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A single prolific r-process event preserved in an ultra-faint dwarf galaxy

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The heaviest elements in the periodic table are synthesized through the r-process, but the astrophysical site for r-process nucleosynthesis is still unknown. Ultra-faint dwarf galaxies contain a simple fossil record of early chemical enrichment that may determine this site. Previous measurements found very low levels of neutron-capture elements in ultra-faint dwarfs, preferring supernovae as the r-process site. I present high-resolution chemical abundances of nine stars in the recently discovered ultra-faint dwarf Reticulum II, which display extremely enhanced r-process abundances 2-3 orders of magnitude higher than the other ultra-faint dwarfs. Stars with such extreme r-process enhancements are only rarely found in the Milky Way halo. The r-process abundances imply that the neutron-capture material in Reticulum II was synthesized in a single prolific event that is incompatible with r-process yields from ordinary core-collapse supernovae. Reticulum II provides an opportunity to discriminate whether the source of this pure r-process signature is a neutron star merger or magnetorotationally driven supernova. The single event is also a uniquely stringent constraint on the metal mixing and star formation history of this ultra-faint dwarf galaxy.

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