Probing the time delay in nanoscale resonators

(M.Sc. project)

Main question

Can we measure the time delay induced by an ensemble of nanoscale resonators?

Description

Devices that allow to modulate the shape of waves are all around us, in the form of digital displays or projectors. In the last 10 years, thanks to wavefront shaping, it became possible to focus a laser behind a scattering materiel as well as to get an image of an object hidden behind a turbid medium. Interestingly, different wavefronts have different properties while interacting with a scattering medium; for instance, some of them can travel much faster than other across the medium.

In this project, you will use the so-called time-delay operator to investigate the properties of nanoscale particles. Indeed, when light interacts with resonant metallic particles, the typical time spend by the light in the medium can be strongly increased. Therefore, by illuminating a random scattering medium with different wavefronts, the time spend by the light to travel across the medium will depend on the degree of interaction between the light and the nanoparticles.

This project can be approach from both a numerical and an experimental point-of-view. In the numerical part of the project, you will develop electromagnetic simulations from an existing code based on Green functions and calculate the eigenstates of the time-delay operator. In the experimental part of the project, you will use a dual-objective microscope to measure the properties of these eigenstates.

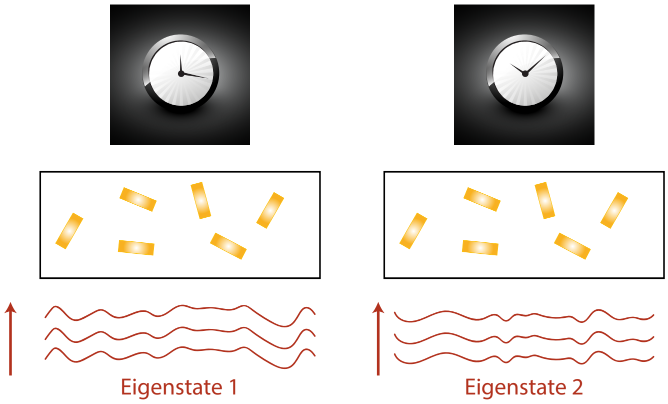

Figure 1: Schematic view of two eigenstates of the Wigner-Smith operator associated with different time delays.

Research group

You will join an active Photonics group, which investigates and explores non-conventional methods of imaging in scattering materials by integrating concepts from distinct fields such as space-time wavefront shaping, compressive sensing, adaptive optics and optical metrology.

Requirements

- solid theoretical knowledge in electrodynamics and linear algebra
- ability to both work as a team member and to work independently

Contact

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