Weak Decay Rates for Neutron Deficient Medium-Mass Isotopes Relevant for the rp-Process *

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Weak interaction rates are studied in neutron-deficient medium-mass waiting-point isotopes in ranges of densities and temperatures relevant for the *rp* process [1]. The nuclear structure involved in the process is described within a deformed quasiparticle random phase approximation based on a selfconsistent mean field obtained from Skyrme Hartree-Fock + BCS. This microscopic model has been shown to reproduce [2] not only the experimental half-lives but also the more demanding Gamow-Teller strength distributions that have been measured with high accuracy from β-decay experiments in the whole Q-energy window [3,4]. Although the decay properties may be different at the high temperatures and densities characteristic of the *rp*-process scenarios, success in their description under terrestrial conditions is a requirement for a reliable calculation of the weak decay rates in more general conditions.

In this work we analyze the ingredients needed to describe the rates in a reliable way, as well as the various sensitivities of the decay rates to both density and temperature [5]. In particular, in a first step we study the contributions to the decay rates coming from excited states in the parent nucleus, which are populated as the temperature increases. In agreement with previous studies [6], it is found that, in general, below $T = 3$ GK their effect can be safely neglected, and thus, the decay from the ground state is already a good approximation for *rp* processes. Nevertheless, special attention should be paid to the cases where the 2^+ excited states are particularly low in energy, because their contributions can be competitive at these temperatures. We then study the continuum electron capture rates, whose origin is related to the fact that atoms in *rp* scenarios are completely ionized and the electrons are no longer bound to the nuclei, but forming a degenerate plasma obeying a Fermi-Dirac distribution. It is found that its effect is enhanced as the temperature and density increase and becomes comparable to the β^+ decay rates at *rp* peak conditions. At slightly larger values of temperatures and densities continuum electron capture dominates over β^+ decay. This point is important because these contributions have been usually neglected in earlier evaluations of weak decay rates at *rp* conditions [1].

* This work was supported by Ministerio de Ciencia e Innovación (Spain) under Contract No. FIS2008–01301.

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