Abstract Submitted
for the DFD16 Meeting of
The American Physical Society

Interfacial turbulence and regularization in electrified falling films[1] DMITRI TSELUIKO, Loughborough University, MARK BLYTH, University of East Anglia, TE-SHENG LIN, National Chiao Tung University, SERAFIM KALLIADASIS, Imperial College London — Consider a liquid film flowing down an inclined wall and subjected to a normal electric field. Previous studies on the problem [1] invoked the long-wave approximation. Here, for the first time, we analyze the Stokes-flow regime using both a non-local long-wave model and the full system of governing equations. For an obtuse inclination angle and strong surface tension, the evolution of the interface is chaotic in space and time. However, a sufficiently strong electric field has a regularizing effect, and the time-dependent solution evolves into an array of continuously interacting pulses, each of which resembles a single-hump solitary pulse. This is the so-called interfacial turbulence regime. For an acute inclination angle and a sufficiently small supercritical value of the electric field, solitary-pulse solutions do not exist, and the time-dependent solution is instead a modulated array of short-wavelength waves. When the electric field is increased, the evolution of the interface first becomes chaotic, but then is regularized so that an array of pulses is generated. A coherent-structure theory for such pulses is developed and corroborated by numerical simulations.
[1] T.S. Lin, M. Pradas, S. Kalliadasis, D.T. Papageorgiou, D. Tseluiko, SIAM J Appl Math 75, 538-563 (2015)

[1]This work was supported by the EPSRC under grants EP/J001740/1 and EP/K041134/1.

Dmitri Tseluiko
Loughborough University

Date submitted: 21 Jul 2016 Electronic form version 1.4