Evolution de la RMN vers l'imagerie médicale

Les Origines : Laboratoire de spectroscopie et luminescence (Prof. J. Janin)

Spectroscopie hertzienne | Spectrométrie optique | Matériaux luminescents | Physico-Chimie quantique

Lasers
RPE (Prof. A. Erbeia, Prof. J. Delmau)
RMN

Physico-Chimie — Spectroscopie RMN

Dynamique moléculaire — Chimie organique

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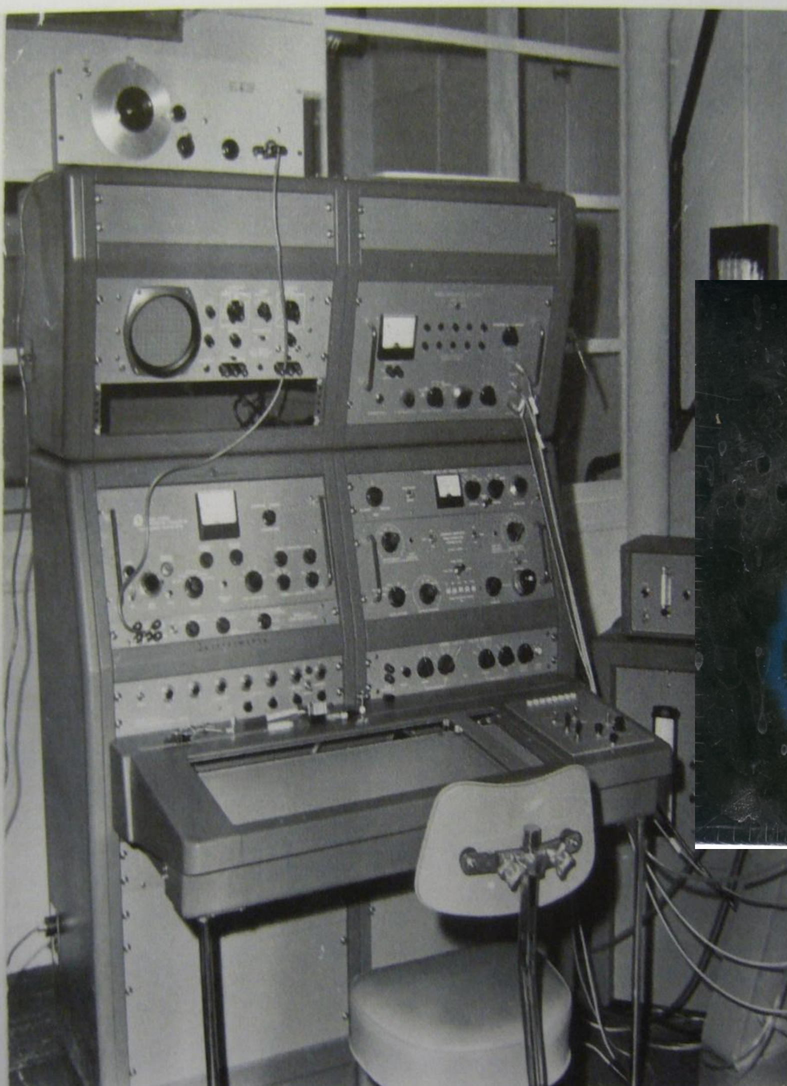
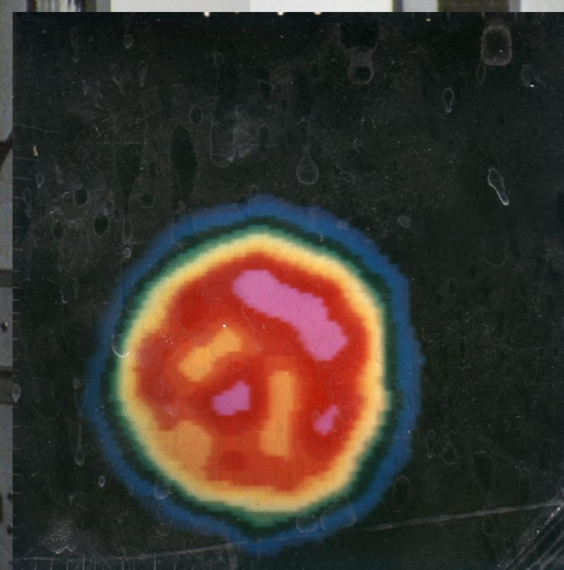
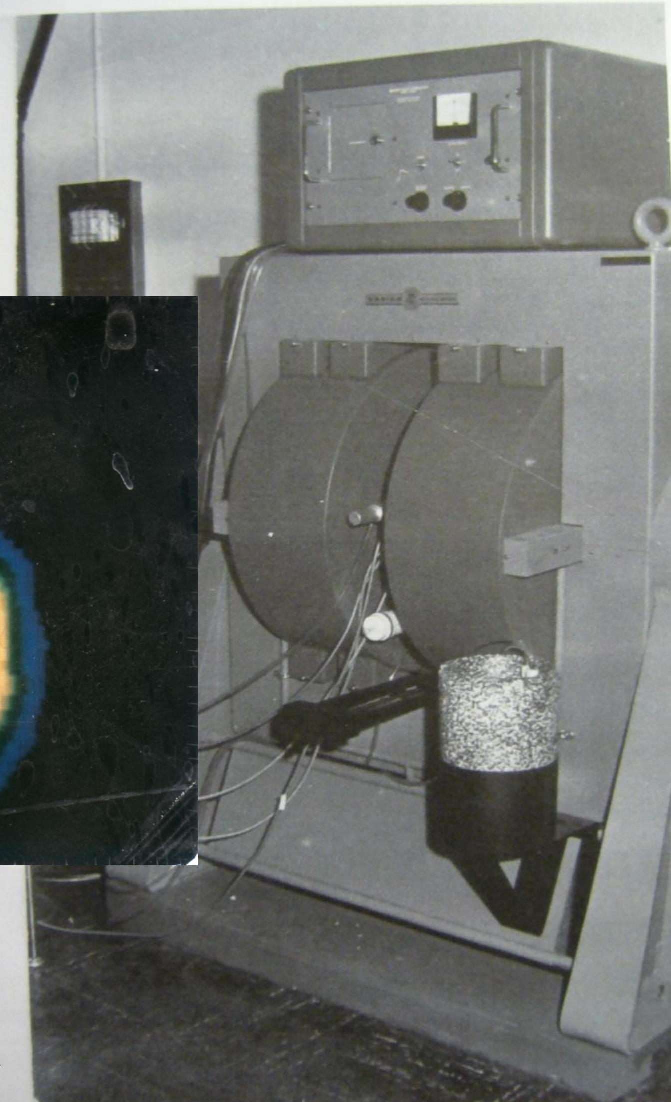
Liens avec RMN biomédicale actuelle

Produits de contraste, Imagerie Moléculaire, Imagerie fonctionnelle, Imagerie métabolique
Imagerie de diffusion, Spectroscopie in vivo

SPECTROMETRE 100 MHz (Varian HA 100) à ondes continues



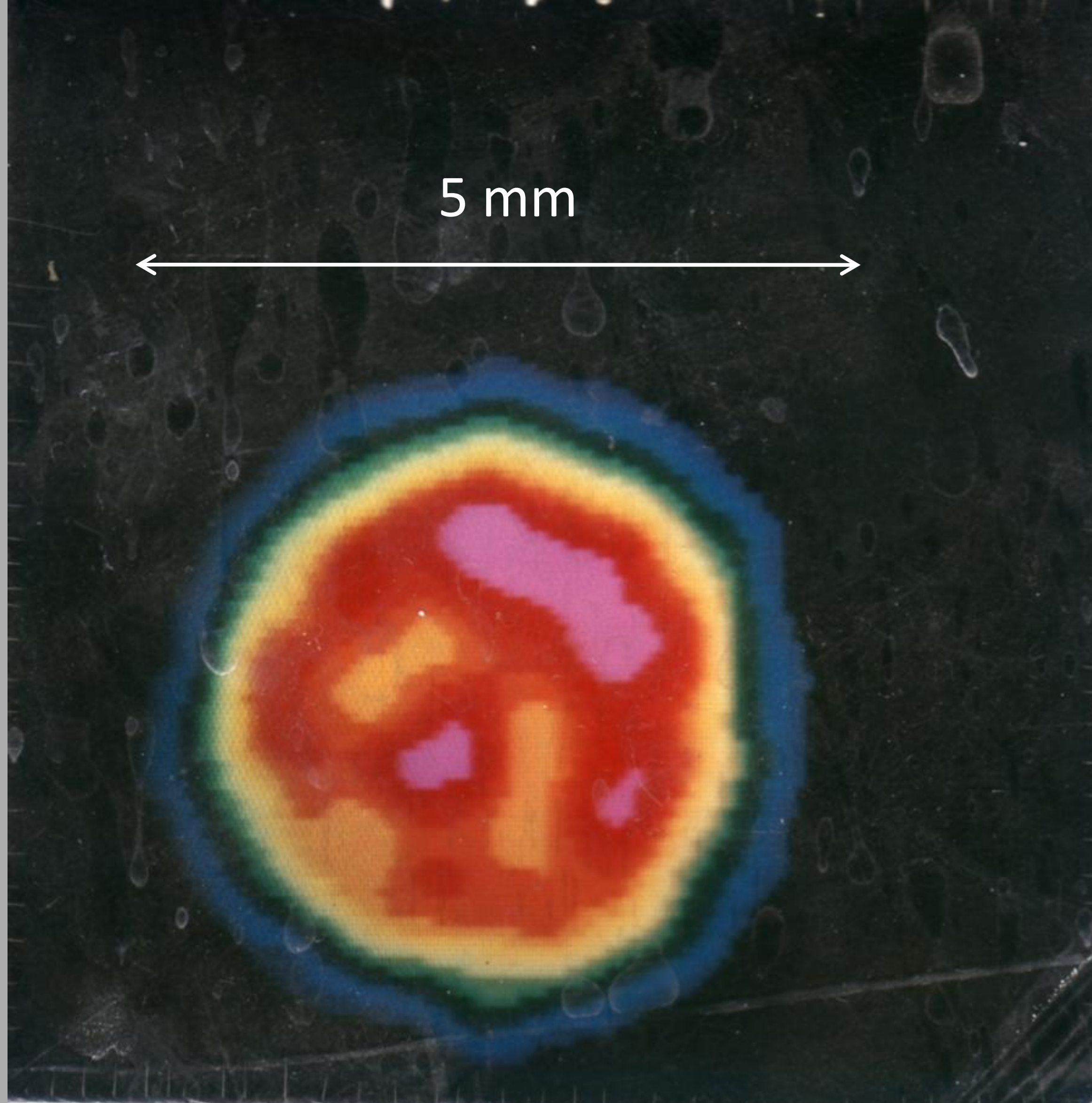




J.J. MALLET
A.BONMARTIN
H. MEHIER

D. GRAVERON
C. LAPRAY
J.C. DUPLAN
A.BRIGUET

(Avril 1978)



2,35 teslas

100 MHz

G_{lec} # 4,7 mT/m

BPFP (72 proj.)

Développement à partir de 1981

Labo RMN: B1*, UPRES,UMR CNRS

-Imageur résistif 20 MHz   (Institut de Physique Nucléaire de Lyon 1980-1986)

-Imageur résistif corps entier Philips 5,5 MHz (Bâtiment Oméga 1986-1994)

-Spectromètre 200 MHz Centre d’études du Métabolisme
(HEH/Inserm U80, 1987-1991)

-Système SMIS-Oxford à 2 teslas (Bâtiment CPE, 1994…) + mise en place de la plateforme de spectroscopie commune UCB-CPE (4 spectromètres + 1 du centre des très hauts champs)

-Système (Bruker-Magnex) 7 teslas (Animage, CERMEP , 2003)

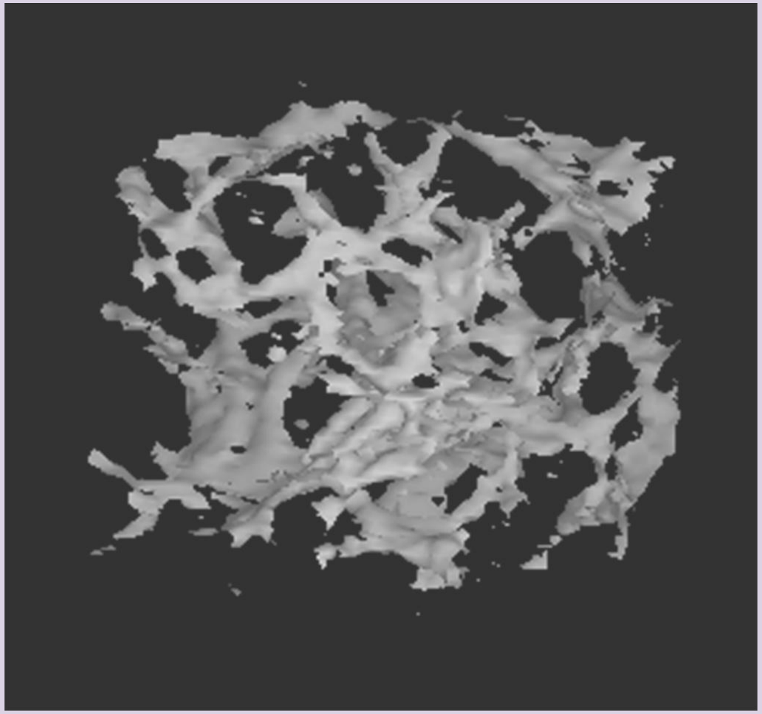
-Corps entier Siemens 1,5 teslas (CERMEP, 2004)

-Système Bruker-Magnex 4,7 teslas (Bâtiment CPE, 2005)

2007 : LRMN rejoint CREATIS

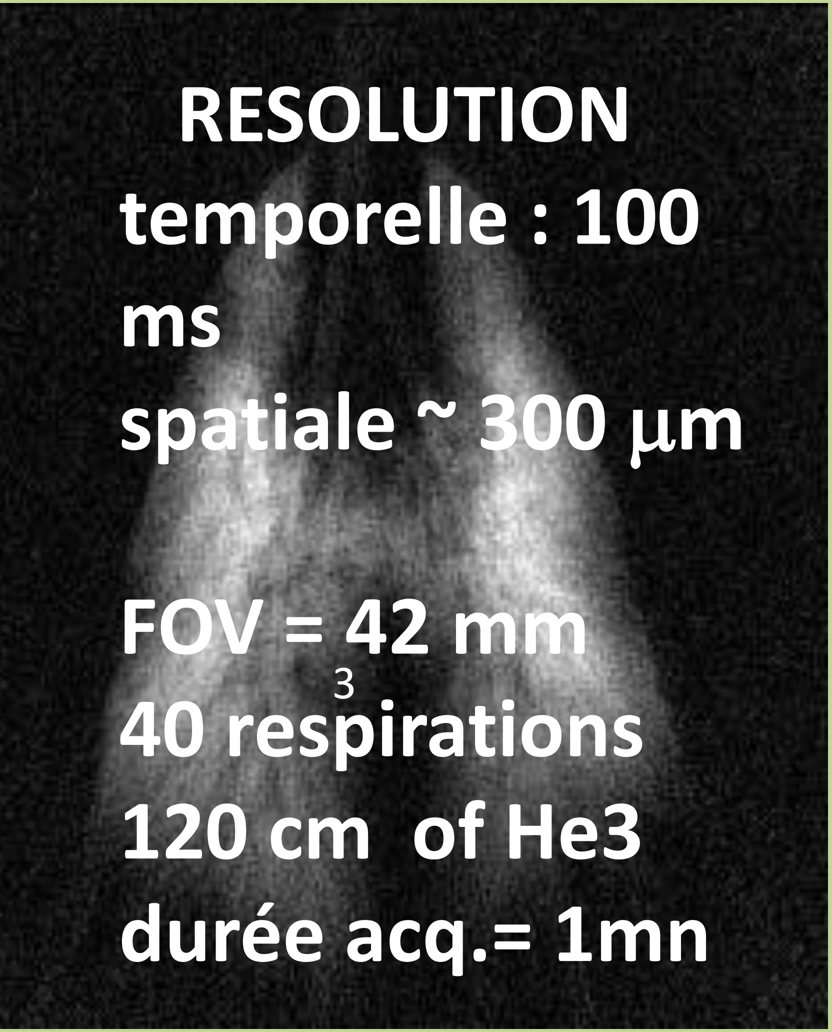
QUELQUES RESULTATS ou THEMES SIGNIFICATIFS

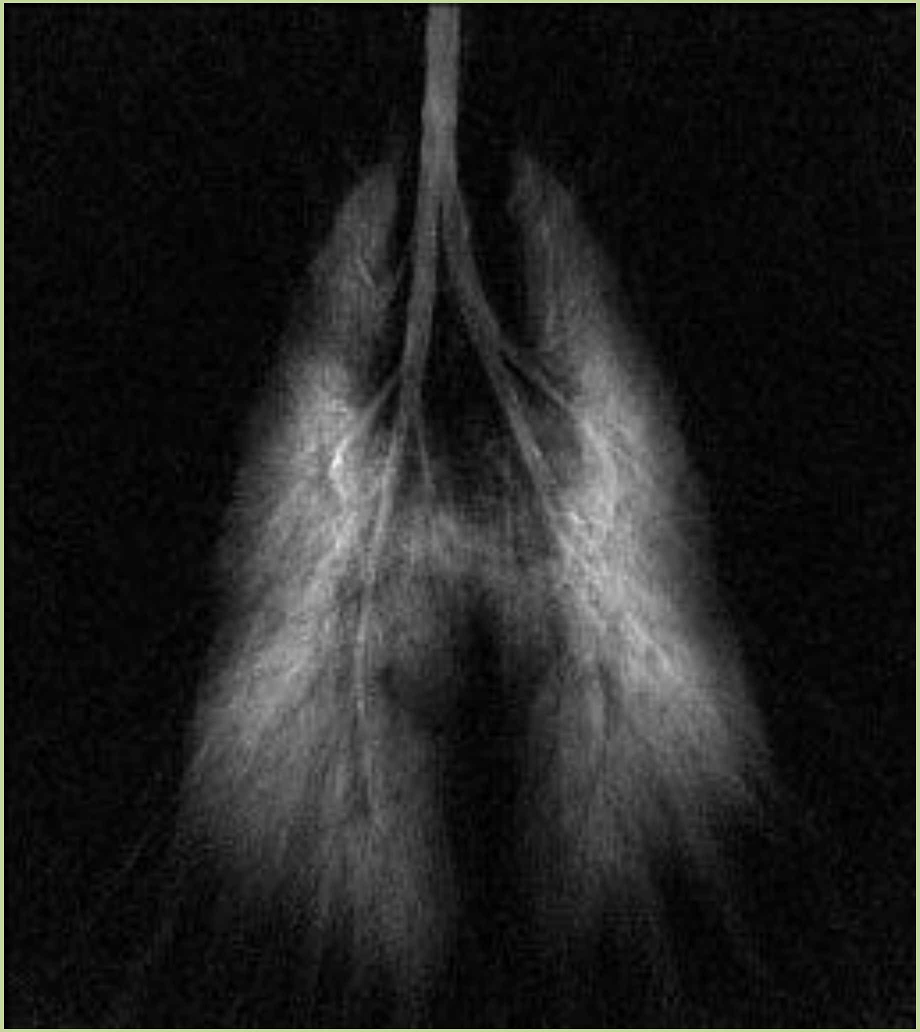
Imagerie des tissus denses (« Biomatériaux vivants »)



Clichés Olivier BEUF

Ventilation pulmonaire avec hélium 3 hyperpolarisé (modèle animal)

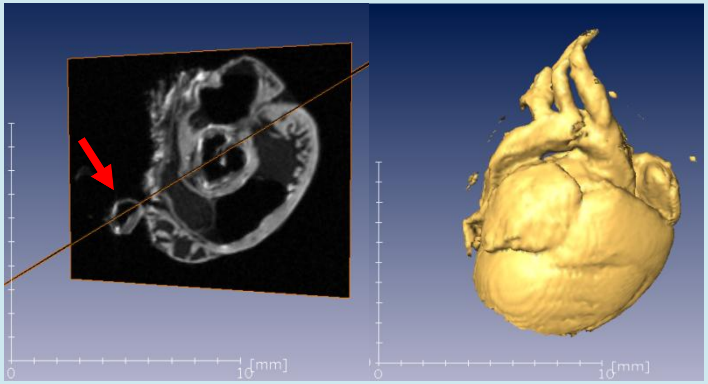


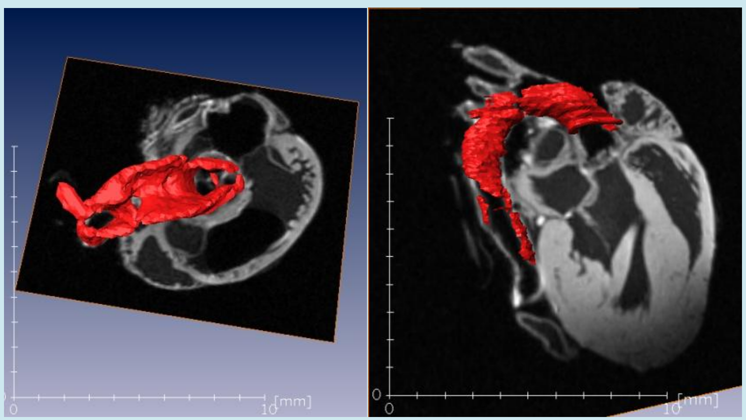


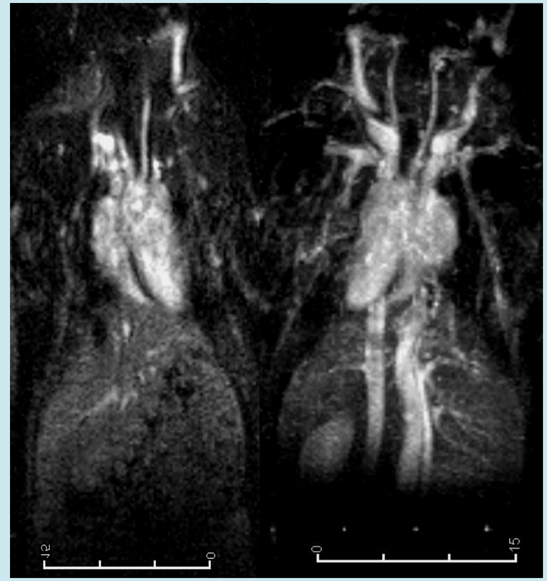
Thèse Magali VIALLON

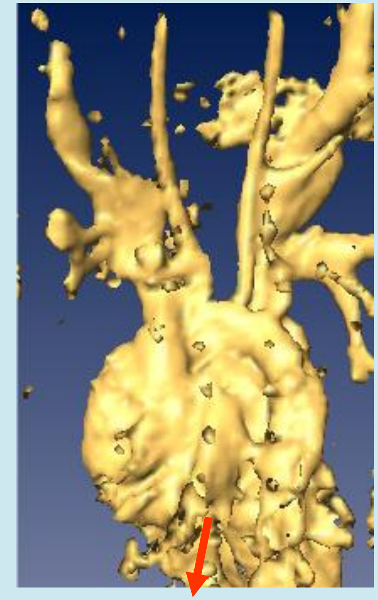
CREATIS-40 ansLyon1

La Plaque d’Athérome (souris)

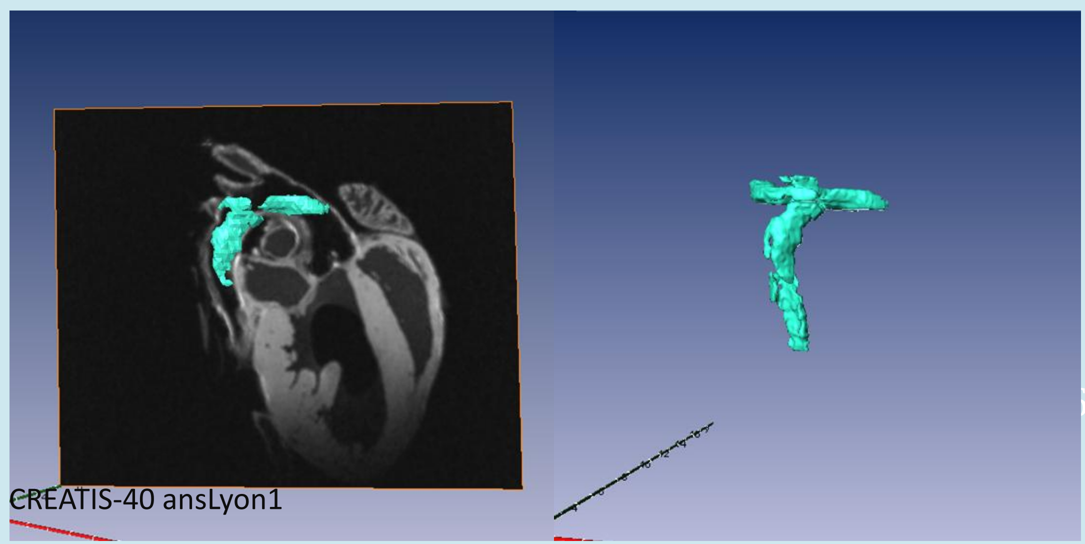




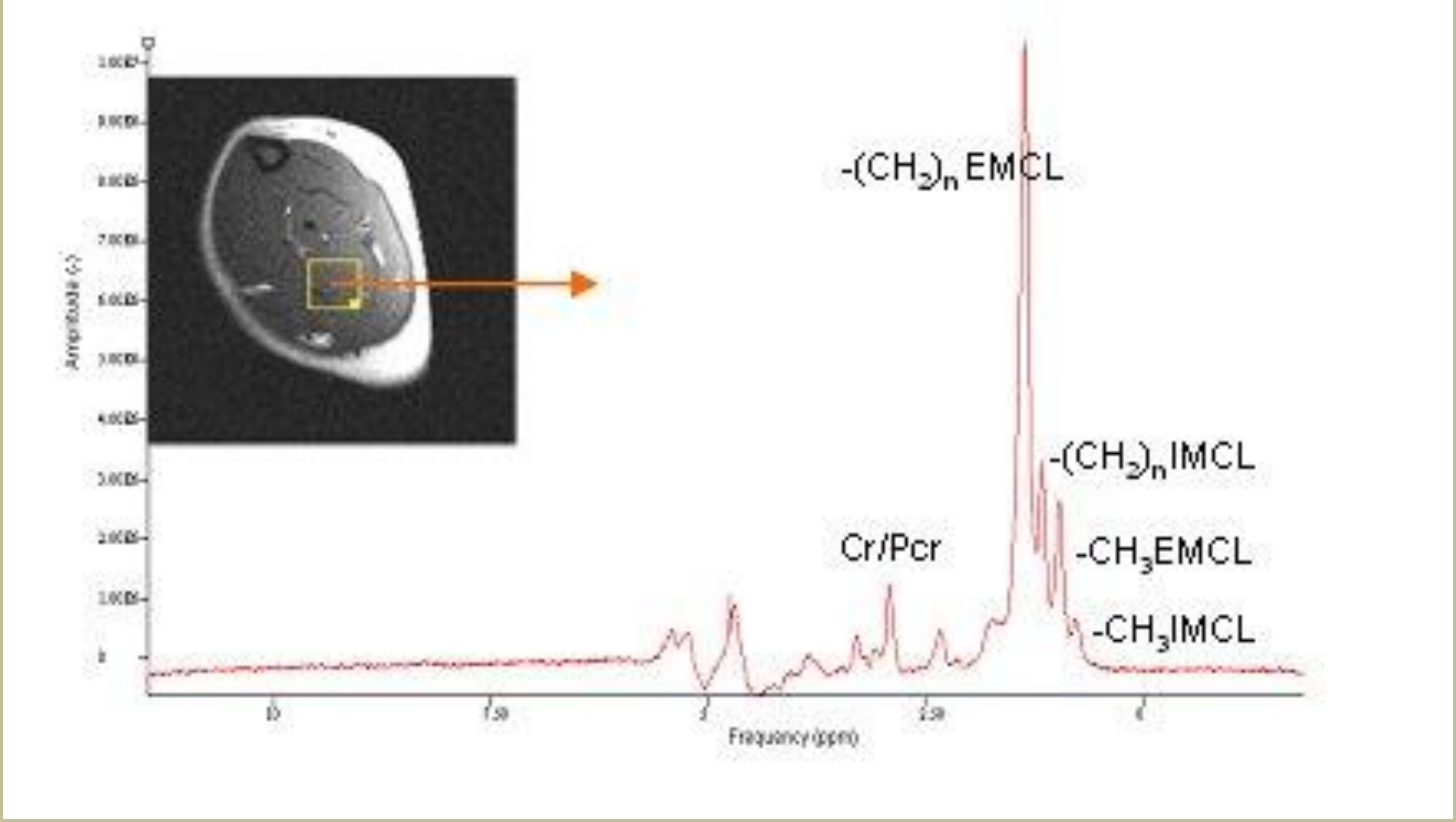




Données Emmanuelle CANET



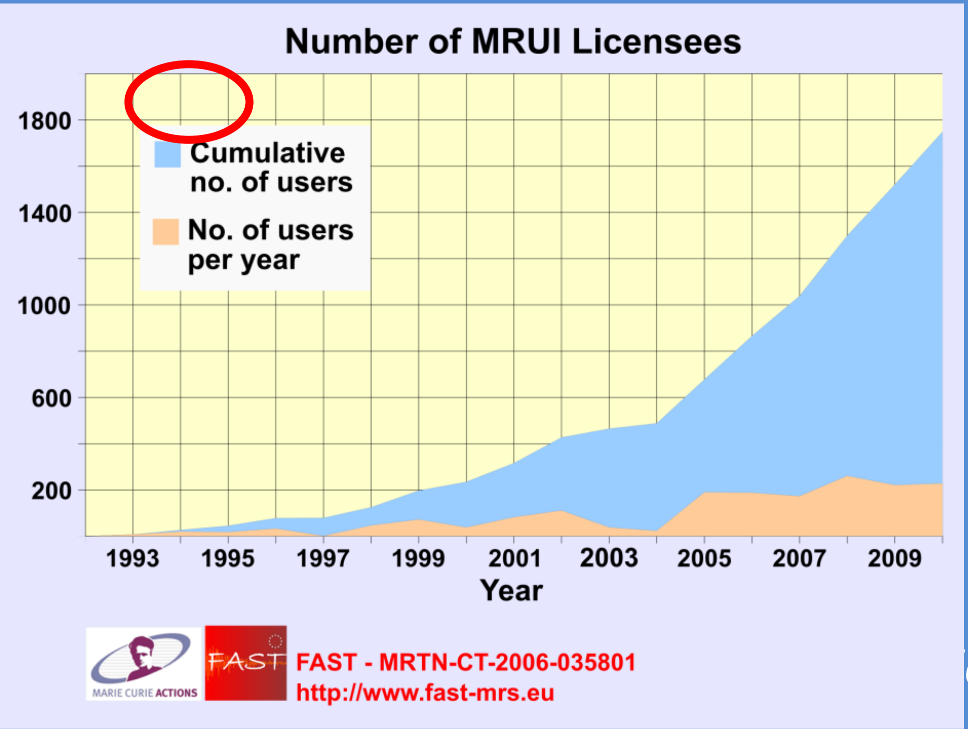
Discrimination des lipides intra/extra-musculaires par spectroscopie proton localisée à l'angle magique

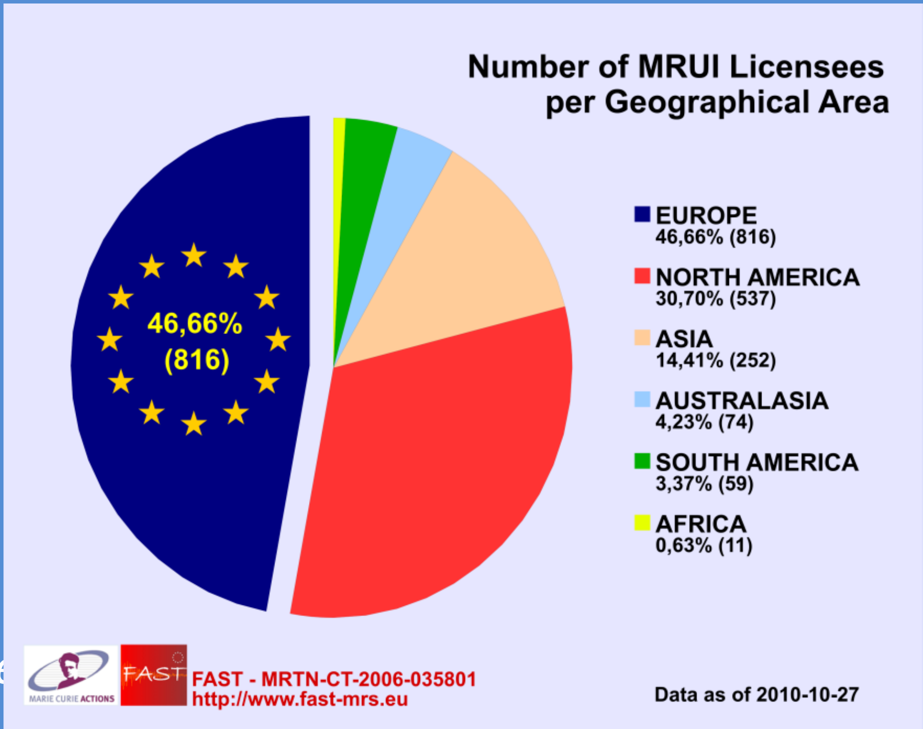


Travaux Rachida FISSOUNE et Hassem HIBA

jMRUI Software Package

Advanced Signal Processing for Medical MRS

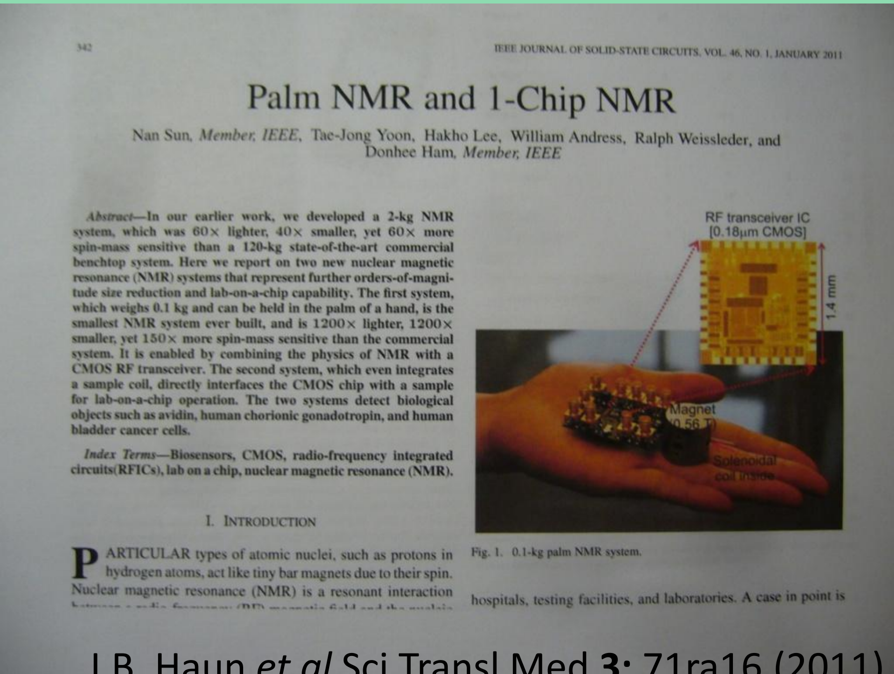




- http://www.mrui.uab.es/mrui/
- Environments: Windows 2000, XP, Vista, Linux

  - Danielle GRAVERON

EVOLUTION DE LA RMN BIOMEDICALE



Palm NMR and 1-Chip NMR

Nan Sun, *Member, IEEE*, Tae-Jong Yoon, Hakho Lee, William Andress, Ralph Weissleder, and Donhee Ham, *Member, IEEE*

Abstract—In our earlier work, we developed a 2-kg NMR system, which was 60× lighter, 40× smaller, yet 60× more spin-mass sensitive than a 120-kg state-of-the-art commercial benchtop system. Here we report on two new nuclear magnetic resonance (NMR) systems that represent further orders-of-magnitude size reduction and lab-on-a-chip capability. The first system, which weighs 0.1 kg and can be held in the palm of a hand, is the smallest NMR system ever built, and is 1200× lighter, 1200× smaller, yet 150× more spin-mass sensitive than the commercial system. It is enabled by combining the physics of NMR with a CMOS RF transceiver. The second system, which even integrates a sample coil, directly interfaces the CMOS chip with a sample for lab-on-a-chip operation. The two systems detect biological objects such as avidin, human chorionic gonadotropin, and human bladder cancer cells.

Index Terms—Biosensors, CMOS, radio-frequency integrated circuits(RFICs), lab on a chip, nuclear magnetic resonance (NMR).

Fig. 1. 0.1-kg palm NMR system.

I. Introduction

PARTICULAR types of atomic nuclei, such as protons in hydrogen atoms, act like tiny bar magnets due to their spin. Nuclear magnetic resonance (NMR) is a resonant interaction

hospitals, testing facilities, and laboratories. A case in point is

J.B. Haun *et al* Sci Transl Med **3:** 71ra16 (2011)

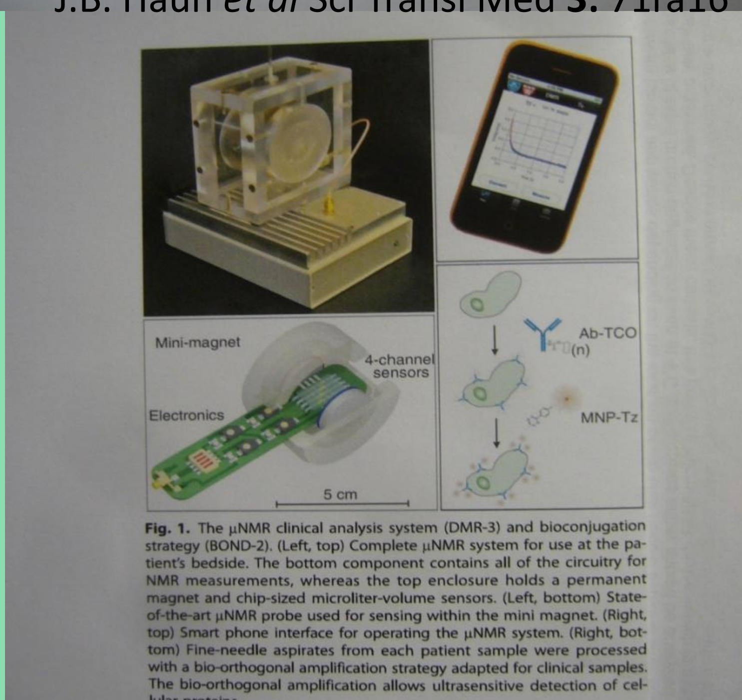


Fig. 1. The μNMR clinical analysis system (DMR-3) and bioconjugation strategy (BOND-2). (Left, top) Complete μNMR system for use at the patient's bedside. The bottom component contains all of the circuitry for NMR measurements, whereas the top enclosure holds a permanent magnet and chip-sized microliter-volume sensors. (Left, bottom) State-of-the-art μNMR probe used for sensing within the mini magnet. (Right, top) Smart phone interface for operating the μNMR system. (Right, bottom) Fine-needle aspirates from each patient sample were processed with a bio-orthogonal amplification strategy adapted for clinical samples. The bio-orthogonal amplification allows ultrasensitive detection of cel-