

Interactive comment on “Origin of the Residual Linewidth Under FSLG-Based Homonuclear Decoupling in MAS Solid-State NMR” by Johannes Hellwagner et al.

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1. The abstract mentions “static rf-field inhomogeneity”. This might be a simple typo. I do not know what a “static rf field” is.

We have decided to delete the term "static" in the abstract since we agree with the reviewer that all rf-fields are time dependent (with the rf-irradiation frequency) in the laboratory frame. In the rotating frame, however, rectangular pulses typically have a constant rf amplitude and the rf-field inhomogeneity is also time independent. Under MAS conditions, the sample rotates through different parts of the coil volume and different rf-field amplitudes if the field is not homogeneous leading to a time-dependence

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of the rf-field amplitude (with the MAS frequency) induced by rf-field inhomogeneities. In this manuscript, this time dependence of the rf-field amplitude due to MAS and rf-field inhomogeneities is not included. In addition, we replaced the term "static rf-field inhomogeneity" on line 342 by "the time-independent part of the rf-field inhomogeneity under MAS" and added a sentence (also in response to point 3) "We have not included phase- or amplitude-modulations generated by MAS due to rf-field inhomogeneity in our investigation." There we give references to papers by Levitt, Tekely and Reif where effects caused by such time-dependent modulations of phase or amplitude due to rf-field inhomogeneities are discussed.

2. Figure 1 compares analytical and numerical simulations of several three-spin tensor operators that may contribute to residual linewidths. However it is not very obvious, neither in the figure annotations, nor the captions, what the definitions of these operators are. This also applies to the text. For example at the top of page 7, an operator $T_{00}(\tau_4)$ is specified but it is unclear to me what τ_4 is. Maybe I missed something but I don't find the definition or relevance of τ_4 . Similar problems occur in many places. The authors should give clear definitions (if necessary, in the SI, or literature references) for all the terms mentioned in the paper.

We follow in the definition of the three-spin spherical-tensor operators the ones proposed in A. Garon, R. Zeier, S.J. Glaser, Visualizing operators of coupled spin systems, Phys. Rev. A. 91 (2015) which was referenced on line 130 of the original manuscript. We have now added the reference to the caption of Fig. 1 and also after the expressions for the three-spin operators in the main text (line 155) where we added: "... tensor operators where we follow the definition and notation introduced in Ref. (Garon et al., 2015)." We hope that these modifications make this part more understandable and the definition of the spherical-tensor operators clearer.

3. One point I would like clarifying is whether the only type of rf field imperfection that was considered was (possibly transient) errors in the rf amplitude. I am aware of two other imperfections that deserve consideration. First, phase

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errors are generated by a limited bandwidth probe when the input frequency is changed (as happens in a FSLG experiment). Early implementations of this method did use a relative phase adjustment of the two pulses to correct this effect (see <http://www.sciencedirect.com/science/article/pii/B9780120255146500113>). I wonder whether the more modern compensation algorithms already include such a phase correction (it is possible that this is so, but clarification is needed). The second feasible error is that spatial inhomogeneity in the direction of the radiofrequency field causes a periodic phase modulation as the sample rotates. NMR effects due to this have been detected in rotary resonance experiments (<http://onlinelibrary.wiley.com/doi/10.1002/ijch.198800039/abstract>). It is possible that such effects might also contribute to the residual linewidths.

We have corrected transient amplitude and transient phase errors in the transient-compensated implementation of the FSLG experiment. We checked the phase and amplitude of the rf pulses and found no significant deviations from the intended shape in the experimental implementation. The spatial homogeneity that translates to a time dependence under MAS was not considered in this investigation. We have clarified this in the text on line 342 (see also above the response to point 1). We do not know whether such effects contribute to the residual line width but we plan to investigate them in the future.

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