Fully kinetic large scale simulations of the collisionless Magnetorotational Instability

G. Inchingolo[1,2], T. Grismayer[1], N. F. Loureiro[2], R. A. Fonseca[1,3], L. O. Silva[1]

[1] GoLP/Instituto de Plasmas e Fusao Nuclear, Instituto Superior Tecnico, Universidade de Lisboa, Lisbon, Portugal

[2] Plasma Science and Fusion Center, MIT, Cambridge, USA

[3] Instituto Universitário de Lisboa (ISCTE-IUL), Lisbon, Portugal

The magnetorotational instability (MRI) is a crucial mechanism of angular momentum transport in a variety of astrophysical scenarios, as accretion disks nearness neutron stars and black holes. The MRI has been widely studied using MHD models and simulations, in order to understand the behaviour of astrophysical fluids in a state of differential rotation. In radiatively inefficient accretion flow models for accretion onto compact objects, the accretion proceeds via a hot, low-density plasma with the proton temperature larger than the electron temperature. In order to maintain such a two-temperature flow, the typical collision rate must be much smaller than the accretion rate. This suggests that the standard MHD approach for the description of the dynamics of such accretion disks may be insufficient, and a kinetic description is required instead.

Leveraging on the recent result obtained in 2D pair plasma configuration [1], we intend to present our recent results of the analysis of collisionless MRI in electron-ion plasma. Increasing the mass ratio of our simulations, we will show the differences between electron-ion plasma and pair plasma in 2D turbulence, induced consistently during the saturation regime of the MRI. In particular, we will show the influence of micro-scale (both electron and ion scales) instabilities in the evolution of collisionless MRI and how these instabilities affect the activation of a turbulent motion during the saturation of the MRI.

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