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Black hole in thermal equilibrium with a spin-2 quantum field

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Abstract

An approximate form for the vacuum averaged stress-energy tensor of a conformal spin-2 quantum field on a black hole background is employed as a source term in the semiclassical Einstein equations. Analytic corrections to the Schwarzschild metric are obtained to first order in ∈=ℏlM 2, where M denotes the mass of the black hole. The approximate tensor possesses the exact trace anomaly and the proper asymptotic behavior at spatial infinity is conserved with respect to the background metric and is uniquely defined up to a free parameter Ĉ 2, which relates to the average quantum fluctuation of the field at the horizon. We are able to determine and calculate an explicit upper bound on Ĉ 2 by requiring that the entropy due to the back reaction be a positive increasing function in r. A lower bound for Ĉ 2 can be established by requiring that the metric perturbations be uniformly small throughout the region 2M≤r