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A Hybrid Method for Inspiralling Black-Hole Binaries YANBEI CHEN, DAVID NICHOLS, Caltech — We adapt a method of matching post-Newtonian and black-hole-perturbation theories on a time-like region (which proved useful for understanding head-on black-hole binary collisions) to treat equal-mass, inspiralling black-hole binaries. We first introduce a procedure to calculate a radiation-reaction potential within our method. This allows us to produce a full inspiral-merger-ringdown waveform of the l=2, m=2 mode of the gravitational waveform of an equal-mass black-hole-binary inspiral. This mode qualitatively matches that of numerical-relativity simulations. We then consider a merger of black holes with anti-aligned spins in the orbital plane (the "superkick" configuration). Since the superkick arises from the fact that the mass- and current-quadrupole radiation evolves in phase during the merger and ringdown (when the quasinormal modes have the same frequency), we provide a mechanism within the near-zone of the binary that gives rise to this effect. We show that if the spins of the black holes evolve via geodetic precession in the perturbed black-hole spacetime of our model, then the spins precess at the orbital frequency during merger. In turn, this gives rise to the correct behavior of the radiation and produces a kick similar to that in numerical simulations.

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