Singular drainage of liquid films on saddle topographies

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Résumé

We investigate the late-time drainage on a substrate featuring a saddle point in the framework of lubrication theory. Unlike stationary points of strictly negative mean curvature, where the film is known to thin in a self-similar fashion (as the inverse of the square root of time), here, the balanced converging and diverging geometry near the saddle point (of vanishing mean curvature) make the pure drainage problem, accounting only for the tangential components of gravity, singular. Indeed, the thickness at the saddle point decreases in time more slowly than the common self-similar evolution. Through a boundary-layer analysis, we unveil a time-evolving hydrostatic ridge in the film, which regularises the singular behaviour of the similarity profiles. A quasi-stationary matching procedure results in a prediction for the film thickness evolution at the saddle point.

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