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## r-Process Radioisotopes from Near-earth Supernovae and Kilonovae

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The astrophysical sites where r-process elements are synthesized remain mysterious: it is clear that neutron star mergers (kilonovae, KNe) contribute, and some classes of core-collapse supernovae (SNe) are also possible sources of at least the lighter r-process species. The discovery of  $^{60}\text{Fe}$  on the Earth and Moon implies that one or more astrophysical explosions have occurred near the Earth within the last few Million years (Myr), probably SNe. Intriguingly,  $^{244}\text{Pu}$  has recently been discovered in deep-sea deposits spanning the past 10 Myr, a period that includes two  $^{60}\text{Fe}$  pulses from nearby supernovae.  $^{244}\text{Pu}$  is among the heaviest r-process products, and we consider whether it was created in the supernovae, which is disfavored by nucleosynthesis simulations, or in an earlier kilonova event that seeded  $^{244}\text{Pu}$  in the nearby interstellar medium that was subsequently swept up by the supernova debris. Accelerator mass spectrometry (AMS) measurements of  $^{244}\text{Pu}$  and searches for other live isotopes could probe the origins of the r-process and the history of the solar neighborhood, including triggers for mass extinctions, e.g., that at the end of the Devonian epoch, motivating the calculations of the abundances of live r-process radioisotopes produced in SNe and KNe that we present here. Given the presence of  $^{244}\text{Pu}$ , other r-process species such as  $^{93}\text{Zr}$ ,  $^{107}\text{Pd}$ ,  $^{129}\text{I}$ ,  $^{135}\text{Cs}$ ,  $^{182}\text{Hf}$ ,  $^{236}\text{U}$ ,  $^{237}\text{Np}$ , and  $^{247}\text{Cm}$  should be present. Their abundances and well-resolved time histories could distinguish between the SN and KN scenarios, and we discuss prospects for their detection in deep-ocean deposits and the lunar regolith samples returned to Earth by missions such as *Chang'e* and *Artemis*.

### Student Submission

No

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