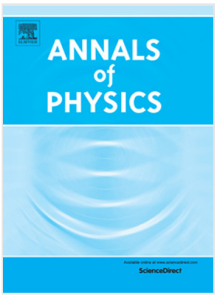

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Black hole as a magnetic monopole within exponential nonlinear electrodynamics

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Abstract

We perform the gauge covariant quantization of the exponential model of nonlinear electrodynamics. Magnetically charged black holes, in the framework of our model is considered, and the regular black hole solution is obtained in general relativity. The asymptotic black hole solution at $r \to \infty$ is found. We calculate the magnetic mass of the black hole and the metric function which are expressed via the parameter β of the model and the magnetic charge. The thermodynamic properties and thermal stability of regular black holes are analyzed. We calculate the Hawking temperature of black holes and their heat capacity at the constant magnetic charge. We find a point where the temperature changes the sign that corresponds to the first-order phase transition. It is shown that at critical point, where the heat capacity diverges, there is a phase transition of the second-order. We obtain the parameters of the model when the black hole is stable.

1 Introduction

Classical electrodynamics is modified due to quantum corrections and becomes nonlinear electrodynamics (NLED). Thus, one-loop corrections in QED lead to nonlinear Heisenberg-Euler electrodynamics [1] which admits the phenomenon of vacuum birefringence. This effect, when indexes of refraction in the presence of the external magnetic field depend on polarization states, is now under experimental verification by PVLAS and BMV collaborations. Therefore, viable models of NLED should describe the birefringence phenomenon. In well-known Born-Infeld electrodynamics [2] the effect of birefringence is absent. But in the modified Born-Infeld electrodynamics, containing two parameters, the birefringence phenomenon takes place

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