

Master 1 / 2 Internship position in coupled Optics / Soft Matter Fluidics

Laser induced cavitation in confined water under tension

Institut de Physique de Nice (INPHYNI) :

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Cavitation corresponds to the nucleation and growth of a vapor bubble in a liquid at low (often negative) pressure. It has been studied a lot using hydraulic or acoustical methods [1]. Then, the use of high intensity laser pulse has been shown to produce cavitation bubbles that are growing fast and disappear after collapse, emitting eventually a strong light (Sonoluminescence) [2]. A last way explored recently concerns the evaporation of water in a confined volume with porous wall which leads to a pressure decrease and ultimately to the nucleation of a cavitation bubble [3]. This is what happen in trees when the water stress is too strong: bubbles take the place of the liquid in the sap ascent network named "xylem". The stronger the drought is (which happens more often due to climate change), the higher the probability of nucleation and growth of bubbles. We intend to better understand these important phenomena for agriculture, forestry and effects of climate change.

We study in INPHYNI this growth in an original biomimetic geometry closer to real trees case: elongated channel, instead of cubic or spherical volume [3,4]. To better understand all this process in the future in more complex microfluidic artificial network, we need to generate bubble on demand, at the times and places we choose using strong laser pulses to trigger bubble nucleation.

The aim of this internship is to exploit the set up already tested on a few experiments. The plan will be 1) to study the variation of threshold laser intensity as function of experimental conditions (pressures from about -1MPa to -25MPa, and other parameters). 2) Determine the bubble growth dynamics in several geometries using high speed imaging. 3) If possible, we will add acoustical measurements.

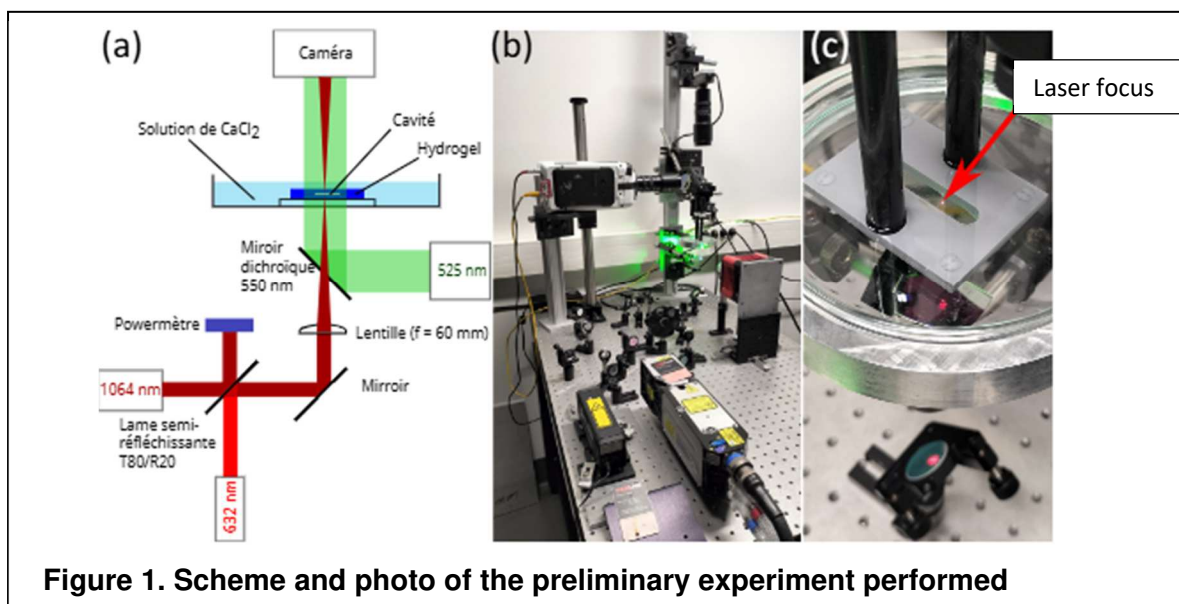
A Ph.D is possible on this topic (not funded), following the internship at level Master 2. The project is in collaboration with Céline Cohen and Ludovic Keiser @INPHYNI.

[1] *Cavitation and bubble dynamics*, CE Brennen, Oxford University Press (1995).

[2] CD Ohi, O Lindau, W Lauterborn. *Physical Review Letters* 80 (2), 393 (1998)

[3] O Vincent, P Marmottant, PA Quinto-Su, CD Ohi. *Physical Review Letters* 108 (18), 184502 (2012)

[4] C Scognamiglio..., CM Casciola, X Noblin. *Soft matter* 14 (39), 7987-7995 (2018)



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