**Master 2 level –Duration: 3 months min.**

***INTERNSHIP PROPOSAL***

Laboratory name: LKB – Laboratoire Kastler Brossel

CNRS identification code: UMR 8552

Internship director's surname: Tastevin G. / Nacher P.-J.

Email: tastevin@lkb.ens.fr Phone number: 01 4432 2025

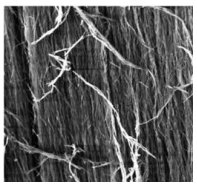
Web page: http://www.lkb.science/polarisedhelium/

Internship location: ENS Physics Department, 24 rue Lhomond, 75005 Paris

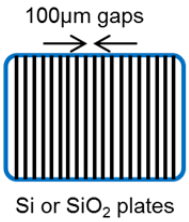
Thesis possibility after internship: YES Funding: NO

**Magnetic Resonance studies of Gas diffusion In Nanoporous systems (MARGIN)**

Context: The "Polarised Helium" group uses laser-polarised $^3$He gas to investigate constrained or restricted gas diffusion within anisotropic or hollow materials. Pioneering work employing low-field NMR and MRI at LKB explored gas diffusion in lung airspaces as well as in high-porosity $SiO_2$ aerogels. Recently, anomalies in gas diffusion within ordered $Al_2O_3$ aerogels were reported at low temperature, tentatively attributed to a breakdown of usual gas transport models and to the distant effect of the attractive wall potential on atomic trajectories.



Internship project: Relying on the group's experience in low-field NMR as well as in preparation and use of hyperpolarised $^3$He gas, new investigations of gas diffusion characterisations over a wide range of gas and aerogel densities were launched. Measurements of nuclear relaxation induced by movements of atoms in applied magnetic-field gradients and associated theoretical or numerical studies are expected to reveal details on correlations in atomic trajectories and to provide keys towards a better understanding of gas diffusion mechanisms in complex porous systems.




The same approach will be used to evaluate the relevance of highly confined $^3$He gas diffusion (in quasi-2D gas slabs) and of magnetic relaxation in static field gradients for searches of WISPs or short-range spin-dependent forces in a proof-of-concept experiment.

Initial tests have shown the feasibility of both kinds of NMR measurements. The experiment was then optimised to yield high SNR even at low gas pressure. A wealth of experimental results is expected by mid-2024 for exploitation using suitable models.

The internship work will include hands-on quantitative low-field MR investigations as well as numerical simulations. It will thus provide opportunities for substantial experience in NMR and MRI, and could be continued as a PhD research work.

*Details: https://www.lkb.upmc.fr/polarisedhelium/359-2/polarised-helium-and-quantum-fluid/margin-project/*