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When Stars Attack! Live Radioactivities as Signatures of Nearby Supernovae

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Supernovae are critical for life in many ways, e.g., their nucleosynthesis is the dominant cosmic source of heavy elements essential for planet formation and ultimately for biology. Yet supernovae take a more sinister shade when they occur closer to home, because an explosion inside a certain "minimum safe distance" would pose a grave threat to life on Earth. We will discuss these cosmic insults to life, and ways to determine whether a supernova occurred nearby over the course of the Earth's existence. We will then present recent evidence that a star exploded near the Earth about 3 million years ago. Radioactive iron-60 atoms have been found in ancient samples of deep-ocean material, and are likely to be debris from this explosion. Recent, high-quality data confirm this radioactive signal, represent a major step forward for this field. We will present simulations of the supernova impact on the solar system and delivery of ejecta into Earth's orbit. We will show how sea sediments can be used for nuclear astrophysics "archaeology": terrestrial samples of supernova debris allow direct laboratory probes of nucleosynthesis products from an individual explosion.

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