Proposition d'un Projet de Recherche en Laboratoire

Titre : Photon-photon interactions in semiconductor microcavities: a numerical study

Laboratoire d'accueil : Centre de Nanosciences et de Nanotechnologies (C2N), CNRS, Université Paris-Saclay, 10 Boulevard Thomas Gobert, 91120 Palaiseau, France

Résumé : Optical photons, the particles representing a quantum of light, are well know not to interact in vacuum. When injecting photons into a nonlinear optical material, one can make them interact together: this is the realm of nonlinear optics. At C2N, we are working on nonlinear optical materials made of semiconductor microcavities, where we are aim to engineer photon-photon interactions that are significant at the quantum (single photon) level. With this goal in mind, we have recently designed an experiment to precisely measure the value of the interaction constant. At the theoretical level, the (open) system is well described by a Linblad master equation, which can be solved numerically using different methods.
In this project, we propose a theoretical and numerical investigation of photon-photon interactions in semiconductor microcavities. In collaboration with the experimental team at C2N, the intern will implement a solver of the quantum master equation that will allow efficiently exploring the vast parameter space and guide the experiments. Two different methods will be tested in parallel: direct solving of the quantum master equation in a truncated basis, or numerical stochastic integration in the positive-P representation. Throughout the project, the intern will benefit from tight collaboration with our theory partners at University College London (M. Szymanska's team) and at Université Paris Cité (A. Le Boité's team).

Mots clés : Quatum physics, Nonlinear Optics, Exciton polaritons, Quantum open systems, Quantum master equation

Nature : The internship will be realized in the quantum polaritonics team at C2N (https://goss.c2n.universite-paris-saclay.fr/fr/members/sylvain-ravets/quantum-polaritonics/), in close collaboration with the experimental team. This project will mostly focus on the numerical aspects of the physics, with a strong theoretical component. Additionally, the obtained results will be confronted to the experiments performed in parallel at C2N.

Accueil d'un binôme possible : Y

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