INTERNSHIP PROPOSAL

(One page maximum)

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CNRS identification code: UMR 8501
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Internship location: LCF Palaiseau

Thesis possibility after internship: YES
Funding: YES If YES, which type of funding: Doctoral school or group funds

Collective spontaneous emission in arrays of single Dy atoms

This project takes place on a new experimental platform producing **arrays of single dysprosium atoms [1]**. The goal of the project is to study and control collective spontaneous emission and subradiance in an ensemble of two-level atoms, benefiting from the specificities of the atomic structure of Dy. Here, the interaction will be the resonant dipole interaction that exists between atoms driven by resonant light, which exhibits both a real (conservative) and imaginary (dissipative) part. The exchange of excitation that results from the interaction naturally implements an interacting spin system where the two atomic states are mapped onto the two states of a spin-1⁄2. The imaginary part modifies spontaneous emission and can lead to a strong increase of the lifetime of the ensemble: **subradiance**. To reach strong interaction effects, the interparticle distance must be shorter than the wavelength of the transition between the two levels.

We currently run a new experimental setup for cooling and trapping Dy [1]. It will allow to obtain sub-$\lambda/2$ spacing and enable probing and addressing at the single atom level. The experiment produces configurable arrays of Dy atoms in optical tweezers (see figure). **In the internship we propose**, we will implement the next step which is to transfer the atoms in an optical lattice with variable spacing to reach the sub-$\lambda/2$ regime. This Master 2 internship will be followed by a funded PhD pursuing the first studies of collective spontaneous emission in such arrays based on recent proposals [2,3].

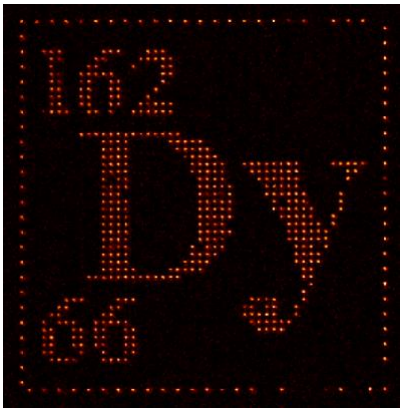

Figure
Experimental picture of single Dy atoms. The image is created by

References

[1] D. Bloch *et al.*, arXiv:2307.04689 Phys. Rev. Lett. (2023).
[2] A. Asenjo-Garcia *et al.*, Phys. Rev. X **7**, 031024 (2017).
[3] S. Masson *et al.*, Phys. Rev. Lett. **125**, 263608 (2020).

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: NO