

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 : 27/10/2014

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Lieu du stage / internship place: Campus Jussieu, couloir 13-12, 2 ^{ème} et 3 ^{ème} étages	

Titre du stage / internship title: Quantum electrodynamics corrections in bound three-body systems
<p>Our group is involved in high-precision calculations on the quantum three-body problem (see for example [1]). Among the systems under study one finds, in particular, the simplest of all molecules: the hydrogen molecular ion H_2^+ and its isotopes HD^+, D_2^+. Similarly to the H atom in the atomic realm, H_2^+ is a privileged system for precise tests of molecular theory and metrology of fundamental constants.</p> <p>One interest of molecules is that they exhibit ro-vibrational transitions whose frequencies are very sensitive to the nuclear masses (unlike electronic transitions in atoms). Comparison between theory and experiment, either in H_2^+ ou HD^+, can be used to obtain a new and more precise determination of the proton-to-electron mass ratio m_p/m_e [2]. Another molecule-like system of interest is antiprotonic helium, in which a recent laser spectroscopy experiment at CERN led to a new determination of the antiproton-to-electron mass ratio [3].</p> <p>A few years ago, a systematic evaluation of QED corrections in three-body molecular systems was initiated, in collaboration with V. Korobov (JINR, Dubna, Russia). We use a perturbative expansion in powers of the fine structure constant α and follow the framework of “nonrelativistic Quantum Electrodynamics” (NRQED), meaning that correction terms are expressed in terms of effective operator mean values on the nonrelativistic (Schrödinger) wave function. We recently evaluated the one-loop self-energy correction for the bound electron at order α^7 [4]. The subject of the internship and thesis will be to consider two-loop corrections at the following order [5].</p> <p>[1] J.-Ph. Karr and L. Hilico, Phys. Rev. Lett. 109, 103401 (2012). [2] U. Bressel et al., Phys. Rev. Lett. 108, 183003 (2012). [3] M. Hori et al., Nature 475, 484 (2011). [4] V.I. Korobov, L. Hilico and J.-Ph. Karr, Phys. Rev. Lett. 112, 103003 (2014). [5] U.D. Jentschura et al., Phys. Rev. A 72, 062102 (2005).</p>

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

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