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r, i & s Nucleosynthesis Sites in Multi-messenger Era of Galactic Chemical Evolution

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GW170817 and SN1987A were the events of the century which opened a window to multi-messenger astronomy and astrophysics. There is a growing consensus that the MHD-Jet supernova and collapsar dominate the heavy r-element production over the entire history of cosmic evolution, and the neutron-star merger contribution delays due to cosmologically long time-delay for slow GW radiation [1,2]. We will first discuss when and how these astrophysical events contribute to the element production in Galactic chemical evolution [3]. We have recently found that the i- and s-processes could occur in the r-process site of collapsar nucleosynthesis [2]. We will propose nuclear experiments to measure the neutron-capture cross sections relevant for the collapsar i-process [4]. These explosive phenomena emit extremely large flux of energetic neutrinos that provide unique nucleosynthetic signals for flavor conversions at high density. We will discuss the neutrino-flavor conversions induced by collective and MSW effects at high density and propose a new astrophysical method to constrain still unknown neutrino mass hierarchy [5,6]. If our theoretical prediction would be verified by precise meteorite analysis of SiC X grains, this could be a piece of evidence constraining still unknown neutrino mass hierarchy, which is complementary to laboratory experiments on vacuum oscillation [7].

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