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The fate of electrospray drops OSMAN BASARAN, Purdue University, ROBERT COLLINS, Oak Ridge National Laboratory, KRISHNARAJ SAMBATH, MICHAEL HARRIS, Purdue University — Drops subjected to strong electric fields emit thin fluid jets from conical structures (Taylor cones) that form at their surfaces. Such behavior has practical, e.g. electrospray mass spectrometry, and fundamental, e.g. raindrops in thunderclouds, implications. Theoretical analysis of the temporal development of such EHD tip-streaming phenomena is challenging given the large disparity in length scales between the macroscopic drops and the microscopic jets. Furthermore, there exist conflicting theories and measurements on the size and charge of these small electrospray droplets. We use theory and simulation to show that conductivity can be tuned to yield three scaling regimes for droplet radius and charge, a finding missed by previous studies. The amount of charge Q that electrospray droplets carry determines whether they are coulombically stable and charged below the Rayleigh limit of stability R or are unstable and hence prone to further explosions once formed. Previous experiments reported droplet charge values ranging from 1/10th to in excess of R. Simulations unequivocally show that electrospray droplets are coulombically stable at the instant they are created and that there exists a universal scaling law for droplet charge, Q=0.44 R.

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