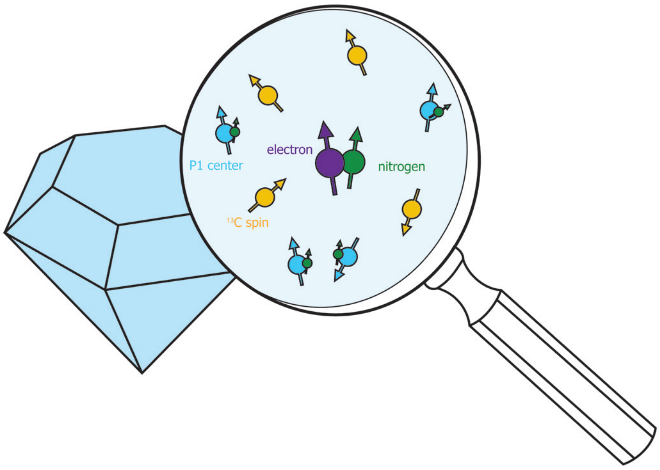
Open positions for master thesis project:
Improving qubit control and readout for the nitrogen-vacancy center in diamond

Taminiau Lab, QuTech

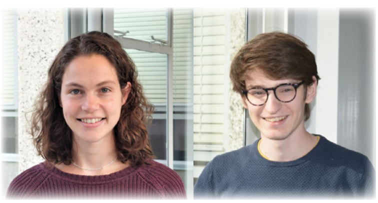
Spins associated with solid-state color centers such as the **nitrogen-vacancy (NV) center in diamond** are promising for **quantum computing** and **quantum networks**. Because qubits are noisy, a scalable quantum computer will require quantum error correction (QEC). In order to realize QEC, the qubit operations ('gates') and readout need to be of a certain quality. Using various methods like **gate set tomography and randomized benchmarking**, the quality of our qubits can be assessed and improved.



Project Directions

In the high-fidelity team of the Taminiau lab, there are various experimental master thesis projects available. Below, we listed some ideas, but we can definitely discuss to match a project and your interests.

1. Investigate methods to improve gate fidelities such as **Pauli Twirling** [1] and **quantum optimal control** [2].
2. Use the **predictive power** of gate set tomography to develop an optimization function for an arbitrary quantum circuit, minimizing the control error over the full circuit.
3. Investigate **robust calibration methods** for quantum gates, to reliably establish high fidelity control on our quantum system [3].
4. Given a new NV center system, use heuristics and/or machine learning to **predict how large a quantum system can be reliably controlled**.
5. The NV center can also be operated at **higher temperatures** than 4 K, using a different readout mechanism [4]. Use gate set tomography to improve gates at 100 K.



Interested?

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[1] Kim, Y. et. al., Nature 618, 500-505 (2023)
[2] Kairys, P. et al. arXiv:2309.03120 (2023)
[3] Bradley, C.E. et al. Phys. Rev. X 9, 031045 (2019)
[4] Neumann, P. et al. Science 329, 542–544 (2010)