Spin noise imaging in three dimensions

Matthias Bechmann[a], Stephan J. Ginthör[a], Alexej Jerschow[c], Norbert Müller[a], Victor Rodin[a], Judith Schlagnitweit[a,b]

[a]Institut für organische Chemie, Johannes Kepler Universität, Linz, Austria
[b]Present address: Karolinska Institutet, Stockholm, Sweden
[c]Chemistry Department, New York University, New York, USA

Three-dimensional spin noise imaging is taking nuclear spin-noise-detected imaging [1] to the next level. Using spin noise detection offers multiple benefits as compared to a more traditional approach. The applicability to nano-sized samples and fast recycling times due to the independence from longitudinal magnetization recovery are two major ones. Our group has been working on developing new methods for spin noise detection [2] for over 10 years and these methods allow for the efficient implementation of such intrinsically insensitive experiments. Among those are methods for avoiding the T/R switching related “transient effects” [3] and finding the optimal tuning of the probe for spin noise detection [4]. Combined with the sliding window processing [5] of the continuously recorded time-domain data, it has become feasible to implement 3D nuclear spin-noise-detected imaging on a high-resolution spectrometer equipped with a cryo probe. Before performing traditional (rf-pulse excitation based) MR imaging experiments a compromise between the resolution and the S/N ratio (mostly dependent on the number of scans) has to be struck. Spin noise detection allows for this compromise to be resolved during the data processing after the experiment has already finished. Based on this fact a novel iterative image reconstruction incorporating the algebraic reconstruction algorithm [6] has been devised.

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