

Abstract Submitted
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Quantum Corrections to the Mass of a Black Hole coupled to N scalars¹ MARTIN SCHADEN, Rutgers University - Newark — Einstein gravity coupled minimally or conformally to N scalar fields has well-known static and spherically symmetric classical black hole solutions of Schwarzschild and extremal Reissner-Nordström type, respectively. These classical solutions depend on a single integration constant corresponding to their Schwarzschild radius NR . Assuming that this system can be considered in isolation and/or other mass scales may be neglected, the mass m of such a configuration is of the form $m(N \sim \infty) = \frac{c^2 NR}{2G} + \chi \frac{\hbar}{cR} + O\left(G\hbar^2/(c^4 NR^3)\right)$, where $l_P = \sqrt{G\hbar/c^3}$ is the Planck length and R corresponds to the Schwarzschild radius for a single scalar. Only the first two terms of the expansion are relevant in the formal asymptotic limit of an infinite number of only gravitationally interacting scalars forming a black hole whose mass essentially is proportional to the number of degrees of freedom,. The correction to the classical mass that is inversely proportional to R may be interpreted as due to the change in vacuum energy caused by forming a black hole of radius NR , i.e. as a Casimir effect. The dimensionless constant χ describing this correction is estimated semi-classically using periodic orbit theory. The value (and sign) of χ in this approximation is determined by the unstable classical periodic orbits on the photon sphere of the black hole.

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