Abstract Submitted
for the DFD16 Meeting of
The American Physical Society

Hydrodynamic balance of solitary waves on falling liquid films[1]

BEREND VAN WACHEM, FABIAN DENNER, ALEXANDROS CHAROGIANNIS, Imperial College London, MARC PRADAS, The Open University, CHRISTOS N. MARKIDES, SERAFIM KALLIADASIS, Imperial College London — Falling liquid films at sufficiently high Reynolds numbers are unstable to long-wave perturbations which at low frequencies evolve into fast moving solitary waves. These solitary waves are strongly nonlinear structures characterised by a dominant elevation with a long tail and steep front, typically with capillary ripples preceding the main wave hump. The objective of our work is to identify the key physical mechanisms governing these solitary waves through direct numerical simulations and experiments. Our results demonstrate that the height and shape of solitary waves is governed by a subtle balance between inertia and surface tension [Denner et al., Phys. Rev. E 93 (2016), 033121]. This leads, for instance, to a stabilisation of the wave height after the onset of flow recirculation in the solitary waves in the moving frame of reference, since the flow rate and, consequently, the effective inertia acting on the waves, are reduced as a result of the recirculation. In addition, the capillary ripples in front of the main solitary humps are strongly contributing to the hydrodynamic balance of solitary waves and we establish a connection between the creation of capillary ripples and the height, stability and speed of the solitary wave.

[1]We acknowledge financial support from the Engineering and Physical Sciences Research Council through grants No. EP/K008595/1 and No. EP/M021556/1.

Fabian Denner
Imperial College London

Date submitted: 30 Jul 2016 Electronic form version 1.4