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Taming systematics in distance and inclination measurements with gravitational waves: role of the detector network and higher-order modes

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Gravitational-wave (GW) observations of compact binaries have the potential to unlock several remarkable applications in astrophysics, cosmology, and nuclear physics through accurate measurements of the source luminosity distance and inclination. However, these parameters are strongly correlated when performing parameter estimation, which may hamper the enormous potential of GW astronomy. We comprehensively explore this problem by performing Bayesian inference on synthetic data for a network of current and planned second-generation GW detectors, and for the third-generation interferometer Einstein Telescope (ET). We quantify the role of the network alignment factor, detector sensitivity, and waveform higher-order modes in breaking this degeneracy. We discuss the crucial role of the binary mass ratio: in particular, we find that ET can efficiently remove the error in the distance as long as the compact binary is asymmetric in mass.

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