

INTERNSHIP PROPOSAL

(One page maximum)

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Internship location: LPENS/LPEM

Thesis possibility after internship: YES

Funding: NO

If YES, which type of funding:

Implementation of a mass scanning quantum haloscope

There is a general consensus that only a small fraction of the matter and energy in the universe has been detected (about 5%), the rest being dark matter (about 27%) and dark energy (about 68%). Elucidating the nature and properties of such objects is one of the greatest challenges in physics. In general, dark matter (e.g. Weakly Interacting Massive Particles, WIMPs) is thought to consist of particles that "floods" galactic halos - and hence the Milky Way. Therefore, in principle, it can in principle be detected in laboratory experiments.

This work will build on our recent theoretical and experimental developments of an apparatus, called a haloscope, designed to detect axions, prominent candidates of dark matter [1,2,3]. We will develop a full data taking setup able to probe the benchmark models for QCD axions on a mass range more than two orders of magnitude larger than the state of the art. This will enable a full test of the axion paradigm in the high mass range which should become one of the most stringent experimental constraints for dark matter models.

[1] « Observation of strong tripartite coupling in a cavity-quantum circuit-antiferromagnet platform » C Fruy, A Théry, B Hue, W Legrand, L Jarjat, J Bally, J Craquelin, MR Delbecq, A Cottet, T Kontos, Nature Mat., (2026).

[2] « Wide-mass-scanning-range setup and phase-resolved protocol for axion dark matter detection » A Cottet and T Kontos, New Journal of Physics **28**, 024504 (2026).

[3] « Time-domain nonlinear quantum interferometry » C Fruy, A Théry, B Hue et al., Physical Review A **113**, 023706 (2026).

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

Condensed Matter Physics: YES/NO

Soft Matter and Biological Physics: YES/NO

Quantum Physics: YES/NO

Theoretical Physics: YES/NO