The physics of bouncing droplets

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A droplet of liquid is one of the smallest fluid entity that a microfluidic physicist has to deal with. A droplet may be considered as a fluid transporting cell or even as a chemical micro-reactor. The manipulation of droplets without contaminating the liquid becomes a key process for various microfluidic applications [1,2]. A way to control droplets has been recently evidenced [3] : bouncing droplets have been observed. Indeed, it has been shown that a droplet is able to bounce without coalescing on the surface of a vertically vibrated liquid bath [4]. It has been also shown that it is possible to move the droplet even without touching it, on demand [5]. The underlying physics still need to be understood; volume and surface effects have the same order of importance. Relevant experiments and statistical analysis of droplet coalescences [6,7] provide new information on such fluidic objects. Contrary to what was first proposed in [2], we have shown that the physical conditions for droplet bouncing involves multiple physical processes such as surface deformation, internal fluid motion, etc... Non-trivial fluid effects will be presented and discussed.

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