

Interactive comment on “High sensitivity Gd³⁺-Gd³⁺ EPR distance measurements that eliminate artefacts seen at short distances” by Hassane El Mkami et al.

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This manuscript describes DEER distance measurements on rigid Gd-Gd rulers in a high-power W-band spectrometer with a weakly resonant probe. Excellent sensitivity is demonstrated. It is shown that short-distance artifacts due to dipolar state mixing are suppressed by using a large pump-observe separation and by avoiding the central transition.

The work is well executed. The manuscript is well written. It provides novel and important insights. I recommend publication, after the following comments are addressed.

C1

1. Some of DEER experiments are performed outside the central transition, but T_m and T_1 values are reported only for the central transition. What are T_m and T_1 for the pump and observer positions on the non-central transitions?
2. Line 111: Is it possible to give $G/W^{1/2}$ conversion efficiencies for the shorted waveguide used in this work, and for a standard cylindrical cavity as reference?
3. Line 272: How significant do the authors think are the differences between the data obtained at 840 MHz and 900 MHz offset? Are they within or outside the expected run-to-run scatter of the experiment?
4. Line 245: A pump-observe offset of 900 MHz is mentioned for the 6 nm ruler, but the data show 120 and 420 MHz offset only (Fig.3,4,S3a,S4).
5. Figs.4 and 6: What do the shaded areas in a) and b) indicate?
6. Fig.5d and 7b: What does the black arrow indicate?
7. Fig.S3a: What is the reason the background in the P3O3 measurement is rising, as opposed to decaying?
8. Table S3: What is T_1 in the last column? Footnote 1 is not clear.
9. Table S1: Separate last column into two, one with the linewidths, and with references.
10. Line 313ff: I don't quite understand the author's arguments concerning intramolecular instantaneous diffusion contribution to dephasing. The modulation depth is only a few percent, so only a few percent of spins get excited by each pulse. Simultaneous excitation of both spins within the same molecule therefore has very low probability. Some clarification would be useful.
11. Line 391ff: What are "backshort positions", and what does it mean to "match out the echo signal"?

C2

12. Line 397: Claiming that sub- μM concentrations are technically feasible is a bit overly speculative. That would correspond to a ca. 50-fold reduction in concentration compared to the presented data, and a 2500-fold extension of the measurement time, for example from 1 hour to 3 months. Doubling the repetition rate to 6 kHz (more is not feasible given the T1) shortens this to 1.5 months, still not feasible. I suggest removing the statement about sub- μM concentrations.

Interactive comment on Magn. Reson. Discuss., <https://doi.org/10.5194/mr-2020-19>, 2020.