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Quantum Black Hole Physics form the Event Horizon

In the realm of quantum gravity theories, predictions suggest deviations from classical black hole solutions. One promising avenue for exploring these deviations is through a model-independent approach that utilizes metric deformations parameterized by physical quantities like proper distance. While this approach preserves the space-time's invariance under coordinate transformations, practical computations are daunting due to the dependence of distance on the deformed metric. Our study focuses on spherically symmetric and static metrics, aiming to establish a self-consistent framework for computing the distance function near black hole event horizons. We achieve this by introducing a minimal level of regularity at the horizon, allowing us to derive explicit (series) expansions of the metric. This advancement enables us to calculate essential thermodynamic quantities, such as the Hawking temperature and entropy, using model-independent expressions that extend beyond the limitations of large mass expansions. Moreover, we investigate the implications of imposing conditions like the absence of curvature singularities at the event horizon. Surprisingly, we uncover violations of these conditions in certain existing models, highlighting the need for further refinement and exploration in the field of quantum gravity and black hole physics

Primary authors: SANNINO, Francesco (Danish IAS and CP3-Origins); DEL PIANO, Manuel (Istituto Nazionale di Fisica Nucleare); HOHENEGGER, Stefan (University of Lyon)

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