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Self-Similar Apical Sharpening of a Perfecting Conducting Ideal Fluid Subject to Maxwell and Capillary Forces CHENGZHE ZHOU, SANDRA TROIAN, California Institute of Technology, 1200 E. California Blvd., MC 128-95, Pasadena, CA 91125 — We examine the apical behavior of a perfectly conducting, incompressible, inviscid fluid in vacuum for which Maxwell, capillary and inertial forces generate a conic cusp. A potential flow model has shown the existence of a family of self-similar solutions which in the far field away from the cusp assumes the conventional static Taylor cone angle (Zubarev 2001). These solutions were obtained by matching powers of the leading order terms in the velocity and electric field potentials to the asymptotic form dictated by the stationary cone shape. We have re-examined this original analysis and uncovered a neglected leading order term in both field potentials, whose solutions also satisfy the governing interfacial and far-field conditions. This new two-parameter family of solutions reveals a non-spherically symmetric velocity field whose streamlines are at an angle to the liquid interface and generate flow focusing. We outline the boundary-element technique used (Schulkes 1994) for solving the exact similarity forms in a semi-infinite domain and discuss consequences of our findings including time reversed shapes describing conic tip recoil after fluid ejection.

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