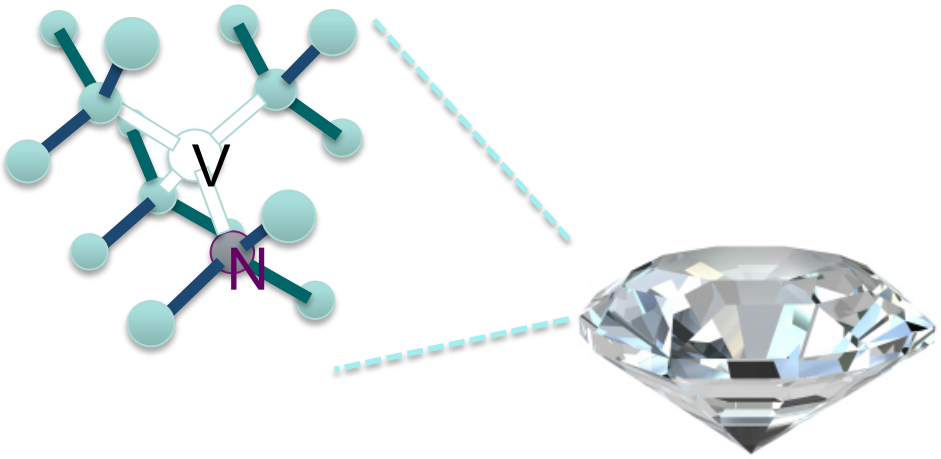
University of Basel

Short Introduction to: NV Centers in Diamond

Molecular and carbon-based electronic systems lecture, Märta Tschudin, 31.05.2017

Nitrogen-Vacancy Center in Diamond



Optical access to individual spins

- Long coherence time
- Small size

⇒ good magnetic sensor

- Spin entanglement

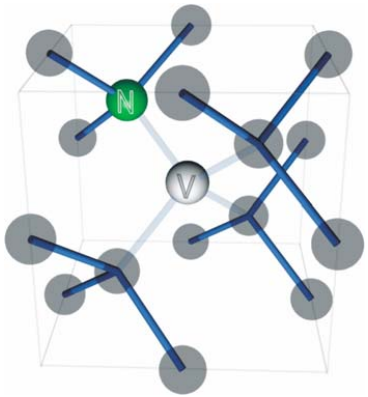
Content:

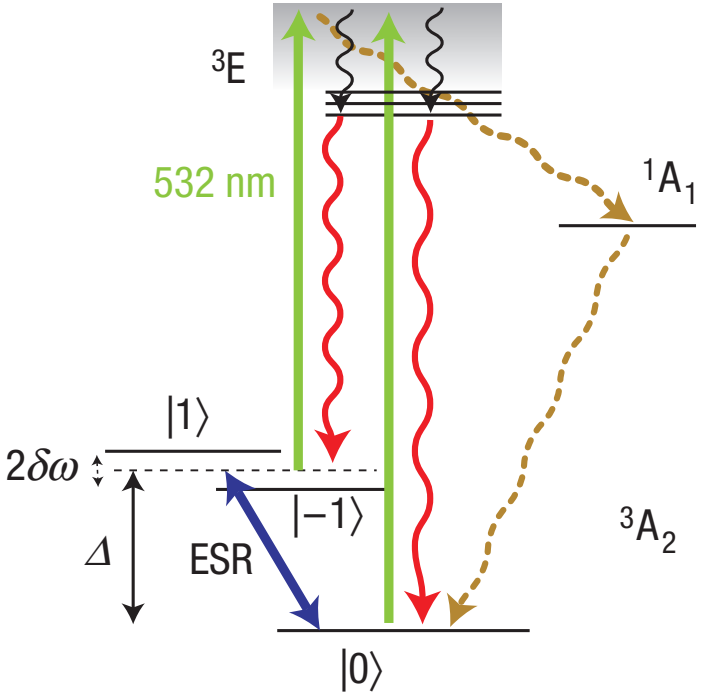
- NV structure
- Detect and address single NV centers
- Magnetometry, Single Photon Source

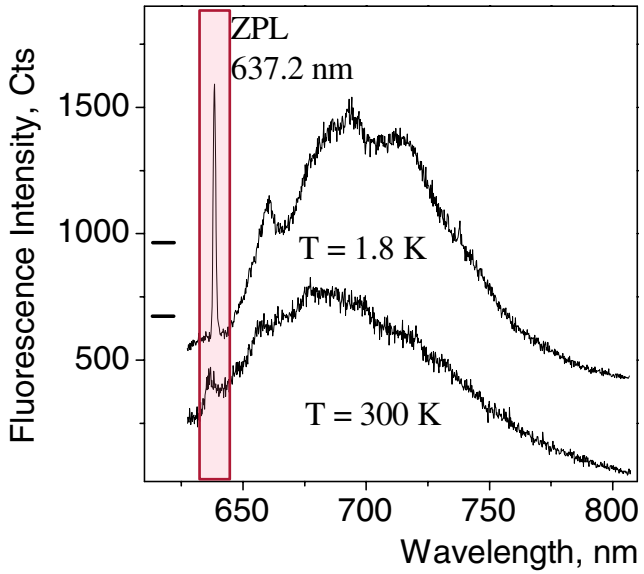
L. Childress, *Diamond Sensing Workshop*, 2015

NV Center Structure

Charge states: NV^0 (5 e^-), NV^- (6 e^-)







J. M. Taylor, *et al. Nature Physics*, Vol.4 (2008)

F. Jelezko and J. Wrachtrup, *phys. stat. sol. (a)* **203**, No.13 (2006)

NV Center Formation

Irradiation and annealing

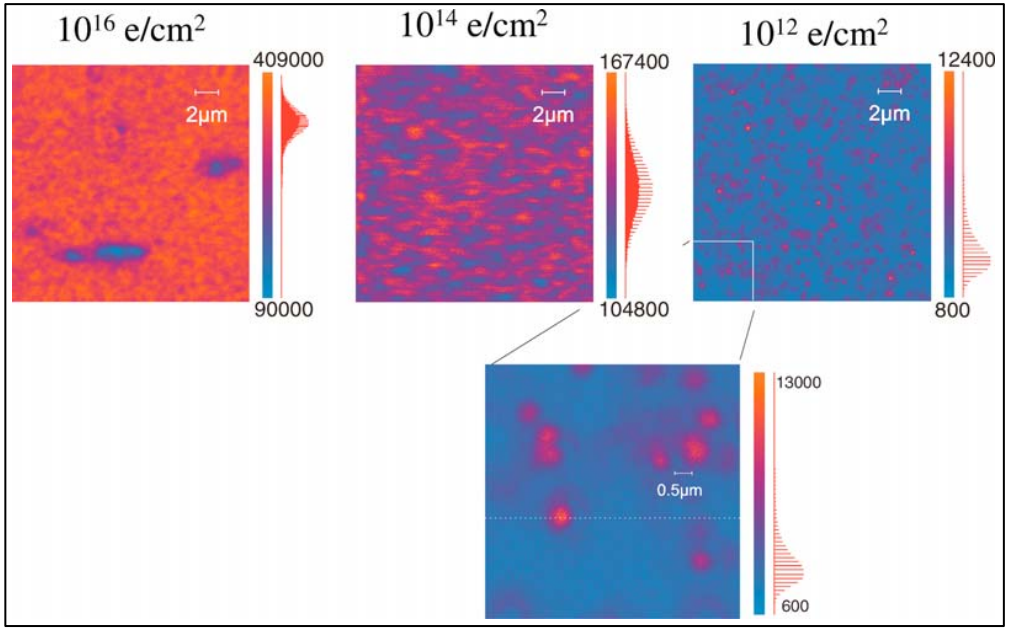
- High NV density possible

Implantation and annealing

- Locate NVs

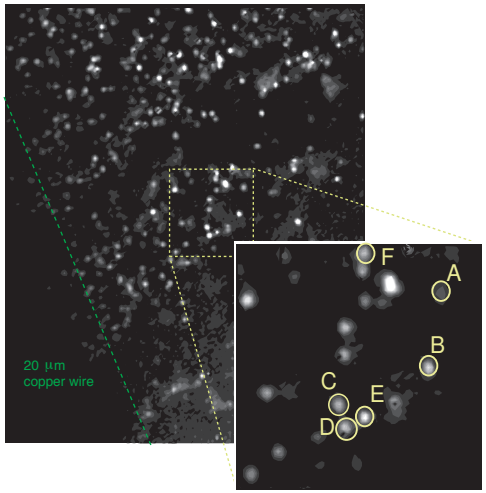
CVD growth

- NVs near surface



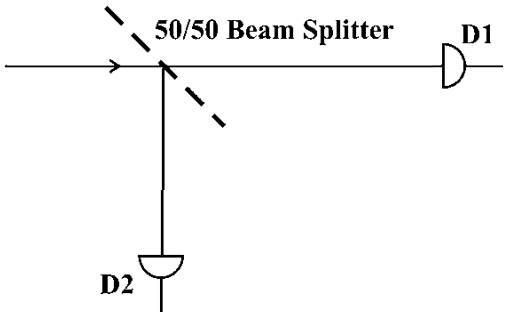
F. Jelezko and J. Wrachtrup, *phys. stat. sol. (a)* **203**, No.13 (2006)

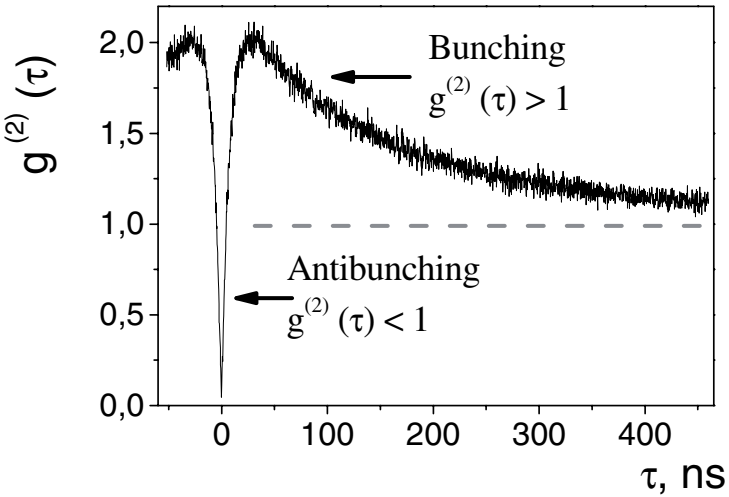
Single Quantum Emitter



L. Childress, Dissertation (2007)

Autocorrelation function $g^2(\tau)$



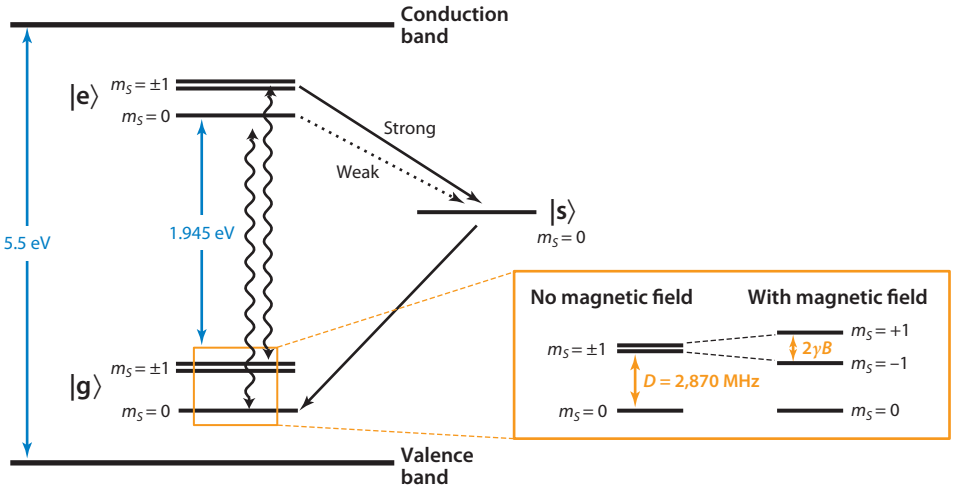


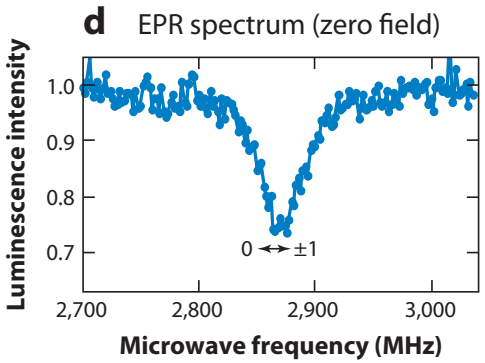
adapted from Gerry & Knight, *Introductory Quantum Optics*

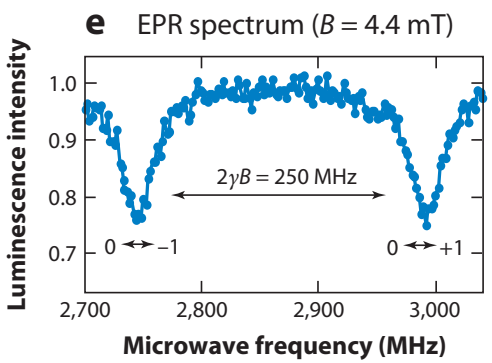
F. Jelezko and J. Wrachtrup, *phys. stat. sol. (a)* **203**, No.13 (2006)

Spin-Dependent Fluorescence

Electron Spin Resonance (EPR)







Romana Schirhagl, et al. *Annu. Rev. Phys. Chem.* (2014)

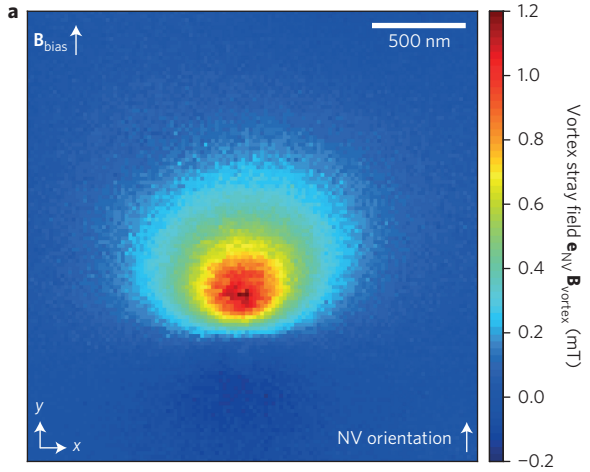
Magnetometry on Nanoscale

Sensor: NV center

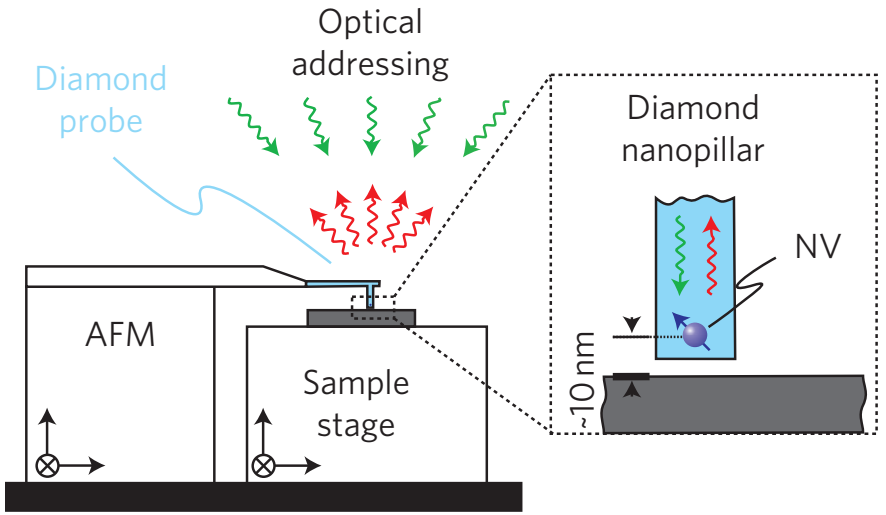
- Small size
- Close proximity to sample surface

⇒ High resolution

Setup with diamond nanopillar



L. Thiel, *et al. Nature Nanotechnology* (2016)



P. Maletinsky, *et al. Nature Nanotechnology* (2012)

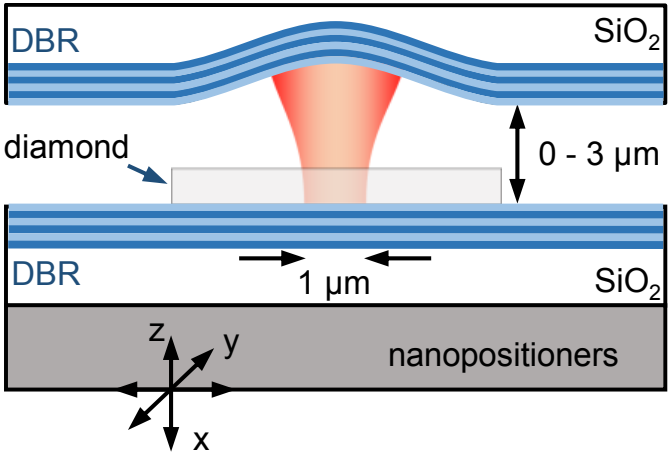
Single Photon Source

Emission of coherent photons from ZPL

NV photon source:

- Small ZPL emission

Solution: Microcavity

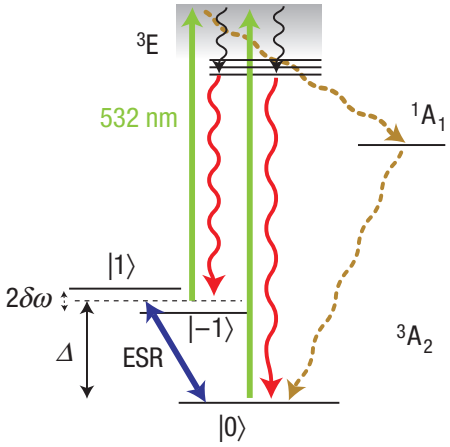


ZPL emission probability from ~ 3 % to ~ 46 %

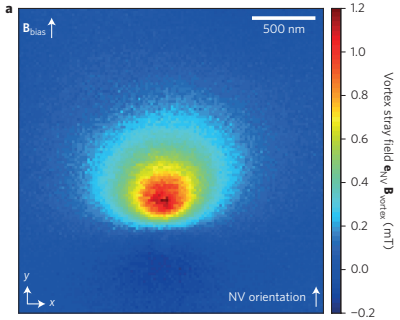
D. Riedel, *et al. arXiv:1703.00815v1*

Conclusion

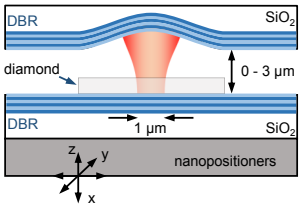
NV structure



Scanning NV magnetometry



NV single photon source



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Thank you
for your attention.