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Impact of Neutron Star Merger and Supernova Nucleosynthesis on the Element Genesis and Neutrino Physics

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GW170817/SSS17a was an event of the century that opened a new window to multi-messenger astronomy and astrophysics. Optical and near-infrared emissions among them suggest that their total energy release is consistent with radiative decays of theoretical prediction of r-process nuclei although no specific r-process element was identified. Core-collapse supernovae (both MHD Jet- and ν-SNe) are viable candidates for the r-process. MHD Jet-SNe explain the universality in the observed elemental r-process abundance pattern in metal poor stars. Neutron star merger (NSM), on the other hand, could not contribute to the early Galaxy for cosmologically long merging time-scale for slow GW radiation. Nevertheless, NSM is still a possible explanation for the solar-system r-process abundance. We propose a novel solution to this twisted problem by carrying out NSM and SN r-process nucleosynthesis calculations in Galactic chemo-dynamical evolution.
We also discuss the impact on neutrino oscillation physics. Heavy elements originate from many processes such as r-, s-, νp-processes. We find that νp-process operates with amounts of free neutrons via weak interactions due to the collective neutrino oscillations. Reaction flows can reach the production of abundant p-nuclei 94Mo, 96Ru, etc. This nucleosynthetic method turns out to be a unique probe indicating still unknown neutrino-mass hierarchy.

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Talk/Poster

Talk

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