

Abstract Submitted
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On self-similar rupture of thin-film equations¹ MICHAEL DALLASTON, Complex Multiscale Systems Group, Department of Chemical Engineering, Imperial College London, DMITRI TSELUIKO, Department of Mathematical Sciences, Loughborough University, ZHONG ZHENG, Department of Mechanical and Aerospace Engineering, Princeton University, MARCO FONTELOS, Instituto de Ciencias Matematicas, SERAFIM KALLIADASIS, Complex Multiscale Systems Group, Department of Chemical Engineering, Imperial College London — Many interfacial fluid dynamical settings consist of a thin film in the presence of two physical mechanisms, one stabilizing, typically surface tension, and the other one destabilizing. Examples include the Marangoni instability of a film heated from below, Rayleigh-Taylor instability of a film on a cylinder, and film dewetting due to intermolecular forces. Lubrication-type models of these phenomena lead to very similar equations for the evolution of the film thickness, differing only in the exponent of the coefficient function of the destabilizing term. However, the behavior of solutions can vary, depending on the value of this exponent. Here we report the results of analysis based on self-similarity, elements from dynamical systems theory and fully time-dependent computations. We find that branches of self-similar rupture solutions merge at critical values of the exponent, and, surprisingly, there are no stable solutions beyond the first value at which merging occurs. In this regime, time-dependent computations indicate the existence of a cascade of instabilities of increasingly short wavelengths.

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Michael Dallaston
Imperial College London

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