Scholarship Work Plan

phd2 – NLP: On-chip optical parametrical oscillator

Category: Ph.D. Candidate (Doutorado Direto)
Supervisor: Gustavo Silva Wiederhecker
Institution: Institute of Physics "Gleb Wataghin"
Duration: 4 years

Abstract:

The student engaged in this proposal will work towards Kerr based combs while designing and measuring its interaction with mechanical modes into the cavity. The final goal is experience nonlinear optomechanical interaction with Kerr nonlinearity.

Proposal

In this project we investigate third-order nonlinear processes in optical microcavities with emphasis on the generation on optical parametric oscillation, leading the goals of investigating the possibility of interacting Kerr combs with mechanical degrees of freedom, to explore multimode optical microcavities to excite simultaneous Kerr frequency combs on the same cavity. The post-doctoral fellow will also investigate dual-comb generation in microcavities using atomic-layer-deposition (ALD) technique for dispersion engineering and also to pursue optomechanical Kerr combs using a modified version of our bullseye cavities in a Si_3N_4 platform. In particular we aim to address two correlated research fronts, the coupling between optical frequency combs and mechanical vibrations and also non-degenerate OPO for generation binary phase states.

Our theoretical studies will be closely aligned with experiments. The temporal dynamics of these effects will be formulated on the basis of nonlinear equations of coupled modes. In addition to establishing the theoretical basis, essential for the experimental studies in the microcavities that have to date in the group, we envisage adapting a code to simulate these effects. Rigorously it includes the frequency dispersion of the group velocity and the nonlinear coefficients of the involved waves.

1. Attend obligatory graduate school courses. Initiate theoretical studies of Kerr and Optomechanical effects in microcavities.

2. Design of optical microcavity that could enable the interaction between Kerr combs and mechanical degrees of freedom. Explore potential materials, such as Si3N4 or SiO2, dispersion engineering.

3. Fabrication of optical cavities based on proposed design.

4. Generation and characterization of optical frequency combs in a suspended microcavity, mode-locking, optical characterization of excited mechanical modes.

5. Explore dispersion engineering to enable binary phase states in OPOs.

The following schedule will be used for this proposal:

	Semester							
Activities	1st	2nd	3rd	4th	5th	6th	7th	8th
1								
2								
3								
4								
5								