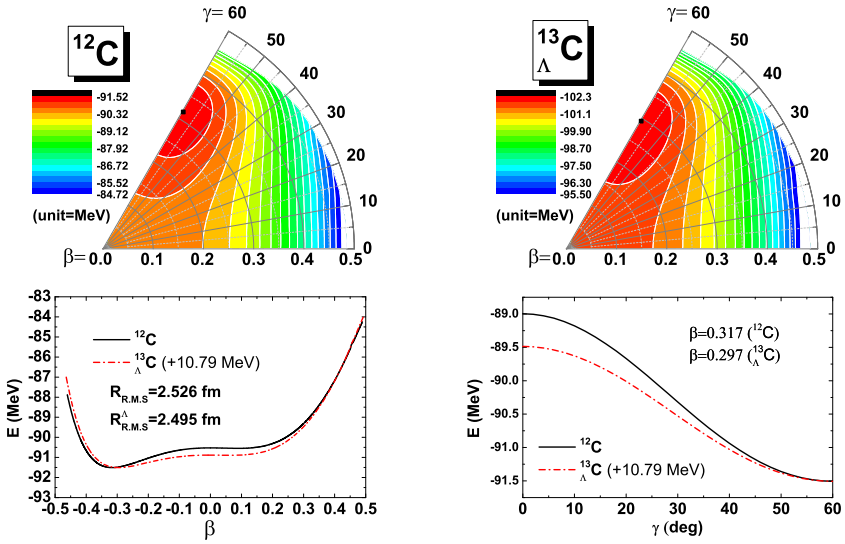

Figure 1: (Color online) (Top row) The PES pattern in the (β, γ) plane for ^{12}C (left) and ${}^{13}_{\Lambda}$C (right). Contour lines are separated by 0.4 MeV. (Bottom row) Binding energy in β direction (left) and γ direction (right; β is fixed at the energy minimum point [black dot]).

[1] Ji-Wei Cui, Xian-Rong Zhou, and Hans-Josef Schulze, Phys. Rev. C 91, 054306 (2015).