

MSc Thesis Project – Hermans Lab (QuTech) Rare-earth ion-based Quantum Networks

In the future, quantum networks could change the way we communicate, run apps in the cloud, and help scientific tools and sensors. In the Hermans lab, we focus on the hardware of such networks. In our lab, we develop quantum nodes based on rare-earth ions (REIs) doped in host crystals. Because of their internal atomic structure, REIs are a promising type of qubits, with long coherence times and emission in the visible and near-infrared spectrum. In the last few years, a lot of research has been done on proving REIs as qubits, including the demonstration of remote entanglement and quantum teleportation^{1,2}.

The Hermans Lab is a new experimental research group at QuTech. We are looking for MSc students who can help with setting up the measurement equipment for new and challenging physics experiments, as well as the fabrication of research samples. The projects will also include simulations, to understand the quantum behavior of rare-earth ions in host crystals during the experiments³.

Does this sound interesting? Are you in for a challenging thesis project? Do you like to work in a new and small team? And are you keen on learning more about quantum optics and information science? Reach out to Sophie!



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More reading?

- (1) Kindem, J. M.; Ruskuc, A.; Bartholomew, J. G.; Rochman, J.; Huan, Y. Q.; Faraon, A. Control and Single-Shot Readout of an Ion Embedded in a Nanophotonic Cavity. *Nature* **2020**, *580* (7802), 201–204.
- (2) Ruskuc, A.; Wu, C.-J.; Green, E.; Hermans, S. L. N.; Pajak, W.; Choi, J.; Faraon, A. Multiplexed Entanglement of Multi-Emitter Quantum Network Nodes. *Nature* **2025**, No. 639, 54–59.
- (3) Tiranov, A.; Green, E.; Hermans, S.; Liu, E.; Chioffi, F.; Serrano, D.; Loiseau, P.; Kumar, A. M.; Bertaina, S.; Faraon, A.; Goldner, P. Sub-Second Spin and Lifetime-Limited Optical Coherences in ¹⁷¹Yb:CaWO₄. arXiv preprint: 2504.01592 **2025**.

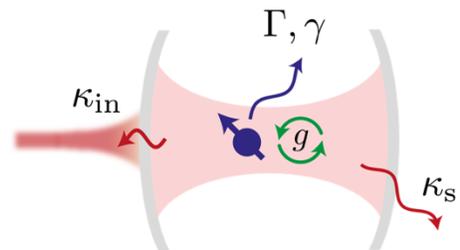
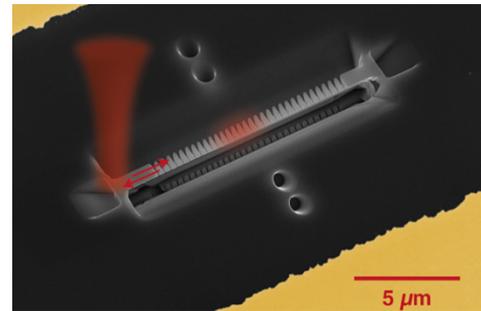


Figure 1 - Microscope image of nanophotonic device (top). Interaction diagram of a REI single photon emitter in an optical cavity (bottom). Adapted from (1)