

Analytical approximation of the stress-energy tensor of a quantized scalar field in static spherically symmetric spacetimes

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Abstract

Analytical approximations for $\langle \phi^2 \rangle$ and $\langle T_{\nu\mu} \rangle$ of a quantized scalar field in static spherically symmetric spacetimes are obtained. The field is assumed to be both massive and massless, with an arbitrary coupling ξ to the scalar curvature, and in a zero temperature vacuum state. The expressions for $\langle \phi^2 \rangle$ and $\langle T_{\nu\mu} \rangle$ are divided into low- and high-frequency parts. The contributions of the high-frequency modes to these quantities are calculated for an arbitrary quantum state. As an example, the low-frequency contributions to $\langle \phi^2 \rangle$ and $\langle T_{\nu\mu} \rangle$ are calculated in asymptotically flat spacetimes in a quantum state corresponding to the Minkowski vacuum (Boulware quantum state). The limits of the applicability of these approximations are discussed. © 2003 The American Physical Society.

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