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The Walking Droplet Instability JOSHUA BOSTWICK, Northwestern University, PAUL STEEN, Cornell University — A droplet of liquid that partially wets a solid substrate assumes a spherical-cap equilibrium shape. We show that the spherical-cap with a mobile contact-line is unstable to a non-axisymmetric disturbance and we characterize the instability mechanism, as it depends upon the wetting properties of the substrate. We then solve the hydrodynamic problem for inviscid motions showing that the flow associated with the instability correlates with horizontal motion of the droplet's center-of-mass. We calculate the resulting "walking speed." A novel feature is that the energy conversion mechanism is not unique, so long as the contact-line is mobilized. Hence, the walking droplet instability is potentially significant to a number of industrial applications, such as self-cleansing surfaces or energy harvesting devices.

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