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Entropy bounds and nonlinear electrodynamics

Demanding the validity of the Generalized Second Law implies the existence of entropy bounds. By considering the absorption of matter from arbitrarily close to the horizon, Bekenstein and collaborators derived a universal entropy bound valid for any charged, rotating distribution of matter (including the Kerr-Newman black hole); and, based on the no-hair conjecture, argued that this bound cannot be further generalized, even when nonlinear interactions are taken into account. In this work we study the analogous situation of a Born-Infeld charged particle falling into an Einstein-Born-Infeld black hole. We derive two modified entropy bounds corresponding to both Schwarzschild and Reissner-Nordström like behaviors for the black hole and verify that both bounds violate the original Bekenstein bound. In the process we derive an important theorem towards obtaining the electrostatic potential of a nonlinear electrodynamics-charged particle in an arbitrary spherically symmetric background.

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