

Spécialité de Master « Optique, Matière, Paris »

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

Proposition de stage

Date de la proposition : 15 octobre 2015

Responsable du stage / internship supervisor:	
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Nom du Laboratoire / laboratory name:	
Code d'identification :	UMR 8552
Organisme :	ENS, CNRS, UPMC (Paris 6), Collège de France
Site Internet / web site:	http://www.lkb.ens.fr/-Helium-polarise-et-fluides-
Adresse / address:	Laboratoire Kastler Brossel , Dep ¹ de Physique de l'ENS, 24 rue Lhomond, 75005 Paris
Lieu du stage / internship place:	ENS Lhomond, 1 ^{er} étage, pièce L164

Titre du stage / internship title: Towards optical pumping of helium-3 at low temperature	
<p>Context – Metastability exchange optical pumping, MEOP, of ^3He gas yields very high nuclear spin polarisations (> 80 – 90%) in "standard" conditions: room temperature, low pressure, low magnetic field. The high efficiency of MEOP (typically 1 polarised nucleus per absorbed photon) relies on OP cycles involving the closed 2^3S-2^3P optical transition at 1083 nm (selective excitation by circularly polarized light / de-excitation by spontaneous emission) and on polarisation transfer by metastability exchange (a binary collisional process in which metastable 2^3S atoms and ground state He atoms exchange electronic-only excitation and retain their nuclear spin orientations). Applications of laser-polarised ^3He include pre-clinical lung MRI, spin filters for neutron beams, targets for high energy physics, high resolution magnetometry, etc.</p> <p>Our recent investigations have focused on the fundamental limits of conventional MEOP, as well as on operation in non-standard conditions (high pressure and high field). A new collaborative project (WideNMR, 2016-2019) provides the challenging opportunity to extend the tests of high field MEOP down to cryogenic temperatures.</p> <p>Internship work - The objective is to perform preliminary tests for optimal design of the low temperature MEOP setup. The internship will provide an opportunity for hands-on experience with optical techniques for laser OP and in-situ plasma diagnosis in pure ^3He gas. The light sources are commercial solid-state lasers (fibre laser / amplifier, tunable laser diodes).</p> <p>The work may include: implementation of experimental devices for RF discharge and beam control inside a cryostat; absorption measurements and OP at low and high field; bibliographic search for specific technical aspects.</p> <p>PhD work - The primary objective is to explain the increase of angular momentum loss which has been systematically observed, so far, during OP with strong 2^3S-2^3P excitation. Ultimately, it is highly desirable to find a way to efficiently control or neutralise the identified source(s) of relaxation in standard and non-standard MEOP conditions. The work will focus on the search for the underlying physical process(es) and for a quantitative description of its (their) contribution(s) to O.P. dynamics, in order to improve the predictive numerical models developed for MEOP. This may require new and complementary experimental tools and further investigations of ^3He MEOP in standard conditions. The work may also involve comparative studies for various gas pressures, magnetic field strengths, for pure ^3He or isotopic ^3He-^4He gas mixtures. Application to high-sensitivity ^3He magnetometry for high resolution mass spectrometry in ion traps provides new challenges and the pioneering work performed at LKB on ^3He MEOP at low temperature may deserve to be revisited, with improved experimental and theoretical tools.</p>	
	 <p>7T NMR spectrometer</p>
	Read more: http://www.lkb.ens.fr/-Polarisation-de-3He- http://www.lkb.ens.fr/Sujet-P-O-des-plasmas-d-He

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: via l'ED ou contrat (demandé)			
Lumière, Matière, Interactions	X	Lasers, Optique, Matière	X