Quantum Dots III: Discussion of Atature et al, Science **312**, 551 (2006)

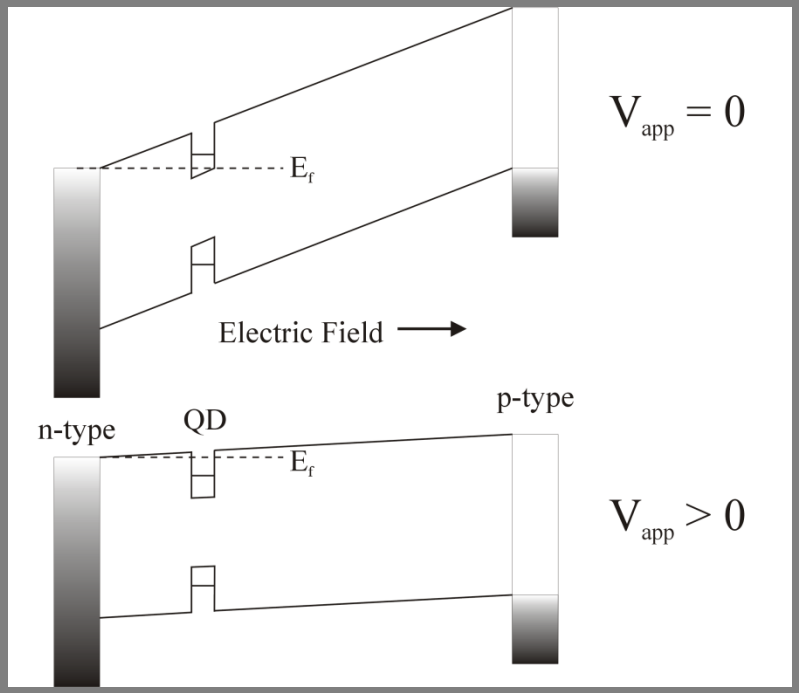
27.04.2011

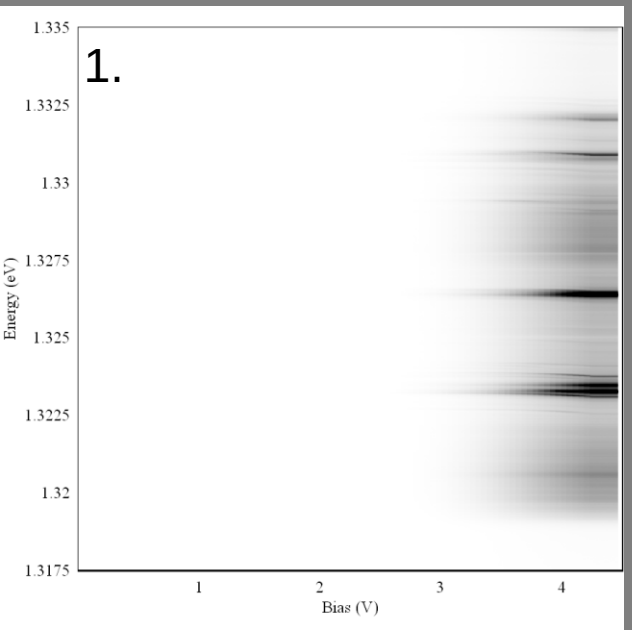
Matthew Rakher

More than an Atom

By embedding the QD in a diode structure, we can manipulate our atom in novel ways depending on the structure:

1. Electrical Excitation

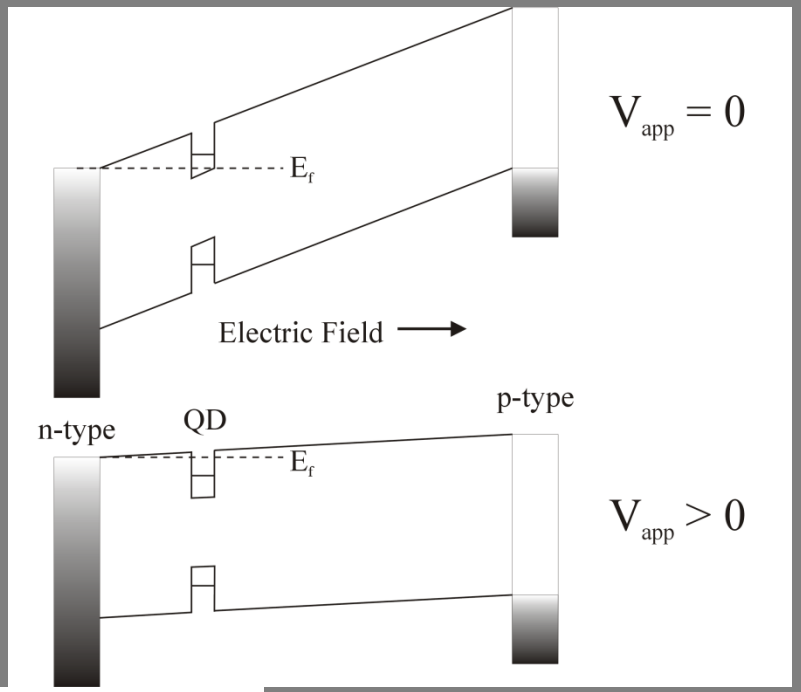


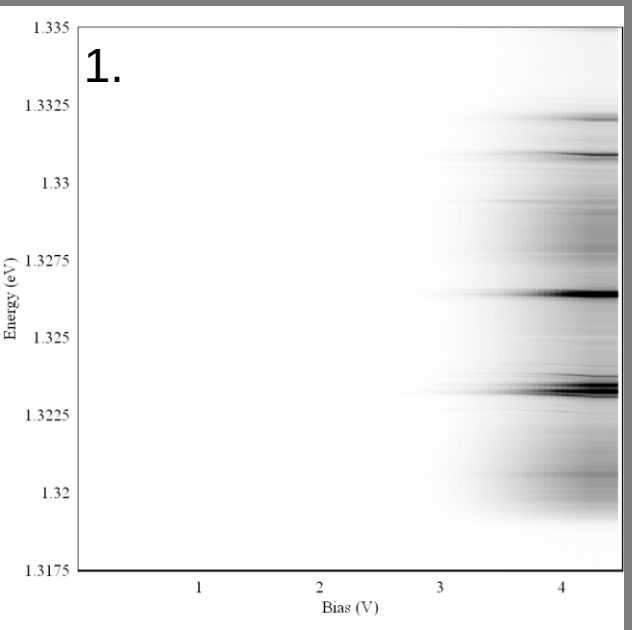


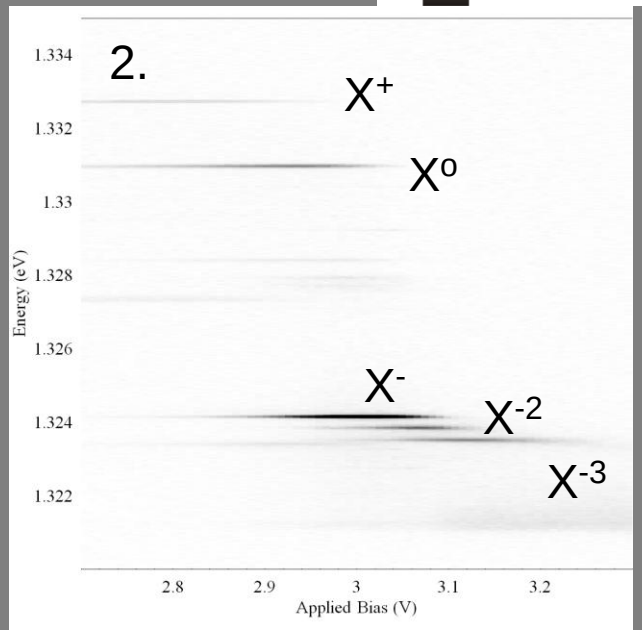
More than an Atom

By embedding the QD in a diode structure, we can manipulate our atom in novel ways depending on the structure:

1. Electrical Excitation
2. Single Carrier Loading



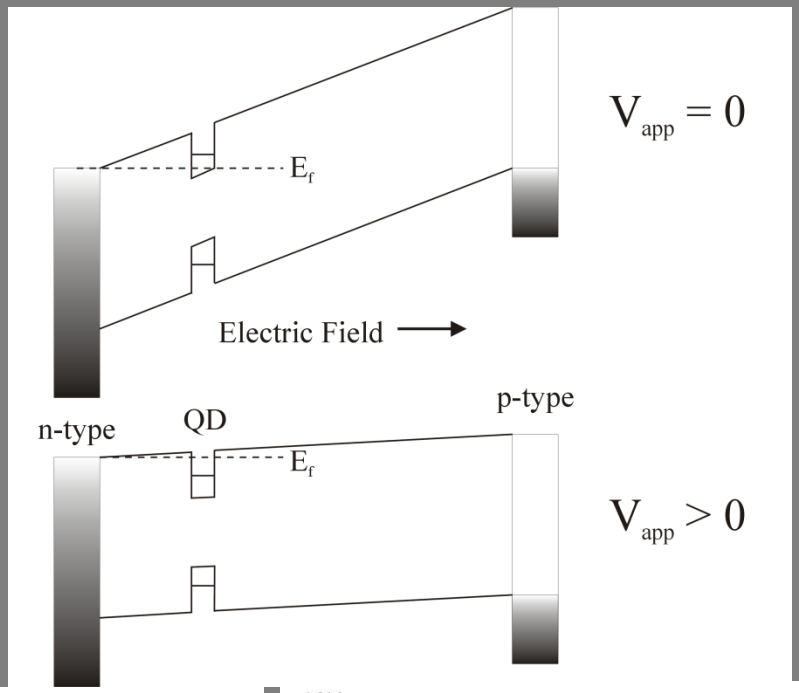


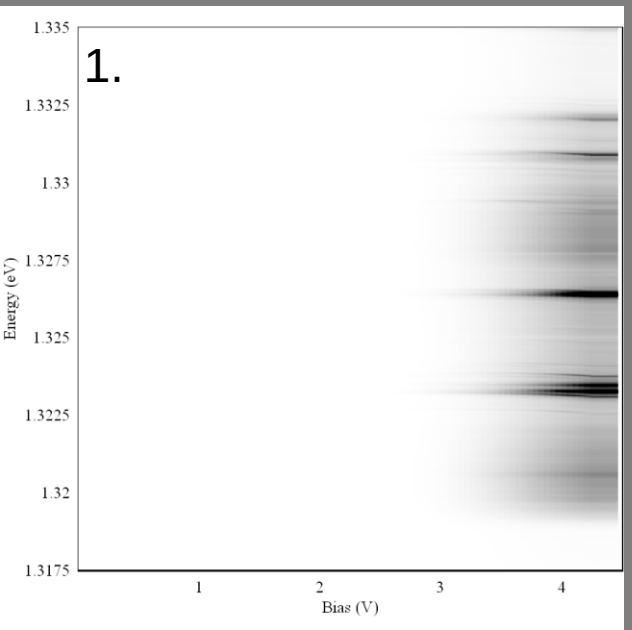


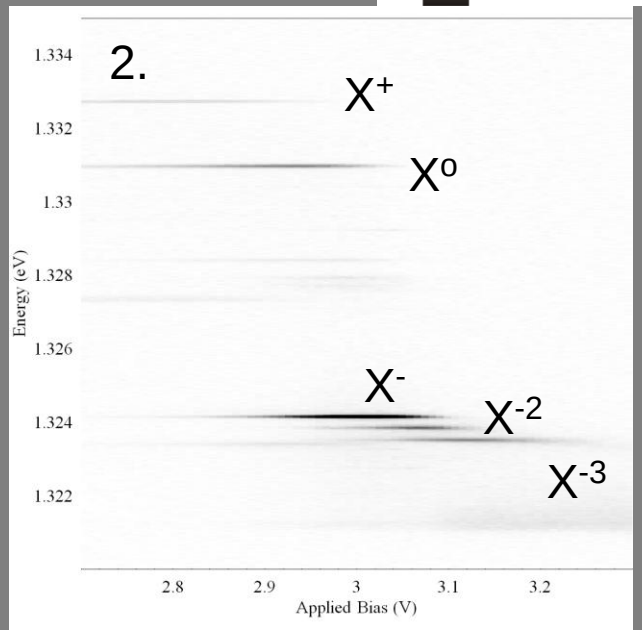
More than an Atom

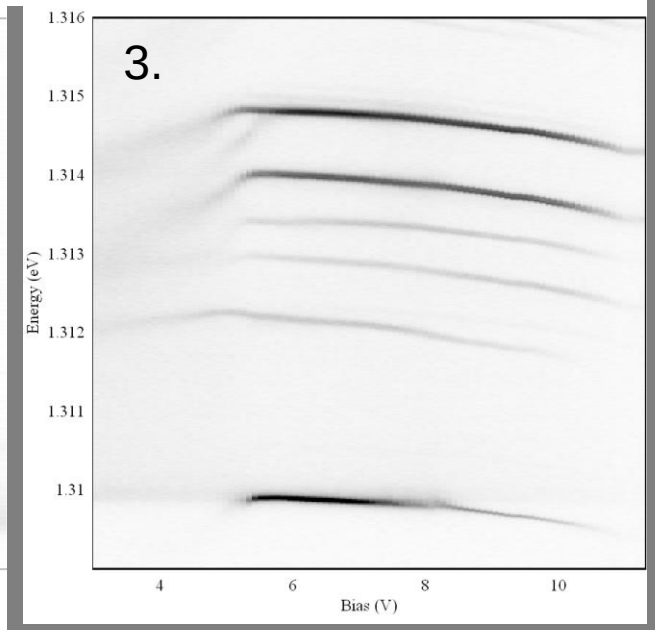
By embedding the QD in a diode structure, we can manipulate our atom in novel ways depending on the structure:

1. Electrical Excitation
2. Single Carrier Loading
3. Stark Shift Spectral Tuning

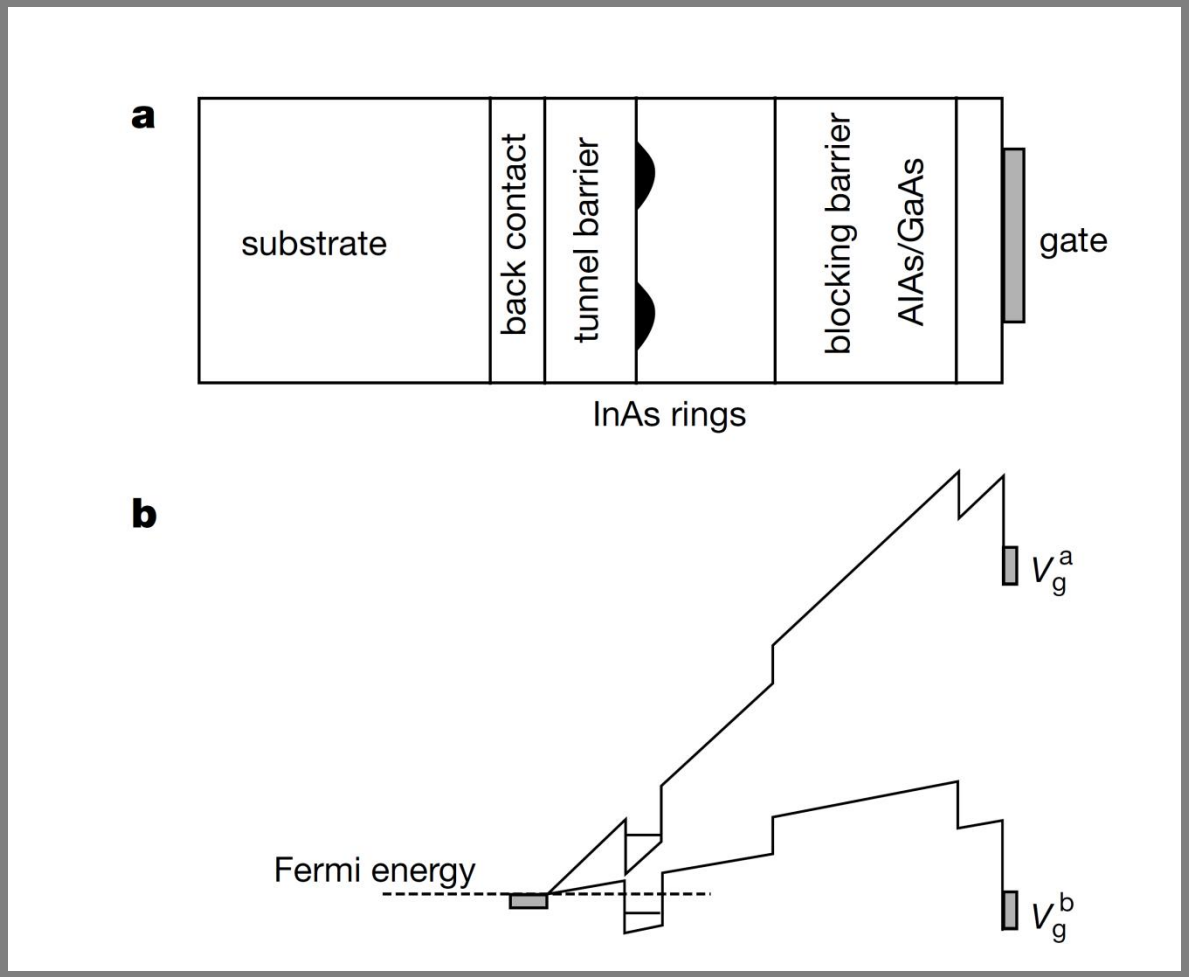




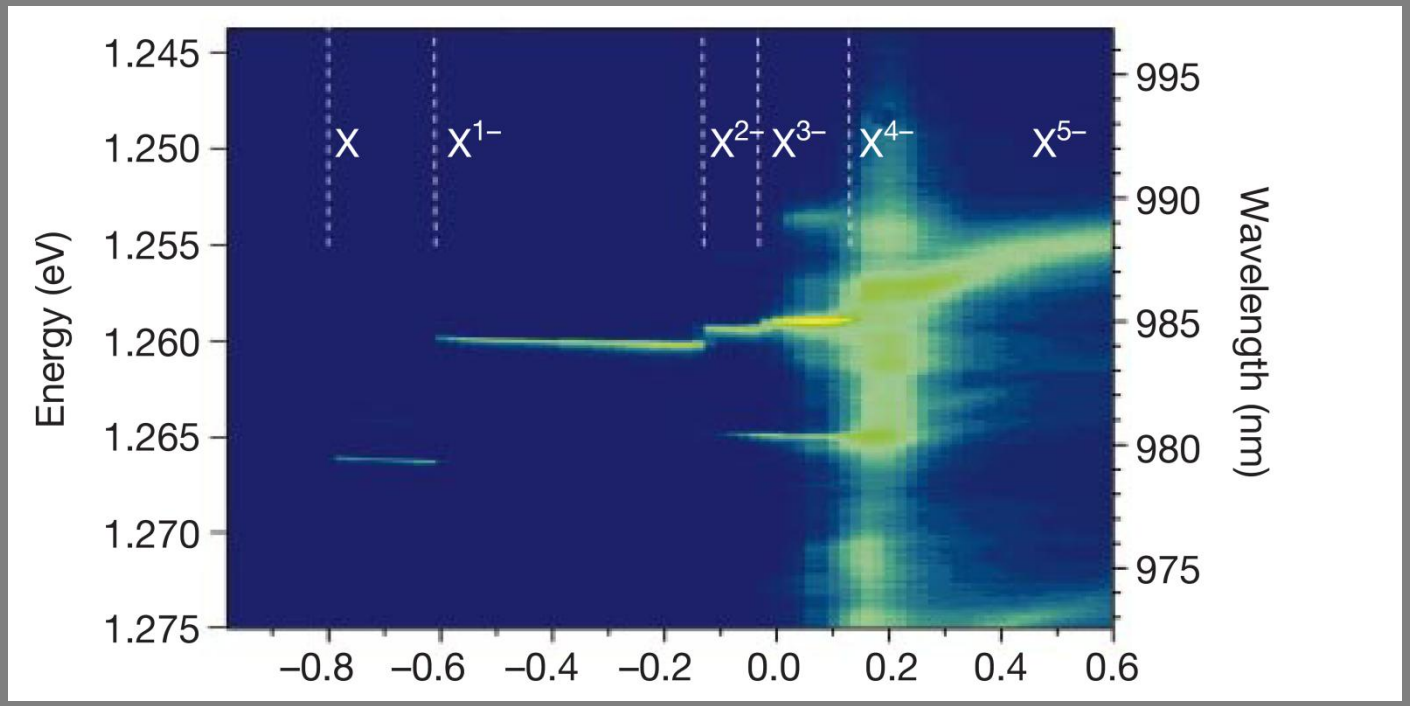


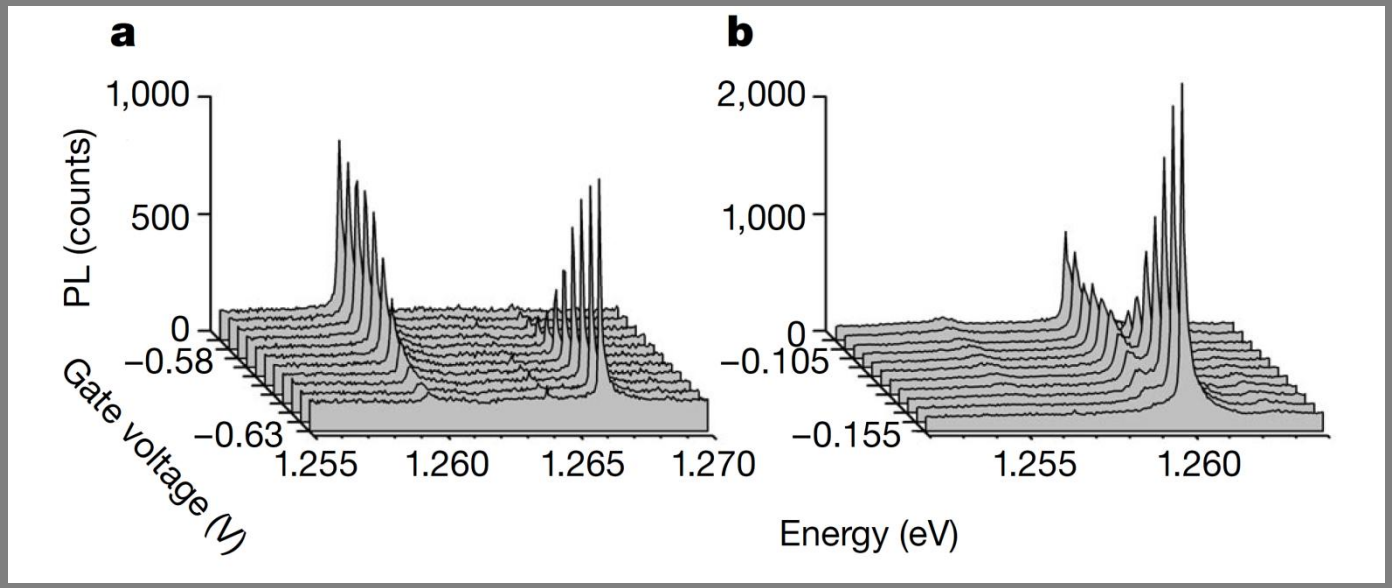


Schottky Contacted QDs

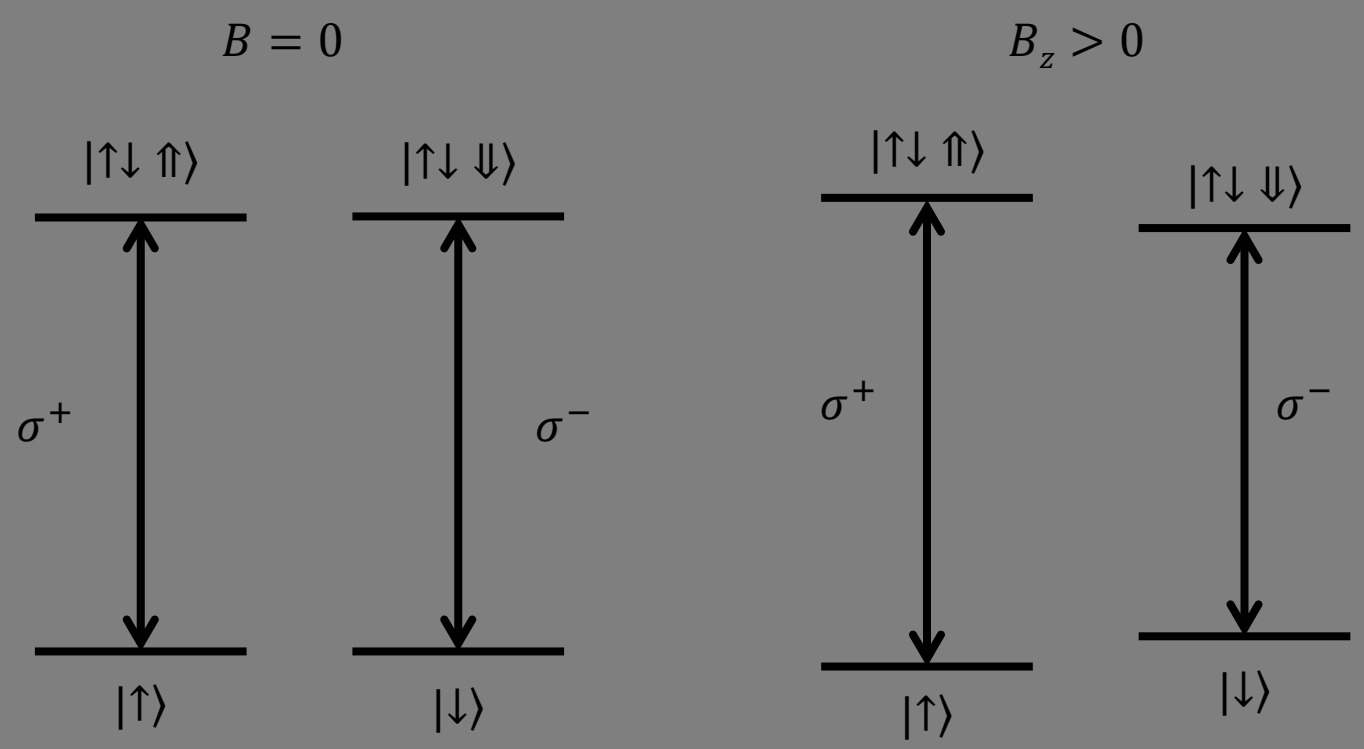


Charging Spectra





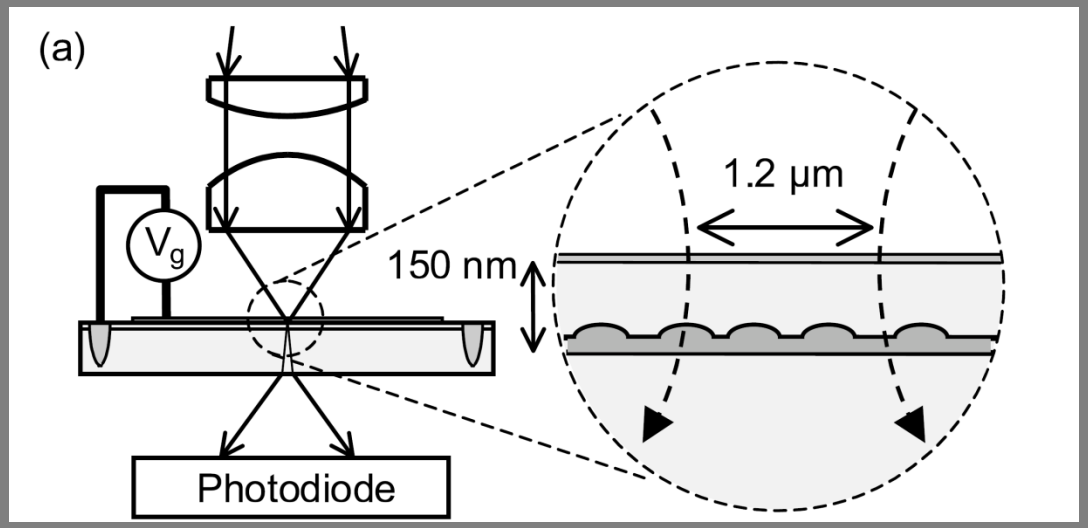
Trion in a B-field



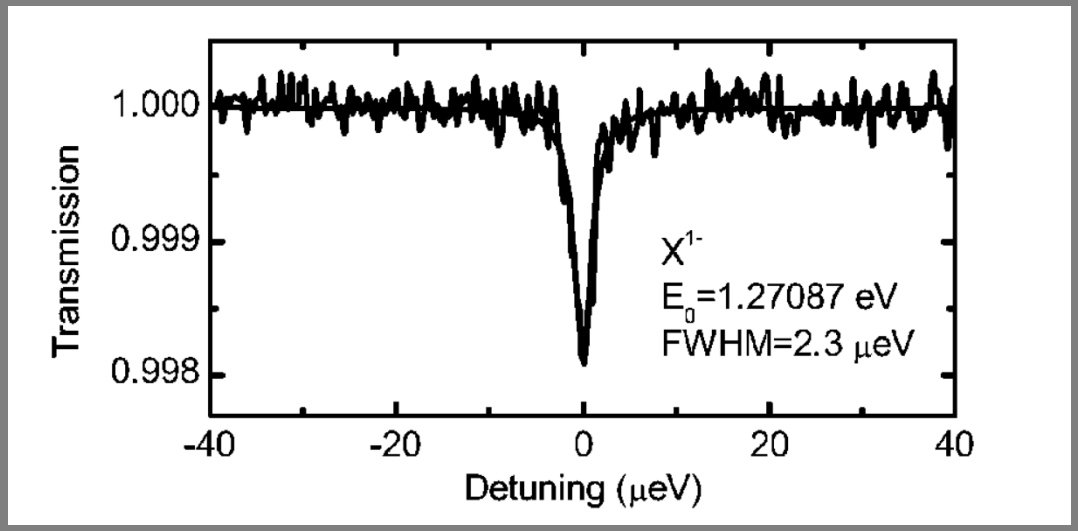
$$\mathcal{H} = \mu_B \left(g_e S_{e,z} - \frac{g_{h,z}}{3} J_{h,z} \right) B_z$$

$g_e \approx -0.6, g_{h,z} \approx -2.2$ Exciton Splitting = 30 GHz/T = 124 μeV/T

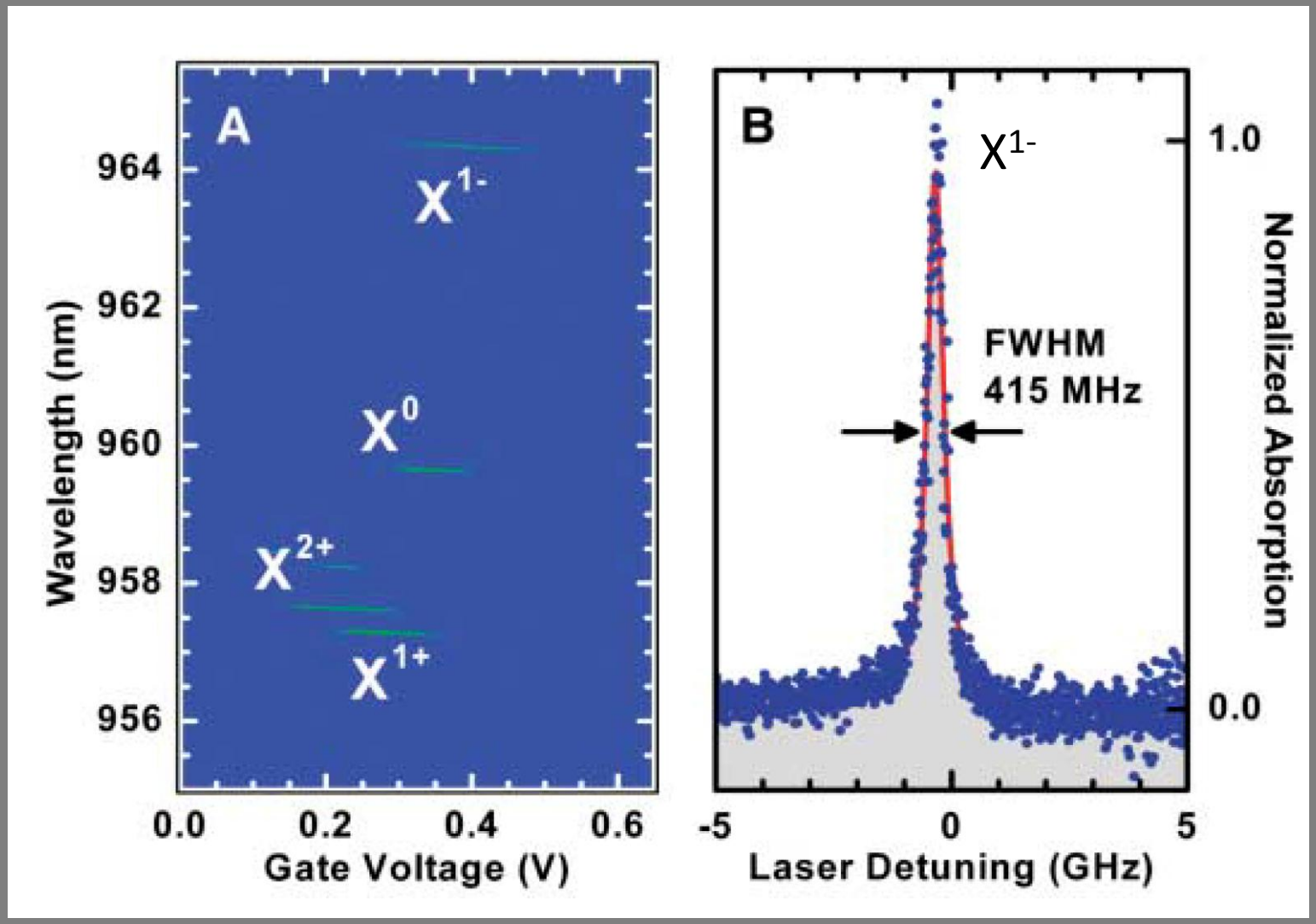
Differential Absorption



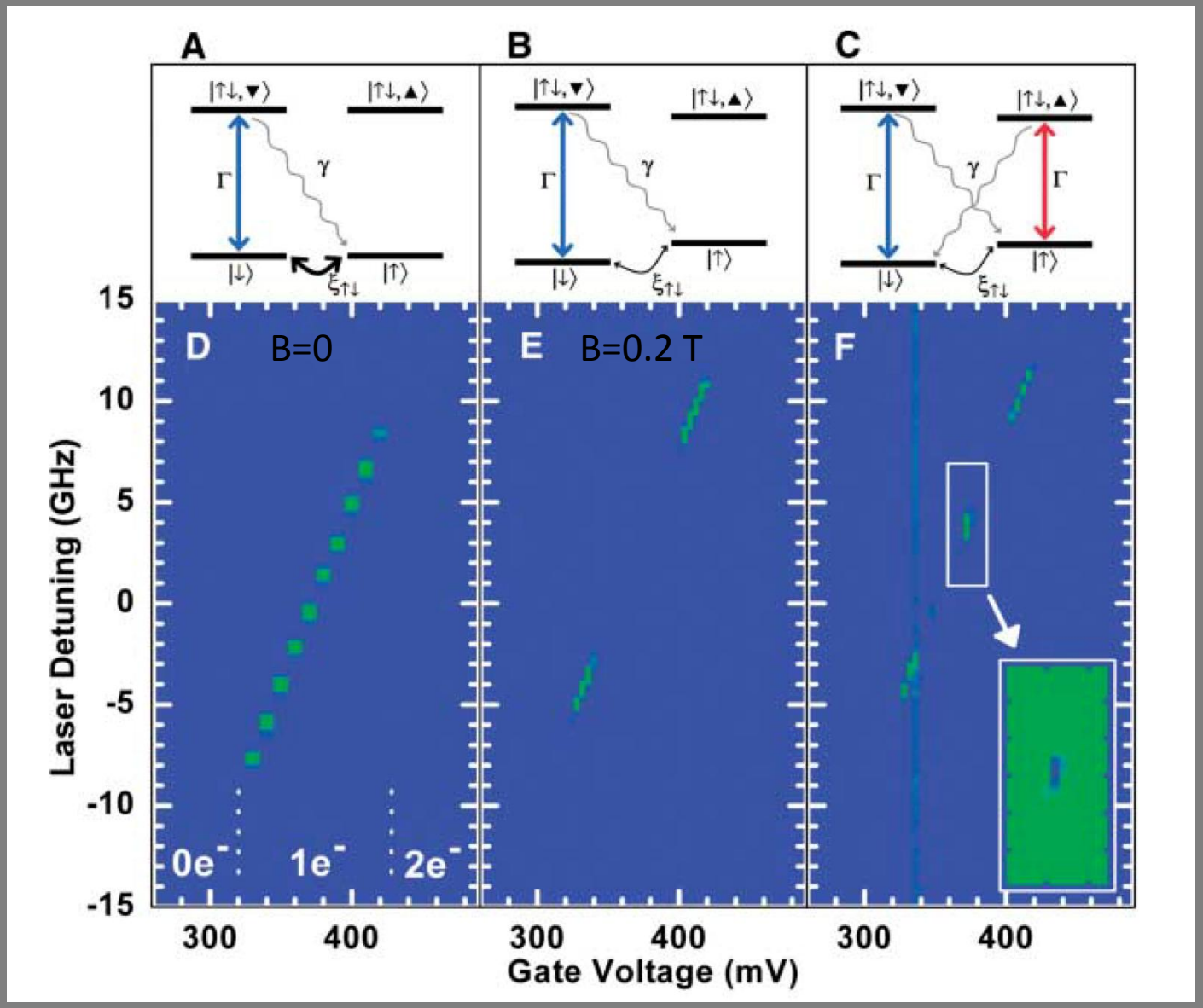
$$\frac{\Delta T}{T} = 1 - \frac{\langle |\boldsymbol{E}_1 + \boldsymbol{E}_s|^2 \rangle}{\langle |\boldsymbol{E}_1|^2 \rangle}$$



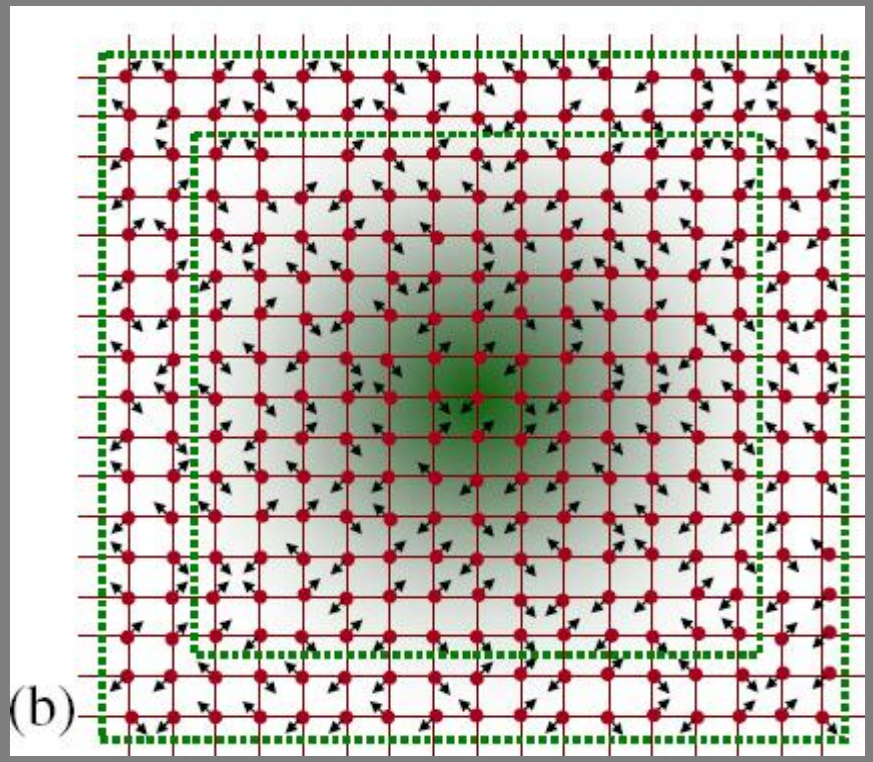
Charging and DT

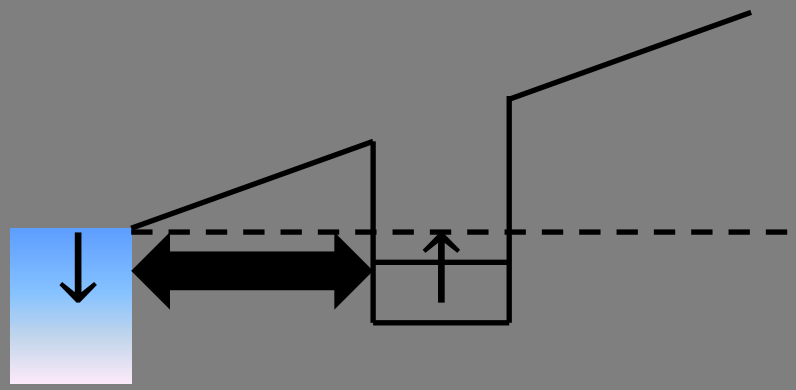


Spin Cooling

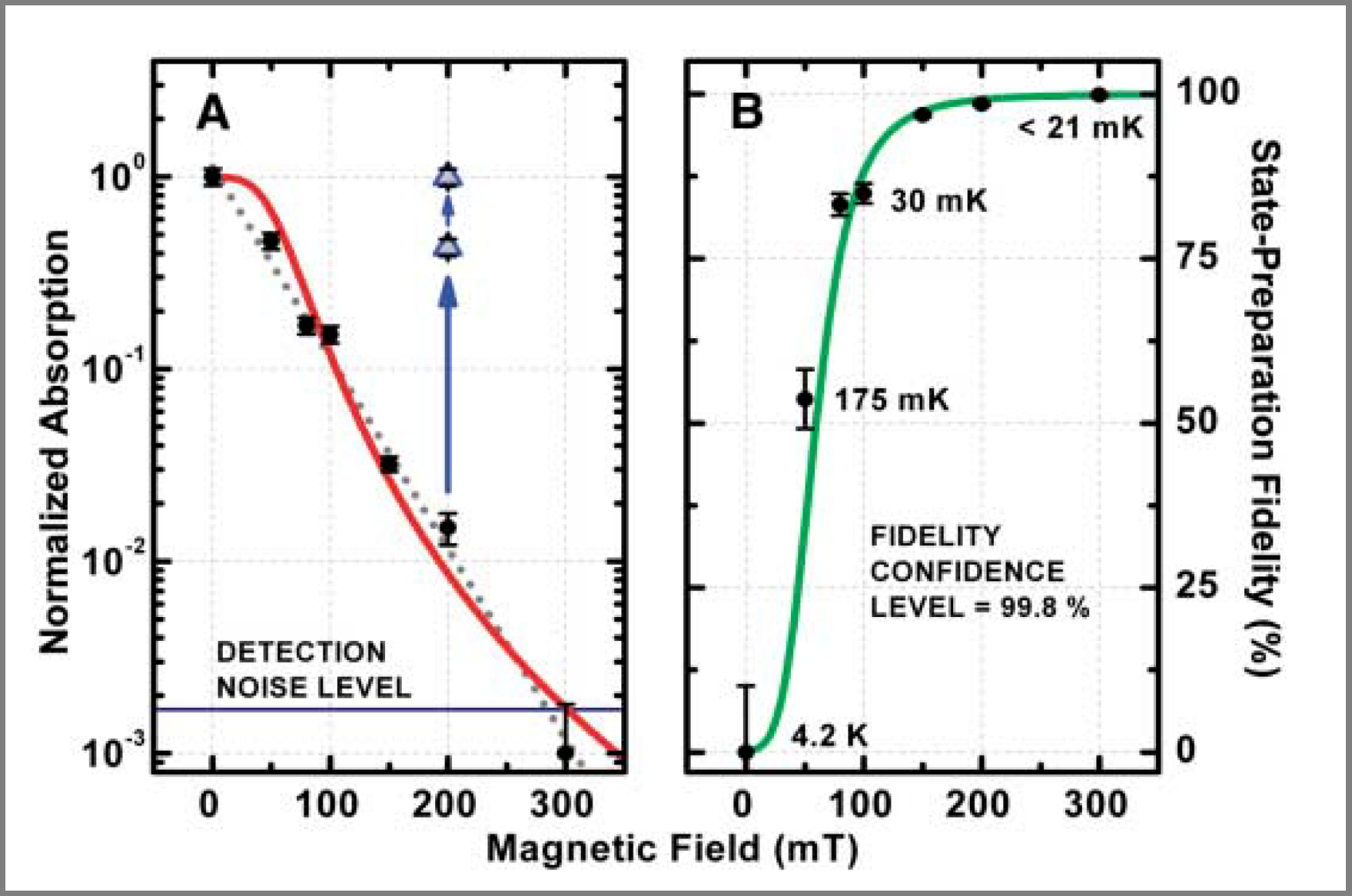


Spin Flip Processes in QDs





B-dependence of Cooling



Spin Temperature

$$\frac{\rho_{\uparrow}}{\rho_{\downarrow}} = e^{-\Delta E/k_b T}$$

$$\Delta \mathrm{E} = g_e \mu_B B_z$$