

The SXS Collaboration catalog of binary black hole simulations

Simulating Extreme Spacetimes collaboration

Abstract

Accurate models of gravitational waves from merging black holes are necessary for detectors to observe as many events as possible while extracting the maximum science. Near the time of merger, the gravitational waves from merging black holes can only be computed using numerical relativity. In this talk, we present a major update of the Simulating eXtreme Spacetimes (SXS) Collaboration catalog of numerical simulations for merging black holes. The catalog contains ~ 2000 distinct configurations, including ~ 1500 spin-precessing configurations, with mass ratios up to 10, and spin magnitudes up to 0.998. The median length of a waveform in the catalog is 39 cycles. We discuss improvements such as correcting for moving centers of mass and extended coverage of the parameter space. We also present a thorough analysis of numerical errors, finding typical truncation errors corresponding to a waveform mismatch of $\sim 10^{-4}$. The simulations provide remnant masses and spins with a typical uncertainty of 0.06% and 0.2%, about an order of magnitude better than analytical models for remnant properties. The full catalog is publicly available at <https://www.black-holes.org/waveforms>.