

LadHyX Seminar – June 20, 10:45

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From bouncing to floating: the Leidenfrost effect with hydrogels

The Leidenfrost effect occurs when an object near a hot surface vaporizes rapidly enough to lift itself up and hover. Although well-understood for liquids and stiff sublimable solids, little is known about the interaction of vaporizable soft solids with superheated surfaces. In this talk, I will introduce a new phenomenon that occurs with vaporizable soft solids: the elastic Leidenfrost effect. By dropping vaporizable hydrogel spheres onto hot surfaces I will show that, rather than hovering, they energetically bounce several times their diameter for minutes at a time. With high-speed video during a single impact, one sees high-frequency microscopic gap dynamics at the sphere-substrate interface. Solving for the dynamics of a simplified system with a simple numerical model, I will reveal how these otherwise-hidden agitations constitute work cycles that harvest mechanical energy from the vapor and sustain the bouncing. Finally, I will show that hydrogels are also capable of exhibiting the regular Leidenfrost effect, and that the transition between these two behaviors is controlled by the substrate temperature and impact velocity.