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Physical symmetries of Taylor cone-jets: foundations of scaling laws[1] ALFONSO M. GANAN-CALVO, ESI, Universidad de Sevilla, JOSE M. MONTANERO, NOELIA REBOLLO-MUNOZ, Universidad de Extremadura — In this work, we aim to establish the scaling laws for the liquid rate of flow naturally ejected by quasi-steady Taylor cone-jets. To this end, we utilize an ample literature in the field reporting precise measurements of the electric current transported and the resulting droplet size as a function of liquid properties and flow rate. The projection of thousands of experimental conditions onto an appropriate non-dimensional parameter space maps a region bounded by the minimum rate of flow attainable in steady state. In this limit, a theoretical model here proposed teaches that a remarkable system of symmetries rises at the geometrical transition from the cone to the jet. This system of symmetries determines an inescapable scaling for the minimum flow rate and related variables. If the flow rate is further decreased, those symmetries break down (the system bifurcates: global instability & dripping). Our model predicts the minimum flow rates reached in experiments reported so far in the literature, including all ranges of liquid properties. The existing literature and a set of new experiments performed for this specific purpose confirms our predictions.

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