Title: Superconfinement tailors fluid flow at microscales

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Abstract: Understanding fluid dynamics under extreme confinement, where device and intrinsic fluid length scales become comparable, is essential to successfully develop the coming generations of fluidic devices. Here we report measurements of advancing fluid fronts in such a regime, which we dub superconfinement. We find that the strong coupling between contact-line friction and geometric confinement gives rise to a new stability regime where the maximum speed for a stable moving front exhibits a distinctive response to changes in the bounding geometry. Unstable fronts develop into drop-emitting jets controlled by thermal fluctuations. Numerical simulations reveal that the dynamics in superconfined systems is dominated by interfacial forces. Henceforth, we present a theory that quantifies our experiments in terms of the relevant interfacial length scale, which in our system is the intrinsic contact-line slip length. Our findings show that length-scale overlap can be used as a new fluid-control mechanism in strongly confined systems.