Spin lifetime in bilayer graphene quantum dots

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Graphene is a promising candidate for future nano-electronic devices including building blocks for quantum information processing. Reasons are the expected long spin lifetimes and high carrier mobilities. So far, these spin lifetimes could only be estimated with a lower bound experimentally [1,2].

Here, we use bilayer graphene and its electrostatically induced band gap to fabricate a fully gate-defined device with quantum dots, where one is used as a charge detector [3]. The Coulomb resonances in the detecting dot are sensitive to individual charging events on another quantum dot nearby. The potential change due to single-electron charging causes a step-like change in the current through the charge detector which matches in signal to noise ratio the traditional semiconductors Si and GaAs. This high-quality detection signal allows us to confirm and investigate the dynamics of last electron\hole quantum dots. Furthermore, we can tune the tunnel barriers individually, such that the tunnel rates get low enough for time resolved measurements.

We apply the Elzerman single shot readout technique [4] to investigate the spin excited state of the first electron in our QD and find spin relaxation times of up to 30ms.

References

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Figures

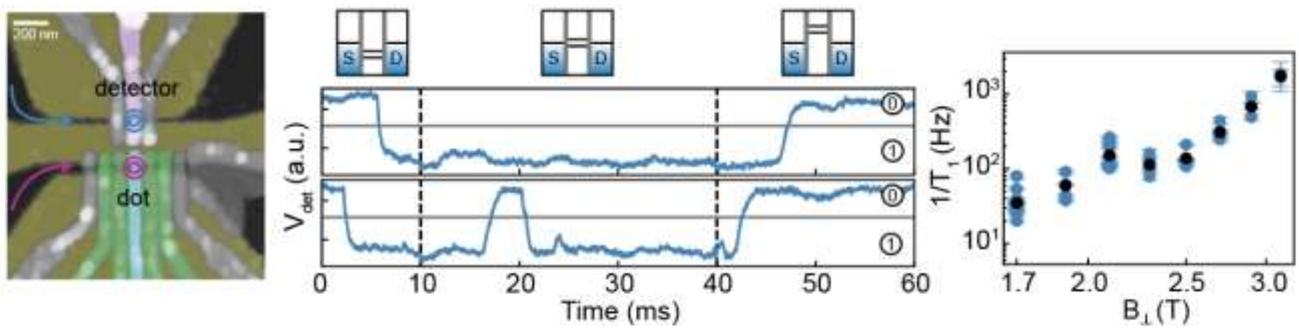

Figure 1: Left: False color atomic force micrograph of the gate structure used to for the quantum dots. Middle: Two exemplary time traces, where the lower one shows the signature 'blip' of an electron tunnelling out of the excited state and back in the ground state. Right: Magnetic field dependence of the measured spin relaxation time.