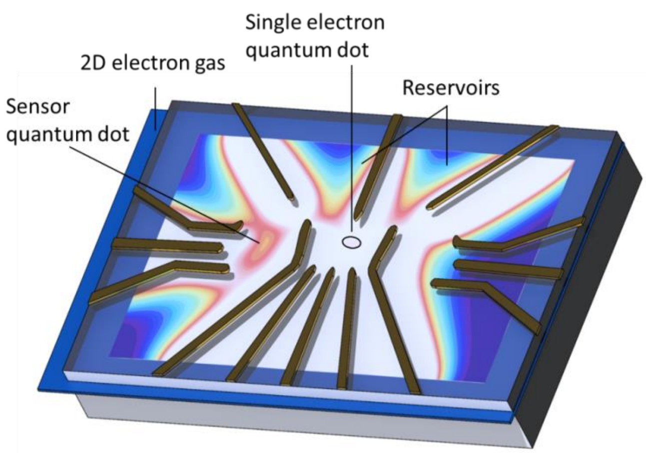
Hands on a Spin Qubit Device: g-factor anisotropy in GaAs

Project or Master Thesis

*In the **Zumbühl Group / Quantum Coherence Group***



By applying voltages on nanofabricated surface-gates, a single electron quantum dot is imprinted into a two dimensional electron gas. The spin of this object is used for quantum computation.

We are looking for a motivated, talented and technology-savvy physics or nanoscience student for research of the theoretically predicted **g-factor anisotropy in a lateral Gallium Arsenide (GaAs) quantum dot spin qubit device** measured at sub-Kelvin temperature.

Spin qubits in gated quantum dots [1–3] based in two dimensional electron gas (2DEG) are now seeing a resurge in interest due to a fast recent progress in both GaAs and Si. Many of the experiments are conducted in relatively strong in-plane magnetic fields, in the order of Teslas to split the spin states. It is a well established fact that such **in-plane magnetic** fields **have sizable effects** on the spin in 2DEGs [4]. However, so far no one was able to resolve a **g-factor anisotropy** in GaAs devices. Predicted as being only $\sim 10\%$ upon changing the direction of the in-plane magnetic field, such anisotropy is of fundamental importance for the stability and controllability of spin qubits and therefore spin based quantum computation in general.

This project involves

- Working in a low temperature lab with a He-3/He-4 dilution refrigerator
- Tuning, controlling and programming of a nano-electronic spin qubit device
- Seeking for experimental evidence of g-factor anisotropy and comparison to theoretical prediction
- Possible extension to fabrication of nanostructures in the clean-room or/and work on a high-frequency spin qubit setup

References

[1] D. Loss & D. P. DiVincenzo, *Quantum computation with quantum dots. Phys. Rev. A* **57,** (1998).
[2] R. Hanson *et al.*, *Spins in few-electron quantum dots. Rev. Mod. Phys.* **79,** (2007).
[3] C. Kloeffel & D. Loss, *Prospects for Spin-Based Quantum Computing in Quantum Dots*. *Annu. Rev. Condens. Matter Phys.* **4,** (2013).
[4] L. C. Camenzind *et al.*, *Hyperfine-phonon spin relaxation in a single-electron GaAs quantum dot*. *arXiv:1711.01474***,** (2017).

Contact

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