SKYRME-TQRPA CALCULATIONS OF ELECTRON CAPTURE AND BETA-DECAY RATES AT PRESUPERNOVA CONDITIONS

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Electron capture and beta-decay reactions play an important role during the pre-supernova phase in the core of massive stars, having a large influence on the distribution of isotopes synthesized at the advanced stages of stellar evolution [1]. Under supernova conditions with high temperature and density, both processes are mainly given by GT transitions and, thus, their reliable determination requires the accurate description of the GT strength distribution in nuclei.

In order to study the influence of thermal effects on weak process rates, the thermal quasiparticle random phase approximation is combined with the Skyrme energy density functional method (Skyrme-TQRPA) [2, 3]. Calculation of GT strength distribution is carried out for isotopes ^{56,78}Ni. Impact of tensor forces is examined in a fashion similar to how it was previously done at zero temperature [4]. It is demonstrated that the increase of temperature of stellar environment leads to the shift of GT strength to lower energies as a result of thermal population of nuclear excited states according to the Boltzmann distribution. The rates of electron capture and beta-decay are shown to increase correspondingly.

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