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Can we predict Self-Force from Numerical Relativity?

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It has long been stated that in order to perform precision tests of general relativity (GR) by comparing gravitational wave (GW) models from black hole perturbation theory with observations, one must calculate the phase to the next-to-leading order in the small mass ratio (SMR) expansion. The extent to which this statement is true however needs to be tested. That is, how far can the SMR expansion be pushed towards equal mass ratios before higher-order terms become non-negligible? Comparisons between SMR and numerical relativity (NR) waveforms have been done for quasicircular, equatorial orbits on a Schwarzschild background, during the inspiral with excellent results. The SMR expansion recovers the results of NR for mass ratios of ~1:10, and even produces results comparable to those of NR at equal mass ratios. The SMR model is therefore a promising candidate for producing fast and accurate waveforms for both intermediate mass ratio inspirals (IMRIs) and extreme mass ratio inspirals (EMRIs), for which SMR models were originally intended. Recent progress has been made to obtain complete SMR waveforms through the transition to plunge, vital for IMRI modelling. We will present new work comparing SMR and NR waveforms during the transition to plunge for quasicircular orbits on a Schwarzschild background.

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