Abstract Submitted
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Dynamics and stability of thin films and drops subjected to magnetic fields[1] DEVIN CONROY, ALEX WRAY, OMAR MATAR, Imperial College London — We consider the interfacial dynamics of a thin, ferrofluidic film flowing down an inclined substrate, under the action of a magnetic field, bounded above by an inviscid gas. The fluid is assumed to be weakly-conducting. Its dynamics are governed by a coupled system of the steady Maxwell's, the Navier-Stokes, and continuity equations. The magnetisation of the film is a function of the magnetic field, and is prescribed by a Langevin function. We make use of a long-wave reduction in order to solve for the dynamics of the pressure and velocity fields inside the film. The potential in the gas phase is solved with the use of Fourier Transforms. Imposition of appropriate interfacial conditions allows for the construction of an evolution equation for the interfacial shape via use of the kinematic condition. The magnetic effects give rise to a non-local contribution. We conduct a parametric study of the system stability to spanwise perturbations in order to evaluate the effects of the magnetic field. Two canonical configurations are considered: constant volume, and constant flux, corresponding to a thin drop and a thin film flowing down the incline.

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