Master 2 Internship

Title: Laser induced buckling for 3D deposition
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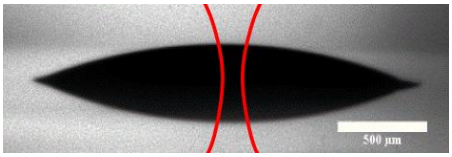
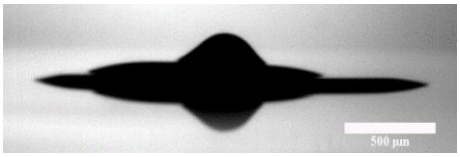
Project:

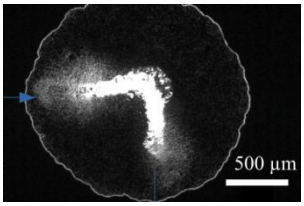
When an infrared laser is focused in a droplet, it induces hydrodynamic flows that concentrate particles in the center due to thermal Marangoni effects. If the particles' fraction is high enough, a buckling instability can occur (see figure 1 a&b) and a kind of « elastic hat » emerges due to the formation of a thin elastic shell at the top of the droplet. Interestingly, our preliminary results indicate that this buckling instability can be governed by laser parameters such as the laser radius and the absorbed power.
To our knowledge, this laser-induced instability has never been investigated in details and can be exploited to perform 3D deposition at micron scales, which is important for future applications.



a) Side view of a droplet at the beginning of the evaporation process. The laser is indicated in red.



b) A buckling instability occurs at the center of the drop governed by laser parameters



c) Particle deposition governed by laser texturing.

The goal of this internship (and PhD) is first to understand the physical origin of this buckling instability and characterize how the dynamics of the formation of the "elastic hat" can be controlled by laser parameters. A detailed characterization of the flows inside the droplet will be performed with PIV technique. A second objective is to shape the laser beam to induce 3D deposition of particles at the micron scales. Indeed, previous results have shown that we can easily carry out 2D deposition at low particle fraction. The challenge would be to do it with high particles' fraction solution to build 3D deposition of particles.

A PhD can be proposed after this internship. This internship requires experimental and theoretical skills.

References

[1] Goy, N-A, J-P Delville, Delabre U, to be submitted, *Thermal Marangoni trapping driven by laser absorption in evaporating droplets for particle deposition.*
[2] David Riviere, Bertrand Selva, Hamza Chraibi, Ulysse Delabre**,** Jean-Pierre Delville, *Convection flows driven by laser heating of a liquid layer*, PHYSICAL REVIEW E 93, 023112 (2016)