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Comment on mr-2022-1

Philippe Pelupessy (Referee)

Referee comment on "SORDOR pulses: expansion of the Böhlen–Bodenhausen scheme for low-power broadband magnetic resonance" by Jens D. Haller et al., Magn. Reson. Discuss., https://doi.org/10.5194/mr-2022-1-RC1, 2022

This article presents the application of a class of broadband Universal Rotation pulses, so called SORDOR pulses. The particularity of these pulses is that the rotation axis depends quadratically on the offset frequency and that they have low RF power requirements. By matching the different pulses in a sequence, SORDOR pulses can be used in virtually any experiment (although sometimes quadratic phase-corrections need to be applied in the data processing). The power of the method is demonstrated on a very demanding "19F-project" experiment. The concept described in this article could have a very wide applicability (even if a, as the authors acknowledge, the pulses still need to be improved) and are of much interest for the readership of *Magnetic Resonance*. I recommend its publication after the following comments have been addressed:

- Figure 4. The profile of the echo sequence with hard pulses seems to be much broader than the one of the of the 90 degree pulse, probably because the coherence pathway selection is not ensured. Usually, it is more instructive to look at a sequence which ensures the correct coherence selection pathway (by gradients or EXORCYCLE for example).

- Figure 4. The amplitudes for the SORDOR profiles vary quite a bit, which is exacerbated for the echo sequence. The authors should quantify these variations. What are the consequences for an experiment with multiple echos (like the project sequence)?

- Figure 5. "Clearly the relaxation of all signals can be easily followed using up to 128 perfect echoes". This figure on its own is not very instructive. Is the decay exponential (clearly not the case for the signal around -110ppm)? How much of the decay is due to imperfections of the pulses (see previous comment) or imperfect homonuclear decoupling? How close is the decay rate to the actual R2?

- Line 162: “A disadvantage of the SORDOR pulses arises in heteronuclear experiments when pulses on different nuclei need to be applied simultaneously.” This also applies for homonuclear experiments. For example, does the fact that the coupled nuclei are not touched simultaneously has any effect on the perfect echo?

-Sometimes the writing is a bit sloppy and imprecise (in particular in the introduction). For example: “With the advent of 1.2 GHz NMR spectrometers practically all common heteronuclear experiments require the use of amplitude- and phase-modulated pulses due to the enlarged bandwidths that need to be covered...”. The need of broadband pulses has only to do with the bandwidths that need to be covered, not whether the experiment is heteronuclear or homonuclear. A very common 15N/1H HMQC (or even an HNCO) does probably not need shaped pulses even at very high fields, while many homonuclear 13C experiments do.

-Finally (this is more a comment to the editors of the journal, since the authors are not to blame): the format of the citations makes some parts of the article virtually unreadable (for a striking example see the second paragraph of the introduction). I think many readers would appreciate a change in format.