Vaidya to Rindler transformation and the Hawking radiation

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Assumptions of finite time formation of trapped region and finiteness of curvature scalars on their boundary are enough to constrain a general spherically symmetric metric to correspond to two classes of solutions of the Einstein equations. Each solution can describe an expanding white hole or an evaporating black hole. In the leading order approximation, evaporating black hole solution takes the form of the Vaidya metric, and we intend to study the nature of the quantum field in the Vaidya background here.

Schwarzschild spacetime behaving Rindler-like near the horizon allows us to use the periodicity time trick to derive the Hawking temperature. Rindler coordinate transformation from the Vaidya metric to apply the periodicity time trick is an entirely nontrivial task because of the time dependence of the metric. We obtain the Hawking temperature for the Vaidya metric using the periodicity time trick here to show that this trick would be useful not only for stationary spacetimes but also for dynamical spacetimes.

However, there are limitations to the finite time periodicity trick as we could not know the hidden assumptions behind the extracted temperature from this method, including the choice of the particular vacuum state. To identify the limitations and to uncover the hidden assumptions behind this trick, we rederive the Hawking temperature explicitly using the field-theoretic calculation on the Vaidya background. This is still a work in progress.