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Amplification of Nonlinear Disturbances on a Falling Liquid Sheet

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We analytically examine behavior of a liquid sheet falling under the action of gravity when liquid viscosity and inertia of surrounding fluids are ignored. Analysis is made based on a set of nonlinear equations for the sheet in the gravitational field derived under the membrane approximation. We numerically find a particular boundary condition for the steady flow whose velocity increases and thickness decreases monotonically as it goes downstream. Weakly nonlinear analysis for unsteady modulational waves shows that only antisymmetric mode of disturbances propagating downstream is amplified and otherwise decayed. Numerical analysis shows that the symmetric mode is locally induced on the antisymmetric mode and it is expected that this induced mode leads to the breakup of the sheet.

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