SEMINARIO

B. S. Kandemir

Ankara University

Hairy BTZ black hole formation in 2D-Dirac materials-graphene

Abstract: Black holes are one of the fascinating objects in physics that are theoretically predicted by general relativity, and observationally verified indirectly in some astrophysical systems. Since the study of physics of gravitational black holes are impossibly difficult in earth-based laboratories, some analogue black hole models that can give the physical properties of the real ones have been developed in the frameworks of acoustics, fluid mechanics and condensed matter physics.
We developed an analogue black hole model on a graphene sheet under the effects of external electric and magnetic fields which can be simulated in the laboratory. To this aim, a two dimensional graphene sheet rolled over a Beltrami trumpet is considered (Cvetic et al., 2012). Its surface is conformally equivalent to the BTZ black hole (Banados et al., 1992) metric solution of the 2+1 dimensional Einstein gravity with cosmological constant. Low energy electron excitations of this curved graphene sheet correspond to the Dirac particles which move in the background gravitational field of the BTZ black hole space-time (Kandemir et al., 2017). The associated energy eigenvalues of these Dirac particles are found, and BTZ black hole parameters such as mass and angular momentum are related to the graphene parameters. In this way, a possible laboratory model of a BTZ black hole in terms of a curved graphene sheet and predictions on Hawking-Unruh radiation is obtained.
Moreover, this model is extended to the case of hairy black holes. Classical black holes are described exactly by their mass, angular momentum and electric charge which is expressed by the statement 'black holes have no hair'. However, some hairy black hole models that are coupled to the external fields have been proposed recently. In this work, we describe an analogue model for the BTZ black hole with scalar hair in terms of two dimensional Dirac materials. By using similar methods to the BTZ black hole case, we find energy eigenvalues and make some predictions on the nature of Hawking-Unruh radiation for the hairy BTZ black hole via two dimensional materials such as dichalcogenides and topological insulators.

Seminario B118, Facultad de Ciencias
Martes 15 de Enero de 2019 (12:00)
Organiza: G.I.R. Física Matemática