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Simulations of binary black hole mergers

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Advanced LIGOs observations of merging binary black holes have inaugurated the era of gravitational wave astronomy. Accurate models of binary black holes and the gravitational waves they emit are helping Advanced LIGO to find as many gravitational waves as possible and to learn as much as possible about the waves sources. These models require numerical-relativity simulations of binary black holes, because near the time when the black holes merge, all analytic approximations break down. Following breakthroughs in 2005, many research groups have built numerical-relativity codes capable of simulating binary black holes. In this talk, I will discuss current challenges in simulating binary black holes for gravitational-wave astronomy, and I will discuss the tremendous progress that has already enabled such simulations to become an essential tool for Advanced LIGO.