



INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

Name of the Student : Subhankar Patra

Roll Number : 206121049

Programme of Study : Ph.D.

Thesis Title: General relativistic accretion flow for a diverse class of black holes

Name of Thesis Supervisor(s) : Dr. Bibhas Ranjan Majhi

Thesis Submitted to the Academic Division : Department of Physics

Date of completion of Thesis Viva-Voce Exam : 05/08/2025

Key words for description of Thesis Work : Accretion, Hydrodynamics, Astrophysical black holes, Shock waves, Active galactic nuclei, black hole X-ray binaries

SHORT ABSTRACT

Astrophysical sources such as active galactic nuclei (AGNs) and black hole X-ray binaries (BH-XRBs) are powered through the accretion of matter onto BHs. Their accretion processes are usually modeled by Kerr BHs, the known solutions in general relativity (GR). However, in the literature, theorists have proposed various non-Kerr BHs beyond GR to test the Kerr hypothesis using different astrophysical phenomena. All those analyses essentially evident that such non-Kerr BHs are also compatible with observational data. Therefore, to address the question of whether these non-Kerr metrics are necessary, we need to study their effects on different BH environments. Towards this, in the first part of the thesis, we study the accretion flow (an intricate BH environment) in the Johannsen-Psaltis (JP) and Konoplya-Zhidenko (KZ) non-Kerr spacetimes. We find various transonic solution topologies and their associated spectral properties by solving the hydrodynamical equations in GR framework. We observe that, for both cases, the respective deformation parameters significantly alter different disc features. We essentially compare the accretion properties of these two spacetimes, which characterize the parametric deviations in JP and KZ metrics. In the second part of the thesis, we investigate the transonic accretion flow around the Cardoso BH, which represents the spacetime of a supermassive BH immersed in a dark matter (DM) halo with a Hernquist density profile. We observe that the physical properties of the disc show noticeable deviations from the results for a Schwarzschild BH when the halo compactness is high. We primarily aim to explore the astrophysical implications of DM halos through accretion physics.