

## THE PUZZLE OF THE *r*-PROCESS ASTROPHYSICAL SITE: A NUCLEAR PHYSICS SOLUTION?

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The astrophysical origin of the heaviest elements is a longstanding mystery. While the basic mechanism of production – rapid neutron capture, or *r*-process, nucleosynthesis – was identified almost five decades ago, the astrophysical environment has still not been conclusively determined. A wide variety of candidate sites have been proposed, and their assessment to date has been primarily astrophysical: modelling of individual events to look for neutron-rich environments, and population studies that can be compared to spectroscopic observations. Nuclear physics plays a vital role in this assessment. We discuss the wide variety of beta decay, mass, and neutron capture measurements necessary for accurate predictions of the elements that can be produced in these environments. In addition, we introduce a new approach to the *r*-process problem, complementary to astrophysical probes, in which candidate environments are evaluated in terms of their implications for nuclear physics. As a specific example, we discuss the rare earth region and find that 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.