Leipzig Spin Resonance Colloquium

May 26th, 2021 – 16:00 Leipzig time – on Zoom

Prof. Ville-Veikko Telkki
University of Oulu, Finland

Ultrafast Laplace NMR

Relaxation and diffusion NMR experiments, which are referred to Laplace NMR (LNMR), provide versatile information about molecular dynamics. The resolution and information content of LNMR can be increased by the multidimensional approach. However, long experiment time restricts the applicability of the multidimensional methods. As a solution for this problem, we are developing a broad range of ultrafast, single-scan multidimensional LNMR experiments, based on the principles of continuous spatial encoding that have been recently successfully applied in ultrafast multidimensional NMR spectroscopy. The method shortens the experimental time by one to three orders of magnitude as compared to the conventional method, offering unprecedented opportunities to study fast molecular processes in real time. Furthermore, the ultrafast approach enables using hyperpolarized substances to boost sensitivity by several orders of magnitude in the multidimensional LNMR experiments, which is not feasible in the case of traditional methods requiring extensive repetition of the experiments.

This presentation describes the basic principles and novel applications of ultrafast Laplace NMR. We have shown that the combination of ultrafast LNMR and dynamic nuclear polarization (DNP) makes it possible to distinguish intra- and extracellular metabolites in cancer cells. We have also demonstrated that the ultrafast approach is feasible also with low-field, single-sided instruments, which are portable and much cheaper than the high-field spectrometers. When combined with hyperpolarization, even single-scan experiments become viable at low fields, offering great prospects for mobile NMR analysis. Recently, we have demonstrated that ultrafast LNMR enables also single-scan 2D exchange measurements and the measurements provide unique information about exchange phenomena in the aggregates relevant in aerosol research.

May 26th, 2021 - 16:00 CEST (Berlin) - 22:00 CST (Peking) - 07:00 PST (San Francisco) - 10:00 EST (New York)

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