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Estimating gauge errors in Newman-Penrose extrapolated waveforms via comparison with Cauchy Characteristic Extraction NICHOLAS TAYLOR, Caltech, MICHAEL BOYLE, Cornell, CHRISTIAN REISSWIG, MARK SCHEEL, BELA SZILAGYI, CHRISTIAN OTT, Caltech, SXS COLLABORATION
— Several methods exist for extracting gravitational waveforms (GW) from numerical simulations of compact object binaries. Understanding the uncertainties in these methods is essential for obtaining trustworthy waveforms. A popular method of obtaining waveforms is to extract the Newman-Penrose scalar Psi4 at several finite radii in a simulation, and then to extrapolate these data to future null infinity in order to remove near-field effects. However, the waveforms thus obtained may still be contaminated by unknown gauge (coordinate) effects. In order to estimate these gauge errors, we consider Cauchy Characteristic Extraction (CCE). Although computationally more expensive, this method yields, by construction, gauge-invariant waveforms at future null infinity. Using data from several binary black hole simulations performed with the Spectral Einstein Code (SpEC), we compare extrapolation of Psi4 to CCE. We examine the various sources of uncertainty in these two extraction methods and confirm the gauge invariance of CCE. We then use the CCE waveforms as a basis for estimating the unknown gauge errors in the extrapolated Psi4 waveforms.

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