Abstract Submitted
for the MAR17 Meeting of
The American Physical Society

Universal entrainment of oil in water by an impulsively started disk IVO PETERS, University of Southampton, MATTEO MADONIA, DETLEF LOHSE, DEVARAJ VAN DER MEER, University of Twente — We experimentally investigate the oil entrainment in the wake of a disk, started impulsively from an oil-water interface. The experimental setup consists of a thick layer of oil floating on a deep layer of water, with the initial position of the disk exactly at the oil-water interface. As the disk is pulled down, part of the oil is entrained into the water bath and forms a smooth funnel shape. The shape and its temporal evolution depends on the relative contribution of gravity, surface tension, and inertia. We first show that there is a regime where both gravity and surface tension can be neglected and all shapes collapse. However, boundary integral simulations under these same conditions show a systematic difference in the shape compared to the experiments. We explain this difference by taking into account the influence of a disk-bounded starting vortex on the funnel shape. The surprising conservation of universal behavior in the experiments is explained by the growth-rate of the starting vortex, which follows the same scaling as the unperturbed funnel shape.

Ivo Peters
University of Southampton

Date submitted: 11 Nov 2016 Electronic form version 1.4