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Self-Excited Motions of Volatile Drops on Swellable Sheets ADITI CHAKRABARTI, GARY P.T. CHOI[1], L. MAHADEVAN, Harvard University — When a volatile droplet, such as acetone, is deposited on a floating swellable PDMS sheet, it becomes asymmetric, lobed, and mobile. We describe and quantify this phenomenon that involves nonequilibrium swelling, evaporation and motion, working together to realize a self-excitable spatially extended oscillator. Solvent penetration causes the film to swell locally and eventually buckle, changing its shape and the drop responds by moving. Simultaneously, solvent evaporation from the swollen film causes it to regain its shape once the droplet has moved away. The process repeats and leads to complex pulsatile spinning and/or sliding motion. We provide a phase diagram that delineates the regimes where these self-excited motions exist, along with scaling laws for the frequency of droplet spinning. An even simpler realization of the effect is provided by a drop of acetone placed on a narrow quasi-1-dimensional sagging PDMS film clamped at both ends – which spontaneously oscillates back and forth while causing the film to buckle and unbuckle. This allows us to build a minimal model for the excitable droplet system, which highlights the slow swelling of and evaporation of acetone from the film and the fast motion of the drop. Finally, we consider a few potential applications of this phenomena.

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