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Topic of Research: Energy-dependent Perturbative Effects on Gravitational Fields

Findings

We have analyzed energy-momentum pseudotensor in the presence of cosmological constant and found a new analytical expression perturbed by cosmological constant in chapter 1.

In chapter 2, we have seen the effect of perturbation on Einstein equation in respect of collapsing system. We have shown that in a collapsing system, perturbing Einstein equation by rainbow function naked singularity does not form, thereby supporting weak cosmic censorship hypothesis.

In chapter 3, we investigated the effect of rainbow gravity on the thermodynamics of black holes. We have seen that rainbow functions cause the black holes to be stable, which can end the information paradox.

Einstein's general theory of relativity has been the most successful theory of gravity that explains the dynamics of gravitating bodies from freely falling stone on earth's surface to cosmological objects like black hole. However, in recent years both theoretical and observational studies suggest a need for modifying the theory. These changes are found to be applicable on a very small scale around plank length as well as at cosmological scales. Which means in classical domain all modified theories are expected to reduce to Einstein's general theory of relativity. With this view of approach, we will apply different types of energy-dependent perturbations in energy-momentum pseudotensor of gravitational field and dust collapse of Tolman-Bondi model. We will also analyze the effects of these energy dependent perturbations on the temperature, entropy and specific heat of black holes.

In chapter 2, we will first analyze the effects of adding the cosmological constant to the Einstein's equations as a perturbation. We found that in the resulting Landau-Lifshitz energy momentum pseudotensor for gravitational field, there are some extra terms, which are cosmological constant dependent as well as coordinate dependent. We also found that this modification leaves energy-momentum tensor asymmetric.

In chapter 3, we will study energy-dependent perturbative effects on Gravitational Fields. This will be done using rainbow gravity. The rainbow gravity would make the geometry of spacetime dependent on the energy of the probe. We will view this energy-dependence as a perturbation to the original Einstein equations. We will start from the original solutions to the Einstein equations, and then deform them using these energy-dependent perturbations. This will be done using rainbow functions. These perturbations can be neglected at large distances or at low energy where the rainbow gravity will reduce to general relativity. However, when the system becomes small, these perturbations cannot be neglected. Thus, the main topic which will be covered in this chapter will be these energy-dependent perturbations produced by rainbow gravity. We will specifically study the consequences of these energy-dependent perturbations on the formation of naked singularity, and Penrose' weak cosmic censorship conjecture. We will discuss the various cases for collapse, and investigate how they get modified by this energy-dependent perturbation.

Finally in chapter 4, We have discussed the consequences of rainbow gravity on the thermodynamics of black holes. In particular, we studied how the temperature, entropy and specific heat of Schwarzschild and Kerr black holes get modified with the introduction of energy dependent perturbation. We also discussed how they can produce stable black remnants.