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Magn. Reson. Discuss., referee comment RC1
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Comment on mr-2021-40

Anonymous Referee #1

Referee comment on "Rapid-scan electron paramagnetic resonance using an EPR-on-a-Chip sensor" by Silvio Künstner et al., Magn. Reson. Discuss., https://doi.org/10.5194/mr-2021-40-RC1, 2021

The manuscript presents a new method that combines the use of EPR on a chip technology with rapid scan (RS) approach in EPR. EPR on a chip uses a small microwave oscillator which is based on active microwave circuit coupled to LC circuit with inductive loop on which the sample is placed. EPR signal is recorded as changes in the oscillator frequency and/or amplitude at the resonance condition. RS with EPR on a chip can be very advantageous since instead of scanning the magnetic field, which has many limitations, one can scan the frequency without the need to have a low Q resonator.

In general, the paper is well-written and presents nice experimental results. I have one major comment and few minor comments as follows:

Major comment: The paper makes some claims about spin sensitivity, which are not convincing. It uses a test sample of BDPA with about 2*10^15 spins (this number is not written in the paper, but can be calculated using the data given), and shows measurements with SNR of 236 and then claims, based on data from another paper, that the absolute spin sensitivity of the setup is 6*10^7 spins. Same problem with the claims for concentration sensitivity. I am afraid this looks very unconvincing. The authors should either present clear experimental evidence for their claim spin and concentration sensitivities, or tone down their claims.

Minor comments:

- Line 33: Conventional EPR employs two types of experimental procedures. High Q is good mainly for CW.
- Line 43: kEuro and not TEuro.
- Line 55: Suggest to also cite related works, such as :A Single-Chip Electron Paramagnetic Resonance Transceiver"" and An Ultrasensitive 14-GHz 1.12-mW EPR Spectrometer in 28-nm CMOS""
- Line 105: Less than 10 ppm is not that simple.. and also temperature stability is not simple..
- Line 110: what is the max frequency of the AM demodulation?
- Line 114 and other places: The claim for compactness of the system and the use of Rohde & Schwarz SMB100A and Anfatec eLockIn 203 and Zurich Instruments UHF-LIA as part of teh setup seem to be conflicting.
- Line 115: what is the minimal B1 that can be used to sustain working conditions for the VCO?
- Line 121: What is the number of spins n the sample?
- Line 122: When referring to Appendices, please mention which Appendix.
- Line 130: This discussion should come before mentioning AM modulation above.
- Line 134: Possible cite this ref from Arxiv?
- Line 140: Try to be more quantitative, what bandwidth you have, what is needed, etc..
- Eqs 3 and 4: not clear why the authors talk about two types of conditions.
- Line 165: Missing "of a"
- Fig. 4:Is this plot for the same total acquisition time? bandwidth of detection? Is the amplitude and SNR are comparable?
- Line 250: delete "is"
- Eq (9) : Please briefly explain why the driving function need to have "memory" to previous time periods and not simply reflect the frequency of excitation at a given time
- Eq (12): This equation does not look intuitive. If T2 is very large the signal is changing slowly as you scan the frequency. Possibly it can be explained in 1-2 sentences.

19: Line 338: re-arm?