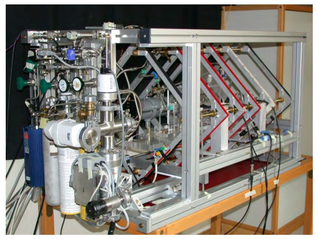
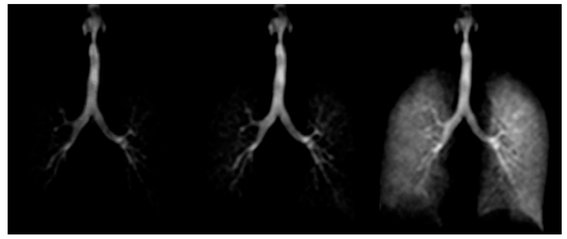
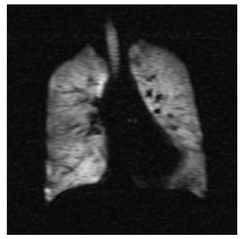
Laboratoire Kastler Brossel
Physique quantique et applications

Innovative methods for low field NMR and MRI

Context and motivation

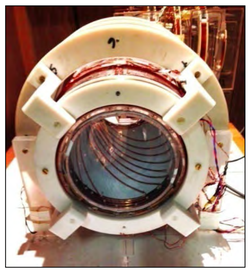


Pre-clinical lung MRI
with (inhaled) laser-polarised ^{3}He gas
3 mT – 0.1 T – 1.5 T

LKB – IR4M collab. + two European projects

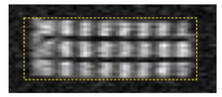
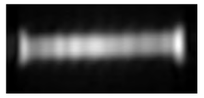
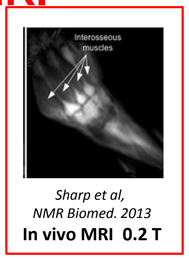
Low field work at LKB: MRI with ^{3}He (laser-polarised gas) / ^{1}H (thermally-polarised water)


Plastinized lungs


Gradient-free TRASE MRI



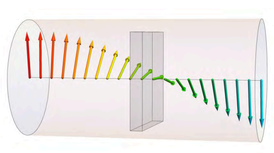
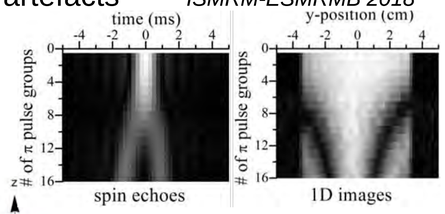





Sharp et al, NMR Biomed. 2013
In vivo MRI 0.2 T

LKB – Univ. of Winnipeg

Current / planned work at LKB

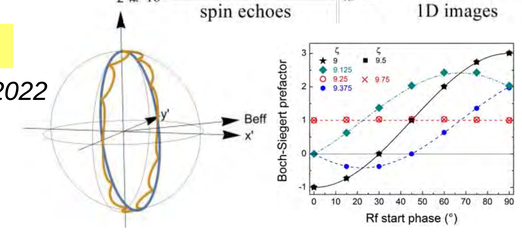
➢ **Towards 3D TRASE MRI:** Evaluation of image artefacts *ISMRM-ESMRMB 2018*

➢ **Breakdown of RWA in low field NMR**

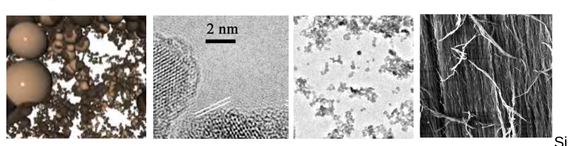
Euromar 2018, ISMRM-ESMRMB 2018, JMR2022

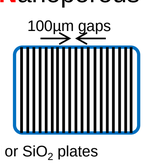
2-level quantum systems have similar time evolution



➢ **MARGIN collaborative project** (with Kazan Fed. Univ, 2020-2022)

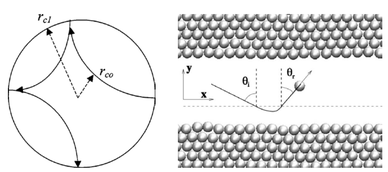
MAgnetic **R**esonance studies of **G**as diffusion **I**n **N**anoporous materials





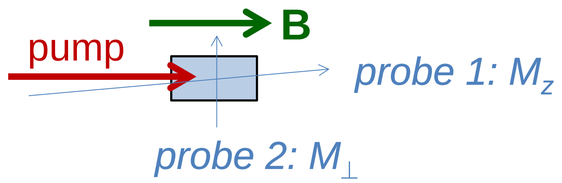
Probe gas diffusion by NMR of 3He and 129Xe
- high and low T (300 K-1.5 K), high and low densities
- wide range of time and distance scales.

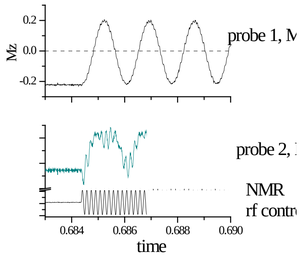
(Experimental and theoretical studies).



Usual gas transport (Knudsen) model:
ballistic or diffusive transport in pores
+ interactions ***at*** walls.
Overlooks distant effect of wall potential

Optical detection of spin dynamics in ^{3}He NMR





INTERNSHIP PROJECTS & PhD TOPICS

All involve hands-on NMR or MRI experiments

(measurements on polarised gas or water samples, advanced data analysis based on lattice simulations)

Optically detected NMR (new)
sensitive detection of dynamics of all M components

Gas diffusion studies in nanoporous materials (MARGIN)
e.g., anisotropic aerogels, effect of wall interactions

Impact of restricted diffusion on image quality
Computer lattice simulations - In vitro experiments

Artefacts and limitations in gradient-free imaging
Bloch Siegert effects - Concomitant RF gradients

http://www.lkb.science/polarisedhelium/

Geneviève Tastevin, Pierre-Jean Nacher