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Electrohydrodynamically induced mixing in immiscible multi-layer flows RADU CIMPEANU, DEMETRIOS PAPAGEORGIOU, Imperial College London — In this study we investigate electrostatic stabilization mechanisms acting on stratified fluids. A classical example shows how an electric field can be used to control and even suppress the Rayleigh-Taylor instability when a heavy fluid lies above lighter fluid. We present a linear stability study, as well as extensive direct numerical simulations via the volume of fluid method to show that when the fluids are dielectrics and an electric field acts horizontally (in the plane of the undisturbed liquid-liquid surface), growth rates and critical stability wavenumbers are reduced thus shifting the instability to longer wavelengths. Agreement between linear theory and direct numerical simulations is shown to be excellent. From a practical perspective, we aim to identify active control protocols in confined geometries that induce time dependent flows in small scale devices without having moving parts. This effect has numerous applications, ranging from mixing phenomena to electric lithography. Two- and three-dimensional computations are carried out and several such protocols are described.

Radu Cimpeanu
Imperial College London

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