Evaporation and information puzzle for 2D nonsingular asymptotically flat black holes

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Abstract

Recent years have witnessed a renewed interest in non-singular black-hole models, which offer a promising solution to the long-standing singularity problem of classical general relativity. Despite this, a detailed quantitative description of their evaporation process and the end state is still lacking. To shed light on these aspects, we consider a setting where all the semiclassical features of evaporation, including backreaction effects, can be kept under control. We build a general class of 2D asymptotically-flat, non-singular dilatonic black holes with a de Sitter core. These feature two horizons, with a related extremal configuration.
We show that the use of a quasistatic approximation to describe the evaporation process leads to an infinite evaporation time. However, when one goes beyond this approximation and takes into account large backreaction effects arising from a large number of Hawking quanta, the evaporation time becomes finite. In both cases, the end state is the extremal configuration. We also discuss the entanglement entropy of the radiation in the quasistatic approximation and the relative Page curve. We find that the latter initially grows, reaches a maximum and then goes down towards zero. Despite the fact that the breakdown of the semiclassical approximation prevents the description of the evaporation process until completion, we have a clear indication of quantum information reconstruction. This suggests the potential implications of nonsingular models in addressing and, potentially, solving the information paradox.

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