Towards Non-Linear Optomechanics with Single Erbium Ions

Gaia Da Prato
Yong Yu, Emanuele Urbinati, Simon Groeblacher

Delft University of Technology, Delft, The Netherlands

g.daprato-1@tudelft.nl

Two of the most active and exciting areas of quantum science are quantum optomechanics and individual spin systems, which are often used for quantum networking. Each of them has its own advantages and disadvantages. In optomechanics [1, 2], the optical field and mechanics are effectively linearly coupled to one another. Such systems have emerged as a leading candidate to investigate quantum physics at a massive, macroscopic scale. However, limited by the linear interaction, creating complex quantum states in such systems is difficult. Individual spins in solid-state systems [3], on the other hand, enable advanced quantum protocols thanks to their inherent strong non-linearity. However, due to their small cross section, high-quality optical cavities are needed to realize advanced quantum information processing [4]. Merging these two worlds together brings synergies that leverage their respective strengths and weaknesses, facilitating new insights into the very foundations of physics, as well as enabling novel quantum applications. I will show our most recent findings on the spectrum characterization of Er^{3+} ions implanted in a silicon waveguide.

Figures

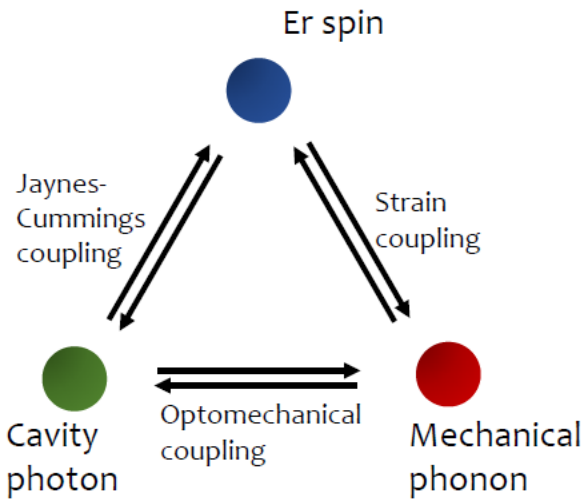

Figure 1: Hybrid system.

References

[1] Aspelmeyer, M., et al. Reviews of Modern Physics, 86, 1391 (2014).
[2] Barzanjeh, S., et al. Nature Physics, 18, 15-24 (2022).
[3] Awschalom, D. D., et al. Nature Photonics, 12, 516-527 (2018).
[4] Reiserer, A., & Rempe, G. Reviews of Modern Physics, 87, 1379 (2015).