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Accounting for Ringdown Mode-Mixing in Black-Hole Merger Waveforms BERNARD KELLY, JOHN BAKER, NASA Goddard Space Flight Center — With rapid progress in numerical relativity recent years, the merger of comparable-mass black-hole binaries has become a reliable source of gravitational waveforms. The dominant harmonic modes $(l, m) = (2, \pm 2)$ are readily extracted and agree across research groups to high precision, making them suitable as raw material for high-accuracy template construction. However, examination of leading subdominant gravitational harmonic modes has revealed more complex behavior that impedes full modeling. For example, the $(3, \pm 2)$ mode, usually comparable to the $(4, 4)$ in power content near merger, shows a complex frequency oscillation after merger, when the system should be ringing down to a Kerr end-state with constant quasi-normal mode (QNM) frequencies. Analysis indicates some kind of mode-mixing between the nominal $(3, 2)$ mode and the dominant $(2, 2)$ mode. We discuss the possible sources of this mode-mixing in numerical wave-extraction algorithms, and how to mitigate it to produce better-behaved waveforms that can be used for parameter estimation in gravitational-wave data analysis.

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