APR12-2012-000193
Abstract for an Invited Paper
for the APR12 Meeting of
the American Physical Society

The overlap of numerical relativity, perturbation theory and post-Newtonian theory in the binary black hole problem

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Inspiralling and coalescing binary black holes are among the most promising sources of gravitational radiation to be detected by current ground-based interferometers and future space-based antennas. The detection and analysis of the signals from these highly relativistic sources require very accurate theoretical predictions, for use as gravitational-wave templates to be compared to the output of the detectors. The orbital dynamics and gravitational-wave emission of such systems can be investigated using a variety of approximation schemes and numerical methods in General Relativity: the post-Newtonian formalism, black hole perturbation theory, numerical relativity, and the effective-one-body framework. The last years have seen an increasing amount of activity at the multiple interfaces of all of these analytical and numerical techniques. I will review this recent work, emphasizing the use of coordinate invariant relations to perform meaningful comparisons. Some highlights include (i) the remarkable agreement between the predictions of the various methods, and (ii) the surprising observation that perturbation theory may turn out to be useful in the modelling of comparable mass binary black holes.