Abstract Submitted
for the DFD15 Meeting of
The American Physical Society

Self-similarity of solitary pulses on falling liquid films[1] FABIAN DENNER, ALEXANDROS CHAROGIANNIS, Imperial College London, MARC PRADAS, The Open University, CHRISTOS N. MARKIDES, BEREND G.M. VAN WACHEM, SERAFIM KALLIADASIS, Imperial College London — A gravity-driven liquid film is unstable to long-wave perturbations above a critical Reynolds number. At low frequencies these perturbations evolve into fast solitary pulses. These strongly non-linear structures have a dominant elevation with a long tail and steep front, typically with capillary ripples preceding the main wave hump. We present the results of a comprehensive numerical study of solitary pulses on gravity-driven inertia-dominated water films flowing down an inclined substrate for a range of inclination angles (45-90 degrees), Reynolds numbers (Re=20-120) and Kapitza numbers (Ka=2765-3887). Our results reveal a self-similarity of solitary pulses on falling films and provide an in-depth understanding of the driving physical mechanisms of such pulses. We formulate a consistent characterisation of the shape and non-linear dispersion of solitary pulses, founded on a newly proposed scaling derived from the Nusselt flat film solution. We present and discuss our findings and resulting correlations with respect to the self-similarity of the shape and non-linear dispersion of solitary pulses as well as the influence of gravity and surface tension on solitary pulses in general.

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

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Date submitted: 31 Jul 2015 Electronic form version 1.4