ID de Contribution: **39** Type: **Présentation orale**

Reduced models of turbulence

mardi 18 juin 2024 16:40 (15 minutes)

Turbulence is ubiquitous in nature. The choice of the theoretical model is particularly important because of its multiscale character. The energy is injected at large scales, coupling phenomena occur at meso-scales, and it is finally dissipated at micro-scales. Kinetic codes include all the physics but they are too heavy to produce simulations in reasonable times. Thus, reduced models are needed.

In this talk, we mainly focus on turbulence in tokamak plasmas. Microinstabilities grow due to spatial gradients, and nonlinearly interact forming turbulence. The turbulent transport is deleterious for the confinement of heat and particles in the tokamak core. Today, the most popular reduced model used for turbulence studies in tokamak plasmas is the gyrokinetic model. Here, we describe some applications of the gyrokinetic model to the multiscale study of turbulence in tokamaks [1]. Other applications of reduced models to turbulence are also mentioned.

References:
[1] A. Biancalani, et al. “Gyrokinetic investigation of Alfven instabilities in the presence of turbulence”, Plasma Physics and Controlled Fusion 63, 065009 (2021), https://iopscience.iop.org/article/10.1088/1361-6587/abf256

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Classification de Session: Présentations