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Delicate windows into evaporating black holes

In this work we revisit the model of AdS$_2$ black hole in JT gravity evaporating into an external bath. We study when and how much information about the black hole interior can be accessed in these models through different portions of the Hawking radiation collected in the bath, and we obtain the corresponding full quantitative Page curves. As a refinement of previous results, we describe the island phase transition for a semi-infinite segment of radiation in the bath, establishing the interior access for times within the regime of applicability of the model. For finite sizes segments in the bath, one needs to include the purifier of the black hole microscopic dual together with the radiation segment in order to access the interior information. We identify four scenarios of the entropy evolution in this case, including a possibility where interior reconstruction window keeps appearing and disappearing as time evolves. Analyzing the phase structure of the entropy evolution depending on the parameters of the model, we demonstrate that unlike the semi-infinite segment Page curve which accounts for almost all of the radiation, the finite segment Page curve is very fragile to changes of the parameters. We also discuss the evolution of the subregion complexity of the radiation during the black hole evaporation.

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