

Internship Offer (M1/M2)

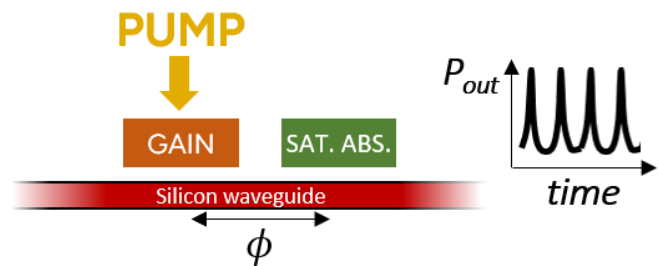
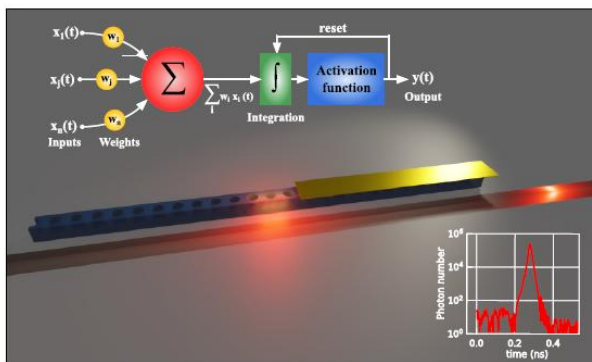
Self-Pulsing Regimes in Coupled Gain-Loss nanocavities

Context

Photonic neuromorphic computing and optical clock generation rely on the ability to control and exploit complex dynamical behaviors in coupled photonic structures. These technologies are essential for next-generation integrated photonic systems, where the interplay between gain, loss, and coupling can lead to rich phenomena such as **self-pulsing**, **bistability**, and **oscillatory behaviors**.

In this framework, pairs of coupled cavities operating in a gain-loss regime—where one cavity exhibits **saturable absorption** and the other provides **optical gain**—offer a unique platform to study these dynamics. The coupling phase, detuning, and differential gain contrast are key parameters that influence the system's behavior, enabling the observation of **Q-switching** and **self-pulsing regimes**.

During this internship, the focus will be on a **numerical study** of these self-pulsing regimes, complemented by **optical characterization** of cavity turn-on dynamics and carrier lifetimes using a **Time-Resolved Photoluminescence (TRPL)** setup.



Left: Artistic view of a spiking nanolaser and its potential for photonic neuromorphic computing tasks. Right: Proposed approach based on two separate photonic crystal cavities: one with gain, one with saturable absorber.

Reference

M.Delmulle (2023) *The nanolaser neuron: excitability in photonic crystal lasers* (PhD thesis, Univ. Paris-Saclay).

Main Tasks (depending on the internship duration)

- Familiarization with the current model based on **coupled-mode theory** and **laser rate equations**,
- Simulation of the **self-pulsing** and **excitability regimes** and analysis of the results.
- Experimental **measurement of the carrier lifetime** in the nanolaser (TRPL setup).
- **Optical characterization** of the gain-loss arrays

About the Candidate

- **Level:** Open to **M1 or M2 students**.
- **Prerequisites:**
 - Background in laser physics and photonics,
 - Good programming skills (Python, Matlab)
 - Interest in optical experimentation,
- **Duration:** 4 to 6 months (flexible).
- **Compensation:** According to French regulations for master internships, approximately €600/month.

Application

To apply, please send:

- A CV,
- A **motivation letter** explaining your interest in the project,
- Any relevant academic records or references.

Contact

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