INTERNSHIP PROPOSAL

Laboratory name: Laboratoire Aimé Cotton
CNRS identification code: UMR 9025
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Internship location:
Laboratoire Aimé Cotton
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Thesis possibility after internship: YES
Funding: YES If YES, which type of funding: PEPR

Blue slave laser for quantum microwave sensing

Rydberg atoms [1], owing to their intrinsic large dipole moments, are promising tools to detect electromagnetic fields [2] in the range 1 GHz – 1 THz using electromagnetically induced transparency (EIT). First detections, around 10 years ago, triggered a great interest and many developments throughout the world. Within a consortium of 4 French laboratories (PEPR contract "CARAMELS", together with ONERA, LumIn, IEMN), we will study this technique in various points of view.

So far, the technique has been applied to alkali atoms in a hot vapor cell. In Laboratoire Aimé Cotton, we propose to study the use of cold ytterbium atoms in order to push the sensitivity limit. Indeed the electronic structure presents specificities, with long lived states, that could allow to narrow down the device signal by orders of magnitude, improving the ultimate field sensitivity accordingly.

This study requires a blue laser on the singlet to singlet transition of ytterbium from $6s^2\ {}^1S_0$ to $6s6p\ {}^1P_1$ states at 399nm which laser is presently shared with another project. **This internship will consist in building up a slave laser system** to replicate the laser beam spectral purity and amplify its power for its future use in the CARAMELS project.

This internship project can be pursued as a PhD on the development of electromagnetic wave detection with cold ytterbium Rydberg atoms. It is funded within the obtained PEPR contract.

[1] T. F. Gallagher, Rydberg atoms (Cambridge University Press 1994)
[2] Fancher, *et al. IEEE Transactions on Quantum Engineering* **2**, 1-13 (2021).

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

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