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Nuclear masses and the r-process astrophysical site

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The key role played by nuclear masses in rapid neutron capture, or r-process, nucleosynthesis has long been recognized. Masses set the reaction flow path for an r-process in equilibrium and influence the neutron capture rates, beta decay rates, and fission properties that determine the final abundances. Here we describe modern efforts to quantify the uncertainties in r-process abundance patterns that result from uncertainties in nuclear masses. In addition we describe a new method to gain insight into the r-process astrophysical environment via the reverse-engineering of unknown nuclear properties. As a specific example, we discuss the rare earth region and show how different assumptions of astrophysical conditions result in distinct predictions for the mass surface in this region. The mass trends we identify will be directly testable by experiment in the near future.

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