

## ***In Situ* Stray-Field MRI of Levitating Diamagnetic Samples**

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The performance of experiments in space, i.e., on board of the International Space Station, to investigate the effect of weightlessness upon living systems and on physical and chemical processes of interest in biology and material science, is costly and very limited in number due to the human and environment requirements of space missions. However, the renewed interest in the exploration of nearby space (i.e., the Moon and Mars) employing manned missions and the need to better understand the cellular mechanisms involved in the biological response to the lack of gravity demand those studies. To facilitate this research effort, simulated microgravity has been proposed as a ground-based alternative to experimentation in space and various experimental strategies have been pursued, including magnetic levitation.<sup>1,2</sup> The rationale of the later approach rests on the diamagnetic properties of water and its presence at very high concentration in most biological systems, which enables the levitation of specimens when they are placed in a sufficiently strong magnetic field gradient.<sup>3</sup>

Physical and chemical changes in test samples are anticipated as a result of their exposure to weightlessness and magnetic forces.<sup>4</sup> In this context, nuclear magnetic resonance (NMR) is a widely used analytical technique to investigate molecular dynamics and chemical structure and, therefore, it could be applied to study those changes at molecular level. Since both, magnetic levitation and NMR, require the sample to be immersed in a magnetic field, it is possible to combine the two experiments and monitor *in situ* and longitudinally the NMR properties of a specimen under magnetic levitation.

In this communication, it will be described the levitation of diamagnetic samples in a superconductive magnet at ambient conditions of pressure and temperature. Furthermore, the presence of a magnetic field gradient at the edge of the superconductive coil is used to obtain proton stray-field (STRAFI) NMR<sup>5</sup> images of the specimens while levitating. This is accomplished using a home-built NMR probe, a quadrature echo pulse sequence consisting of  $(\alpha)_x-\tau-(\alpha)_y-\tau$ -echo and varying the spectrometer carrier frequency step-wise within a suitable range of the resonance frequency at the levitation position. Differences between the relaxation times of protons and the diffusion coefficient of water in samples and medium are exploited to enhance image profile contrast.

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