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Kitchen Sink Hydraulic Jumps; Unravelling the Fundamental Nature of Interfacial Flows RAJESH K BHAGAT, PAUL F LINDEN, IAN WILSON, University of Cambridge — For more than a century it was believed that thin-film hydraulic jumps which can be seen in kitchen sinks are created due to gravity. In 2018, we (Bhagat et al. 2018) demonstrated experimentally, supported by theory, that these jumps are caused by surface tension, and gravity does not play a significant role. Recently (Bhagat & Linden (2020)), we have shown that our energy-based analysis is consistent with the conservation of momentum. We have also shown a fundamental flaw in the existing interfacial flow theory that in hydrodynamics, the influence of surface tension is not fully contained in Laplace pressure. Here we test the validity of our theory by comparing its predictions with the experimental results for jumps presented in the literature by other independent groups. We have compared ten sets of experimental data reported in the literature for jumps in the steady-state, for a range of liquids with different physical parameters, flow rates and experimental conditions, and the theory gives excellent prediction to the experimental data. We also show that beyond a critical flow rate, $Q_C^* \propto \gamma^2/\nu\rho^2 g$, gravity plays a role, but at lower flow rates surface tension is the dominating force, confirming that kitchen sink jumps are caused by surface tension.

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