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Dynamics of thin annular films with electrokinetic effects[1] DEVIN CONROY, Imperial College London, RICHARD CRASTER, University of Alberta, DEMETRIOS PAPAGEORGIOU, OMAR MATAR, Imperial College London — The evolution of an electrolyte in a uniform cylindrical tube in the presence of an applied electric field is investigated. A thread of a perfectly conducting fluid occupies the core of the tube. We derive an evolution equation for the interfacial position in the limit where the annular film is thin. This equation accounts for electrostatic and electrokinetic effects, and is characterised by an electric capillary number, a dimensionless Debye length and a ratio of interface to wall electrostatic potentials. We explore the effect of electrokinetics on the interfacial dynamics using a linear stability analysis and transient numerical simulations. The electrokinetics are shown to either stabilise or destabilise the film and, in the former case, causes the film to rupture in finite time. In this case, the time to touch down scales as time to the one-third and the final film shape undergoes either a ring or line-like rupture.

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