

Chasing the Signature of a Single Prolific R-Process Event in an Ultra-Faint Dwarf Galaxy

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The heaviest chemical elements in the periodic table are synthesized through the rapid neutron-capture (r-) process but the astrophysical site where r-process nucleosynthesis occurs is still unknown. The best candidate sites are ordinary core-collapse supernovae (deaths of massive stars) and mergers of two orbiting exotic neutron stars. 13 billion year old ultra-faint dwarf galaxies preserve a "fossil" record of early chemical enrichment that provides the means to isolate and study clean signatures of individual nucleosynthesis events. Based on new spectroscopic data from the 6.5m Magellan Telescope, we found seven stars in the recently discovered ultra-faint dwarf Reticulum II that show extreme r-process overabundances. This enhancement implies that the r-process material in Reticulum II was synthesized in a single prolific event. Our results are clearly incompatible with r-process yields from an ordinary core-collapse supernova but instead consistent with that of a neutron star merger. This first signature of a neutron star merger in the early universe holds the key to finally, after 60 years, identifying the cosmic r-process production site.



Bio: Anna Frebel is an Associate Professor in the Astrophysics Division of the the Physics Department at MIT in Cambridge, MA. Originally from Germany, she received her PhD from the Australian National University's Mt. Stromlo Observatory. Her postdoctoral work took her to the University of Texas at Austin and the Harvard-Smithsonian Center for Astrophysics in Cambridge, MA. For her research into the oldest stars in the universe and the early evolution of the chemical elements she has received national and international awards including the 2010 Annie Jump Cannon Award (American Astronomical Society) In 2013, she received a CAREER Award from the National Science Foundation, and in 2016 she was named one of ScienceNews Magazine's 10 scientists to watch. Frebel also enjoys communicating science to the public, lately through her popular science book "Searching for the oldest stars: Ancient Relics from the Early Universe."