Abstract Submitted
for the DFD17 Meeting of
The American Physical Society

Evaporation-driven Marangoni Transport of Particles over Free Surface: A Potential Window into Vapor Recoil Forces and Self-rewetting Pool Boiling[1] ALEXANDER YARIN, ABHILASH SANKARAN, University of Illinois at Chicago — Experiments were conducted using liquids evaporating from Petri dish. Spatio-temporal variation of temperature on the liquid surface was measured using infrared imaging, which revealed significant temperature reduction (a stronger evaporation) toward the center. This drives strong Marangoni flow toward the center. A model is developed for the thermal-Marangoni convection due to non-uniform cooling of the free surface of liquid in an open vessel. In particular, an analytical solution of the plane problem in creeping flow approximation is found using the Goursat complex potential technique for the biharmonic equation for stream function. The velocity field of such thermocapillarity-driven motion was thus predicted and compared to experimental data. In the experiments, buoyant particles were located at periphery of free surface, entrained by the Marangoni convection, and their motion tracked. Velocities of particle motion and their trajectories were measured. The wiggling trajectories were observed and discussed in the framework of vapor recoil force. Experiments with different liquids were conducted including water–heptanol mixtures. The latter are important to elucidate self-rewetting phenomena, which allow one to intensify heat removal in pool boiling.

[1]This work is supported by NASA (Grant No. NNX13AQ77G).

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Date submitted: 19 Jul 2017 Electronic form version 1.4