Numerical simulations and linear analysis of Simon-Hoh type instabilities in magnetized plasmas

Sarah Sadouni, Gerjan Hagelaar

LAPLACE (Laboratoire Plasma et Conversion d'Energie), Université de Toulouse, INPT, CNRS,UPS, 118 route de Narbonne, 31062 Toulouse Cedex 9, France
*e-mail: sarah.sadouni@laplace.univ-tlse.fr

Low-temperature magnetized plasmas, submitted to some specific conditions, show an interesting phenomenon: the emergence and growth of instabilities. In this study, the focus is made on the Simon-Hoh instabilities, developing when an electric field and a plasma density gradient occur both in the same direction across the magnetic field [1].

The LAPLACE laboratory in Toulouse elaborated its own self-consistent fluid code called "MAGNIS", previously used for the study of instabilities occurring in the negative ion source ITER. This code considers the plane perpendicular to the magnetic field for its simulations, and can describe the **E**x**B** (crossed electric and magnetic fields) plasma configuration.

The purpose of this study is to compare the instabilities described by MAGNIS to the results of an analytical linear analysis. For this, the fluid equations (continuity and momentum equations) are linearized to the first order and then solved by injecting linear solutions such as existing solutions for the linearized system, to finally end up with a linear dispersion relation. In a second phase, MAGNIS is configured to describe exactly the same system as the analytical analysis, with periodic boundary conditions in one direction and a voltage and density gradient imposed in the other direction. The MAGNIS results are Fourier analyzed in order to measure the growth rate, frequency and wave numbers of the simulated instabilities, which can then be compared with the results from the analytical dispersion relation.

Through this analysis we are able to verify the numerical capabilities of the MAGNIS code and to better understand the behavior of the instabilities over a wide range of the model parameters (electric field, density gradient, magnetic field, ion and electron inertia).

This study is carried out in collaboration with Andreï Smolyakov of the University of Saskatchewan.

Reference

1. A. Simon, The Physics of Fluids, vol. 6, n.3, 382-388 (1963)