IMPACT OF THE FIRST-FORBIDDEN BETA DECAY ON THE PRODCUTION OF THE A~195 R-PROCESS PEAK

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We investigated the effects of first-forbidden transitions in β decays on the production of the r-process A ∼195 peak. Theoretical calculated β-decay rates with β-delayed neutron emission were examined using several astrophysical conditions. We adopted β-decay rates calculated based on the spherical QRPA method with realistic forces. We adopted a recent magneto-rotational supernova (MR-SNe) model as well as a neutron star merger model and a proto-neutron-star wind (PNSW) model that have been used in previous studies. These astronomical models cover a range of realistic physical conditions of the r-process environments. The reached conclusions are general, and are independent of the chosen nuclear physics input calculation. We found the following impacts on the production of the A =195 r-process abundance peak:

(i) The inclusion of the first-forbidden β decay leads to faster progress of the r process for the waiting-point nuclei. This is mostly caused by the shorter β-decay half-lives of the $N\sim126$ nuclei. This shifts the A ∼195 peak towards higher masses and results in slightly wider distribution.

(ii) The delayed neutron emission widens the abundance peak in the direction of smaller neutron number, modifying its lower mass tail. The asymmetry of neutron emission probability between the odd and even Z nuclei smoothens the final abundances during the decay phase.

These characteristics are commonly seen in the all adopted astrophysical models, although the size of the effect depends on physical conditions and details of the nuclear physics inputs.

Details of calculation, results and their interpretation will be presented.