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Hamiltonian formalism for Perturbed Black Hole Spacetimes[1]
DEYAN MIHAYLOV, University of Cambridge, JONATHAN GAIR, University of Edinburgh — Present and future gravitational wave observations provide a new mechanism to probe the predictions of general relativity. Observations of extreme mass ratio inspirals with millihertz gravitational wave detectors such as LISA will provide exquisite constraints on the spacetime structure outside astrophysical black holes, enabling tests of the no-hair property that all general relativistic black holes are described by the Kerr metric. Previous work to understand what constraints LISA observations will be able to place has focussed on specific alternative theories of gravity, or generic deviations that preserve geodesic separability. We describe an alternative approach to this problem a technique that employs canonical perturbations of the Hamiltonian function describing motion in the Kerr metric. We derive this new approach and demonstrate its application to the cases of a slowly rotating Kerr black hole which is viewed as a perturbation of a Schwarzschild black hole, of coupled perturbations of black holes in the second-order Chern-Simons modified gravity theory, and several more indicative scenarios.

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