PHYSICAL MATHEMATICS SEMINAR

Capillary ballistic droplet motions fill a periodic table

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ABSTRACT:

Drop splat, drop break up and drop-drop coalescence on a solid support all exhibit fast moving contact lines. As examples of motions dominated by liquid inertia and shaped by surface tension, we call these 'capillary ballistic' motions. A canonical problem regards the capillary ballistic motions of a droplet on a planar support. This system, governed integro-differential equations, is our focus and our story is one of symmetry breaking of a discrete spectrum. Drawing parallels to the symmetry-breaking of atomic orbitals used to explain the classical periodic table of chemical elements, we introduce the periodic table of droplet motions. Motions of a partially wetting liquid on a support have natural mode shapes, motions ordered by kinetic energy into one of a two-parameter family of periodic tables, each table characteristic of the droplet volume and contact-line drag parameters. For water on a support having a contact angle of about 60°, the first 35 predicted elements of its periodic table are discovered in the laboratory. A number of implications are discussed, from the invention of a wettability spectrometer on the engineering side to the idea of using "periodic table irregularities" as a metric for closeness of differing "chemical worlds" on the side of metaphysics. Our main perspective is applied mathematical, however, and we end by citing evidence supporting our vision of a spectral decomposition framework for understanding capillary ballistic dynamics, not unlike how we understand the decomposition of the Heaviside function in terms of Fourier series basis functions.

TUESDAY, MAY 14, 2019
2:30 PM – 3:30 PM
Building 2, Room 139

Reception following in Building 2, Room 290
(Math Dept. Common Room)

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