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Coherent-structure theory and bound-state formation in electrified falling films TE-SHENG LIN, National Chiao Tung University, DMITRI TSELUIKO, Loughborough University, MARK BLYTH, University of East Anglia, SERAFIM KALLIADASIS, Imperial College London — We consider a perfectly conducting viscous liquid film flowing down an inclined wall and subjected to a normal electric filed. The electric field introduces a destabilizing non-local term in the long-wave evolution equation [1] and the solutions may evolve into arrays of interacting pulses. We develop a weak-interaction theory for these pulses using elements from previous coherent-structure interaction theories we have developed [2,3]. We show that the standard first-neighbor approximation is no longer valid and it is essential to take into account long-range interactions. We also develop numerical continuation techniques to explore bifurcation diagrams in systems possessing translational symmetry, including traveling waves and spatially varying time-periodic solutions. We find that each bound state bifurcates from the primary branch when continuing with respect to the domain size, and we then construct full bifurcation diagrams taking into account all the bound states. Finally, we compare the bound states for the long-wave evolution equation with the ones found in Stokes calculations and find excellent agreement.

[1] D. Tseluiko et al., J. Fluid Mech. (2006).
[2] D. Tseluiko et al., IMA J. Appl. Math. (2014).
[3] T.-S. Lin et al., SIAM J. Appl. Math. (2015)

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