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Gravitational wave informed pointing of short-gamma-ray bursts observations

Poster Abstract:

The dawn of multimessenger astrophysics (MMA) with the joint observation of gravitational waves (GWs) and gamma-rays from a binary neutron star (BNS) merger initiated a transformative era in astrophysical research. Our study proposes utilizing early-warning GW signals preceding BNS mergers to refine source location and viewing angle determination. By simulating diverse BNS populations on NASA high-performance computing clusters and accounting for modeling uncertainties, we aim to probabilistically infer key binary orientations and locations, crucial for optimizing gamma-ray observability. As observed through GWs by both current and XG observatories, the simulated population of BNS signals spans a range of distances corresponding to redshifts between 0.05 and 2. These redshift ranges align with the observing capabilities of instruments like Swift and anticipated future space-based high-energy EM observatories. The population is designed to encompass one thousand BNS observations, equivalent to about a day's observations using an XG-GW detector network operating at complete sensitivity. This scale is crucial for achieving the required statistical power in developing a predictive model. This interdisciplinary effort spans theoretical studies, simulations, and data analysis, aimed at revealing fundamental neutron star physics and enhancing our understanding of the Universe's evolution. The central objective of this endeavor is to construct a probabilistic framework capable of accurately deducing the orientation and location of BNS systems from noisy EM-GW simulated data.

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