Physical Mathematics Seminar

Moving contact lines over imperfect surfaces: from stick-slip to steady-sliding

BAUYRZHAN PRIMKULOV
Massachusetts Institute of Technology

ABSTRACT:

The vast majority of solid surfaces exhibit physical and chemical defects. For instance, surface heterogeneity of window glass is apparent in how it interacts with rain---here, larger raindrops slide smoothly down the slope, smaller ones remain pinned, and droplets of intermediate size undergo macroscopic stick-slip motion. The complex behavior of fluid-fluid interfaces moving over heterogeneous solid surfaces has captivated the fluid-mechanics community over the past several decades, driven by the elegant physics of the problem and the multitude of relevant practical applications.

Here, we reduce the dynamics of fluid-fluid displacement in partial wetting to a system of coupled ordinary differential equations. This allows reducing the complexity of stick-slip dynamics to a few key parameters, elucidating both constant-force and constant-rate displacement regimes through a mechanical analog. We demonstrate that stick-slip motion crosses over to steady sliding at high displacement rates, revealing a balance of timescales that helps rationalize observations of stick-slip dynamics in recent experimental studies.

Tuesday, May 3, 2022
2:30 PM – 3:30 PM
Building 2, Room 449

https://math.mit.edu/sites/pms/

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