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Probing Remnant Properties of Binary Black Hole Mergers Using a Novel Ringdown Analysis

Abstract

The quasi-normal modes (QNMs) in the ringdown gravitational waves of a binary black hole (BBH) merger are uniquely determined by their frequencies and damping times, which depend only on the mass and spin of the remnant black hole. The measurement of these frequencies and damping times can be used in two ways. Firstly as a test of general relativity (GR) and secondly to identify BBH mergers with unusual remnant properties, indicating the existence of a new population of stellar mass BBH mergers. We propose a novel ringdown analysis based on the cWB-reconstructed signal. This allows us to measure the frequency and damping time of the dominant (l=2,m=2) mode.

We also study the effects of non-gaussian noise on the reconstructed parameters. This analysis yields significantly tighter constraints on the frequency and damping time than previous measurements. The improved precision is due to the noise reduction provided by the cWB reconstruction and the novel ringdown analysis, which allows us to probe remnant properties closer to the merger. We have used publicly available BBH detections for this analysis.