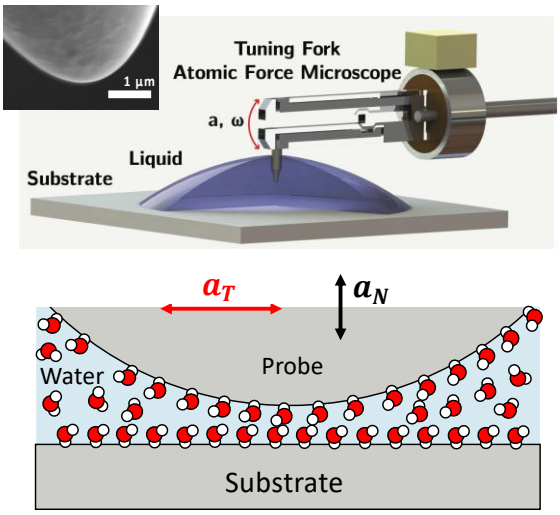
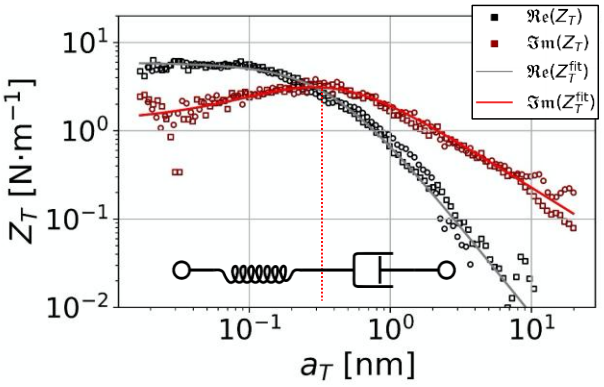
INTERNSHIP PROPOSAL

Laboratory name: **SIMM Soft Matter Science and Engineering**
CNRS identification code: **UMR7615**
Internship director's surname: **Jean Comtet, Guilhem Mariette**
e-mail: **jean.comtet@espci.fr**
Web page: **https://blog.espci.fr/jcomtet/**
Internship location: **ESPCI PSL, 10 rue Vauquelin, 75005 Paris**
Thesis possibility after internship: **YES**
Funding: Not at the moment If YES, which type of funding:

Freezing water under nanoscale confinement





Context: At the nanoscale, water exhibits remarkable deviations from bulk behavior. When confined between solid surfaces, it forms **ordered hydration layers** that display **viscoelastic** and even **yield-stress properties**. Previous **dynamic atomic force microscopy (AFM)** studies revealed a strong dependence of these behaviors on surface hydrophilicity, suggesting that interfacial water undergoes a confinement-induced slowdown reminiscent of glassy or supercooled dynamics.

Objective: The goal of this internship is to deepen our understanding of the **nonlinear rheology of confined water** and to identify the microscopic mechanisms governing the transition from fluid-like to solid-like behavior under nanometric confinement.

Proposed Work:
- **Perform dynamic AFM measurements** in controlled environments (humidity, temperature, and ionic concentration) to explore how these parameters influence relaxation dynamics.
- **Develop or adapt viscoelastic and activation models** (Eyring, Maxwell, or extended phenomenological frameworks) to quantitatively describe the observed transitions.
- **Compare hydrophilic and hydrophobic substrates** to clarify the role of surface chemistry and wettability in determining interfacial water mobility and slippage.

Expected Outcomes: The internship will provide insights into the microscopic origins of nanoconfined water's viscoelasticity, contribute to a better understanding of **nanoscale friction mechanisms**, and potentially help design superlubric or anti-stiction surfaces in micro- and nanofluidic systems.

Condensed Matter Physics: YES Soft Matter and Biological Physics: YES
Quantum Physics: NO Theoretical Physics: YES