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# EHD CONVECTION IN AN ANNULAR GEOMETRY

**Abstract**

Heat management is a crucial issue in designing fluid experiments in the ISS. Electrohydrodynamically induced convection can provide an effective method to control heat transfer in microgravity environments. We investigate the electrohydrodynamical (EHD) convection theoretically for dielectric liquid in a cylindrical annulus subjected to both a radial temperature gradient and a radial electric field. Coupling of thermal variation of the electric permittivity and an imposed radial ac electric field produces a dielectrophoretic body force and can destabilize initial stationary state of the fluid. Resulting convection is expected to enhance the heat transfer between the inner and outer cylindrical walls of the annulus. Although some theoretical studies on the initiation of this EHD convection are found in the literature, only axisymmetric perturbations have been considered in the analyses. We present a linear stability analysis for non-axisymmetric modes. The dynamics of a dielectric is modeled in a Boussinesq–type approximation with an assumption of linear thermal variation of the permittivity. Linearized dynamical equations are resolved by a spectral collocation method. The analysis shows that the instability threshold is given by a constant electric Rayleigh number independently from the Prandtl number. It is also shown that the critical mode is non-axisymmetric and that the critical wavenumber in the axial direction is lowered for the non-axisymmetric mode. When the radius ratio $\eta = R_1/R_2$ is small ($R_1$ and $R_2$ are the radii of the inner and outer cylinders.), the system is destabilized much more easily by non-axisymmetric perturbations than by the axisymmetric ones. This result implies that efficient heat transfer enhancement can be realized by choosing a small $\eta$ in design of heat transfer devices. Influence of residual Earth gravity will be also discussed.