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Probing deviations to Kerr geometry with extreme mass-ratio inspirals

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One of the primary research aims of the Laser Interferometer Space Antenna (LISA) mission is to comprehensively map the Kerr spacetime, a fundamental pursuit in the realm of general relativity. To achieve this goal, it is essential to develop precise tools capable of discerning any deviations from the Kerr geometry. Extreme mass-ratio inspirals (EMRIs) stand out as particularly promising sources for probing the spacetime metric, offering profound insights into the gravitational phenomena. In this direction, we analyze a deformed Kerr geometry, being the central source of an EMRI system, with an inspiralling object that exhibits eccentric equatorial motion. We conduct a leading order post-Newtonian analysis and examine the deviations in gravitational wave fluxes and phase, emerging at two post-Newtonian order. Our findings evaluate the detectability of these deviations through gravitational wave dephasing, highlighting the pivotal role of LISA observations in advancing our understanding of spacetime geometry.

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