Spécialité de Master « Optique, Matière, Plasmas »

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

Date de la proposition : 30 Octobre 2013

Responsable du stage / *internship supervisor*: **Pierre-Jean NACHER et Geneviève TASTEVIN**

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Nom du Laboratoire / *laboratory name*: **Laboratoire Kastler Brossel**

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

Low field MRI: innovative sequences for hyperpolarised gases

Context: Conventional NMR / MRI involves a **dense medium** with equilibrium polarisation in a **strong magnetic field** (protons from H atoms in H_2O or tissues, in $B \geq 1.5$T).

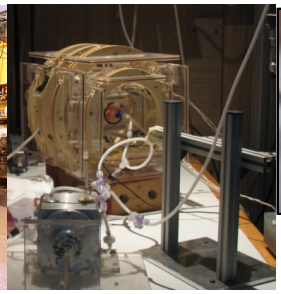
A gas can be used as if the nuclei are hyperpolarised (HP). With **optical pumping techniques** high magnetisations (hence good S/N ratios) are obtained **at arbitrary magnetic field** in spite of the low probe density. For lung imaging, the HP gas is mixed with air and inhaled just before imaging.

Benefit of low field operation: less artefacts and longer MR signals due to the much lower impact of the magnetic susceptibility of the blood and lung tissues (significant field inhomogeneities induced at short length scales).

Our group at LKB performs **methodological developments** and in vitro / in vivo validation (with on-site production of HP ^{3}He gas and MRI at B= 3 to 6 mT) and resorts to collaborations for high-*B* tests.

MEOP-based gas polariser

Faraday cage + MRI



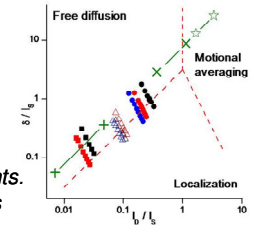
Prototype MR system

Preserved mammalian lungs (left), enclosed in a sealed box (right) with preserving liquid, used to control lung inflation. Refillable glass cells.

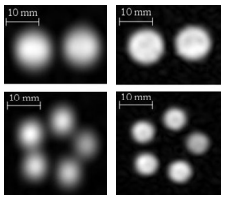
Recent work

❖ Attenuation by diffusion in confined geometries

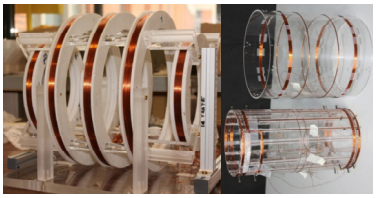
Small symbols: in-vitro measurements.
×, + and line: human lung conditions



❖ Tests of innovative MR sequences in cells and lungs



❖ New MRI system (2013)



More details:
http://www.lkb.ens.fr/IRM-du-poumon

Internship projects:

- **Use the new MR system**
  Improved spatial homogeneity of *B, G, B1 coils.*
- **Implement and test at low *B* a new method with HP gas:**
  Gradient-free MRI !
- **Study impact of restricted diffusion on image quality**
  - computer lattice simulations
  - in vitro experiments

This could be continued in a **PhD** work, that will also include **comparative in-vivo** studies of lung MRI on small animals.

www.lkb.ens.fr/-Offres-de-theses-et-stages-

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**		