Analysis of driven dust vortex flow equilibria in weakly magnetized plasma

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Driven dust vortex flow equilibrium is analyzed which is driven in the absence of any non-conservative fields [1,2] or dust charge variation. The 2D hydrodynamic model is applied to the confined dust fluid in a weak non-uniform magnetic field to analyze the dust vortex flow which is driven purely by the ambipolar electric field in a conservative force field set up [3]. The ambipolar electric field is generated by polarization produced by electron E×B drift which is provided by the combination of sheath electric and magnetic field.

A sheared E× B drift flow is facilitated by the magnetic field gradient, driving the vortex flow in the absence of ion drag. The analytical stream-function solutions have been analyzed with varying magnetic field strengths, gradients, and kinematic viscosity of the dust fluid. The solutions obtained are, generally, agreeing with the experimental results [4], especially reproducing the reversal of the dust flow direction when varying the strength of the magnetic field.

References

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