Abstract Submitted
for the DFD12 Meeting of
The American Physical Society

The meandering instability of a partial wetting rivulet
STÉPHANIE COUVREUR, ADRIAN DAERR, Paris Diderot University — When a liquid rivulet flows down an inclined plate in partial wetting conditions, it can takes different kinds of shapes. For small flow speed rates, the rivulet flows down the gravity direction, straight along the steepest slope. When increasing the flow rate, an instability leads to the growth of curves and the rivulet finally adopts a sinuous stationary shape, we call this the meandering regime. The rivulet bends grow from defects of the contact line: when the liquid flows along a small perturbation, it is submitted to an inertial centrifugal force which tends to move it to the exterior side of the small curve. Below the instability threshold this force merely distorts the rivulet cross section away from its symetric circular shape at rest, but the contact line remains pinned.When increasing the speed of the liquid (by increasing the flow rate), the inertial effect becomes higher and higher, increasing the external contact angle, until it reaches its critical value, whereupon the rivulet moves and the instability grows. We will show experiments that the critical flow rate depends strongly on the geometry of the initial rivulet. We will explain this dependency through a force balance model, in quantitative agreement with our experiments. S. Couvreur and A. Daerr, EPL, 2012

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Date submitted: 01 Aug 2012 Electronic form version 1.4