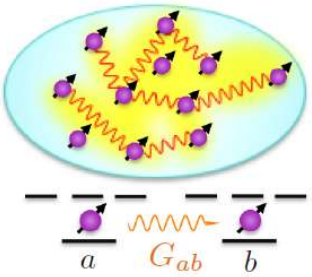
STRUCTURED ELECTROMAGNETIC MATERIALS GROUP

MASTER PROJECT

Project title: Subradiant multi-atom states as a quantum memory

- **MSc/(BSc)**
- **Theory and simulation**
- Method used: Multiple-scattering theory (analytical) and numerical implementation/simulation
- Desired student skills: The student has a background in optics and ideally quantum optics, and likes both theoretical and numerical studies. Can work independently and communicates well.

Objectives: The goal is to study and optimize 1D, 2D, and 3D configurations of quantum emitters such that their collective light emission is highly suppressed (sub-radiance), so that together they could act as a quantum memory. At the same time, the configuration should be such that the subradiant state can be well excited in the near field. We explore optimal dielectric environments for the emitters.



Background: A collection of atoms forms collective states and emit light together (superradiance), sometimes much slower than individual atoms (subradiance). Subradiant states are interesting because their long lifetimes may enable encoding quantum information. These states cannot be excited by plane waves, so one needs to explore other ways to encode information. A useful study for scalar waves can be found in Ref. [1], and we will study light (vector waves) instead [2].

Motivation: Collective emission can be very different, but often it is neglected that quantum emitters can act collectively. There is a renewed interest in super- and subradiance [1,3] because of upcoming quantum technologies and in particular the need to store quantum information.
Project description: Reading literature, introduction to multiple-scattering theory, analytical and numerical calculations, frequent discussions, attending group meetings, writing of thesis.

References:

[1]: F. Schäfer et al., J. Phys. B: At. Mol. Opt. Phys. **50**, 235502 (2017).

[2] M. Wubs et al., Phys. Rev. A **70**, 053823 (2004).

[3]: A. Albrecht et al., ArXiv:1803.02115 (2018).

Contact persons: Martijn Wubs, mwubs@fotonik.dtu.dk, Building 345A, room 068

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Technical University of Denmark
Department of Photonics Engineering
Ørsteds Plads
Building 345A, room 176
2800 Kgs. Lyngby
Denmark
Tel +45 45 25 63 79
www.fotonik.dtu.dk
niste@fotonik.dtu.dk