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Nuclear deformation effects to the formation cross section of eta(958) mesic nucleus

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The significantly large mass of the $\eta(958)$ (η') meson within the other light pseudoscalar mesons is understood to be generated by the $\mathrm{U_A}(1)$ anomaly and the chiral symmetry breaking. In the nuclear medium, the η' mass is considered to be reduced due to a partial restoration of chiral symmetry [1]. The reduction of the η' mass leads to an attractive η'-nucleus interaction and to a possible existence of η'-nucleus bound states, namely η'-mesic nuclei [2]. The η'-mesic nuclei are believed to provide new insights of the properties of η' meson and the aspects of strong interaction at finite nuclear density.

The first experiment to search for the η'-mesic nuclei by the missing mass spectroscopy in the $^{12}\mathrm{C}(p,d)$ reaction was performed at GSI [3, 4, 5] and the excitation energy spectrum of $^{11}\mathrm{C}$ around η'-meson threshold was obtained. Since no peak structure indicating the η' bound states was found, the upper limits of the formation cross section and the constraints for the η'-nucleus potential parameters were determined [5, 6].

In the analyses in Refs. [5, 6], the $^{11}\mathrm{C}$ core nucleus in the η'-mesic nuclei was implicitly assumed to have the standard nuclear density distribution as usual stable nuclei. However, the latest theoretical work reported in Ref. [7] indicated the possible change of the density distribution of $^{11}\mathrm{C}$ due to the interaction with η'. Thus in this report we investigate theoretically the nuclear deformation (compression) effects to the structures and the formation spectra of η'-$^{11}\mathrm{C}$ bound states to provide the realistic basis to deduce the physical information from the experimental spectra.

Reference

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