

Sub-GHz linewidths ensembles of SiV centers in a diamond nano-pyramid revealed by charge state conversion

Clément Pellet-Mary¹, Louis Nicolas¹, Tom Delord¹, Paul Huillery¹, and Gabriel Hétet^{1*}

¹ Laboratoire de Physique de l'Ecole normale supérieure, ENS, Université PSL, CNRS, Sorbonne Université, Université Paris-Diderot, Sorbonne Paris Cité, Paris, France

Efficient interfaces between two-level emitters and photons are key components of quantum networks and sensing. SiV⁻ centers embedded into a diamond nanostructure are promising for such purpose. We have studied photoluminescence properties at cryogenic temperatures of diamond AFM probes [1,2] and observed photochromism of a very dense ensemble of SiV⁻ centers consisting in trapping into a dark state under resonant excitation when nitrogen impurities are present. We suppose that this effect is a charge state switching between negatively charged and neutral SiV charge states. This effect is used to perform persistent hole burning which reveals very low homogeneous broadening, only twice the lifetime limit. It is promising for quantum optics experiments and paves the way to sub-wavelength microscopy techniques.

We will also present our latest results on the Zeeman splitting and possible lifetime measurement of the SiV⁻ 1/2 spin.

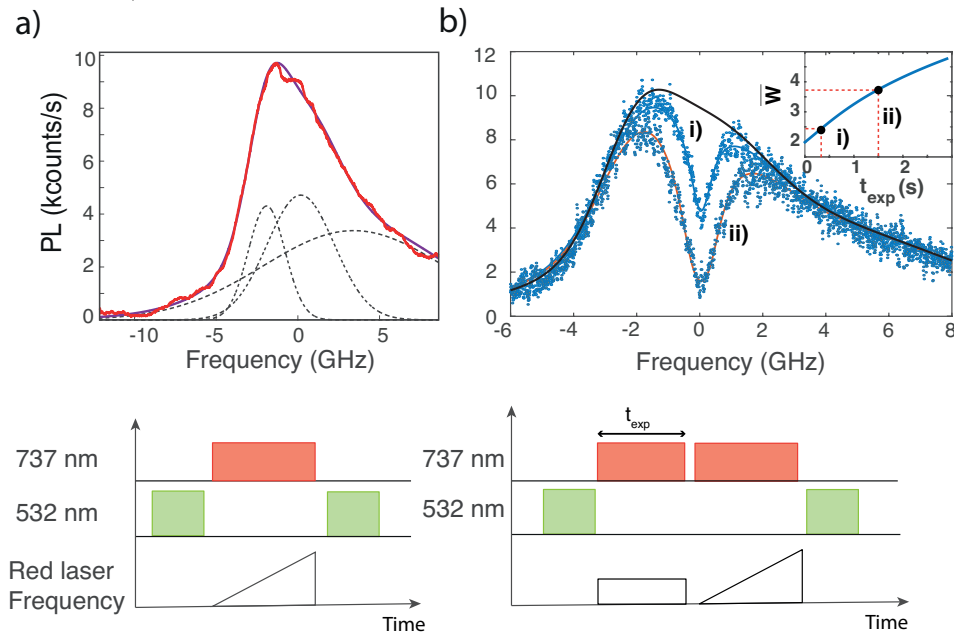


Figure 1. a) Averaged PLE measured at 6K by scanning the resonant laser at 737 nm around an electronic transition in the presence of green laser light between scans. b) PLE spectra after three different exposure times at 6K : in black without hole burning, in blue $t_{exp} = 300$ ms and in orange, $t_{exp} = 1500$ ms. The dots represent raw data and the continuous lines are fitted data. Here $P_{737} = 0.877 \mu W$. The inset shows the width of the holes Γ_h inferred from the fit and normalized to the homogeneous linewidth Γ_e ($W = \Gamma_h / \Gamma_e$).

[1] AR. Nelz et al., Applied Physics Letters, 109, 19, 193105, (2016).

[2] L. Nicolas et al., AIP Advances, 8, 6, 065102, (2018).

* clement.pellet-mary@phys.ens.fr