Abstract Submitted
for the DFD06 Meeting of
The American Physical Society

On the advective Cahn-Hilliard Equation[1] LENNON O'NARAIGH, JEAN-LUC THIFFEAULT, Imperial College London — The advective Cahn-Hilliard equation describes the chef's problem of stirring olive oil and soy sauce. An efficient way of doing this is to choose a chaotic mixing protocol. Intuition suggests that bubbles of oil and soy will form on a certain scale, and previous studies of Cahn-Hilliard dynamics indicate the presence of one dominant length scale. See, for example, Berthier et al., 2001. The Cahn-Hilliard demixing mechanism however, contains a hyperdiffusion term and in this study we show how, by stirring the mixture at sufficiently large amplitude, we may excite the diffusion and overwhelm the demixing to create a homogeneous liquid. At intermediate amplitudes we see regions with oil and soy bubbles, and regions with hyperdiffusive filaments, implying that the problem in fact possesses two length scales. In this state, the system is in dynamical equilibrium and this is surprising, given that the homogenous state is unstable in the unstirred case. We compare our results with the case for a variable mobility, in which coarsening (growth of bubble size) is dominated by interfacial, rather than bulk, effects. The no-flow equivalent of this situation was considered by Zhu et al. (1999). We discuss the possibility that these results point in fact to the real-world limitations of the binary fluid model.

[1]The work of JLT and LON is supported by EPSRC.

Lennon O'Naraigh
Imperial College London

Date submitted: 03 Aug 2006 Electronic form version 1.4