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PhD Thesis Abstract

Scaling up plasma micro instabilities in magnetized plasmas up to kinetic turbulent dynamo

During his PhD project, the student will explore plasma processes that can generate magnetic fields in turbulent and rotational regimes and will scale systems up to fluid time and space scales to observe the amplification of the magnetic field via kinetic turbulent dynamo.

To perform these objective, the student will implement in OSIRIS Particle-In-Cell (PIC) code shearing boundary conditions and turbulent routine, to analyze the behaviour of Biermann battery and plasma micro instabilities (Weibel, shear flows, firehose, ...) on kinetic scale in turbulent and rotational regime.

In collaboration with Prof. Nuno Loureiro at the Plasma Science and Fusion Center (PSFC) of MIT, the student will increment the scales of the systems up to fluid scales to reproduce the fluid instabilities that can trigger the turbulent dynamo amplification process. In particular, the student will focus on reproducing Kelvin-Helhmoltz and Magneto-Rotational instabilities in low-magnetized plasmas using OSIRIS.

The final goal of this PhD project will be run the first PIC multi-scale simulation able to study the generation and the amplification of magnetic fields to compare the results with observable astrophysical scenarios.