Abstract Submitted
for the DFD15 Meeting of
The American Physical Society

Hydrodynamics of a self-propelled camphor boat at the air-water interface[1] SATHISH AKELLA, DHIRAJ SINGH, Okinawa Institute of Science and Technology, RAVI SINGH, Brown University, MAHESH BANDI, Okinawa Institute of Science and Technology — A camphor tablet, when placed at the air-water interface undergoes sublimation and camphor vapour spreads radially outwards across the surface due to Marangoni forces. This steady camphor influx from tablet onto the air-water interface is balanced by the camphor outflux due to evaporation. When spontaneous fluctuations in evaporation break the axial symmetry of Marangoni force acting radially outwards, the camphor tablet is propelled like a boat along the water surface. We report experiments on the hydrodynamics of a self-propelled camphor boat at air-water interfaces. We observe three different modes of motion, namely continuous, harmonic and periodic, due to the volatile nature of camphor. We explain these modes in terms of ratio of two time-scales: the time-scale over which viscous forces are dominant over the Marangoni forces (τ_η) and the time-scale over which Marangoni forces are dominant over the viscous forces (τ_σ). The continuous, harmonic and periodic motions are observed when $\tau_\eta/\tau_\sigma \sim 1$, $\tau_\eta/\tau_\sigma \geq 1$ and $\tau_\eta/\tau_\sigma \gg 1$ respectively. Experimentally, the ratio of the time scales is varied by changing the interfacial tension of the air-water interface using Sodium Dodecyl Sulfate.

[1]This work was supported by the Collective Interactions Unit, OIST Graduate University

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Date submitted: 31 Jul 2015 Electronic form version 1.4