

Spécialité de Master « Optique, Matière, Plasmas »

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

Date de la proposition : 30 Octobre 2013

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Code d'identification : UMR 8552	Organisme : ENS / CNRS / Paris 6
Site Internet / web site: http://www.lkb.ens.fr/-Helium-polarise-et-fluides-	
Lieu du stage / internship place: ENS 24 rue Lhomond 75005 Paris, pièce L164 / P5	

Optical pumping in helium plasmas: new methods for new challenges

Hyperpolarisation by optical pumping (OP) in a He-3 plasma

- In an RF discharge plasma, He → He* (metastable excited state)
 - OP cycles between 2³S, 2³P hyperfine sublevels => nuclear spin orientation of He*
 - Collisional exchange of excitation => transfer of orientation to He (without loss)
- At room T, p ≈ 1 mbar, and B ≈ 0.5 mT: $M \approx 80\%$ >> $M^{eq} = \mu B/kT$ (10⁻⁸)
 Fast pumping: a few tens of seconds => suited for massive gas production

Applications of hyperpolarised (HP) ³He gas:

- ❖ Neutron spin filters (polarisers, analysers)
- ❖ High precision Zeeman magnetometers
- ❖ Nuclear targets
- ❖ MRI of lung airspaces

Recent work:

- ❖ Improved OP model
- ❖ Accurate polarimetry

Powerful lasers (up to 15W) provide high M, but lower than expected from validated models:

=> clear **OP-enhanced relaxation**

Observed at all fields up to 1.5T, measured, but not yet understood.

Current and future tools:

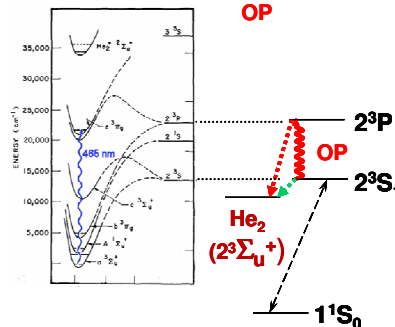
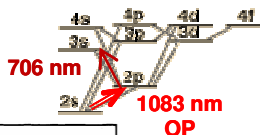
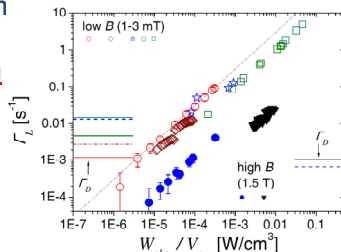
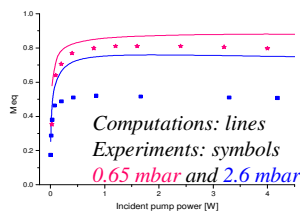
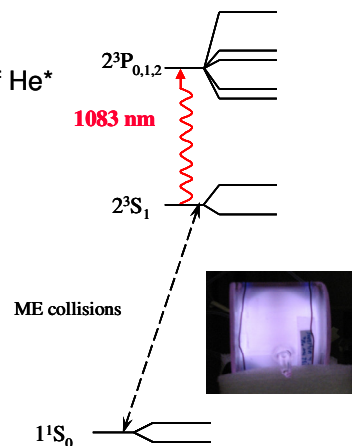
- Tunable lasers at 1083nm, 706 nm, 465 nm to probe populations in relevant atomic and molecular levels

- Dedicated experimental setups (various fields) and gas cells cells (various shapes, pressures).

- Improved control of plasma conditions

More details:

www.lkb.ens.fr/-Polarisation-de-3He-



Internship projects:

- Characterise, implement, and use **optical probing tools** to study the universally observed angular momentum losses: IR or visible laser diodes, light polarimetry, absorption lineshape analyses,...
 - Compare OP in CW or pulsed RF plasmas
 - Directly probe and theoretically model effects of re-absorbed OP light
- Understanding the current limitations of OP, revisiting accepted models, and boosting up its efficiency in a **PhD** work will have important practical applications.

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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 doctoral ou BDI

Lasers, Optique, Matière	X		
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