Instabilities in the linear plasma device Mistral

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Plasma transport across magnetic field lines has been experimentally studied in the linear machine Mistral to address the physics of plasmas encountered in the scrape-off layer of controlled magnetic fusion machines. The transport in the scrape-off layer is still far from being completely understood and needs to be studied in laboratory plasmas, where parameters can be easily controlled. The Mistral device is dedicated to study cross-field plasma instabilities in the presence of a magnetic field, essentially by optical diagnostics [1, 2]. The linear magnetized plasma column is created by the injection of energetic ionizing electrons (primary electrons) through a diaphragm and is limited at both ends by two planar conducting grids. We mainly focus on the study of plasma flute instabilities regularly rotating around a central plasma. The crucial role of primary electrons has been shown by retarding field analyzer [3] and spectroscopic measurements [1]. The complex radial/azimuthal evolution of the ionic velocity distribution function in the presence of a coherent rotating mode is measured by Laser induced Fluorescence (LIF) [5]. More recently, a fast optical tomographic diagnostic of the plasma emission was installed and is used to measure the 2D profile of the light emitted in a section of the plasma column [4]. The experimental measurements demonstrate a steady rotation of the plasma column, confirming an assumption frequently used to reconstruct the 2D cross-section from a series of single Langmuir probe measurements. Considering the momentum equations for ions and electrons, a physical model has been developed to interpret the experimental data [6]. The solutions are in qualitative agreement with the experiments and the physics is discussed.

References

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