Periodical orbits and waveforms with spontaneous Lorentz symmetry-breaking in Kalb–Ramond gravity

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In the present work, we study time-like geodesics around a spherically symmetric black hole in Kalb–Ramond (KR) gravity, characterized by the parameter l, which induces spontaneous Lorentz symmetry breaking. The geodesic equations and effective potential are derived to investigate the influence of l. We calculate the marginally bound orbits and innermost stable circular orbits, analyzing the parameter's impact. Periodic orbits are computed numerically and classified within the standard taxonomy, revealing significant effects of l on their momentum and energy. Additionally, we explore an extreme mass ratio inspiral system under the adiabatic approximation to derive gravitational waveforms emitted by an object orbiting a supermassive black hole in KR gravity. These waveforms reflect the distinctive characteristics of periodic orbits and highlight the influence of l. With advancements in gravitational wave detection, these results offer insights into black holes influenced by Lorentz symmetry-breaking fields.