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Title: Grand canonical ensemble of a d-dimensional Reissner-Nordstrom black hole in a cavity

Abstract: We construct semi-classically the grand canonical ensemble of a d-dimensional Reissner-Nordstrom black hole inside a cavity. We use the path integral approach to compute the partition function of a spacetime inside a cavity, whose boundary is treated as a heat reservoir with a fixed electrostatic potential. To compute the path integral, we make the analytical continuation of the Lorentzian action, thus yielding an Euclidean path integral depending on the Euclidean action. We then perform the semi-classical approximation to the Euclidean path integral, which will be reduced to the contribution of the configuration with least action. We assume that spacetimes with spherical symmetry give the main contribution to the Euclidean path integral. We obtain two solutions for a Reissner-Nordstrom black hole in thermal and electrostatic equilibrium with the cavity in d-dimensions. We also analyse the reduced Euclidean action, which contains information about phase transitions and stability of the two black hole solutions found. We find that the solution with higher mass is stable, whereas the solution with lower mass is unstable.