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Are Neutron Star Mergers Really the Dominant r-Process Site?

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Neutron star mergers (NSMs) are popular candidates for being the dominant r-process site in the universe. Several arguments such as nucleosynthesis calculations, the recent gravitational wave detection GW170817 and its associated multi-wavelength electromagnetic emission, and galactic chemical evolution studies that require NSM rates similar to what is established by LIGO/Virgo, all point toward the idea that NSMs could be at the origin of the heaviest r-process elements. In this talk, however, I will focus on the current problems that are emerging from this idea. Besides the well known problem of the minimal delay time needed for NSMs to pollute metal-poor stars in the Galactic halo, there exist a deeper problem related to the temporal profile of the delay-time distributions of these events. Indeed, there is a serious discrepancy between the fields of galactic chemical evolution, binary population synthesis, and astronomical observations. In order to recover the decreasing chemical evolution trend of europium (an r-process element) in the metal-rich stars of the Galactic disk, chemical evolution simulations require a delay-time distributions for NSMs that are incompatible with population synthesis predictions and gamma-ray burst observations. I will review and describe the extent of this challenge, and discuss its implications on the quest to isolate the dominant site of the r process.

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