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Numerical simulations of merging black holes for gravitational-wave astronomy

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Gravitational waves from merging binary black holes (BBHs) are among the most promising sources for current and future gravitational-wave detectors. Accurate models of these waves are necessary to maximize the number of detections and our knowledge of the waves' sources; near the time of merger, the waves can only be computed using numerical-relativity simulations. For optimal application to gravitational-wave astronomy, BBH simulations must achieve sufficient accuracy and length, and all relevant regions of the BBH parameter space must be covered. While great progress toward these goals has been made in the almost nine years since BBH simulations became possible, considerable challenges remain. In this talk, I will discuss current efforts to meet these challenges, and I will present recent BBH simulations produced using the Spectral Einstein Code, including a catalog of publicly available gravitational waveforms [black-holes.org/waveforms]. I will also discuss simulations of merging black holes with high mass ratios and with spins nearly as fast as possible, the most challenging regions of the BBH parameter space.