SPIN-ISOSPIN RESPONSES OF DEFORMED NEURON-RICH NUCLEI

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Spin-isospin responses of unstable nuclei have attracted a lot of interest. In particular, the Gamow-Teller (GT) strength distribution has been extensively investigated not only because of interest in nuclear structure but also because β-decay half-lives set a time scale for the rapid-neutron-capture process (r-process), and hence determine the production of heavy elements in the universe. The r-process path is far away from the stability line, and involves very neutron-rich nuclei. They are weakly bound and many of them are deformed according to the systematic investigation based on nuclear density functional theory.

To investigate the GT mode of excitation and β-decay properties of the deformed neutron-rich nuclei, we constructed a new framework of the deformed HFB + proton-neutron QRPA employing the Skyrme energy-density-functional self-consistently in both the static and dynamic levels. It is found that the $T = 0$ pairing enhances the low-lying strengths cooperatively with the $T = 1$ pairing correlation, which shortens the β-decay half-lives by at most an order of magnitude in some nuclei.

In this paper, we put emphasis on the roles of the proton-neutron pairing and nuclear deformation in the spin-isospin responses and an impact on the β-decay rates. Furthermore, we discuss the roles of neutron excess on the charge-changing modes of excitation.