# Boxing Leidenfrost drops

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When a liquid drop is deposited on a solid substrate that is heated well above the boiling temperature of the liquid, it may evaporate so fast that a lubrication film made of the vapour isolates the drop from the substrate. This is the Leidenfrost effect. It has been showed that it happens even for an effective gravity of $20g$ [1]. However, a huge centrifuge is not the only way to increase the gravity. Moreover, in that case, the effective gravity is constant. But one can also change it periodically, *e.g.* with a shaker. We heated an aluminium substrate at the temperature of 400°C, made it oscillate at a frequency $\nu$ with an amplitude $A$, and then deposited on it a water drop. The substrate is slightly curved to confine the drop.

In the first part, we use a unique frequency $\nu = 28.2$ Hz to box a drop with a radius $R = 1.2$ mm. Even though no contact is observed between the drop and the substrate, we consider that the drop is in "contact" with the substrate when the thickness of the vapour film that is below the equilibrium thickness of a static drop of the same size on a substrate at the same temperature ($\sim 100\ \mu$m). Practically, it corresponds to the absence of light between the drop and the substrate on our movies. We observe that the drop bounces even for a small reduced acceleration, *i.e.* $\Gamma = A(2\pi\nu)^2/g \simeq 0.25$. In most analog systems where an object is vibrated with a shaker, the condition $\Gamma > 1$ is required for bouncing [2]. However, it has already been seen in the case of a drop bouncing on an oscillated liquid bath that that condition is not necessary when a lubrication film is involved [3].

In our case, for $\Gamma < 1$, the time between successive rebounds is stable. However, transitions occur between 1 and 1.5, and between 1.5 and 2, the drop bounces in a mix of two modes : the mode $(1, 2)$ where the drop bounces once each two oscillations, and the mode $(2, 2)$ where the drop does two different bounces (a large and a small one) each two oscillations.

In the second part, we focus on the case of $\Gamma = 0.5$, and we vary $\nu$. We observe that the contact time is independent on the parameters of the oscillations, $\Gamma$ and $\nu$. Indeed, the contact time is $\tau_c = 2.6\left(\rho R^3/g\right)^{1/2}$, as in the case of the rebound of a drop on a static substrate [4]. But then, what happens if the period of the oscillation decreases until it reaches the contact time ? We show that when the contact time becomes higher than half the period of the oscillation, the drop switches its mode to a mode $(1, 2)$ (one rebound each two oscillations), and when it becomes higher than one complete oscillation, the mode becomes $(1, 3)$, *etc.*

## Références

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