Post: Master 2 internship
Location: Laboratoire de Physique des Lasers (LPL), CNRS-Univ Sorbonne Paris Nord, Villetaneuse, France
Advisor: Quentin Bouton (quentin.bouton@univ-paris13.fr)
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Contract: 4-6 months, starting in sping 2024

Casimir-Polder interaction probed by cold atom diffraction through a nanograting

An atom in front of a surface is one of the simplest and fundamental problems in physics. Yet, it allows testing fluctuations associated with the quantum vacuum (Casimir-Polder force), while providing platforms for nanotechnologies and quantum technologies.

Despite its simplicity, combined with strong scientific and technological interests, atom-surface physics, at its fundamental level, remains largely unexplored mainly due to challenges associated with precise control of the atom-surface distance. In this context, our team *Optic and atomic interferometry* (Physique des Lasers) has built a slow atomic beam interacting with a nanograting. The nanograting is made by ourselves in order to control the geometries (atom-surface distance) as best as possible. The interaction between the atoms and the nanograting leads to a diffraction pattern which is dominated by the C.P force [1]. This configuration allows us to study precisely the C.P interaction, with an agreement between the theory and the experiment better than 10%.

To achieve an in-depth understanding of the C.P interaction, the aim of this internship is to increase the precision and the sensitivity of the measurements. To achieve this goal, one of the objectives is to characterize the atomic source and to install an optical dipole trap in order to increase the atomic flux. This trap will also reduce the atomic velocity and therefore will improve the sensitivity of the data. This internship has as well a theoretical aspect with a description of the interference figure (resolution of the Schrödinger equation). Besides, we have started developing deep learning network to accurately reconstruct the diffraction pattern. This method is well suited to extract parameters from high dimensional data. We aim, with these developments, to reach a precision below the percentage level.

[1] C. Garcion et al., *Phys. Rev. Lett*. **127**, 170402 (2021).