Masters's Project

Characterisation of an ASD for Spin Qubit Readout

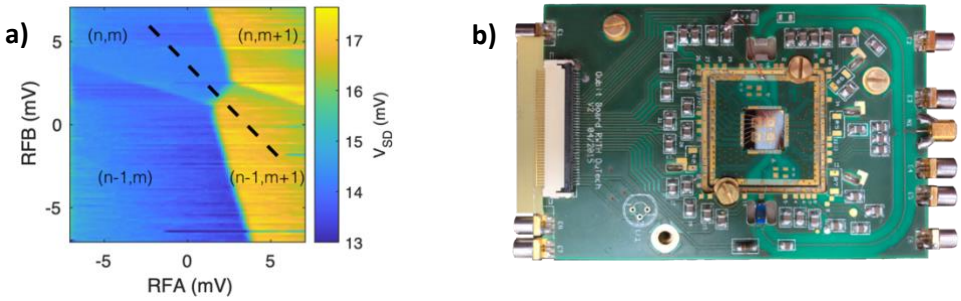

Fig. 1 (a) *Stability diagram of a qubit acquired via charge sensing of an Asymmetric Sensing Dot (ASD). The ASD operates with a current bias and produces a much stronger signal than conventional readout sensors.* ***(b)*** *Picture of an quantum device sample (chip in the centre) with an integrated ASD. The chip is wire bonded to a printed circuit board, which is cooled down to 10 mK.*

Background

High fidelity scalable readout is one of the key requirements for quantum computers with more than just a few qubits. Charge sensing dots (SDs) are in this regard the most sensitive sensors for spin qubit readout. The most widespread readout technique is based on RF reflectometry, satisfying the requirement of high fidelity, but requires bulky, power-hungry components and is not well scalable. A more scalable alternative is to use transistors in close proximity to the qubit [1,2]. For best performance a high output signal of the sensor is desirable. We developed a novel sensor design, which improves the sensor response by a factor of 15 in recent experiments.

Your Task

Your task will be the measurement of one or several quantum devices with an integrated ASD in one of our dilution refrigerators. These measurements include the tune-up of the ASD, as well as a conventional SD and a qubit between both. Further, you will analyse the back action of the ASD on the qubit using the relaxation rate T1. Valuable insights from this experimental work can lead to a co-authored publication.
Additionally, you will model the ASD performance in combination with a transistor readout and validate your findings experimentally.

This project will allow you to extend your knowledge of these topics, among other things:

- Theory of electron spin qubits and quantum computation
- Experimental methods at sub-Kelvin temperatures
- Small-signal analysis of transistor circuits
- Qubit tuning and different readout methods

Furthermore, you will participate in group seminars and Journal Clubs to discuss cutting-edge developments in this area of research.

References

[1] M. J. Curry et al., APL 2015
[2] L. A. Tracy et al., APL 2016

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