Master internship position with PhD available

Internship location: Institut de Physique de Nice (INPHYNI) https://inphyni.univ-cotedazur.eu/sites/cold-atoms
17 rue Julien Lauprêtre, 06200 Nice, FRANCE

Contacts: William Guerin — William.Guerin@univ-cotedazur.fr

Salary: ~ 600 euros/months

PhD thesis possibility after internship: YES Thesis funding: ANR grant (project E-CANNON)

Spontaneous emission in a cold-atom photonic band gap

Context — **Cold atoms coupled to photons** are a promising platform for **quantum information, computation and communication**: atoms are adequate systems to store and/or correlate photons, while the photons themselves can be efficient carriers of information over great distances. One important issue for application is to enhance the coupling between light and atoms. Several strategies are under study in the cold-atom community, one of them is to put the atoms close to a photonic structure that modifies the electromagnetic density of states (DOS). In our team we explore this idea with a different method, which is to use the atoms themselves to modify the DOS. Indeed, by trapping the atoms in a periodic way (in a so-called 1D lattice, see picture), a **photonic band gap** opens. So far, this photonic band gap has only been probed via the Bragg reflection of the light that is sent along the lattice. Steady-state and dynamical properties have been studied [1,2].

Objectives — The goal on our experiment is now to characterize the **modification of the density of states**. We are planning two experiments:

- The measurement of a "slow light" effect at the band edges. The expected reduction of the group velocity at the band edges corresponds to an increase of the DOS. Expected: Fall 2025 to Spring 2026
- The study of the **spontaneous emission** from atoms excited in the middle of the lattice. The goal will be to compare the spontaneous emission rate in the Bragg direction and out of the Bragg direction. The temporal dynamics of the decay after switching off the excitation is also an open question: is it superradiant or subradiant ? Expected: Spring 2026 – Fall 2026.

On the longer term, a PhD thesis will explore the use of this system for an efficient **quantum memory with two output ports**. This master internship is experimental but can also include numerical studies.

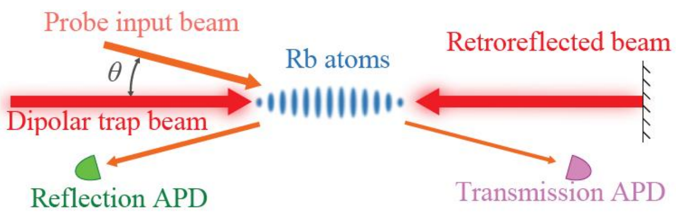

Illustration of cold atoms trapped in 1D lattice, probed at the Bragg angle: light can be efficiently reflected.

You will learn :

- Extensive experience with cold atom experiments
- Practical skills in optics experiments, including alignment, fiber coupling, and AOM setup for example
- Practical skills in operating advanced instrumentation (single-photon detectors, time-to-digital converter,…)

Profile :

- Strong interest in **atomic physics** and **experimental optics**
- A strong motivation and a proactive attitude
- An inclination for collaborative work

References:
[1] Schilke *et al*., Phys. Rev. Lett. **106**, 223903 (2011) ; [2] Asselie *et al*., arXiv:2505.19930 (2025).