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Nonlinear electrohydrodynamics of leaky dielectric drops in the Quincke regime: Numerical simulations[1] DEBASISH DAS, DAVID SAINTILLAN, Univ of California - San Diego — The deformation of leaky dielectric drops in a dielectric fluid medium when subject to a uniform electric field is a classic electrohydrodynamic phenomenon best described by the well-known Melcher-Taylor leaky dielectric model. In this work, we develop a three-dimensional boundary element method for the full leaky dielectric model to systematically study the deformation and dynamics of liquid drops in strong electric fields. We compare our results with existing numerical studies, most of which have been constrained to axisymmetric drops or have neglected interfacial charge convection by the flow. The leading effect of convection is to enhance deformation of prolate drops and suppress deformation of oblate drops, as previously observed in the axisymmetric case. The inclusion of charge convection also enables us to investigate the dynamics in the Quincke regime, in which experiments exhibit a symmetry-breaking bifurcation leading to a tank-treading regime. Our simulations confirm the existence of this bifurcation for highly viscous drops, and also reveal the development of sharp interfacial charge gradients driven by convection near the drop's equator.

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