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Observations of the r-Process in Galactic Halo Stars: Successes and Frustrations¹

CHRIS SNEDEN, University of Texas at Austin

Our understanding of early Galactic nucleosynthesis was fundamentally changed in the 1980s and 1990s by the serendipitous discovery of a few stars with extremely large abundance enhancements of neutron-capture ($Z > 30$) elements. Detailed spectroscopic analyses of these stars revealed their neutron-capture abundance ratios to be well-matched by the solar-system r-process-only distribution. Subsequent work has significantly sharpened our knowledge of the r-process in low-metallicity Galactic halo stars. Astronomers have found many more r-rich stars and have analyzed them in often excruciating detail; lab atomic physicists have radically altered the quantity and quality of atomic transition data; nuclear experimental physicists have improved reaction rates away from the valley of beta stability; and theoretical nuclear physicists have begun to make realistic r-process abundance predictions. Here I will summarize our observational knowledge of the r-process in stars, trying to distinguish between those results which undoubtedly will stand the test of time, and those still much in need of further development. Suggestions will be given for profitable future studies by astronomers, and requests for vital parallel investigations by physicists.

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