Abstract Submitted for the DFD19 Meeting of The American Physical Society

Air-induced axisymmetric sloshing waves on a water surface¹ UTKARSH JAIN, FRANCESCO VIOLA, DETLEF LOHSE, DEVARAJ VAN DER MEER, Physics of Fluids group, University of Twente — Here we experimentally study the surface wave trains generated by an oscillating disk placed above a water basin. The harmonic vertical motion of the disk yields a radial, periodic flow of air in the thin gap between the disk and the water. Although the disk is never in contact with the water, the oscillating air pressure in the gap is sufficient to excite a system of standing and travelling capillary-gravity waves at the free-water surface. The dynamics of these waves are measured both inside and outside the disk's projection over the free water surface using an in-house experimental method based on total internal reflection. This allows us to reconstruct the instantaneous free surface elevation in the whole basin. To rationalize our experimental observations, we analytically solve the air flow below the disk using the lubrication equations. The resulting oscillating pressure is then coupled to the water phase through the dynamic condition at the free water surface, which forces axisymmetric waves on the entire liquid surface, for which we solve by means of Hankel transforms. Theoretical calculations and experiments show qualitatively similar behavior, and the wavenumbers measured experimentally are well reproduced by theory over a large frequency range.

¹We acknowledge funding from SLING (project number P14-10.1) which is (partly) financed by the Netherlands Organisation for Scientific Research (NWO)

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Date submitted: 30 Jul 2019

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