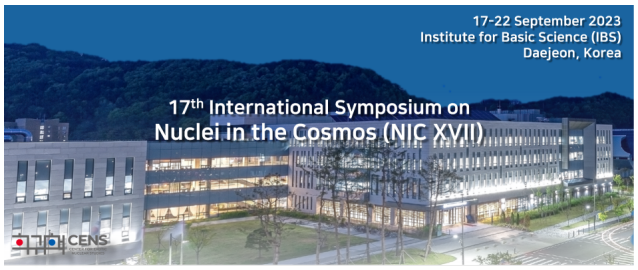

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QRPA calculations of weak-interaction rates in stellar conditions

Tuesday, 19 September 2023 17:50 (5 minutes)

Weak-interaction rates, including beta-decay and capture of electrons from the stellar plasma, are studied under various density and temperature conditions of astrophysical interest. The study focuses on different nuclear mass regions, such as 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 importance as constituents in pre-supernova formations.

The nuclear structure involved in the weak processes is described within a microscopic proton-neutron quasi-particle random-phase approximation with residual interactions in both particle-hole and particle-particle channels on top of a deformed Skyrme Hartree-Fock mean field with pairing correlations. This approach is found to reproduce reasonably well both the experimental beta-decay half-lives and the Gamow-Teller strength distributions measured under terrestrial conditions. Compared to terrestrial half-lives, the stellar ones receive contributions from thermally populated excited states in the decaying nucleus, as well as from electron captures in the stellar plasma. Both effects may modify substantially the weak-decay rates measured in the laboratory.

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