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The isospin-forbidden proton emission of proton-rich sd- and pf- shell nuclei

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The study of beta-delayed decay modes of nuclei near the proton drip line is pivotal for nuclear-structure physics in understanding the role of isospin impurity in the states of outermost imbalance of the proton and neutron numbers with respect to stable nuclei. The mechanism of a beta-delayed decay involves first a beta decay, with the highest probability for a superallowed beta-decay to the isobaric analogue state (IAS), followed by a proton or multi-particle emission. This second-stage proton (or multi-particle) emission from the high-lying IAS is isospin-forbidden, while decay from Gamow-Teller populated states may proceed according to the isospin-symmetry limit. A precisely measured exotic decay scheme and branching ratios for an isospin-forbidden and/or allowed particle emission provide a stringent and sensitive test for a microscopic approach that takes into account isospin non-conservation (INC). With our recently constructed INC Hamiltonians, we calculated the partial decay schemes of some precursors, e.g., 25Si, 29S, 33Ar, 37Ca, 53Ni, etc., within large-scale shell model approach. The microscopic description with an INC Hamiltonian enables us to take into account the isospin-symmetry breaking consistently in all physics processes under consideration, namely, beta decay, proton emission and electromagnetic de-excitation. The results show an excellent agreement with available experimental data.

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