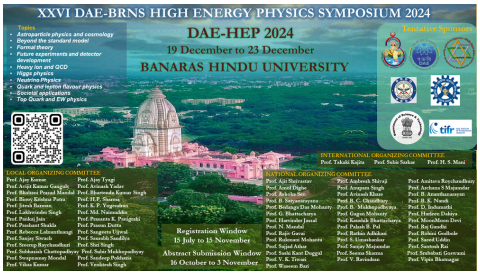

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The Phase Diagram of AdS5 Black Holes with Four Derivative Corrections

Motivated by recent studies of supersymmetric black holes, we revisit the phase diagram of both non-BPS and BPS AdS_5 black holes in grand canonical ensemble using recently constructed four derivative effective action. In the universal two derivative theory, for non-BPS AdS_5 black holes, three distinct limits exist where the phase diagrams change qualitatively. In the sub critical electric potential limit ($0 \leq \Phi < \sqrt{3}$), the phase diagrams resemble those of Schwarzschild black holes, featuring branches for small and large black holes, with the latter undergoing a Hawking-Page (HP) transition. Considering the four derivative (α) corrections to be small, the Schwarzschild-like behavior remains intact. For temperatures below T_{HP}, α corrections destabilize both small and large black holes; however, for temperatures above T_{HP}, they continue to destabilize the small black hole while stabilizing the large one. In the critical electric potential limit ($\Phi = \sqrt{3}$), only large black holes with negative Gibbs free energy exists, with no HP transition occurring and α corrections stabilize these large black holes. In the maximum angular velocity limit ($\Omega = 1$), only small black holes with positive Gibbs free energy exist, and α corrections destabilize them. Finally we present four derivative corrected phase diagram of BPS AdS_5 black holes with $\varphi' = 0$. The two derivative BPS phase diagram are Schwarzschild kind, hence as expected the effect of α corrections are similar to sub critical electric potential limit of non-BPS AdS_5 black holes.

Field of contribution

Theory

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