Abstract Submitted
for the DFD19 Meeting of
The American Physical Society

Self-propulsion and capillary orbits of inverse Leidenfrost droplets. ANAIS GAUTHIER, ESPCI Paris, France, GUILLAUME LAJOINIE, CHRISTIAN DIDDENS, DETLEF LOHSE, JACCO SNOEIJER, DEVARAJ VAN DER MEER, PoF - University of Twente, The Netherlands — Ambient temperature drops deposited on a liquid nitrogen bath can be maintained in the inverse Leidenfrost state, a levitating state that is enabled by a continuous vapor flow produced by the cryogenic bath. In such freezing conditions, the droplets (which do not evaporate) can levitate for a dozen of minutes. We show here how the deformability of the liquid substrate dramatically impacts the Leidenfrost dynamics. First, we show that a micrometer-sized instability grows within the film sustaining the drop, which causes a partial redirection the vapor flow and generates spontaneous self-propulsion. The drops then behave as active particles, which hover in straight lines above the bath and form a remarkably regular pattern. In addition, the bath surface is deformed at the millimeter scale by the droplets weight. Due to this non-wetting meniscus, the particles are repelled at large distance by objects dipped into the bath: this can be used as a contactless method to finely control the particles trajectories. Conversely, we show that the attraction between identical menisci impacts the motion of approaching droplets which spontaneously orbit around each other – mirroring a miniature celestial system.

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Date submitted: 29 Jul 2019 Electronic form version 1.4