Master 2: INTERNSHIP PROPOSAL

Laboratory name: Laboratoire de Physique Statistique
CNRS identification code: UMR 8550
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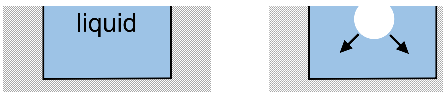
Internship location: ENS and INSP (Jussieu) – Annie Grosman (INSP) will be co-director.

Thesis possibility after internship: YES
Funding: YES If YES, which type of funding: ANR

CAVITATION OF CONFINED FLUIDS IN NANOPORES

Cavitation – the formation of a vapor bubble in a metastable liquid – is relevant in many fields, ranging from engineering to the natural sciences. However, the occurrence of cavitation in porous materials is usually disregarded and standard models assume that the evaporation of a fluid confined in a porous material requires the creation of a vapor path from the periphery to the inside of pores, via the propagation of the liquid-vapor interface. For instance, in a solid made of cavities connected to the gas reservoir via necks (see illustration below), the emptying of cavities can occur only when necks become unstable.

Our preliminary experiments in model nano-porous solids directly demonstrate, for the first time, that evaporation of the fluid can occur via cavitation, *i.e.*, a thermally activated nucleation of gas bubbles in the cavities. We have also observed an unexpected dependence on the pore geometry and on the material forming the porous matrix.



When the outer gas pressure is decreased, liquid in the cavity evaporates via a receding meniscus in the neck (left) or bubble nucleation (right).

The goal of this internship is to study the cavitation scenario and to understand the nucleation mechanism in nanopores. To this aim, model porous silicon and porous alumina materials will be designed with controlled geometries. Both a simple van der Waals liquid (nitrogen up to the critical point) and room temperature liquids such as water or alkanes will be used in order to vary the fluid-wall interaction.

The internship/thesis is primarily experimental and calls upon various techniques: from the fabrication of porous silicon and alumina samples, to the measurement of adsorption/desorption isotherms using both volumetric measurements and innovative interferometric techniques. This work is part of a collaborative project with Institut Néel (Grenoble – porous alumina synthesis and liquid helium experiments) and ICMN (Orléans – Monte Carlo simulations and molecular dynamics).

Please, indicate which speciality(ies) seem(s) to be more adapted to the subject:

Condensed Matter Physics: YES Macroscopic Physics and complexity: YES
Quantum Physics: YES/NO Theoretical Physics: YES/NO