Abstract Submitted
for the DFD19 Meeting of
The American Physical Society

How air deforms the free surface just before disk impact on a liquid bath DEVARAJ VAN DER MEER, UTKARSH JAIN, ANAIS GAUTHIER, DETLEF LOHSE, University of Twente — When a flat disk impacts onto a liquid bath, a layer of air is trapped between the disk and the free surface, a phenomenon known as air cushioning. The air layer is pushed out radially at increasing speeds, causing the water surface to be lifted up towards the approaching disk. This qualitative observation is traditionally ascribed to Bernoulli suction occurring in the low-pressure region created by the large air velocities in the gap. Here, by means of a novel high-speed imaging technique that uses the free surface as a mirror, we quantitatively measure the time evolution of the free surface profile. The predicted elevation of the free surface below the disk is observed to be followed by an unanticipated depression just outside the disk's edge. Although this depression starts growing at a later point in time, its magnitude eventually surpasses that of the elevation. We show that the results are inconsistent with Bernoulli suction and that instead, the deformation appears to be initiated by a Kelvin-Helmholtz instability occuring under the edge of the approaching disk.

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Date submitted: 30 Jul 2019 Electronic form version 1.4