QRPA CALCULATIONS OF STELLAR WEAK-INTERACTION RATES

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Weak-decay rates under various stellar density and temperature conditions are studied in several mass regions including neutron-deficient medium-mass waiting-point nuclei involved in the rp-process, neutron-rich medium-mass isotopes involved in the r-process, and pf-shell nuclei of special relevance as constituents in presupernova formations. Weak rates are relevant to understand the late stages of the stellar evolution, as well as the nucleosynthesis of heavier nuclei [1,2,3].

The nuclear structure involved in the weak-decay processes is described within a microscopic deformed quasiparticle random-phase approximation (QRPA) based on a self-consistent mean field obtained from Skyrme Hartree-Fock + BCS calculations. This approach reproduces reasonably well both the experimental beta-decay half-lives and the Gamow-Teller strength distributions measured under terrestrial conditions from beta-decay in the case of the unstable nuclei [4,5] and from charge-exchange reactions [6] in the case of stable nuclei. In this work we discuss the various sensitivities of the Gamow-Teller strength distributions to the the nuclear model, as well as the sensitivity of the weak-decay rates to both density and temperature [6,7].

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