CIDMA — CENTRO DE I&D EM MATEMÁTICA E APLICAÇÕES / CENTER FOR R&D IN MATHEMATICS AND APPLICATIONS

universidade de aveiro

Gravitational Geometry and Dynamics Group Seminar

Wed., February 19, 2025, at 11h00.

Room: Online only and **Zoom ID:** 955 4130 8539

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More about Gr@v at: gravitation.web.ua.pt

An Overview of the magnetized advective flows around black holes

One of the most efficient energy sources in the universe is the matter accretion onto compact objects, such as black holes (BHs) and neutron stars (NSs). Since magnetic fields are ubiquitous everywhere, the accretion flow is expected to be magnetized in nature, where the large-scale magnetic fields inside the disks are commonly rooted either from the companion star or the interstellar medium. Being motivated by this, we investigate the structure of low angular momentum magnetohydrodynamic (MHD) accretion flows around a Kerr BH using a general relativistic (GR) framework. To begin with, we adopt a steady, axisymmetric, advective accretion disk, which is threaded by the radial (b^r) and toroidal (b^\phi) components of magnetic fields. These magnetic field lines are frozen in the accreting plasmas following the ideal GRMHD approximation. In addition, we adopt the relativistic equation of state (variable adiabatic index \Gamma) and obtain the family of trans-fast-magnetosonic accretion solutions. In a magnetized flow, the inflowing matter experiences centrifugal repulsion and an additional barrier due to the magnetic pressure that eventually causes a discontinuous shock transition of the flow variables following the necessary jump conditions. With this, we examine the shock dynamics with the variation of radial magnetic flux (\Phi) and the iso-rotation parameter (F). It is worth mentioning that the toroidal magnetic field jumps significantly across the shock front, resulting in a highly magnetized PSC. We further identify the effective region of the parameter space for standing fast-MHD shocks and observe that shock forms for a wide range of flow parameters, namely energy (\mathcal{E}), angular momentum (\mathcal{L}), and radial magnetic flux (\Phi), respectively. Meanwhile, we observe that the shocked GRMHD flow fails to achieve the Magnetically Arrested Disk (MAD) state in the midplane, yet it sustains a 'SANE' (Standard And Normal Evolution) flux. It is intriguing that the present steady state formalism could be useful to provide background seed solutions to perform GRMHD simulations in higher dimensions. Finally, we comment on the possible SEDs from the GRMHD flows.

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