

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 :

Responsable du stage / internship supervisor:			
Nom / name:	Boiron	Prénom/ first name :	Denis
Tél :	01 64 53 33 54	Fax :	
Courriel / mail:	denis.boiron@institutoptique.fr		
Nom du Laboratoire / laboratory name: Laboratoire Charles Fabry de l'Institut d'Optique			
Code d'identification :	UMR8501	Organisme :	Institut d'Optique Graduate School
Site Internet / web site:	www.atomoptic.fr		
Adresse / address:	2 avenue Fresnel, 91127 Palaiseau		
Lieu du stage / internship place:	Laboratoire Charles Fabry		

Titre du stage / internship title: Two particle interference and entanglement
Résumé / summary <p>Our group has perfected methods to detect cold atom clouds released from a trap in three dimensions and with single atom sensitivity. We have been using this method to perform fundamental experiments on entanglement produced by non-linear processes in Bose-Einstein condensates. A recent example is the demonstration of the Hong-Ou-Mandel effect for atoms [1]. We are currently working on a version of a two particle interference effect which, if the performance is optimized, can demonstrate a violation of Bell's inequalities. This would be the first time that such inequalities have been tested for the motional degrees of freedom of freely falling, massive particles. Preliminary experiment are underway and one of the tasks of the internship will be to participate in the acquisition of the data and its analysis.</p> <p>We use a particular type of non-linear process in a Bose-Einstein condensate to produce entangled atom pairs. However, there exist many other processes which can produce entanglement and a second line of our research to explore them. We are currently investigating an effect analogous to the dynamical Casimir effect in quantum electrodynamics. The dynamical Casimir effect corresponds to the creation of photon pairs by a mirror moving in vacuum [2]. Instead of producing photon pairs, our mechanism produces <i>phonon</i> pairs in a Bose-Einstein condensate. We have demonstrated the basic effect [3], and we are planning an experiment to observe the entanglement of these phonons. A second part of the internship will be to work on the design and the preliminary phases of the execution of this experiment. If this experiment is successful, we can envisage an ambitious extension of these techniques to a demonstration of an analog of Hawking radiation of phonons in the hydrodynamic flow of a condensate. Theoretical explorations of this problem could also be part of this internship.</p> <p>[1] R. Lopes <i>et al.</i>, Nature 520, 66-68 (2015), arXiv:1501.03065. [2] P. D. Nation <i>et al.</i>, Rev. Mod. Phys. 84, 1 (2012). [3] J.-C. Jaskula <i>et al.</i>, Phys. Rev. Lett. 109, 220401 (2012), arXiv:1207.1338. [4] D. Boiron <i>et al.</i>, Phys. Rev. Lett. 115, 025301 (2015).</p>
Toutes les rubriques ci-dessous doivent obligatoirement être remplies

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: contrat ANR			
Lumière, Matière, Interactions	<input checked="" type="checkbox"/>	Lasers, Optique, Matière	<input checked="" type="checkbox"/>

Fiche à transmettre (fichier pdf **obligatoirement**) sur le site <http://stages.master-omp.fr>