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Binary Black Holes: Mergers, Dynamics, and Waveforms¹

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The final merger of two black holes is expected to be the strongest gravitational wave source for ground-based interferometers such as LIGO, VIRGO, and GEO600, as well as the space-based interferometer LISA. Observing these sources with gravitational wave detectors requires that we know the radiation waveforms they emit. Since these mergers take place in regions of extreme gravity, we need to solve Einstein's equations of general relativity on a computer in order to calculate these waveforms. For more than 30 years, scientists have tried to compute black hole mergers using the methods of numerical relativity. The resulting computer codes have been plagued by instabilities, causing them to crash well before the black holes in the binary could complete even a single orbit. Within the past few years, however, this situation has changed dramatically, with a series of remarkable breakthroughs. This talk will focus on new simulations that are revealing the dynamics and waveforms of binary black hole mergers, and their applications in gravitational wave detection, data analysis, and astrophysics.

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