Contribution ID: **46** Type: **Invited Talk**

Origin of r- and nu-process elements in cosmic evolution and nuclear physics

Sunday, 8 September 2024 11:10 (25 minutes)

There is a growing consensus in recent multi-messenger astronomy that the explosions of single massive stars, i.e. magneto-hydrodynamic jet supernovae and collapsars, dominate the r-element enrichment over the entire history of cosmic evolution, while kilonovae could partly contribute to recent epoch due to the cosmologically long time-delay of merging binary neutron stars [1,2]. We have recently found that the i- and s-processes could follow the collapsar r-process [3]. These explosive phenomena emit extremely large flux of energetic neutrinos and provide unique nucleosynthetic signals of the neutrino-nucleus interactions at high-densities [4]. We first discuss when and how these different astrophysical sites have contributed to the enrichment of the r-process elements in cosmic and Galactic chemical evolution model. We then discuss the roles of nuclear fissions, isomers, neutron-captures, beta-decays and neutrino-weak responses in these explosive nucleosyntheses.

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Session Classification: Theoretical Nuclear Physics for Astrophysics

Track Classification: Theoretical Nuclear Physics for Astrophysics