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*Submission of our manuscript*: “Relaxation of Dipolar-Coupled Spins in Transverse Fields : The role of double-flips”.

Dear editors,

Please find enclosed our manuscript entitled “Relaxation of Dipolar-Coupled Spins in Transverse Fields : The role of double-flips”, which we submit for consideration as a Letter in Physical Review Letter. In brief, *we succeeded in finding new processes that lead to decay of the spin NV centers.*

Moreover, we actually harness these mechanisms to *realize a new efficient magnetometer*.

Below, we explain which we think our results will have important implications and why, specifically, we truly believe it is a stepping stone towards robust high-sensitivity magnetometry.

Arguably, the NV center in diamond is one of the most promising system in emerging quantum technologies. Amongst the many applications in that directions, NV magnetometry stands out will impressive demonstrations both in high resolution imaging with record-high sensitivity.

To improve on the latter aspect, one requires larger and larger densities of NV centers. This ultimately comes at price however : as the density of NV centers grow depolarization mechanism start to appear which, in turn, lowers the sensitivity.

In this manuscript we uncover novel depolarization mechanisms that involve dipolar interacting ensembles of closely packs NV centers. Moreover, we in fact use these mechanisms to provide a new efficient and robust magnetometer that presents many salient features : First, our magnetometer is not sensitive to the orientation of the external magnetic field, making it applicable to sensing in harsh environments. Many NV magnetometers suffer from heating due to microwave tones as well as from the laser: we relax these two issues by remove the need for microwaves as well as using spectral features that do not depend on temperature to first order.

We are thus very enthusiastic about the idea of presenting our results to PRL and believe that the manuscript meets the requirements for publication. Thank you very much for your efforts on our behalf.

Best regards,

Gabriel Hétet, on behalf of the authors.