

Magn. Reson. Discuss., referee comment RC2
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Comment on mr-2022-4

Anonymous Referee #2

Referee comment on "A portable NMR platform with arbitrary phase control and temperature compensation" by Qing Yang et al., Magn. Reson. Discuss., <https://doi.org/10.5194/mr-2022-4-RC2>, 2022

The manuscript represents an important increment in the capabilities of integrated CMOS-based NMR systems. As the authors say, such systems, in combination with compact permanent magnets, have the potential to extend the usefulness of NMR spectroscopy, imaging, and relaxometry into domains where portability is a paramount concern. The paper gives a very useful and compact account of the relevant literature. It improves on the previous state of art in two key respects. On the one hand, an elegant solution is provided to allow phase-coherent signal acquisition at non-zero IF (with an IF significantly larger than the spectral window). This enhances sensitivity as it allows the receiver to operate above the influence of $1/f$ noise. On the other hand, a temperature/frequency compensation is built in that allows to compensate for magnetic field drifts, and corresponding shifts in Larmor frequency, due to temperature fluctuations.

The manuscript is well written, and the argument is supported by clear and carefully designed figures. It is a nice addition to the existing literature, and should be published in Magnetic Resonance.

A few minor concerns that should be addressed prior to publication:

- L75ff. In the discussion of the phase control approach, the manuscript uses the term "off-resonance", if I interpret this correctly, to mean a frequency that is different from the excitation frequency, not from the Larmor frequency. I find this confusing, since "off-resonance", in the NMR context, typically refers to a situation where the excitation pulse frequency is different from the Larmor frequency. This then requires higher pulse power, etc. The paragraph should be reformulated to make this clear. It may be best to avoid the term "off-resonance" altogether, because of its inherent ambiguity (off resonance to what?).
- L94. Typo: low-filed should be low-field
- L200, Figure 4. Would a plot of oscillator phase vs time (as opposed to amplitude vs

time) make the argument more easily accessible to the reader?

- L286: "[...], changes of the ..." This sentence is correct but awkward - reformulate?

- L288: What is the mechanism that leads to the described artefacts in the CPMG data due to magnet drift? (This may be well known, in which case a reference would be helpful)

- L290ff: In addition to rectifying temperature drift effects in CPMG measurements, would the approach also be capable of doing the same for spectral resolution, in a situation where signal averaging over an extended period of time is required? What would be the limitations? If this could be done reliably, it could significantly reduce the complexity of permanent-magnet NMR spectroscopy systems.

- L308ff, Table II: the SI unit for concentration is either "mmol/l" or "mM". "mM/L" does not make sense.