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Sessile-drop oscillations fill a symmetry-breaking periodic table
JOSHUA BOSTWICK, PAUL STEEN, Cornell University — Oscillations of a sessile drop are of fundamental interest for the contact-line instabilities they can exhibit and of practical importance in a number of industrial applications. We consider the small oscillations of the inviscid sessile drop under a number of contact line conditions, including a contact-line modeled using a continuous contact-angle against speed relationship. The integro-differential equation, governing the motion of the interface, is formulated as a functional equation using inverse operators, which are parameterized by volume via the static contact angle of the drop base-state and by the mobility of the contact-line. In the symmetric limit, a hemispherical drop perturbed by a fixed contact-angle disturbance has characteristic oscillation frequencies, which are degenerate with respect to azimuthal wave-number much like the Bohr model of the atom is degenerate with respect to angular momentum quantum number. This degeneracy is broken by smoothly varying either i) the volume and/or ii) the contact line mobility. The analogy between the spectrum of these "broken" states and the filling order of the periodic table by energy levels both organizes and explains the hierarchy of frequencies.

Joshua Bostwick
Cornell University

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