Massive double compact object mergers: gravitational wave sources and r-process element production sites

N. Mennekens, D. Vanbeveren

Astrophysical Institute, Vrije Universiteit Brussel

With our galactic evolutionary code that contains a detailed intermediate mass and massive binary population model, we study the temporal evolution of the galactic population of double neutron star binaries, mixed systems with a neutron star and black hole component and double black hole binaries. We compute the merger rates of these relativistic binaries and we translate them into LIGO II detection rates. We demonstrate that accounting for the uncertainties in the relation 'initial mass-final mass' predicted by massive close binary evolution and due to the possible effect of large stellar wind mass loss during the luminous blue variable phase of a star with initial mass larger than 30-40 Mo and during the red supergiant phase of a star with initial mass smaller than 30-40 Mo when such a star is a binary component, the double black hole merger rate may be very small, contrary to predictions made by other groups. Hydrodynamic computations of r-process chemical yields ejected during the relativistic binary merger process have recently become available. With our galactic code that includes binaries it is then straightforward to calculate the temporal galactic evolution of the r-process elements ejected by these mergers. We conclude that except for the earliest evolutionary phase of the Galaxy (~the first 100 Myr) double compact star mergers may be the major production sites of r-process elements and it is probable that the mixed systems dominate this production over double neutron star binary mergers.

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Email: dvbevere@vub.ac.be