

$\langle \phi^2 \rangle$ for a scalar field in 2D black holes: A new uniform approximation

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Abstract

We study nonconformal quantum scalar fields and averages of their local observables (such as $\langle \phi^2 \rangle_{\text{ren}}$ and $\langle T_{\mu\nu} \rangle_{\text{ren}}$) in the spacetime of a two-dimensional black hole. In order to get an analytical approximation for these expressions the WKB approximation is often used. We demonstrate that at the horizon the WKB approximation is violated for a nonconformal field, that is, when the field mass or/and the parameter of nonminimal coupling does not vanish. We propose a new "uniform approximation" which solves this problem. We use this approximation to obtain an improved analytical approximation for $\langle \phi^2 \rangle_{\text{ren}}$ in the two-dimensional black hole geometry. We compare the results obtained with numerical calculations. © 2003 The American Physical Society.

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