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The heavies in CEMP

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Elements heavier than iron are predominantly formed through neutron-capture processes, the slow (s-process) and rapid (r-process) neutron-capture processes. The s-process occurs in low- and intermediate-mass stars during the Asymptotic giant branch stage, while the r-process takes place under more extreme conditions, such as neutron star or black hole mergers.

Recently, an intermediate neutron-capture process (i-process) has been proposed to explain the dual s- and r-process enrichment observed in carbon-enhanced metal-poor (CEMP-r/s) stars. However, the astrophysical site of the i-process remains uncertain. Previous studies suggested that CEMP-r/s stars could have been enriched by a low-mass, low-metallicity thermally pulsing asymptotic giant branch (TP-AGB) companion undergoing i-process nucleosynthesis triggered by proton ingestion during its first convective thermal pulses. These conclusions were based on abundance measurements of several lanthanides and heavy elements such as lead (Pb).

Here, for the first time, we determine the abundances of very heavy r-process elements, including terbium (Tb), holmium (Ho), thulium (Tm), tantalum (Ta), iridium (Ir), lutetium (Lu), and ytterbium (Yb). These new measurements are compared with nucleosynthesis model predictions, providing further insights into the i-process and its role in heavy-element enrichment.

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