IONIZATION WAVES (STRIATIONS) IN A LOW-CURRENT PLASMA COLUMN REVISITED

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The formation of striations in a low temperature plasma column has been known for more than a century and a considerable number of papers have been devoted to experimental and theoretical studies of these striations. Due to the large variety of regimes and to the complexity of the physics involved, our understanding of these instabilities is still limited. In this presentation we focus on the formation of striations under low current and low pressure conditions, i.e. when stepwise ionization or Coulomb collisions are negligible.

A one-dimensional Particle-In-Cell Monte Carlo Collisions simulation is used to study the formation of the striations. The model reproduces many of the well-known experimental characteristics (wavelength, spatial resonances, etc...) of the ionization waves. These are the first fully kinetic self-consistent simulations over a large range of conditions reproducing the development of p, r and s ionization waves. The properties of the ionization waves in the non-linear regime are kinetic in nature, but we show that the conditions of formation of these instabilities can be described with a fluid model. An essential aspect of the instability leading to the development of the striations is the non-Mawellian nature of the electron energy distribution function in the uniform electric field prior to the instability onset, resulting in an electron diffusion coefficient in space much larger than the energy diffusion coefficient.

References
[1] Boeuf, JP, "Ionization waves (striations) in a low-current plasma column revisited with kinetic and fluid models", to appear in Physics of Plasmas, February 2022