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The cosmic merger rate density of compact binaries

With the recent publication of the second gravitational wave transient catalog by the LIGO-Virgo collaboration (LVC), the number of binary compact object mergers has risen dramatically, from a dozen to ~ 50 events. From these detections, the LVC inferred the merger rate density both in the local Universe and as a function of redshift. It is then of foremost importance to compare the merger rate density predicted by different astrophysical models with the value inferred by the LVC. In my talk, I will present a semi-analytic model that evaluates the cosmic merge rate density, by taking into account the cosmic star formation rate density and the metallicity evolution of stars across cosmic time. These are then combined with catalogues of merging compact binaries. I have considered binaries that form in isolation versus dynamical binaries. My results indicate that dynamical binaries are much less sensitive to stellar metallicity than isolated binaries (Santoliquido et al. 2020 - arXiv: 2004.09533). Furthermore, I have explored the impact of various binary evolution processes on the merger rate density. For example, when I vary the common envelope ejection efficiency parameter from α_{CE}=7 to 0.5, the local merger rate density of binary neutron stars varies from 10^3 to 20 Gpc^{-3} yr^{-1}, whereas the local merger rates of binary black holes and black hole - neutron star binaries vary just by a factor of ~2-3. I will also show that by propagating the uncertainties of the metallicity evolution model on the merger rate density, the binary black hole merger rate can change by one order of magnitude within 50% credible interval (Santoliquido et al. 2021 - arXiv: 2009.03911).

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