

Early results show promising applications in stroke and cancer and other studies using cell models of breast cancer lines have already showed links with cellular activity^{2,3}. Several studies are under way to exploit this new source of information.

References:

1. Lurie DJ, et al. *Comptes Rendus Phys.* 2010.
2. Kimmich R, Anzardo E. *Progr Nucl Magn Res Spect* 2004.
3. Korb J-P, Bryant RG. *Comptes Rendus Phys.* 2004.
4. Koenig SH, Brown RD. *Magn Reson Med.* 1993.
5. Kruk D, Herrmann A, Rössler EA. *Progr Nucl Magn Reson Spect.* 2012.
6. Fries PH, Belorizky E. *Journ Chem Phys.* 2015.
7. Ruggiero MR, et al. *Angew Chem Int Ed.* 2018.
8. Baroni S, et al. *Magn Reson Chem.* 2019.

L02.04

Fast Field-Cycling MRI for molecular dynamics imaging

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Purpose/Introduction: Fast Field-Cycling (FFC) MRI is a new non-invasive technology¹ that allows measuring quantitative information on molecular dynamics time scales, from tens of nanoseconds to a few milliseconds, by varying the magnetic field during a pulse sequence to generate T₁-based contrast. In the body T₁ is closely linked to the autocorrelation function of water and fatty molecules so its field-dependant spectrum, also called the T₁ dispersion curve, provides a direct view of molecular motions over a range of time scales that is determined by the strength of the magnetic field, via the Larmor frequency of the spin system observed. The T₁ dispersion curve has been used for decades to study materials and various models exist that predict the dispersion profiles in particular microscopic environments^{2–6}. Our efforts over the last years have focused on developing a system able to measure T₁ dispersion curves in vivo to exploit this source of information in medicine and to provide unique insights of tissue architectures.

Subjects and Methods: The FFC-MRI scanner can reach any field from 0.2 T to 20 μ T within 12.5 ms and T₁-weighted images are produced at five field strengths to complete the scan within 30 min. We have measured T₁ dispersion curve and contrast in vivo and non-invasively in volunteers, including patients from stroke and cancer, and compared with images from standard modalities, including CT and 3T MRI, and patient diagnostic.

Results: Image contrast derived on T₁ was found to be larger at lower field in general, with good correlation with clinical images and in particular with diffusion weighted imaging. Interestingly, T₁ contrast at 0.2 T was usually found to be less informative than at fields below 20 mT, at least in the pathologies investigated to date. Early results from T₁ dispersion curve measured in vivo show good agreement with ex vivo data, opening the way to in vivo molecular dynamics biomarkers and characterisation of molecular motions.

Discussion/Conclusion: The device we constructed is an excellent research tool to investigate T₁ contrast over a large range of magnetic fields that are difficult to reach using conventional imaging methods.