Abstract Submitted
for the DFD13 Meeting of
The American Physical Society

Theoretical and numerical investigation of turbulence/interface interactions due to surface tension effects JEREMY MCCASLIN, CHIAN YEH GOH, OLIVIER DESJARDINS, Cornell University — The interaction between turbulence and an interface subjected to surface tension is studied by inserting an interface into a triply periodic box of decaying homogeneous isotropic turbulence, simulated with a volume-of-fluid scheme on a mesh of size 512^3. Unity density and viscosity ratios are used in order to isolate the interaction between turbulent eddies and the surface tension force. Interfacial height correlations are used to study the spatial scales of corrugations on the interface. At a Taylor-microscale Reynolds number of $\mathrm{Re}_\lambda = 146$, a case with zero surface tension is first considered, yielding a passive interface that moves materially with the fluid. Simulation results confirm a theoretically predicted universal κ^{-2} scaling of the corrugation power spectral density, where κ is the wavenumber. In the presence of surface tension, the corrugation spectrum follows the κ^{-2} law for large scales, but then deviates towards a $\kappa^{-11/3}$ scaling once inertia becomes balanced by surface tension. Coupling between the interface and surrounding fluid modulates the turbulent flow, and a transfer of turbulent kinetic energy from low to high wavenumbers is observed in the energy spectrum.

Jeremy McCaslin
Cornell University

Date submitted: 02 Aug 2013 Electronic form version 1.4