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Electrostatically-induced complex dynamics in viscous liquid film flows down the exterior of a cylinder[1] ALEXANDER WRAY, DEMETRIOS PAPAGEORGIOU, OMAR MATAR, Imperial College London — Annular flows on both the inner and outer walls of cylinders have a significant number of practical applications, from printing to fluid stabilisation to the augmentation of heat and mass transfer. It is important to understand the spatiotemporal dynamics of the interface in order to facilitate the possible control of the flow and efficiency of underlying processes. We investigate the evolution and stability of a viscous fluid layer wetting the surface of a cylinder and surrounded by a conductive gas. The inner cylinder is an electrode kept at constant voltage. A second concentric electrode, whose potential is allowed to vary as a function of both space and time, encloses the system. This induces electrostatic forces at the interface in competition to surface tension and viscous stresses. Asymptotic methods are used to derive several systems governing the interfacial position and charge accumulation. Two canonical sets of equations are derived, one valid for long-wave systems of moderate conductivity (a coupled Craster-Matar type system) and one valid for thin films of high conductivity (a Benney-type system). The resulting systems and their stabilities are investigated both analytically and numerically to compute travelling wave and transient simulations.

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