Laser dynamics

This research activity aims at understanding different aspects of laser dynamics, with a special focus on two-frequency lasers. We are interested in reducing the phase and intensity noise of solid-state or semiconductor lasers, in order to develop low-noise laser oscillators. We also study the spatial properties of laser fields, and the vectorial properties of the intracavity modes. All these activities have both a fundamental interest, and the potential for practical applications. For instance, our studies on synchronization and on laser noise are important for the implementation of ultrastable oscillators. Low intensity noise sources are mandatory in the future microwave-photonics systems, but also in cold atoms experiments and in coherent optics. The themes developed in this research domain have several connections other studies of the team in **Microwave photonics** and **TeraHertz and metrology**.

Low-noise laser sources

Synchronization in vectorial lasers

Transverse effects

Laser control by electronic spin injection

These researches are conducted in close collaboration with the UMR CNRS/Thales and the LPN. Their objective is to control the polarization properties of a laser by electronic spin injection. To this end, we try to exploit the dynamical and vectorial properties of VCSEL-type lasers. In particular, we try to enhance the polarization switching induced by a change of the electronic spin of the pump, even if the latter is quite uneffective. Theoretical modeling has allowed to design a proper architecture for this kind of laser. We have recently observed experimentally the polarization switching in an extended cavity laser [Fro13], paving the way for many potential applications in opto-spintronics.

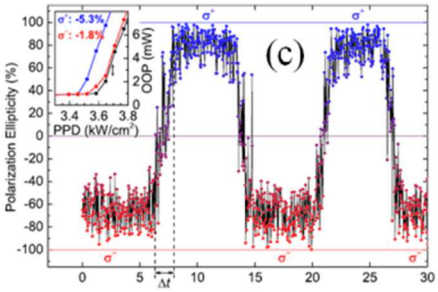

Fig. 7 : Observation of polarization switching in an extended-cavity VCSEL laser, induced by control of the electronic spin of the pump current [Fro13].

Selected publications:

[Fro13] J. Frougier, G. Baili, M. Alouini, I. Sagnes, H. Jaffrès, A. Garnache, C. Deranlot, D. Dolfi, and J-M. George, "Control of light polarization using optically spin-injected vertical external cavity surface emitting lasers," Appl. Phys. Lett. 103, 252402 (2013).

PhD theses (*past* / ongoing) **:**

Jérémy Thévenin, « Accrochages de fréquences dans les lasers vectoriels à état solide : étude du verrouillage de modes passif et de la réinjection décalée en fréquence », 2012.

Nicolas Barré, « Étude de la sélection des structures transverses stationnaires dans les lasers », 2014.

Kevin Audo, *« Lasers solides bifréquences auto-régulés en bruit d'intensité »*

Aurélien Thorette, *«Structures de polarisation dans les lasers et réinjection : application à la génération de faisceaux opto-hyper »*

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