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Static and dynamic fluid-driven fracturing of adhered elastica

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The transient spreading of viscous fluid beneath an elastic sheet adhered to the substrate is controlled by the dynamics at the tip. The divergence of viscous stresses near the tip necessitates the formation of a vapour tip separating the fluid front and fracture front. Adhesion gives rise to the possibility of static, elastic droplets and to two dynamical regimes of spreading; viscosity dominant spreading controlled by flow of viscous fluid into the vapour tip, and adhesion dominant spreading. Constant flux experiments using clear, PDMS elastic sheets enable new, direct measurements of the vapour tip and confirm the existence of spreading regimes controlled by viscosity and adhesion. The theory and experiments thereby provide an important test coupling the dynamics of viscous flow with elastic deformation and have implications in fluid-driven fracturing of elastic media more generally.

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