PhD Position

MODELLING OF LIGHT-MATTER COUPLING IN SEMICONDUCTOR MICROCAVITIES

SUMMARY

Photons trapped in a semiconductor microcavity can couple to excitons forming a special half-light half-matter state known as polariton. This project will focus on theoretical and computer modelling of microcavity polaritons and development of polariton circuits.

Details of the Project

Light interaction with matter is the fundamental process that is responsible for optical nonlinearities and is in the core of operation of most of the photonic devices. When placed in a microcavity containing semiconductor quantum wells, photons can interact with excitons particularly strongly, forming a special type of half-light half-matter excitations – polaritons. Microcavity polaritons possess unique dispersion characterics, combined with strong and fast nonlinear interaction – altogether leading to formation of the whole range of interesting waveforms, including self-localized excitations (solitons) [1], see Fig. 1, and polariton vortices.

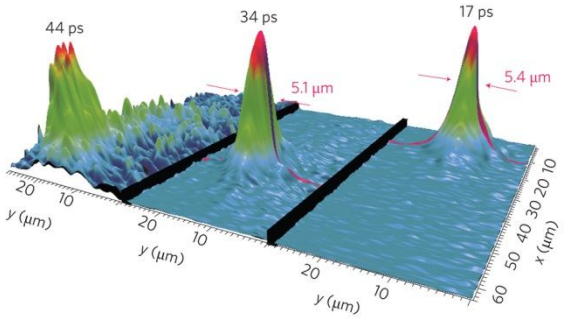

Fig. 1 Formation of a self-localized polariton wave (soliton) in a microcavity [1].

This project will focus on theoretical and numerical analysis of polaritons in micro-cavities with integrated nano-structures, aiming to develop a range of setups that will form the basis of polariton circuits. These setups include polariton nano-wires, logic gates, and periodic structures. The project involves collaboration with experimentalists from the University of Sheffield.

The project gives you an opportunity to develop analytical and programming skills and acquire advanced knowledge of nonlinear, semiconductor and optical physics. You will participate in developing of a range of methods and techniques for analysis and numerical solution of nonlinear partial differential equations, and contribute into prediction of new physical effects.

Applications: Applicants should have a background in the physical sciences and have or expect to gain a First or good Upper Second Class UK Honours degree, or the equivalent from an overseas University. Possible funding sources include the Doctoral Training Account (for UK applicants) or Faculty/University studentships and scholarships. Applications from self-funded students are always welcome.

Contact Prof. Dmitry Skryabin (D.V.Skryabin@bath.ac.uk) and Dr. Andrey Gorbach (A.Gorbach@bath.ac.uk, http://people.bath.ac.uk/ag263) for further information.

References:

[1] M. Sich, D. N. Krizhanovskii, M. S. Skolnick, A. V. Gorbach, R. Harvey, D. V. Skryabin *et al.*, Nature Photonics **6**, 50 (2012).