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Recent Breakthroughs in Gravitational Self-force

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Gravitational self-force theory provides a natural method of modeling binaries with small mass ratios. By expanding the binary's metric around the background metric of the larger body, this approach greatly simplifies the binary problem while remaining accurate in the highly relativistic regime. In this talk, I summarize the foundations of self-force theory, how it leads to an elegant two-timescale description of the binary problem, and the current state of the art. I particularly focus on two recent breakthroughs: a two-timescale expansion of the field equations for generic orbital configurations, which enables rapid "post-adiabatic" waveform generation at second order in the binary's mass ratio; and the first calculation of post-adiabatic waveforms. The post-adiabatic waveforms are found to agree well with full numerical relativity waveforms even for mass ratios close to 1, showing that this small-mass-ratio method can be accurate well outside the small-mass-ratio regime.

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