Stark tuning of tin-vacancy centers in diamond

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Color centers in diamond are among the best performing optically accessible qubits in the solid state. Group IV-vacancy centers in particular can provide highly coherent and stable optical interfaces, a property which is attributed to their inversion symmetry [1]. In this work we investigate the effect of an external electric field on the optical transition of a single tin-vacancy (SnV) center [2].
By measuring small Stark shifts on the emitter, our study reveals a vanishingly small permanent electric dipole as well as a suppressed polarizability of the SnV, more than 4 orders of magnitude lower than for an NV center, demonstrating the inversion symmetry protection of a Group IV-vacancy defect in diamond from charge noise. At the same time, a non-zero shift suggests the Stark effect as a useful mechanism for the fine spectral tuning of the emission wavelength of these defects.
Additionally, we show that by modulating the SnV electric-field-induced dipole we can use the emitter's linewidth as a nanoscale probe for electric noise spectroscopy. The external electrodes enable to controllably tune the emitter's susceptibility to electric field, and we use the increased spectral diffusion effect on the SnV to quantify the local electric field noise at the defect location.

References

[1] C. Bradac et al., Nat. Commun. 10, 1 (2019).
[2] L. De Santis et al., Phys. Rev. Letter 127, 147402 (2021).

Figures

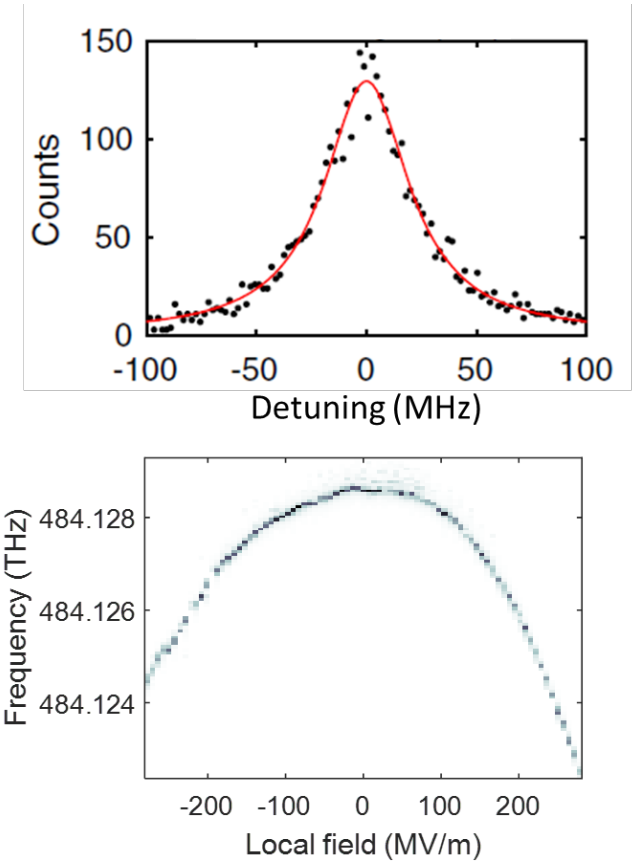

Figure 1: Top panel: PLE spectrum of the SnV center's optical transition analyzed here. Bottom panel: measurement of the SnV transition as a function of the external electric field, showing a nonlinear response.