Spécialité de Master « Optique, Matière, Paris »

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

Proposition de stage

Date de la proposition : October 20, 2016

Responsable du stage / *internship supervisor*:

Nom / *name*:	**COUDERT**	**Prénom/ *first name* :**	**Laurent**
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Nom du Laboratoire / *laboratory name*: Institut des Sciences Moléculaires d'Orsay

Code d'identification : UMR8214 **Organisme :** CNRS-Université Paris-Sud

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

Adresse / *address:* ISMO, Bât. 210, Université Paris-Sud, 91405 Orsay

Lieu du stage / *internship place*: Orsay, FRANCE

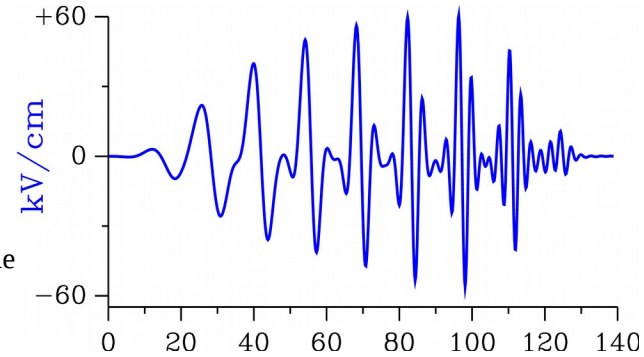
Titre du stage / *internship title*: **Coherent control with terahertz pulses**

Résumé / *summary*

Optimal Control Theory (OCT) is a modern approach to the dynamic optimization which can be applied to a wide variety of fields including mathematics, economy, and chemistry. OCT allows us to stir a system to a selected final state with the help of a control function. In the present case, OCT will be used to control molecular systems [1] using as control function the electric field available with terahertz pulses.

Indeed, the very large electric field which can now be obtained with terahertz pulses makes it possible to manipulate molecular degrees of freedom. Terahertz pulses allow us to control the degrees of freedom corresponding to molecular rotation and to achieve a high degree of orientation [2]. More precisely the average values of the direction cosines Φ_{Zx}, Φ_{Zy}, and Φ_{Zz}, which are equal to 0 without the electric field, can be changed by the terahertz pulse so that one of them becomes close to 1. For instance, a large value of Φ_{Zx} means that the molecule-fixed *x* axis is almost parallel to the laboratory-fixed *Z* axis.

The scope of the internship is applying OCT to design terahertz pulses for different problems involving molecular systems. The terahertz pulse leading to an increased orientation of a linear molecule has thus already been obtained [3] and is plotted here as a function of the time in ps. This pulse leads to a high degree of orientation with $\Phi_{Zz} > 0.9$.



During the internship, OCT will first be applied to several simple cases. For instance, the pulse allowing us to either stop or accelerate molecular rotation will be designed using classical mechanics. OCT will then be applied to retrieve the terahertz pulse allowing us to populate selected excited vibrational states of molecules using classical and quantum mechanics.

1.Werschnik and Gross, *J. Phys.* B **40** (2007) R175

2. Fleischer, Zhou, Field, and Nelson, *Phys. Rev. Lett.* **107** (2011) 163603

3. Salomon, Dion, and Turinici, *J. Chem. Phys.* **123** (2005) 144310

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*: **Doctoral School EDOM**

Lumière, Matière, Interactions	**X**	Lasers, Optique, Matière	**X**

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