Abstract Submitted
for the DFD20 Meeting of
The American Physical Society

**Control of Instability by Injection Rate Oscillations in a Radial Hele-Shaw Cell**[1] RAHUL ARUN, California Institute of Technology, SCOTT DAWSON, Illinois Institute of Technology, PETER SCHMID, Imperial College London, ANGELIKI LASKARI, Delft University of Technology, BEVERLEY MCKEON, California Institute of Technology — We investigate theoretically and experimentally the effect of sinusoidal injection rate oscillations on the linear stability of the interface between air displacing a more viscous silicone oil in a radial Hele-Shaw cell. We define a solution to the linear growth of wavelike perturbations that elucidates the competing effects of radial growth and surface tension. This solution suggests an integral criterion for the linear stability of flow driven by a variable flow rate relative to a constant flow rate with the same time-averaged value. These theoretical results are presented for three distinct frequencies and for oscillation magnitudes as large as the mean flow rate. For the selected frequencies, we perform analogous experiments at various oscillation magnitudes and track the interfacial morphology as it expands radially. Neglecting wetting effects, the theoretical maximally growing wavenumber is larger than that observed experimentally. The low frequency oscillations and, to a lesser extent, the high frequency oscillations we consider experimentally slightly stabilize the interface by selectively suppressing instability growth at larger wavenumbers. At an intermediate frequency, we observe significant destabilization of the interface over the most unstable wavenumbers.

[1]The support of Student Faculty Programs at Caltech and, in particular, that of Brenda and Louis Alpinieri is gratefully acknowledged.

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Date submitted: 10 Aug 2020 Electronic form version 1.4