

Abstract Submitted
for the DFD06 Meeting of
The American Physical Society

Harmonic moments of radial viscous fingering patterns HARRY L. SWINNEY, ALEXANDER LESHCHINER, MATTHEW THRASHER, University of Texas at Austin, MARK MINEEV-WEINSTEIN, Los Alamos National Laboratory — We measure the displacement of oil by air in a Hele-Shaw cell constructed of circular glass plates 288 mm in diameter, separated by a gap of 0.38 mm [1]. Oil is removed from the cell perimeter and is replaced by air that enters through a hole in the bottom plate. High resolution digital imaging is used to track the growth of the air bubble, which develops viscous fingers. We determine the pattern's harmonic moments, which are integrals of integer powers of $z = x + iy$ over the oil domain. The results for the harmonic moments are in accord with Richardson's theory [2], which predicts that harmonic moments should be time invariant in the absence of surface tension. Extending the theory to include surface tension, we obtain from measurements of the time evolution of the harmonic moments a value for the surface tension that is within 10 percent of the accepted value.

[1] L. Ristroph, M. Thrasher, M. B. Mineev-Weinstein, and H. L. Swinney, Phys. Rev. E 74, 015201 (2006).

[2] S. Richardson, J. Fluid Mechanics 56, 609 (1972).

Harry L. Swinney
University of Texas at Austin

Date submitted: 31 Jul 2006

Electronic form version 1.4