Dynamics and stability in RF-generated nonneutral plasmas

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Born and used for a long time as a tool to confine a single-species nonneutral plasma, Penning-Malmberg traps have been exploited in a wider range of applications than originally imagined [1]. Deviations from ideal conditions, like the presence of several charged-particle species and the application of radio-frequency (RF) excitations, represent a challenge both in terms of physical modelling and of accurate control and manipulation. At the same time, they have led to important results (e.g., antimatter synthesis) and offer new opportunities of physics investigations in collective systems. We present here several important features arising from the in-trap generation of a non-neutral plasma by means of low-amplitude RF fields, whose continuous application plays a dramatic role in the dynamics of the confined sample [2, 3, 4]. An analysis of basic collective properties is performed by means of a series of experiments, highlighting analogies and differences between 'conventional' trapped nonneutral plasmas (i.e., injected from a source and let to evolve) and their RF-generated and continuously excited counterpart. The observations on RF-excited plasmas produce a wealth of non-trivial features in terms of: Evolution towards stable configurations (single and multiple vortex structures); Manifestation of nonlinear diocotron modes; Accumulation of positive ions; New opportunities for plasma manipulation, e.g., by means of multipolar RF fields combined with the generation drive, which result in the possible use of the RF-drive technique as a valid alternative to conventional sources for the study of turbulent fluid flows [5].

References

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