Spécialité de Master « Optique, Matière, Plasmas »

Stage de recherche (4 mois minimum, à partir de début mars)

Proposition de stage (ne pas dépasser 1 page)

Date de la proposition :

Responsable du stage / *internship supervisor*:

Nom / *name*:	LEPERS	Prénom/ *first name* :	Maxence
Tél :	01 69 35 20 50	Page web :	http://www.lac.u-psud.fr/spip.php?rubrique240
Courriel / *mail*:	Maxence.lepers@u-psud.fr		

Nom du Laboratoire / *laboratory name*: Laboratoire Aimé Cotton

Code d'identification : UPR 3321 Organisme : CNRS

Site Internet / *web site*: http://www.lac.u-psud.fr/

Adresse / *address:* Bâtiment 505, Université Paris-Sud, 91405 Orsay

Lieu du stage / *internship place*: IDRIS, Bât. 506, Université Paris-Sud, 91405 Orsay

Titre du stage / *internship title*: Modeling the optical trapping of ultracold gases composed of rare-earth atoms

Résumé / *summary*

In spite of their names, rare-earth atoms are present in many fields of modern industry, including telecommunications and optical fibers, electronics, spintronics… They are also promising candidates for the implementation of quantum-information protocols. Over the last years, rare-earth atoms have also entered the field of ultracold gases, which resulted for instance in the Bose-Einstein condensation of dysprosium [1] and erbium [2]. When they interact with an external electromagnetic field, laser-cooled rare-earth atoms show an anisotropic behavior due to their strong magnetic dipole moment [3], which means that the energy of interaction significantly depends on the field polarization. However the optical trapping of rare-earth atoms by electromagnetic fields has still to be quantitatively understood, and in particular the role played by the rich energy spectrum of the atoms.

The aim of this theoretical internship is to model the trapping conditions of ultracold rare-earth atoms, to determine to which extent the trapping mechanism can be improved. In particular the student will calculate the real and imaginary parts of the atomic dipole polarizability, which respectively characterize the potential energy and the photon-scattering rate, experienced by the atoms in an optical trap. The central part of the work will consist in modeling the atomic energy-level structure, using a combination of *ab initio* and semi-empirical methods implemented in quantum-chemistry codes.

[1] M. Lu *et al.*, Phys. Rev. Lett. **107**, 190401 (2011)
[2] K. Aikawa *et al.*, Phys. Rev. Lett. **109**, 210401 (2012)
[3] M. Lepers *et al.*, Phys. Rev. A **89**, 022505 (2014)

Toutes les rubriques ci-dessous doivent obligatoirement être remplies

Ce stage pourra-t-il se prolonger en thèse ? *Possibility of a PhD* **? : Yes**

Si oui, financement de thèse envisagé/ *financial support for the PhD***: école doctorale « Ondes et matière »**

Lasers, Optique, Matière	**X**	Lumière, Matière, Interactions	
Plasmas : de l'espace au laboratoire			

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