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Suppression of Viscous Fingers in Miscible Hele-Shaw Flow
RADHA RAMACHANDRAN, JUSTIN BURTON, SIDNEY NAGEL, University of Chicago — The flow of two immiscible fluids between closely-spaced parallel plates can be highly unstable and produce a series of complex fingering patterns when the less viscous injected fluid invades the more viscous one. Air displacing granular material in such a Hele-Shaw geometry shows similar patterns with sharp features consistent with the granular/air surface tension being virtually zero [1]. Here we investigate the flow of two *miscible* fluids in a radial Hele-Shaw cell, with an inner liquid displacing an outer one of higher viscosity. We use two glycerol- water mixtures so that the viscosity can be tuned by varying the glycerol concentration. We vary the plate spacing and flow rate as well as the fluid viscosites. The non-equilibrium interfacial tension between these two miscible fluids is expected to be nearly zero. However, extrapolating to zero surface tension in the linear theory for Hele-Shaw flow does not describe our results. Specifically, flow becomes *stable* even when the inner liquid has a much lower viscosity than the outer one. At higher velocity, it is possible to see small amplitude fingering patterns develop.

[1] X. Cheng, L. Xu, A. Patterson, H. M. Jaeger and S. R. Nagel *Nature Physics* 4, 234 (2008).

Radha Ramachandran
University of Chicago

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