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Analytic Solutions to Plunging Geodesics in Kerr.

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Geodesic motion plays a fundamental role in the gravitational self-force approach to solving the relativistic dynamics of binary black holes. In this scheme, the zeroth approximation to the motion of the lighter secondary component is given by a geodesic in the Kerr geometry generated by the (heavier) primary black hole. At higher orders, this motion is corrected by an effective force term, the gravitational self-force, causing the system to evolve. During the inspiral phase, this evolution can be solved using a 2-timescale formalism, adiabatically evolving the system along a sequence of bound geodesics. EMRIs are expected to have mass ratios of order 10^5, and will therefore spend hundreds of thousands of orbits in the strong field regime of the inspiral phase. Consequently, the handful of orbits represented by the transition and plunge phases are generally expected to provide a negligible contribution to the total signal. However, over time evidence has mounted suggesting that the self-force formalism can produce accurate results at much higher mass ratios, and possibly even for comparable mass binaries. The growing applicability for modeling intermediary mass ratio inspirals has inspired further investigations of both the transition regime and the gravitational waves produced during the plunge and subsequent ringdown. In this talk I will present recent work supporting the latter, in which we derive analytic closed form solutions to generic plunges in Kerr.

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