Nuclear Physics in Astrophysics XI



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The R-Process Alliance: Hunting for Gold (or, maybe just, uranium)

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Heavy elements like gold and uranium are produced via the rapid neutron-capture (r-)process. This process only occurs in rare explosive events in the Universe, like supernovae and neutron star mergers, making it highly challenging for astronomers to gather direct observations of the element creation. Likewise, it is difficult for nuclear physicists to recreate and study the nuclear process in the laboratory. These obstacles are why we today, more than six decades after the theoretical prediction of the r-process, still don't fully understand how and where gold and silver are made in the Universe. However, in 2017, the R-Process Alliance (RPA) initiated a successful new search to uncover bright metal-poor stars enriched with r-process elements. These stars are invaluable laboratories for studying the r-process as the gas from which these stars formed was polluted by at most a few enrichment events — perhaps even a single explosion. The RPA has collected spectra of ~ 2000 stars and discovered over 70 new highly r-process-enhanced stars. I will report recent results from the RPA efforts, including evidence for the formation of super-heavy elements formed during the r-process and abundances from new Hubble Space Telescope observations.

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