Ultra-low field NMR relaxometry: calibration method and acquisition of T_1-dispersion curves from biological samples extended to the region of μT

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Introduction

Fast Field-Cycling (FFC) NMR can be developed into a new diagnostic tool thanks to the information about molecular dynamics which it provides[1]. The acquired T_1-dispersion curves are expected to allow for the investigation of much slower molecular motions that occur in biological samples, when extended to the region of μT.

Methods

FFC measurements were performed using a commercial FFC-NMR relaxometer (Stelar S.r.l., Italy). In order to make measurements at ultra-low magnetic fields, calibration is necessary for the compensation of the environmental magnetic fields. This involves the application and calibration of correction magnetic fields. The results acquired show the precession frequency of the magnetisation from which the magnitude of the environmental magnetic fields is deduced, for the range of the correction magnetic fields applied. The successful calibration is then verified according to the T_1-dispersion curves obtained from samples of polydimethylsiloxane in the region of μT.

Results

After the successful calibration ultra-low FFC measurements can be performed, as shown from the R_1-dispersion curves of samples of cartilage (Figure 1).

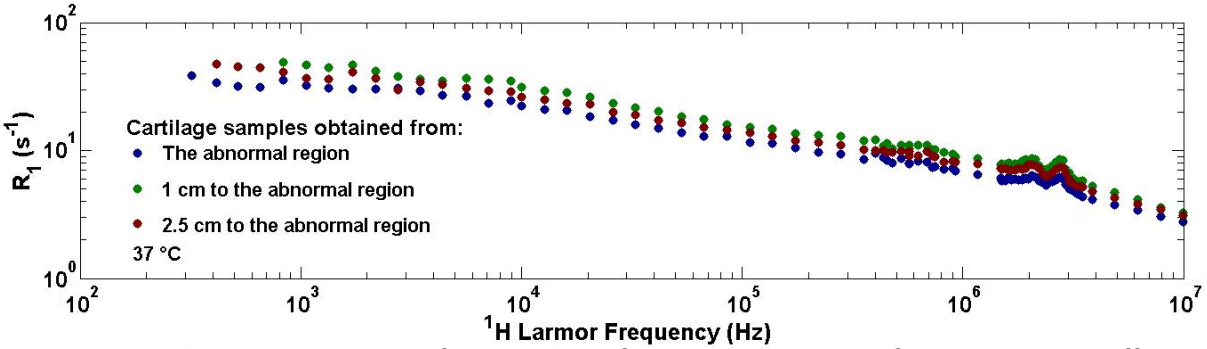

Figure 1. *R_1-dispersion curves of 3 samples of cartilage obtained from a patient suffering from osteoarthritis. The calibration extends the range of minimum measurement frequencies down to 400 Hz (corresponding to a magnetic field of ca. 9.4 μT).*

Conclusions

This work shows that it is possible to calibrate a FFC NMR relaxometer so that the μT range is accessible for experimentations that are expected to provide clinically relevant information on slow dynamic processes in tissues.

References:

[1] D.J. Lurie, S. Aime, S. Baroni, N.A. Booth, et al *C. R. Phys.* **2010,** 11, 136-148.