The Self-force Approach to the Two-body Problem

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The motion of two compact bodies in General Relativity is a fundamental problem. Numerical Relativity techniques have achieved impressive results in the last decade when the mass ratio of the two bodies is not 'too' large. However, in many astrophysical setttings of interest, the mass ratio is 'very' large. For example, the centers of most galaxies host massive black holes which are eagerly devouring smaller astrophysical objects in their vicinity and, in the process, emitting gravitational waves. Such two-body systems have mass ratios of the order of at least tens of a thousand, a regime that is unfortunately out-of-reach for Numerical Relativity. On the other hand, perturbation theory is naturally suited to such regime. Within this framework, the smaller compact object deviates from a geodesic of the space-time created by the massive black hole due to the action of its own field, a self-force. In this talk I will present the self-force approach to modelling binary inspirals, review recent results by the self-force community and particularly focus on a method for calculating the self-force which is based on the Green function of the perturbation wave equation.