National Institute of Technology Rourkela

Progress Seminar

Seminar Title	: Constraining EMDA gravity in presence of plasma using EHT observations of M87* and Sgr A*
Speaker	: Siddharth Kumar Sahoo (Rollno : 521ph1007)
Supervisor	: Indrani Banerjee
Venue	: MC126
Date and Time	: 22 Apr 2025 (11 a.m.)
Abstract	: The present work explores the role of the dilaton charge r_2 and the plasma environment in explaining the observed images of M87* and Sgr A*. Dilaton charges are associated with Kerr-Sen black holes, the stationary, axi-symmetric black hole solution in the Einstein-Maxwell-dilaton-axion (EMDA) gravity which arise in the low energy effective action of superstring theories. We investigate the impact of the background spacetime (here dilaton charge and spin) and the plasma environment in modifying the shape and size of the black hole shadow. The theoretically derived shadow is compared with the observed images of M87* and Sgr A* which enables us to constrain the background spacetime in presence of the plasma environment. Our analysis reveals that the shadow of M87* favors the Kerr scenario and rules out $r_2 > 0.48$, while the shadow of Sgr A* exhibits a marginal preference towards the Kerr-Sen scenario (although GR is allowed within 1-&sigma) and rules out $r_2 > 1$. Thus, large values of dilaton charge are disfavored for M87* and Sgr A* and this result holds good irrespective of the inhomogeneous plasma environment. In fact, the presence of plasma further constrains the allowed parameter space of r_2 and within the observed 1-&sigma interval, the present data cannot distinguish between the Kerr and the Kerr-Sen black holes with mild dilaton charges. Moreover, the shadows of M87* and Sgr A* rule out very dense inhomogeneous plasma environments surrounding these objects and hence, black holes with less dense plasma environments seem to be good sites to detect signatures of dilaton charge. These findings not only underscore the importance of considering plasma effects in shadow related studies but also provide a pathway for refining constraints on alternative gravitational theories using black hole observations.