INTERNSHIP PROPOSAL

(One page maximum)

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Internship location: ESPCI

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

Nano-imaging of non-Fourier heat flow

Efficient heat management is critical for the optimal performance and energy consumption of modern-day electronics. While Fourier's macroscopic model for heat diffusion has been a valuable tool for homogeneous solids at room temperature, it falls short in describing heat propagation accurately under certain conditions. This PhD project aims to quantitatively investigate scenarios where the Fourier model breaks down and work towards developing a more physically satisfying model of heat propagation. In particular, this project will focus on the phonon viscous hydrodynamic transport regime that has recently attracted considerable interest in the scientific community. It is a regime that is neither ballistic nor diffusive and emerges when quasi-particles interact strongly with each other without loosing momentum.

The goal of this PhD will be to build a very sensitive and local thermometer (based on SQUID technology) so as to map out the temperature distribution at a few tens of nm to look for signatures of this non-Fourier like behaviour.

As a PhD researcher, you will participate in the design, construction and operation of the SQUID based microscope. Enthusiasm for instrumentation is a necessity.

References:

Halbertal, D. et al. Nanoscale thermal imaging of dissipation in quantum systems. Nature 539, 407–410 (2016). https://doi.org/10.1038/nature19843

Chen, G. Non-Fourier phonon heat conduction at the microscale and nanoscale. Nat Rev Phys 3, 555–569 (2021). https://doi.org/10.1038/s42254-021-00334-1

K. Ghosh, *et al.*, Phonon hydrodynamics in crystalline materials, Journal of Physics: Condensed Matter (2022), doi:10.1088/1361-648X/AC718A

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

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