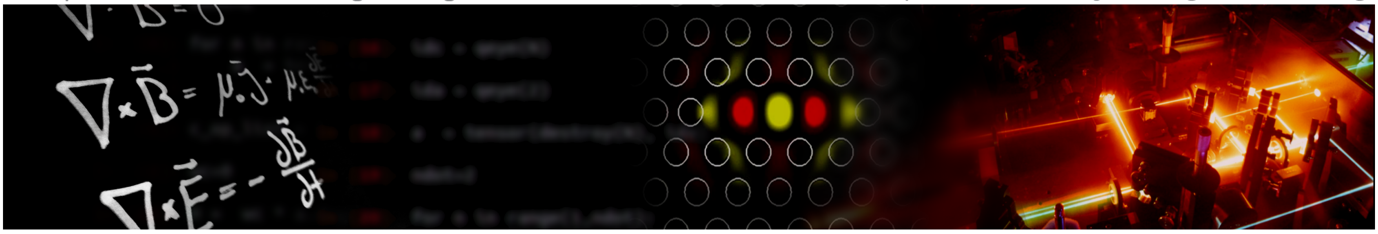


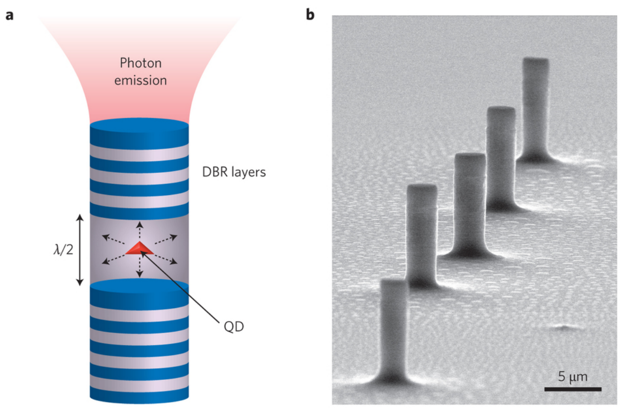
Multi-photon processes in solid-state quantum emitters

(B.Sc. or M.Sci. Project)

Background

Sources of single indistinguishable photons are of central importance for a number of emerging quantum technologies. An ideal single photon source would emit precisely one photon when triggered, and any two such photons would be perfectly indistinguishable from each other. Self-assembled semiconductor quantum dots embedded in micro-cavities are promising candidates for such devices [1].

In order to stimulate these systems into emitting photons, lasers are used to excite them to high-level excited states. These states relax, and in doing so release photons. This is called quasi-resonant excitation. The problem with this quasi-resonant excitation procedure is that it also excites the semiconductor solid-state environment surrounding the quantum dot. This can couple to the quantum dot in unwanted ways, and cause it to emit two or more photons as it relaxes. These multi-photon processes degrade the quantum dot's usefulness as a single photon source.



Project aims

Though quasi-resonant excitation schemes are common, they are still not fully understood, and have only recently begun to be investigated experimentally [2]. DTU Fotonik has strong collaborations with experimental and theoretical groups fabricating single photon sources. The aim of this theoretical project is to better understand the quasi-resonant excitation procedure and its relation to multi-photon processes. In particular, project goals will include:

- The development of an analytic theory which includes multi-photon processes in the quantum dot dynamics
- To investigate the relationship between multi-photon processes and indistinguishability
- To devise excitation schemes which will reduce multi-photon processes

The ideal student for this project will have strengths in quantum mechanics and quantum optics, and have good numerical computation skills.

Supervisors and contact information

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References

[1] C. Santori *et al.*, Nature **419**, 594 (2002).

[2] E. B. Flagg, S. V. Polyakov, and G. S. Solomon, Phys. Rev. Lett. **109**, 163601 (2012).