Resonant excitation of high-order diocotron modes with rotating RF fields

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The ability to excite and control low-frequency diocotron (Kelvin-Helmholtz) perturbations in a magnetized nonneutral plasma goes beyond the obvious interest in the attainment of long-time, stable confinement of a charged particle species. Indeed it represents an opportunity to study dynamical properties of turbulent two-dimensional fluids [1, 2, 3], and recent investigations have directed attention to the behaviour of strained flows under the action of externally imposed perturbations [4, 5].

In a Penning-Malmberg device, diocotron waves are typically excited by means of suitable multipolar radio-frequency drives applied on an azimuthally sectored electrode of the trap at the resonance frequency of the desired wavenumber. This scheme is limited by the number N of electrically insulated azimuthal sectors of the electrode, yielding modes with an order $\leq N/2$.

Generalizing a previous work [6], it is demostrated both theoretically with a linearized 2D drift-Poisson model and experimentally in the Penning-Malmberg trap ELTRAP [7] that it is possible to overcome this limit and selectively excite high-order diocotron modes with applied electric fields which are co- or counter-rotating with respect to the azimuthal plasma rotation direction, by properly choosing the drive frequency and the phase difference between adjacent sectors.

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