Centre
DE Nanosciences
et DE Nanotechnologies

Internship proposal

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Internship location: Palaiseau

Title: Photonic neuromorphic computing with coupled microlaser spiking neurons

Neuromorphic photonics is an expanding field of research at the heart of recent progresses in analog computation and machine learning. Its goal is to investigate new ways to process optical information or to compute using brain-inspired physical concepts. We propose to investigate the physics and applications of coupled spiking photonic nodes implementing artificial spiking neural networks. Each node (optical neuron) is materialized by a micropillar laser with integrated saturable absorber, whose neuromimetic properties have already been explored in the team. In neurons, information is coded with spikes (electrical pulses) which are excited in an all-or-none fashion provided input stimuli to the neuron soma exceed a given threshold. This generic property is called excitability and has been demonstrated in micropillar lasers with optical spikes [1]. Though, the optical spikes emitted by these latter are more than one millions times shorter in duration than biological action potentials. Hence, photonic neurons could in principle be interesting to build ultrafast artificial neural networks with low power consumption.

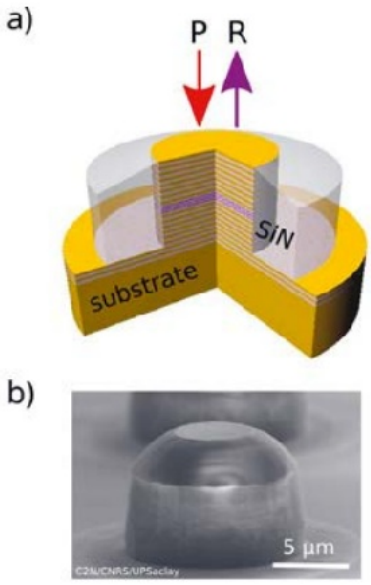

Figure 1: Sketch (a) and SEM image of a muromimetic micropillar laser with saturable absorber.

The objective of the internship will be to take part to the projects developed in the group to fabricate and study neuromorphic architectures, understand the physics involved in the dynamics of these coupled microlasers and demonstrate ultrafast analog computation. The work will mainly involve experimental and modeling activities, with nanofabrication aspects. The internship will take place at the C2N (Palaiseau) which hosts a first-class nanofabrication facility.

The applicant should have a background in physics, optics, laser physics, semiconductor physics. Background in semiconductor lasers and/or nonlinear dynamics and/or machine learning is appreciated but not compulsory.

Website: https://toniq.c2n.universite-paris-saclay.fr/fr/activites/smila/

Reference

[1] Micro-lasers for neuromorphic computing V. A. Pammi, S. Barbay, Photoniques 104, 26-29 (2020) https://doi.org/10.1051/photon/202010426