Falling films on flexible substrates OMAR MATAR, RICHARD
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— Falling films have a long history and modern advances in the theory have led to
accurate modelling for flows down rigid inclines. We now consider the possible effects
that can be introduced by flexible substrates. In this work, we derive Benney-like
coupled equations for the film thickness and substrate deflection using long-wave
theory. Weakly nonlinear equations are also derived, which, in the limit of small
substrate deflections, reduce to the Kuramoto-Sivashinsky equation. We also use
boundary-layer theory in conjunction with the Karman-Polhausen approximation
to derive three strongly coupled evolution equations for the film thickness, substrate
deflection and film volumetric flow rate. Inertial, gravtiational, capillary, viscous,
substrate tension and damping effects are elucidated via numerical solutions of the
above systems of equations.

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