Origin and evolution of r-process nuclides in Local Universe

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To understand the feature of elemental abundances as well as their isotope anomalies in the early solar system, the precise knowledge on the astrophysical sites of individual elements is undoubtedly required. The origin of r-process nuclides has remained unidentified and puzzled us for several decades. Since r-process nucleosynthesis demands an extremely neutron-rich environment, the possible sites are limited to two events, i.e., core-collapse supernovae (CCSNe) as deaths of massive stars leaving neutron stars (NSs) or NS mergers. In the recent couple of years, remarkable progress in this issue has been made from both observational and theoretical aspects. Here we report the following latest results.

Heavy r-process nuclides from neutron star mergers

Recent theoretical studies reveal that observed chemical feature of heavy r-process nuclides such as Eu and Ba in the Milky Way is compatible with the enrichment evolutionary paths driven by NS mergers. More direct evidence is clearly seen in Eu (Ba) abundances in external small galaxies (Fig.1).

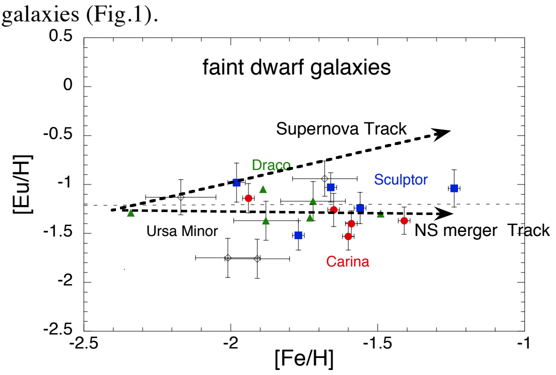

Figure 1: Observed correlations of Eu/H with Fe/H for nearby faint dwarf galaxies. We see no increase in the Eu abundance with time, suggesting that NS mergers are the r-process site.

Light r-process nuclides from core-collapse supernovae

On the other hand, the chemical feature of the Milky Way's halo suggests that light r-process nuclides (*A*<130) such as Sr, Y are produced in the different site, i.e., CCSNe.

Mystery in the early Universe

However, the origin of early heavy r-process nuclides detected in galaxies including our own is still a mystery. It seems hard to identify it as NS mergers. Alternatively, rare SNe likely associated with magnetars might play a key role.