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Multiband Gravitational Wave Observations at the Low to Middle and High Frequencies.

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The ground-based gravitational wave (GW) observations discover a population of merging stellar binary black holes (BBHs), which could also be detected by the space-based low-frequency GW detectors, such as LISA, Taiji and Tianqin, in their early inspiral stages. The middle-frequency GW band, a missing link between the high-frequency and low-frequency band, is an important piece for multiband GW observations of stellar BBHs. There are several different proposed detectors (e.g. DECIGO, AMIGO, BBO and LGWA) for the middle-frequency band. We investigate the multiband GW detections of stellar BBHs and demonstrate the advantages of such observations in improving the localization and parameter estimations of the sources. We generate mock samples of BBHs by considering different formation models as well as the merger rate density constrained by the current observations (GWTC-3). We specifically consider the astrodynamical middle-frequency interferometer GW observatory (AMIGO) in the middle-frequency band and estimate that it may detect 21–91 BBHs with signal-to-noise ratio $\varrho \geq 8$ in a 4-yr observation period. The multiband observations by the low-frequency detectors（LISA and Taiji) and the middle-frequency detector (AMIGO) may detect 5–33 BBHs with $\varrho_{\rm LT} \geq 5$ and $\varrho_{\rm AMI} \geq 5$, which can evolve to the high-frequency band within 4 yr and can be detected by CE and ET. The joint observations of LISA-Taiji-AMIGO-ET-CE can also lead to an improvement of the localization and the measurement precision of the chirp mass by a factor of ~120, ~2.4×10^5, ~1.8×10^4, or ~1.2×10^4, and ~5.5×10^4, ~16, ~120, or ~5, comparing with those by CE-ET, AMIGO, LISA-Taiji, or LISA-Taiji-AMIGO.

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