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An analysis of generation, evolution and self-organization of RF-excited trapped plasmas

The dynamics of the flow in magnetized non-neutral plasmas is dominated by the diocotron (Kelvin-Helmholtz) instability, which leads to features like turbulence and self-organization and at the same time yields manipulation opportunities through resonant interaction with external perturbations. Crucial factors in the dynamics and equilibrium of the trapped plasma are the initial conditions and the possible presence of multiple charged species, both of which may be related to the generation technique, and therefore the evolution of initially quiescent particle distributions has generally been investigated. Both the dynamics and the possible final equilibrium states are dramatically altered when the plasma is generated by means of a strong external forcing leading to residual-gas ionization and continuous production and loss of particles from the confinement region. The measurement of the relevant plasma features, such as density, transverse distribution and temperature is characterized during the evolution of the system using an array of diagnostics that includes both destructive and non-destructive techniques. Measurement and analysis show how the specific features of this forced evolution and the resulting interplay of phenomena occurring over different time scales concur to establish a much more complicated plasma dynamics, characterized by the formation of coherent structures and non-axisymmetric final states that show unexpected robustness properties against common sources of instability.

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