Spécialité de Master « Optique, Matière, Paris »

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

Proposition de stage

Date de la proposition : 25 / 09 / 2017

Responsable du stage / *internship supervisor*: Dr. Goulven Quéméner

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Nom du Laboratoire / *laboratory name*: Laboratoire Aimé Cotton (Théomol team)

Code d'identification : UMR 9188 Organisme : CNRS, Université Paris-Sud, ENS Paris-Saclay, Université Paris-Saclay

Site Internet / *web site*: http://www.lac.u-psud.fr/spip.php?rubrique77
Adresse / *address:* Bâtiment 505, Campus d'Orsay, 91405 Orsay
Lieu du stage / *internship place*: IDRIS, Bâtiment 506, Campus d'Orsay (near Laboratoire Aimé Cotton)

Microwave shielding of ultracold dipolar molecules

Ultracold particles are excellent candidates for applications dealing with quantum technologies such as quantum simulation, quantum information, precision measurements and ultracold controlled chemistry [1]. Therefore a lot of effort is devoted nowadays to produce ultracold particles in high densities as well as to understand their properties. The ultracold particles can be atoms or molecules, in neutral, charged or dipolar form, in the ground or in an excited state.

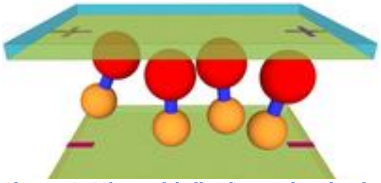

Figure 1: Ultracold dipolar molecules in an electric field. Taken from M. Guo et al., Phys. Rev. Lett. 116, 205303 (2016).

We will focus here on ultracold dipolar molecules [2] in their ground electronic, vibrational and rotational state. One of a main goal is to create a quantum degenerate gas of dipolar molecules such as a Bose-Einstein condensate [3] or a degenerate Fermi gas [4]. However when the molecules start to collide, lot of molecules are lost in the process. Hoping for a long-lived quantum degenerate gas is then compromised unless to shield the molecules from collisional losses. This can be achieved using microwaves [5]. The Master 2 internship will consist in a theoretical and numerical work investigating the efficiency of this shielding for different molecules of experimental interest (NaRb, RbCs, NaK, KRb, LiCs ...) and if possible using a unified adimensional perspective [6]. The present work will likely result in a publication of a scientific paper in a peer-review journal. After successful completion of the internship, **the Master 2 student will be able to pursue her/his scientific research in our team with a 3 years PhD position for which we obtained a full financial support**. The PhD thesis will be the continuity of the work performed during the Master 2 internship.

It is recommended to have a good knowledge in Quantum Mechanics and in Atomic and Molecular Physics, especially in the Quantum Theory of Collisions (for a comprehensive lecture, see [7]). Skills in numerical programming are required especially in Fortran. Knowledge in C, Matlab, Mathematica can still be useful.

[1] L. Carr et al., New J. Phys. 11, 055049 (2009)
[2] G. Quéméner, P. Julienne, Chem. Rev. 112, 4949 (2012)
[3] E. Cornell, C. Wieman, Rev. Mod. Phys.74, 875 (2002); W. Ketterle, Rev. Mod. Phys. 74, 1131 (2002)
[4] B. DeMarco, D. Jin, Science 285, 1703 (1999)
[5] A. Gorhskov et al., Phys. Rev. Lett. 101, 073201 (2008)
[6] M. Gonzalez-Martinez et al., https://arxiv.org/abs/1707.03239 (in press)
[7] Ultracold collisions of molecules, G. Quéméner, https://arxiv.org/abs/1703.09174

Ce stage pourra-t-il se prolonger en thèse ? *Possibility of a PhD* **? : Yes. Starting of PhD: 1st Sept. 2018**

Si oui, financement de thèse envisagé/ *financial support for the PhD***: Full financial support from ANR FEW2MANY-SHIELD (Financial support obtained for a 3 years PhD position)**

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