Doctoral Thesis Project: Theory of Opto-Mechanical Frequency Comb Formation and Stabilisation

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A PhD grant is advertised in the context of a *Plan Nacional* project (PID2021-124618NB-C21) studying stabilisation of opto-mechanical frequency combs from a dual approach combining theory and state of the art experiments. The project below takes important steps forward and departs from the standard problems addressed nowadays. One important open problem in the field is the formulation of a global model based on first principles capable of explaining and predicting a wide collection of phenomena, being such an ambitious task the main goal of this PhD project.

Overview

- PhD grant: FPI from Spanish government

- Subject: Theory of robust Opto-Mechanical comb formation in Photonic Crystal Cavities

- Duration: 36 months

- Start date: as soon as possible

- Key words: Nonlinear Optics, Frequency Combs, Solitons.

In this project, the PhD candidate will study theoretically the formation and dynamics of frequency combs in opto-mechanical systems. The nonlinear dynamics, including soliton formation amongst others, involves the coupling between the optical field with mechanical oscillations, thermal waves, quasi-free electron plasmas, and molecular vibrations. Phenomena arising due to the above complex picture will be studied in essentially one-dimensional photonic crystal waveguides. The accurate theoretical model describing these hybrid combs will be derived from first principles, including the nonlinear Maxwell's equations and density matrix theory. In addition, several theoretical and numerical techniques will be implemented to analyze the nonlinear dynamics, solitonic waves, and stability of combs. The candidate will be integrated into the research team consisting of both theoreticians and experimentalists. This theoretical research project will aim at shedding light on ongoing experiments as well as proposing and guiding new ones.

Concepts/background

- Nonlinear optics, optomechanics, thermal diffusion, perturbation theory, density matrix theory, numerical computing. Basic knowledge of the above topics is desirable but not essential. A strong mathematical background is necessary.

Interested candidates should contact Prof. A. Martínez and Dr. C. Milián by email.

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