

The Probability Distribution of Astrophysical Gravitational-Wave Background Fluctuations

The coalescence of compact binary stars is expected to produce a stochastic background of gravitational waves (GW) observable with future GW detectors. Such backgrounds are usually characterized by their power spectrum as a function of frequency. Here, we present a method to calculate the full 1-point distribution of strain fluctuations. We focus on time series data, but our approach generalizes to the frequency domain. We illustrate how this probability distribution can be evaluated numerically. In addition, we derive accurate analytical asymptotic expressions for the large strain tail, which demonstrate that it is dominated by the nearest source. As an application, we also calculate the distribution of strain fluctuations for the astrophysical GW background produced by binary mergers of compact stars in the Universe, and quantify the extent to which it deviates from a Gaussian distribution. Our approach could be useful for the spectral shape reconstruction of stochastic GW backgrounds.

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