Where: ILM, Université Claude Bernard Lyon 1
Liquids and interfaces group
Who: Frédéric CAUPIN

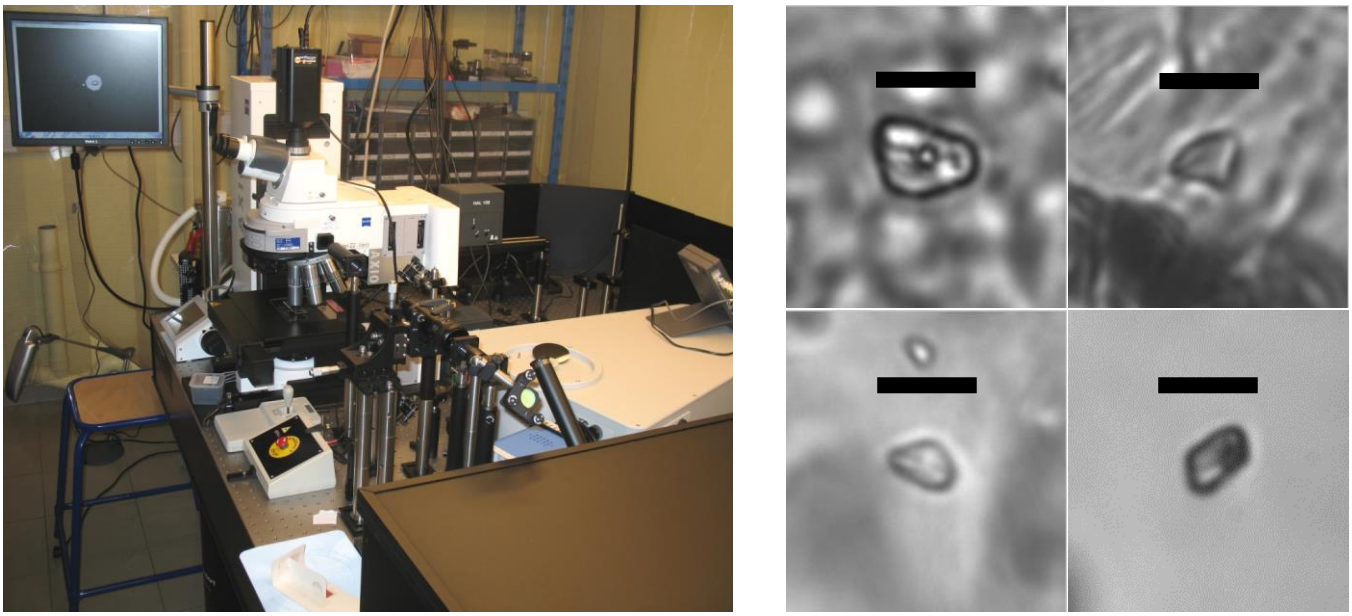
frederic.caupin@univ-lyon1.fr
http://ilm-perso.univ-lyon1.fr/~fcaupin/
Tél : 04 72 44 85 65

WATER : ONE LIQUID, TWO STRUCTURES ?
Spectroscopic study

An hypothesis proposed for water more than 20 years ago [1] is still highly debated [2]. Water might exist in two liquid states, that would differ by the local arrangement of the molecules. The problem is that the two liquids would separate only at very low temperature. Thus, up to now, even the experiments which achieved the highest supercooling of water (-46°C [3]) were not able to detect this transition. However, such a liquid-liquid transition has been experimentally observed in water-glycerol mixtures [4].

Recently, evidence for two distinct local structures of water has been found in spectra of low-energy excitations of water [5]. This work was able to follow the liquid in the supercooled region down to -26°C. The goal of the internship will be to extend this study using low-frequency Raman spectroscopy coupled to our capillary stage able to supercool water down to -34°C.

This work can be extended during a PhD by investigating even deeper supercooling (collaboration with Robert Grisenti in Frankfurt) and other metastable regions: supercooled water at positive pressure (up to 2000 bar), and also at negative pressure. Negative pressures can exist thanks to the liquid cohesion (trees use them to pull their sap up!), and we can generate in the lab beyond -1000 bar using water inclusions in quartz crystals.



Experimental setup and examples of inclusions studied (scale bar = 7 µm)

[1] Poole *et al.*, *Nature* **360** 324 (1992)
[2] Gallo *et al.*, *Chem. Rev.* **116** 7463 (2016)
[3] Sellberg *et al.*, *Nature* **510** 381 (2014)
[4] Suzuki and Mishima, *J. Chem. Phys.* **141** 094505 (2014)
[5] Taschin *et al.*, *Nature Comm.* **4** 2401 (2013)