TEMPERATURE AND PHASE TRANSITION OF A DEFORMED SCHWARZSCHILD BLACK HOLE IN NON-COMMUTATIVE GAUGE THEORY OF GRAVITY

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Abstract

In this study, we investigate the Hawking temperature and phase transitions of a deformed Schwarzschild black hole (SBH) within the non-commutative (NC) gauge theory of gravity (GTG). First, we compute the leading-order NC corrections (in the parameter Θ) to the metric components using the star product and the Seiberg-Witten map (SW), taking into account both the (r, θ) and (r, ϕ) twists. Then, the temperature of this black hole is obtained using the NC event horizon with a correction up to the second order in Θ. The obtained results show that the non-commutativity removes the divergence behavior of the temperature, and makes a difference in the poles-equator temperature. Also, the estimation of the NC parameter shows a new fundamental length at the Planck scale $\Theta^{Phys} \sim 10^{-35}m$, which indicates that spacetime is quantized at the Planck level. Finally, a simple analysis to the heat capacity show a phase transition of the NC SBH, and predicts a new evaporation scenario. Also, this geometry prevent SBH from a complete evaporation leading to the emergence of a stable BH remnant in the final stage of evaporation is emerged.