THE IMPACT OF NUCLEAR MASSES NEAR CLOSED SHELLS ON $r$-PROCESS ABUNDANCES

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Nuclear masses are one of the key ingredients of nuclear physics that go into astrophysical simulations of the $r$ process. Nuclear masses effect $r$-process abundances by entering into calculations of $Q$-values, neutron capture rates, photo-dissociation rates, beta-decay rates and the probability to emit neutrons. Most of the thousands of short-lived neutron-rich nuclei which are believed to participate in the $r$ process lack any experimental verification, thus the identification of the most influential nuclei is of paramount importance. We have conducted mass sensitivity studies near closed shells in the context of a main $r$-process. Our studies take into account how an uncertainty in a single nuclear mass propagates to influence the relevant quantities of neighboring nuclei and finally to $r$-process abundances. Using various nuclear models and astrophysical conditions we identify key nuclei in these studies whose mass has a substantial impact on final $r$-process abundances and discuss implications for measurements at radioactive beam facilities.

This work was supported by the Joint Institute for Nuclear Astrophysics grant number PHY0822648.