Amplified Nanoscale Detection of Labelled Molecules via Surface Electrons on Diamond[1]

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The detection of individual molecules and their dynamics has been a long-standing challenge in the field of nanotechnology. In this work, we present a method that utilizes a nitrogen vacancy (NV) center and a dangling bond (DB) on the diamond surface to measure the coupling between two electronic targets (L1 and L2) tagged on a macromolecule. To achieve this, we design a multi-tone dynamical decoupling sequence that leverages the strong interaction between the nitrogen vacancy center and the dangling bond. In addition, this sequence minimizes the impact of decoherence finally resulting in an increased signal-to-noise ratio. This proposal has the potential to open up new avenues for fundamental research and technological innovation in distinct areas such as biophysics and biochemistry.

References

[1] A. Biteri-Uribarren, P. Alsina-Bolívar, C. Munuera-Javaloy, R. Puebla and J. Casanova, Communication Physics, 6 (2023) 359.

Figures

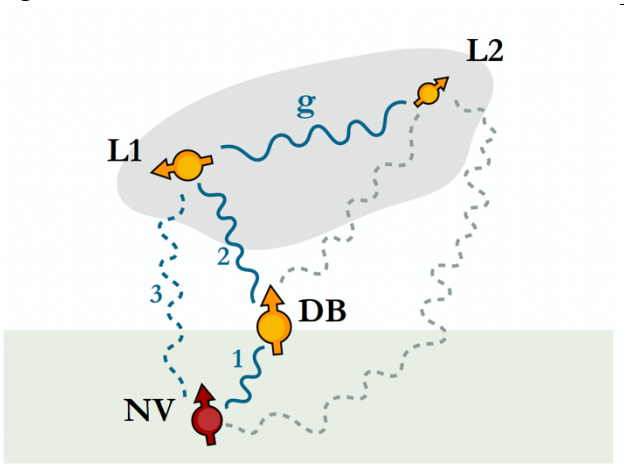

Figure 1: Illustration of the system. The dipolar coupling g between L1 and L2 is the target parameter of the protocol.

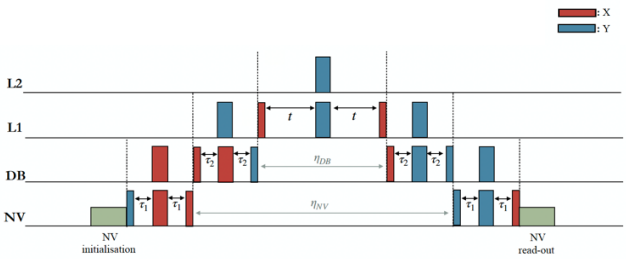

Figure 2: Scheme of the multi-tone dynamical decoupling sequence, where each channel is associated to an element of the system (NV, DB and labels). The blue and red boxes represent the pulses to be delivered, the wider ones indicate π pulses while the others π/2 pulses, and the color encodes the axis of the pulse. To extract the dipolar coupling, the protocol needs to be applied for different values of t.