Spécialité de Master « Optique, Matière, Plasmas »

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

Proposition de stage

Date de la proposition : 22/10/2013

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

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Nom du Laboratoire / *laboratory name*:

Code d'identification : UPR 3321 Organisme : CNRS

Site Internet / *web site*: http://www.lac.u-psud.fr/spip.php?rubrique77

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

Lieu du stage / *internship place*: Laboratoire Aimé Cotton, Bat. 505, Campus d'Orsay

Titre du stage / *internship title*: Control of ultracold polar molecules in electric fields

Résumé / *summary*

The creation of a dense sample of ultracold polar molecules of KRb in 2008 [1] has led to striking advances in ultracold molecular control [2], including ultracold chemical reactions [3], dipolar effects in electric fields [4], confinement in reduced dimensions [5]. Ultracold polar molecules are good candidates for many applications such as many-body physics in optical lattices, quantum simulation, quantum information, precision measurements, and it is therefore crucial to understand their interacting properties.

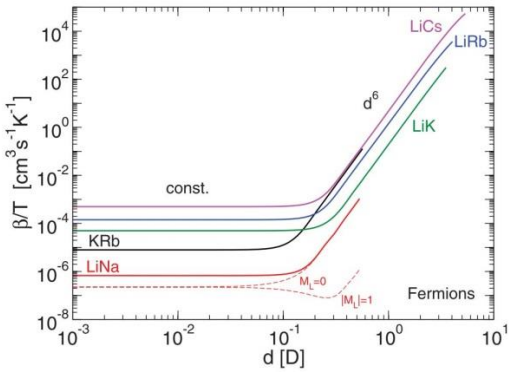

Figure 1: Reactive rate coefficient between fermionic ultracold molecules as a function of the dipole moment induced by the electric field. From Ref. [8].

To describe the molecular dynamics involved in these experiments, the dominant term at long-range, the dipole-dipole interaction, has been used in the theoretical descriptions [6]. However, contributions from other terms such as the dipole-quadrupole, dipole-octopole or quadrupole-quadrupole interactions can be important. Using the dipole, quadrupole and octopole values of different alkali polar molecules calculated in a recent paper [7], the Master 2 student will compute the loss rate coefficients when these higher multipole terms are included and compare with the results of previous works, when they were not included [8]. The student will determine for which electric fields and collision energies those terms become important. The outcomes of this work could result in a publication in a peer-reviewed journal in physics.

It is recommended to have a good knowledge in Quantum Mechanics and in Atomic and Molecular Physics, especially in the Quantum Theory of Collisions. Skills in numerical programming are required (Fortran, C, Matlab, Mathematica).

[1] Ni et al., Science 322, 231 (2008)
[2] Quéméner et al., Chemical Reviews 112, 4949 (2012)
[3] Ospelkaus et al., Science 327, 853 (2010)
[4] Ni et al., Nature 464, 1324 (2010)
[5] de Miranda et al., Nature Physics 7, 502 (2011)
[6] Quéméner et al., Physical Review A 81, 022702 (2010)
[7] Byrd et al., Physical Review A 86, 032711 (2012)
[8] Quéméner et al., Physical Review A 84, 062703 (2011)

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***: bourse EDOM**

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