Dribbling Leidenfrost droplets in an electric field

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In a video broadcast dubbed the "Knitting Needle Experiment", astronaut Don Petit aboard the ISS demonstrated how weightless water droplets can be made to orbit a statically charged Teflon rod. We study the earthly analogue of mobile droplets in an electric field, whereby the mobility is ensured by a thin vapor film sustained between the droplet and a hot plate (the Leidenfrost effect). We find that in a strong vertical electric field the droplet can start to bounce progressively higher, defying gravitational attraction. From the droplet's trajectory we infer the temporal evolution of the amount of charge on the droplet. This reveals that the charge starts high and then decreases in steps as the droplet evaporates. After each discharge event the charge is in a fixed proportion to the droplet's surface area. We show that this behavior can be predicted by modeling the droplet as a conducting sphere that occasionally makes electrical contact with the hot plate.