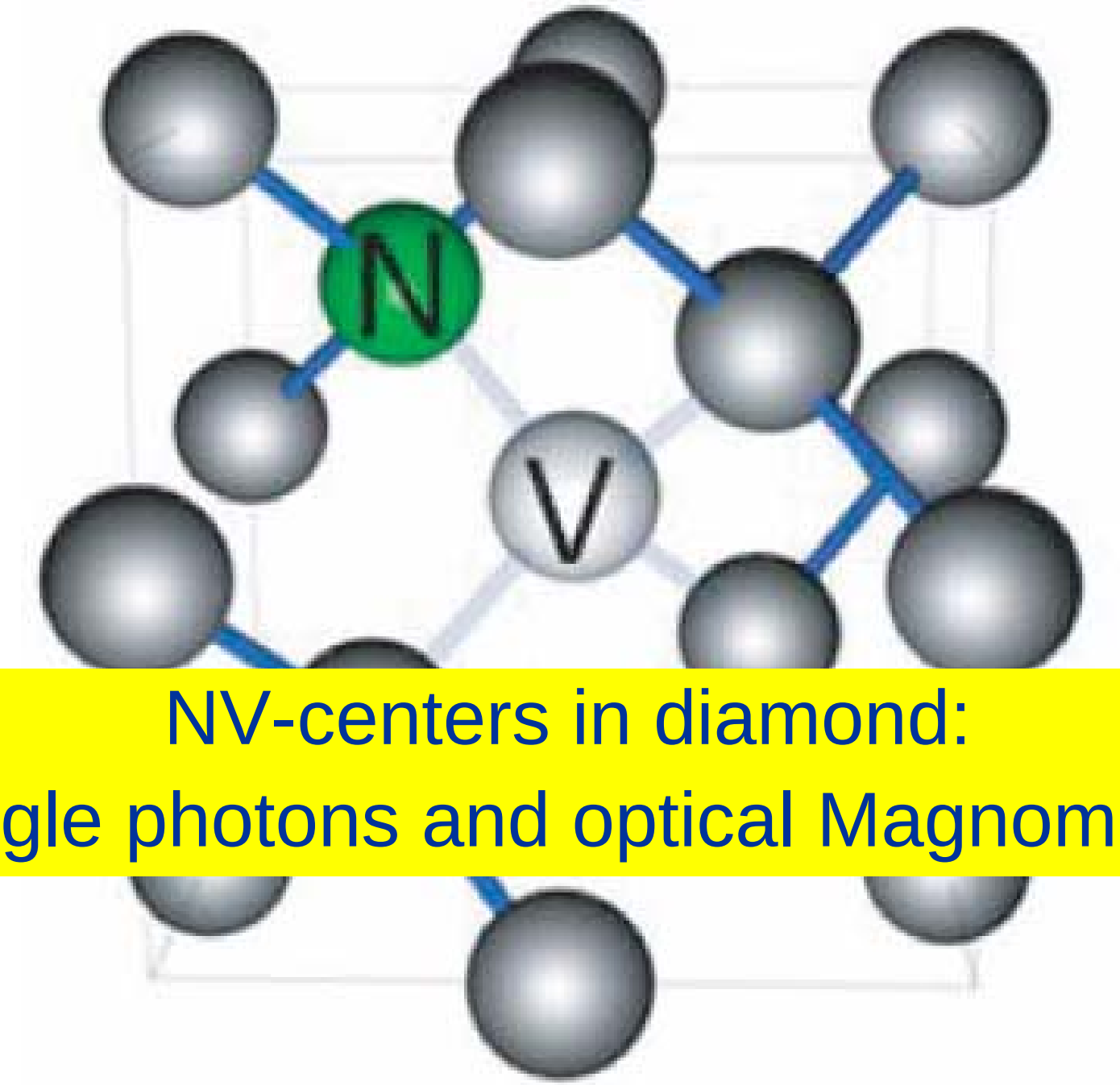
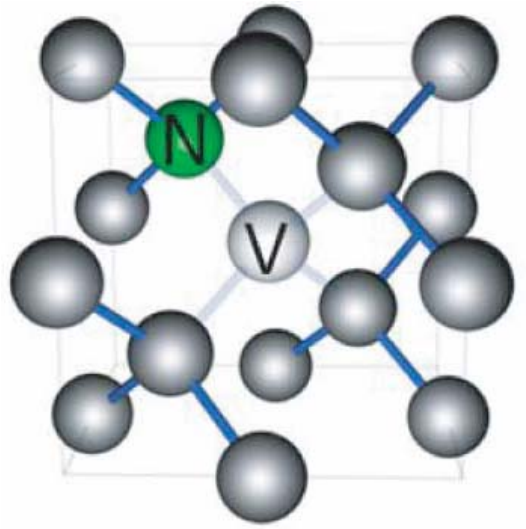


NV-centers in diamond:
Single photons and optical Magnometry

What are NV-centers?

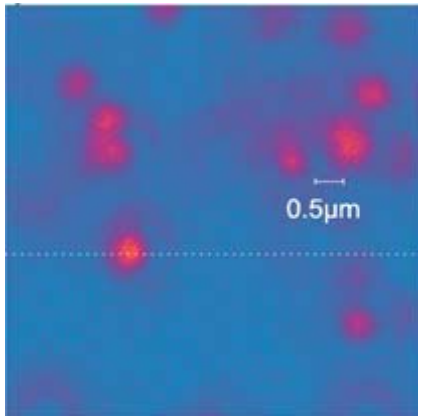
- Nitrogen impurities => ion bombardement => annealing
- Clean crystal => Nitrogen doping => annealing

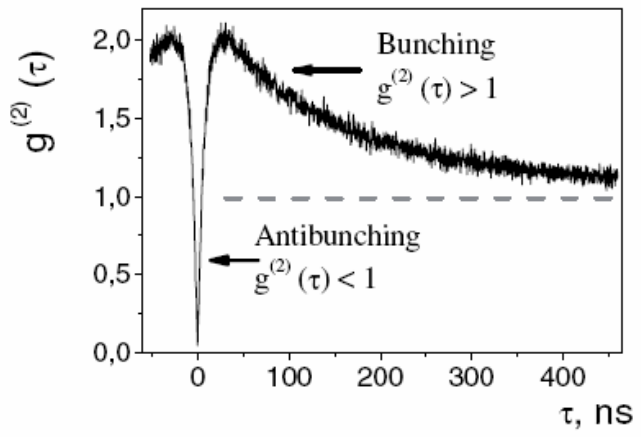


Density of NV-centers can be controlled!

Fluorescence properties

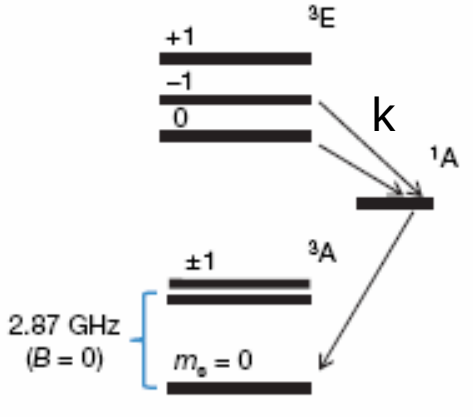
- Absorption at 637nm
- No bleaching or blinking (even at room temperature)
- 10^7 photons/s
- Inert + biocompatible => ideal fluorescent label
- Antibunching => single photon source

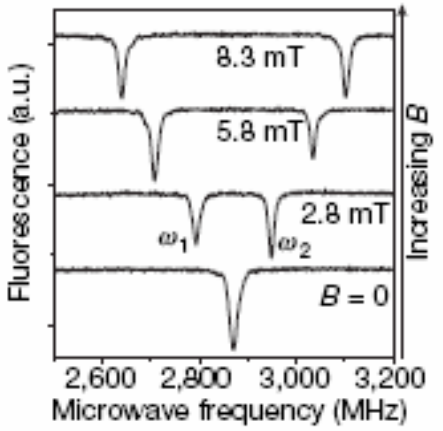




The level scheme

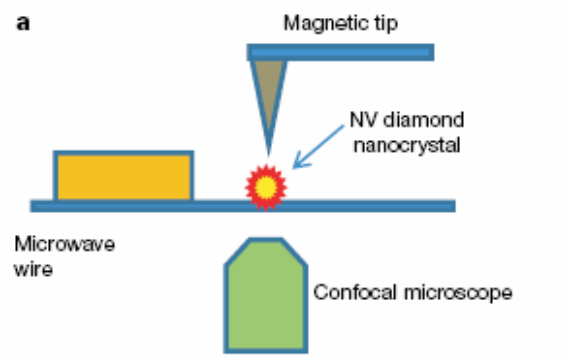
- Triplet ground and excited state
- Singlet metastable state
- Microwave transition between m_S= and m_S=±1 (due to magnetic dipole interactions)
- **Spin-dependent fluorescent intensity!** (k is changed by 3 orders of magnitude, LS coupling)
- B field dependent energy splitting

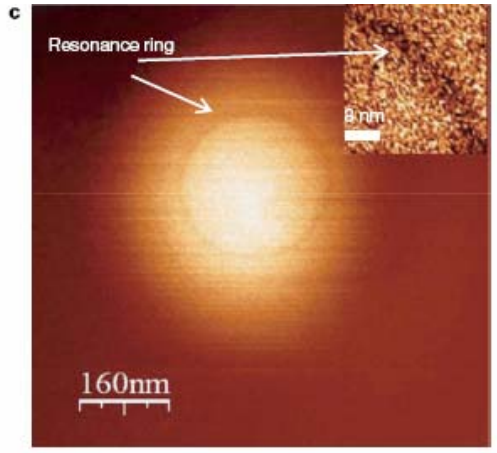


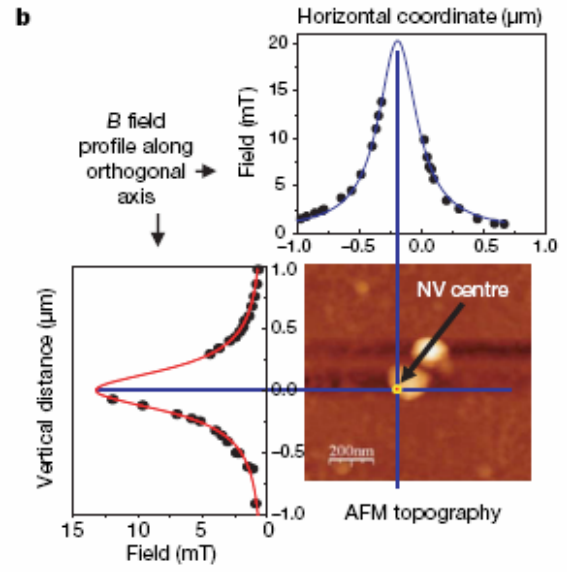


A magneto optical sensor

- 5nm resolution, dependent on the linewidth of the ESR

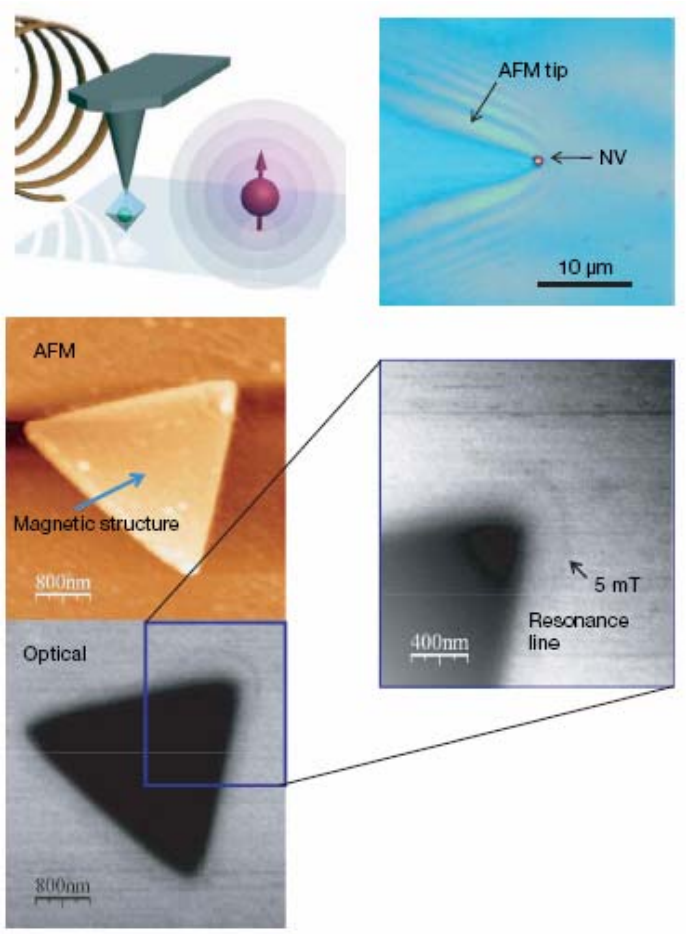






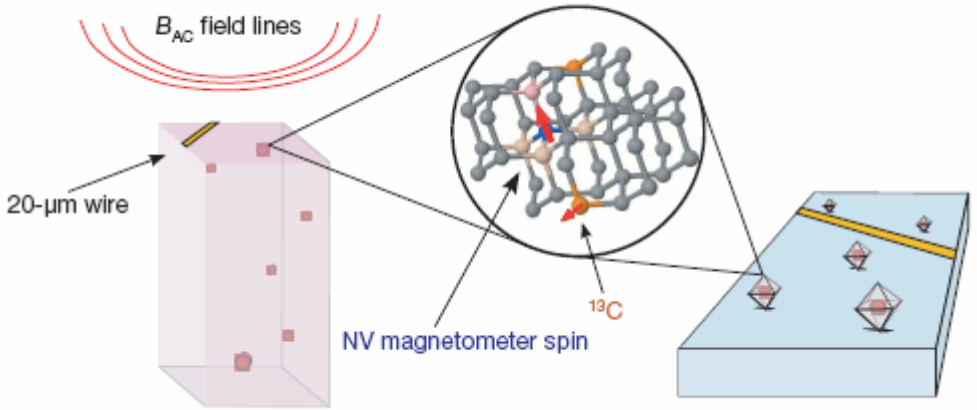
A scanning probe magnetometer

- NV-center attached to an AFM tip
- 0,5mT resolution; restricted by the motion of the AFM cantilever
- Electron Spin Resonance (ESR) line => 5nm spatial resolution
- In Principle: 10nT and sub nm resolution possible



Literature

- Review:
  - Jelezko et al., Phys. Stat. Sol. (a) 203, No. 13, p.3207 (2006).
- Experiments:
  - Balasubramanian et al., Nature 455, p.692 (2008).
- **40nT resolution:**
  - Maze et al., Nature 455, p.644 (2008).



Applications

- Fluorescence:
  - Fluorescent label
  - Single photon source
- Solid state spin system for Quantum computation:
  - long decoherence times (at RT!)
  - Spin-Spin Interactions controllable and robust
- B-field sensing
  - 5nm resolution (no wavelength limit)
  - Single spin sensitivity