INTERNSHIP PROPOSAL

Laboratory name: Laboratoire de Physique des Lasers
CNRS identification code: UMR 7538
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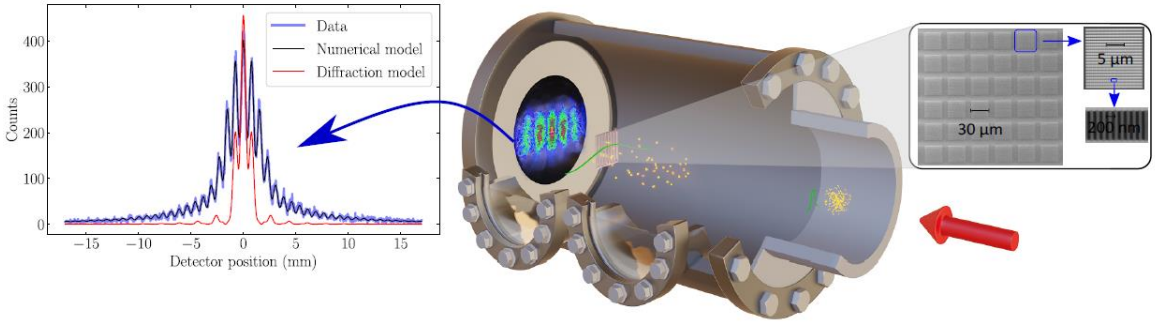
Internship location: Laboratoire de Physique des Lasers, 99 av J-B Clément, 93430 (Villetaneuse)
Thesis possibility after internship: YES
Funding: YES If YES, which type of funding: ANR

Casimir-Polder interaction control of cold atoms and nano devices for fundamental physics

An atom in front of a surface is one of the simplest and fundamental problem in physics. Yet, it allows testing quantum electrodynamics, while providing platforms for the nanotechnologies and quantum technologies. In particular, the presence of electromagnetic quantum fluctuations leads to a force between an atom and a surface. This force is called the Casimir-Polder (C-P) force. This force becomes preponderant at the nanoscale and thus plays a major role in a multitude of areas of Physics, ranging from atomic physic to theoretical fundamental physics such as the 5th force.

Despite its simplicity, combined with strong scientific and technological interests, C-P interaction, at its fundamental level, remains largely unexplored. In this context, our team has built a slow atomic beam interacting with a nanograting (see Figure). This jet interacts with a carefully self-engineered nanograting, leading to a diffraction pattern dominated by the C-P force. This unique configuration allows us to study precisely the C-P interaction.



The current interest of the experiment is to achieve an in-depth understanding of the C-P interaction. To achieve this goal, the successful applicant will take an active role in various aspects of the experiment including **data acquisition, data analysis**, the development of tools for characterizing the **atomic source**, and the installation of an **optical dipole trap** (to increase the atomic flux and reduce the atomic velocity). Additionally, the internship has as well a **theoretical component with the description of the interference figure and quantum electrodynamic calculations**. According to the candidate's preferences, there may also be a clean-room aspect to the internship, involving work on the generation of new nanogratings. The short-term goal of the project is to tailor the C-P interaction using material geometries. In the medium term, this work will open the door to study eventual modifications of the Newtonian gravitational interaction at short range, where C-P interaction shields such forces.

The successful applicant will work as a fully integrated team member. The internship encompasses various components, including experimental work, cleaning room activities, and theoretical studies, which we can be arranged to suit the applicant's preferences. The master's internship is scheduled to begin in spring 2025, and it can be followed by a PhD thesis funded by ANR, starting in September 2025.

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