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Search for r-process signatures in collapsars

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Massive stars produce the building blocks of life on Earth, such as carbon and oxygen. However, we still do not understand the physical processes responsible for the production of elements heavier than iron, such as gold, via rapid neutron-capture nucleosynthesis (r-process). The first-ever kilonova associated with the gravitational wave event GW170817 demonstrated that binary neutron star mergers produce heavy elements via rapid r-process nucleosynthesis. However, emerging evidence suggests they cannot be the sole source of this nucleosynthesis. Chemical abundance patterns and evolution history in Milky Way halo stars and dwarf galaxies both suggest a prompt enrichment channel in the early universe, well before the binary neutron stars could merge. This enrichment requires a substantially different type of r-process event. Collapsars, a rapidly rotating massive star that collapses and launches outflows rich in neutrons, are another channel proposed by theoretical works. In this talk, I will present the results of JWST observations of a nearby collapsar SN 2024abup. I will discuss difficulties in separating different line signatures to extract the r-process signatures, and what the future pathways are to solve this problem.

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