EFFECT OF NON–COMMUTATIVE GEOMETRY ON OPTICAL APPEARANCE OF A REGULAR BLACK HOLE

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Abstract

The reconciliation of general relativity with quantum gravity remains a central challenge in theoretical physics. Non-commutative geometry offers a promising path toward this goal by introducing a fundamental minimal length. In this work, we present a novel regular black hole solution derived from a non-commutative gauge theory incorporating a $\partial_r \wedge \partial_\theta$ Moyal twist. We analyze the fundamental properties of this Hayward-like metric, confirming its regularity and exploring its horizon structure. Furthermore, we investigate the black hole's dynamical features by computing its quasinormal modes for scalar perturbations. The characteristics of the photon sphere and shadow are studied through null geodesics and the Gaussian curvature, while the topological feature is analyzed. Finally, we derive stringent constraints on the non-commutativity parameter Θ and the Hayward parameter l using EHT observational data. This work provides a comprehensive framework for testing non-commutative geometry through astrophysical observation.