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Realistic Detection and Early Warning of Binary Neutron Stars with Decihertz Gravitational-wave Observatories

Tuesday, 24 May 2022 13:30 (2 hours)

We investigated the detection and localization of binary neutron star (BNS) populations with decihertz gravitational-wave observatories in a realistic detecting strategy, including real-time observations and early warnings. Assuming 4 years' operation of B-DECIGO, we found that the detected BNSs can be divided into three categories: (a) sources that merge within 1 year, which could be localized with an uncertainty of $\Delta\Omega \sim 10^0 \mathrm{deg}^2$; (b) sources that merge in 1-4 years, which take up three quarters of the total events and yield the most precise angular resolution with $\Delta\Omega \sim 10^{-2}\mathrm{deg}^2$ and time-of-merger accuracy with $\Delta t_c \sim 10^{-1}$s; and (c) sources that do not merge during the 4-yr mission window, which enable possible early warnings, with $\Delta\Omega \sim 10^{-1}\mathrm{deg}^2$ and $\Delta t_c \sim 10^0$s. Furthermore, we compared the pros and cons of B-DECIGO with the Einstein Telescope, and explored the prospects of detections using 3 other decihertz observatories and 4 BNS population models. In realistic observing scenarios, we found that decihertz detectors could even provide early-warning alerts to a source decades before its merger while their localizations are still more accurate than ground-based facilities.

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