Dependence of Two-proton Radioactivity on Nuclear Pairing Models

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Two-proton ($2p$) radioactive decay is one of the typical phenomena, in which the multi-particle quantum resonance plays an essential role. Its elucidation could provide an universal knowledge on the multi-particle quantum phenomena in various domains. Those include, *e.g.* the quantum entanglement, BCS-BEC crossover, and Efimov physics.

Thanks to the experimental developments, there has been a considerable accumulation of data for the $2p$-emitting nuclei. On the other side, however, theoretical studies have not been sufficient to clarify the relation between the $2p$ radioactivity and the nuclear force properties. For this purpose, several theoretical frameworks, in which the quantum resonance with non-perturbative interactions can be discussed, have been utilized. Those can be categorized into two classes: the time-independent, non-Hermitian framework and the time-dependent framework.

In this study, the sensitivity of two-proton emitting decays to the nuclear pairing correlation is discussed within a time-dependent three-body model [1, 2]. We focus on the ^{6}Be nucleus assuming $\alpha + p + p$ configuration, and its decay process is described as a time-evolution of the three-body resonance state. A noticeable model-dependence of two-proton decay width is found by utilizing schematic density-dependent contact (SDDC) and the finite-range Minnesota pairing models. The model-dependence with the SDDC pairing forces can be understood from the density distribution of the resonance state, which reflects a synergy of participating interactions. Our result suggests that two-proton decay width may be a suitable reference quantity to sophisticate the nuclear pairing model beyond the nucleon driplines [2].

References

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