Spécialité de Master « Optique, Matière, Paris »

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

Proposition de stage (ne pas dépasser 1 page)

Date de la proposition : 20/10/2016

Responsable du stage / *internship supervisor*:

Nom / *name*:	KARR	Prénom/ *first name* :	Jean-Philippe
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Nom du Laboratoire / *laboratory name*: Laboratoire Kastler Brossel

Code d'identification : UMR 8552 Organisme : UPMC/CNRS/

Site Internet / *web site*: http://www.lkb.upmc.fr/iontrap/

Adresse / *address:* 4 place Jussieu, Case 74, 75252 Paris Cedex 05

Lieu du stage / *internship place*: Tour 13, couloir 13-12, 2ème étage

Titre du stage / *internship title*:

Quantum electrodynamics corrections in three-body systems

The theory of quantum electrodynamics (QED) has led to extremely precise theoretical predictions, which have been verified by similarly accurate experiments. Well-known examples are the electron's anomalous magnetic moment or the spectrum of the hydrogen atom. A current challenge for theory is to reach such high levels of accuracy in more complex systems made of more than two particles, starting with three-body systems like the H_2^+ ion (or its isotope HD^+), the simplest molecule in nature [1,2]. The goal is to explain the results of high-resolution spectroscopy experiments that are in progress in several groups [3] (including ours). Comparison between theory and experiment may lead to improved determinations of fundamental physical constants such as the proton-to-electron mass ratio m_p/m_e.

The internship will focus on the nonrelativistic three-body problem (Schrödinger equation) and light-matter interaction, with the aim of studying the possibility of performing Raman spectroscopy of rotational transitions in H_2^+.
The main objective of the PhD will be to advance the theoretical accuracy by calculating the most important QED contributions which have not been evaluated yet, such as one- and two-loop radiative corrections at sixth order of the expansion in powers of the fine-structure constant □.

[1] V.I. Korobov, L. Hilico, and J.-Ph. Karr, *$m\alpha^7$-Order Corrections in the Hydrogen Molecular Ions and Antiprotonic Helium*, PRL **112**, 103003 (2014).
[2] V.I. Korobov, J.C.J. Koelemeij, L. Hilico, and J.-Ph. Karr, *Theoretical Hyperfine Structure of the Molecular Hydrogen Ion at the 1 ppm Level*, PRL **116**, 053003 (2016).
[3] J. Biesheuvel et al., *Probing QED and fundamental constants through laser spectroscopy of vibrational transitions in HD^+*, Nature Comm. **7**, 10385 (2016).

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

Si oui, financement de thèse envisagé/ *financial support for the PhD***: EDPIF**

Lumière, Matière, Interactions	**OUI**	Lasers, Optique, Matière	**OUI**