Abstract Submitted
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How does electricity make liquid bristle?[1] BORIS KHUSID, EZINWA ELELE, YUEYANG SHEN, New Jersey Institute of Technology, Newark, NJ, DONALD R. PETTIT, NASA Johnson Space Center, Houston, TX — Electrified fluid forms pointed cones triggering sparks, flashes of light, and ejecting droplets. This phenomenon is encountered in lightning and utilized in a number of technologies. Taylor showed that surface tension and electric forces form a conical meniscus with a semivertex angle of 49.3°. However, meniscus evolution from a rounded shape to a cone was a long-standing puzzle as it overlaps with spontaneous fluid ejection. We developed a method to control the cone-shaped spikes just shy of droplet ejection (PRL 114, 054501, 2015). Experiments were conducted on deionized (DI) water, DI-water with 0.1M KCl, polyethylene glycol, polymer solution simulating human saliva, lubricant with 0.02wt% graphene. Experiments on DI water under microgravity in International Space Station enabled us to extend the measured cone lengths from 0.5 mm (Earth) to 5 cm. The meniscus evolution to a cone was found to exhibit a universal self-similarity scaled by the fluid surface tension and density and strikingly insensitive to the forcing field while a 50% increase in applied voltage shortens the overall time for the meniscus to rise by more than an order of magnitude. Field induced flow inside the cone offers possibilities for non-contact control of separation and mixing inside tiny droplets.

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Boris Khusid
New Jersey Institute of Technology, Newark, NJ

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