

On the Schwarzschild-Kottler black hole with cloud of strings

In the later 1970's and early 1980's, Letelier presented in a series of papers a formalism to treat gravity coupled to a cloud of strings, in the general relativity. Using this formalism, he obtained a generalization of the Schwarzschild solution in the sense that the resulting space-time is generated by a source constituted by a spherically symmetric body of mass M , surrounded by a spherically symmetric cloud of strings, which we are calling Letelier spacetime. Using this same formalism he also obtained the solution of the Einstein's equations corresponding to plane symmetry, as well as, a particular case with cylindrical symmetry. This formalism was motivated by the idea to analyze the role played by a cloud of strings, as source of gravitational fields due to the fact that the universe can be represented, in principle, by a collection of extended objects, like one-dimensional objects, like strings. The use of extended objects, instead of point particles, offers a potential alternative to describe appropriately the physics of the universe with fundamental elements. Otherwise, from the gravitational point of view, it is important to investigate, for example, a black hole with an atmosphere of cloud of strings. On the other hand, the presence of the cosmological constant in different approaches in the framework of general relativity indicates that it is important to take into account the role played by this constant because of its connection with possible gravitational effects of its vacuum energy density in the physics of black holes. With the proposal to analyze the combined effects of the cloud of strings and the cosmological constant, we obtain the solution corresponding to black hole in this scenario and analyze the influence of these sources on the scattering of particles by examining the effective potential, which is investigated in detail, in terms of the parameters involved, namely, the mass of the black hole, the parameter which codifies the presence of the cloud of strings and the cosmological constant. The analysis of these parameters from the point of view of their roles on the conditions necessary for the existence of bound orbits is also discussed.

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