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Fast eccentric and inclined inspirals into a rotating black hole

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Extreme mass ratio inspirals (EMRIs) are a prime gravitational wave source for the upcoming LISA mission and are expected to be both eccentric and inclined with respect to the equatorial plane of the primary. To this end, we develop a model for these inspirals using an action angle formulation of the method of osculating geodesics and a toy model of the gravitational self force (GSF). The resulting equations of motion take hours to solve numerically for a typical EMRI. To overcome this difficulty, we employ near-identity (averaging) transformations (NITs) to remove the rapidly oscillating orbital phases from the equations of motion while accurately modelling the secular evolution of the system to the post-adiabatic accuracy required by the LISA science objectives. However, this averaging technique breaks down when the radial and polar frequencies are an integer ratio of each other and form an orbital resonance. Thus, when in the vicinity of an orbital resonance, we modify the NIT procedure to average out all phase contributions to the equations of motion except those proportional to the resonant phase and when no resonance is present, we switch back to the original NIT procedure. This allows us to model generic inspirals with transient resonances with post-adiabtic accuracy in a matter of seconds.

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