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Action-Angle formalism for extreme mass ratio inspirals in Kerr spacetime

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We introduce an action-angle formalism for bounded geodesic motion in Kerr black hole spacetime using canonical perturbation theory. Namely, we employ a Lie series technique to produce a series of canonical transformations on a Hamiltonian function describing geodesic motion in Kerr background written in Boyer-Lindquist coordinates to a Hamiltonian system written in action-angle variables. This technique allows us to produce a closed-form invertible relation between the Boyer-Lindquist variables and the action-angle ones, while it generates in analytical closed form all the characteristic functions of the system as well. The expressed in the action-angle variable Hamiltonian system is employed to model an extreme mass ratio inspiral (EMRI), i.e. a binary system where a stellar compact object inspirals into a supermassive black hole due to gravitational radiation reaction. We consider the adiabatic evolution of an EMRI, for which the energy and angular momentum fluxes are computed by solving the Teukolsky equation in the frequency domain.

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