Abstract Submitted
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Static structure of a pointed charged drop JUAN FERNANDEZ DE LA MORA, Yale University, USA — The static equilibrium structure of an equipotential drop with two symmetric Taylor cones is computed by assigning a charge distribution along the z axis $q(z) = \sum B_n(L^2 - z^2)^{n+1/2}$. Taylors local equilibrium at the poles $z = L, -L$ fixes two of the B_n coefficients as a function of the other, determined by minimizing stress imbalance. Just two optimally chosen terms in the B_n expansion yield imperceptible errors. Prior work has argued that an exploding drop initially carrying Rayleighs charge qR is quasi static. Paradoxically, quasi-static predictions on the size of the progeny drops emitted during a Coulombic explosion disagree with observations. The static drop structure found here also models poorly a Coulomb explosion having an equatorial over polar length ratio (0.42) and the a drop charge exceeding those observed (0.28-0.36 and $q_R/2$). Our explanation for this paradox is that, while the duration t_c of a Coulomb explosion is much larger than the charge relaxation time, the dynamic time scale for drop elongation is typically far longer than t_c. Therefore, the pressure distribution within the exploding drop is not uniform. A similar analysis for a drop in an external field fits well the experimental shape.

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