Abstract Submitted
for the DFD16 Meeting of
The American Physical Society

Self-Similar Apical Sharpening of an Ideal Perfecting Conducting Fluid Subject to Maxwell Stresses CHENGZHE ZHOU , SANDRA M. TROIAN, California Institute of Technology, 1200 E. California Blvd. MC 128-95, Pasadena, CA 91125 — We examine the apical behavior of an ideal, perfectly conducting incompressible fluid surrounded by vacuum in circumstances where the capillary, Maxwell and inertial forces contribute to formation of a liquid cone. A previous model based on potential flow [1] describes a family of self-similar solutions with conic cusps whose interior angles approach the Taylor cone angle. These solutions were obtained by matching powers of the leading order terms in the velocity and electric field potential to the asymptotic form dictated by a stationary cone shape. In re-examining this earlier work, we have found a more important, neglected leading order term in the velocity and field potentials, which satisfies the governing, interfacial and far-field conditions as well. This term allows for the development of additional self-similar, sharpening apical shapes, including time reversed solutions for conic tip recoil after fluid ejection. We outline the boundary-element technique [2] for solving the exact similarity solutions, which have parametric dependence on the far-field conditions, and discuss consequences of our findings.

[1] N. M. Zubarev, JETP **73**, 544-548 (2001)
[2] R. M. S. M. Schulkes, JFM **261**, 223-252 (1994)

Sandra M. Troian
California Institute of Technology, 1200 E. California Blvd. MC 128-95, Pasadena, CA 91125

Date submitted: 01 Aug 2016 Electronic form version 1.4