

Internship Offer (M1/M2)

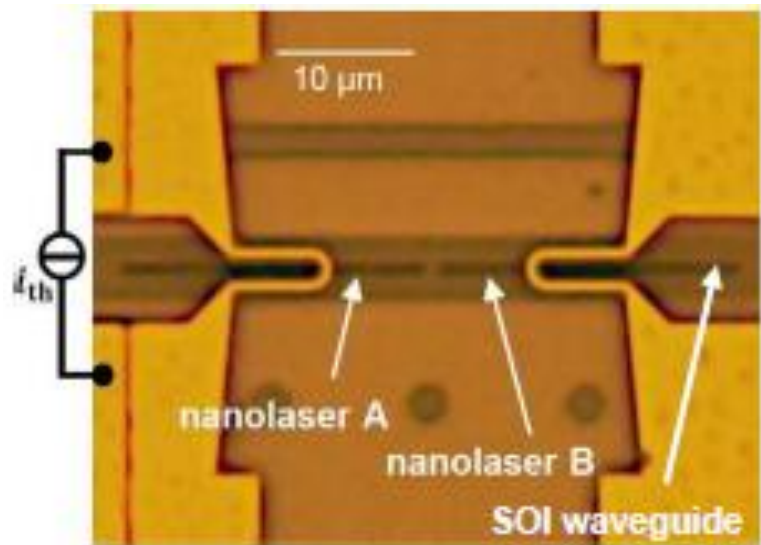
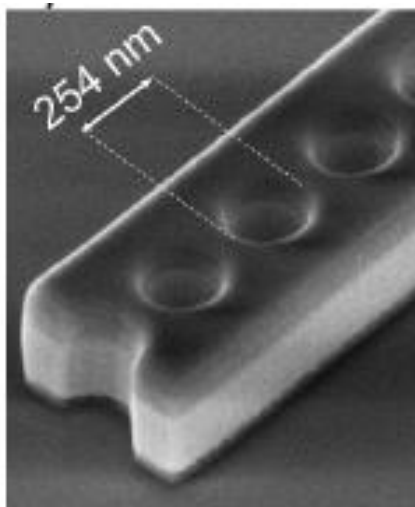
Reconfigurable control of waveguide-coupled nanolaser arrays

Context

Advances in micro- and nano-fabrication have enabled the confinement of electromagnetic fields at unprecedented scales, enhancing light-matter interactions and leading to significant nonlinear behaviors. This miniaturization allows for highly complex optical systems, such as arrays of coupled nanolasers, which can sustain collective dynamics like **synchronization**, **mode competition**, and **chaos**. These systems are also inherently subject to dissipation, making **non-Hermitian physics** a relevant framework for their study.

In this context, the use of integrated arrays of semiconductor nanolaser diodes allows for the exploration of nonlinear and non-Hermitian dynamics. The arrays are composed of $N \geq 3$ nanolasers coupled via a common waveguide, enabling the study of **mode hybridization** and **collective emission**. The precise **control of coupling phases and detuning** is achieved through integrated nano-heaters, compensating for nanofabrication imperfections.

During this internship, the focus will be on installing and familiarizing with a **Spatial Light Modulator** (SLM) for selective excitation of nanolaser arrays, followed by the modal characterization of these coupled systems.



Left: SEM image of a photonic crystal nanolaser. Right : Arrays of two coupled nanolasers, integrated on a silicon waveguide, and spectrally tuned by gold nano-heaters.

References

1. Madiot, G., Chateiller, Q., Bazin, A., Loren, P., Pantzas, K., Beaudoin, G., ... & Raineri, F. (2024). **Science Advances**, 10(45), eadr8283.
2. Seegert, K., Gajardo, R., Huyet, G., Raineri, F., & Madiot, G. (2026). **ACS Photonics** 13 (17): 5083–5089.

Main Tasks

- **Familiarization** and **remote interfacing** of a **Spatial Light Modulator (SLM)** for selective excitation of nanolaser arrays,
- **Installation of the SLM** in the current optical setup
- **Modal characterization** of coupled nanolaser arrays
- Study of the array modal properties using ***Coupled-Mode Theory***

About the Candidate

- **Level:** Open to **M1 or M2 students** (for M2 students, possibility of continuing to a PhD).
- **Prerequisites:**
 - Background in **optics & photonics**,
 - Good programming basis in **Python**
 - Strong motivation for **experimental work**,
- **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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