Large scale evaluation of β-decay rates of r-process nuclei

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R-process nucleosynthesis models rely, by necessity, on nuclear structure models for input. Particularly important are the β-decay half-lives of neutron-rich nuclei which have a direct impact on the distribution of elemental abundances [1]. The interacting shell model has been applied to the calculation of decay properties of nuclei, but due to the computational cost, it is restricted to the nuclei around the closed shells leaving the quasiparticle random phase approximation (QRPA) as the only approach able to provide results across the whole nuclear chart. However, currently only a single large-scale calculation of β-decay properties exists, and it is based on an QRPA calculation with a schematic calculation on top of the Finite Range Droplet Model [2]. In this work we utilize a fully self-consistent theoretical framework based on the relativistic Hartree-Bogoliubov (RHB) model + QRPA in order to study both the allowed and the first-forbidden transitions in several thousand nuclei involved in the r-process nucleosynthesis. The transition rates, together with the obtained beta-delayed neutron emission probabilities are then employed in the r-process simulations with the goal of obtaining the resulting elemental abundances.

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