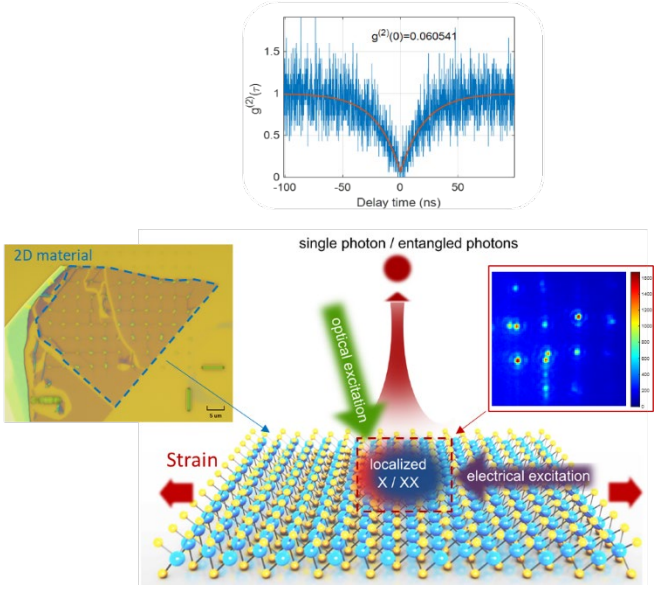
Strain engineering of quantum emitters in two-dimensional materials

Background: Solid-state-based qubits are a central building block for a diverse set of quantum technologies. Two-dimensional (2D) materials offer new opportunities in developing such qubits on a chip and are compatible with various other technological platforms. However, they are suffering from fine structure splitting and inhomogeneous broadening of their emission energies, which are detrimental factors for their application in quantum technologies. Strain engineering [1] has been demonstrated to be a simple but powerful method to compensate these negative characteristics. In our lab, we are interested in strain tuning of quantum emitters in 2D materials and exploring the possibility on coupling these qubits via strain to mechanical resonators [2]. This combined system would enable novel ways to read-out and control mechanical motion, which are particularly useful in mechanical sensing applications or mechanics-based quantum technologies.



Idea of the experiment. Quantum emitters denoted by X/XX in a 2D material can be excited optically. Their emission energy depends on strain, which we will either generate statically via applying an external mechanical force or dynamically via mechanical motion.

References:

[1] Z. Dai et al., Adv. Mater. 31, 1805417 (2019)
[2] D. Lee et al., J. Opt. 19, 033001 (2017)

Goals of the thesis:

- Generate and characterize quantum emitters in 2D materials
- Study the strain tunability of quantum emitters in 2D materials
- Couple quantum emitters in 2D materials to a high-quality nanomechanical resonator

What will you learn?

- Experimental techniques such as hyperspectral imaging for acquiring the spectral and spatial distribution of quantum emitters
- Learn the basics about quantum emitters and how to identify them in experiments
- Understand the physical mechanisms behind strain tuning of quantum emitters in 2D materials
- Fabrication methods for transferring 2D materials
- Teamwork in a lively lab environment

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