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Direct numerical simulation of leaky dielectrics with application to electrohydrodynamic atomization MARK OWKES, OLIVIER DESJARDINS, Cornell University — Electrohydrodynamics (EHD) have the potential to greatly enhance liquid break-up, as demonstrated in numerical simulations by Van Poppel et al. (JCP (229) 2010). In liquid-gas EHD flows, the ratio of charge mobility to charge convection timescales can be used to determine whether the charge can be assumed to exist in the bulk of the liquid or at the surface only. However, for EHD-aided fuel injection applications, these timescales are of similar magnitude and charge mobility within the fluid might need to be accounted for explicitly. In this work, a computational approach for simulating two-phase EHD flows including the charge transport equation is presented. Under certain assumptions compatible with a leaky dielectric model, charge transport simplifies to a scalar transport equation that is only defined in the liquid phase, where electric charges are present. To ensure consistency with interfacial transport, the charge equation is solved using a semi-Lagrangian geometric transport approach, similar to the method proposed by Le Chenadec and Pitsch (JCP (233) 2013). This methodology is then applied to EHD atomization of a liquid kerosene jet, and compared to results produced under the assumption of a bulk volumetric charge.

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