Master degree internship position

Laboratory name: Institut de Physique de Nice (INPHYNI)
CNRS identification code: UMR 7010
Intership location: INPHYNI, 17 rue Julien Lauprêtre, 06200 Nice, FRANCE
Internship directors:

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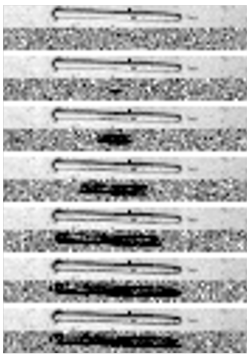
PhD thesis possibility after internship: **YES**

Requested funding: **Doctoral School EDSFA**

Laser induced cavitation in confined water under tension

Cavitation corresponds to the nucleation and growth of a vapor bubble in a liquid at low (often negative) pressure. Cavitation has been studied a lot using hydraulic or acoustical methods [1]. More recently, the use of high intensity laser pulses have 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 even more recently concerns the evaporation of water in a confined volume with porous walls which leads to a pressure decrease and ultimately to the nucleation of a cavitation bubble [3]. This is what happens in trees when the water stress is too strong: bubbles take the place of the liquid in the sap ascent network named “xylem”. The higher the drought event (which happens more often due to climate change), the higher the probability of having nucleation and growth of bubbles. We study at INPHYNI this growth in an original geometry closer to the tree case than in previous studies cited above. Indeed, we use an elongated channel, instead of cubic or spherical volume [4]. To better understand all this process in more complex microfluidic artificial networks, we need to generate bubbles on demand, at the times and places we choose using strong laser pulse to trigger bubble nucleation. This will enable having more information on the relation between laser intensity and cavitation pressure and describing more quantitatively and more precisely the bubble growth (which happens randomly in current systems). The aim of this internship is to develop a new technique from scratch, to trigger the cavitation events that couple optics and fluids physics. It does not exist at INPHYNI and has not been used is such geometry. It will thus open several new perspectives for the field of the physics of cavitation.



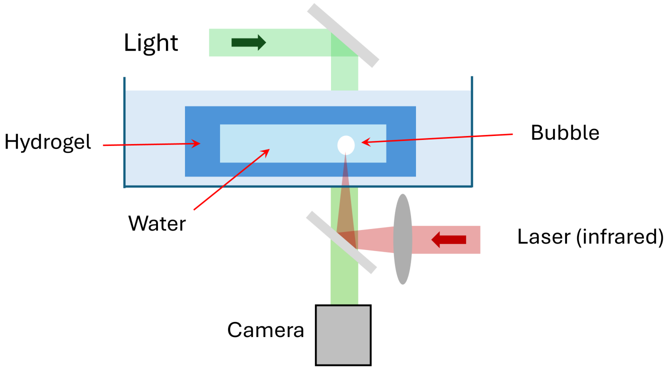


Fig. 1 – (left) Growth of a cavitation bubble in a 1.5 mm long channel, 700 ns between each image (movie: Ludovic Jami), (right) Scheme of the experiment.

Profile.— We are looking for candidates with a broad outlook and a strong interest in **experimental studies in optics and fluids physics**. The candidate will have the opportunity to work in collaboration with two teams of INPHYNI (“Microfluidics, Physical-Chemestry and Biology at Interfaces” and “Waves in Complex Systems”). The internship gratification is about 580 € net/month. The candidate will have the opportunity to apply to the École Doctorale Sciences Fondamentales et Applications (EDSFA) for a PhD thesis grant.

[1] Cavitation and bubble dynamics, CE Brennen, Oxford University Press (1995).
[2] Luminescence from spherically and aspherically collapsing laser induced bubbles. CD Ohl, O Lindau, W Lauterborn. Physical Review Letters 80 (2), 393
[3] Birth and growth of cavitation bubbles within water under tension confined in a simple synthetic tree. O Vincent, P Marmottant, PA Quinto-Su, CD Ohl. Physical Review Letters 108 (18), 184502.
[4] The detailed acoustic signature of a micro-confined cavitation bubble. C Scognamiglio, F Magaletti, Y Izmaylov, M Gallo, CM Casciola, X Noblin. Soft matter 14 (39), 7987-7995.