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Electrohydrodynamics of drops in strong electric fields: Simulations and theory[1] DAVID SAINTILLAN, DEBASISH DAS, University of California San Diego — Weakly conducting dielectric liquid drops suspended in another dielectric liquid exhibit a wide range of dynamical behaviors when subject to an applied uniform electric field contingent on field strength and material properties. These phenomena are best described by the much celebrated Maylor-Taylor leaky dielectric model that hypothesizes charge accumulation on the drop-fluid interface and prescribes a balance between charge relaxation, the jump in Ohmic currents and charge convection by the interfacial fluid flow. Most previous numerical simulations based on this model have either neglected interfacial charge convection or restricted themselves to axisymmetric drops. In this work, we develop a three-dimensional boundary element method for the complete leaky dielectric model to systematically study the deformation and dynamics of liquid drops in electric fields. The inclusion of charge convection in our simulation permits us to investigate drops in the Quincke regime, in which experiments have demonstrated symmetry-breaking bifurcations leading to steady electrorotation. Our simulation results show excellent agreement with existing experimental data and small deformation theories.

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