Make your PhD in organic photonics

Join the organic lasers team at Laser Physics Lab, Paris 13 University, France

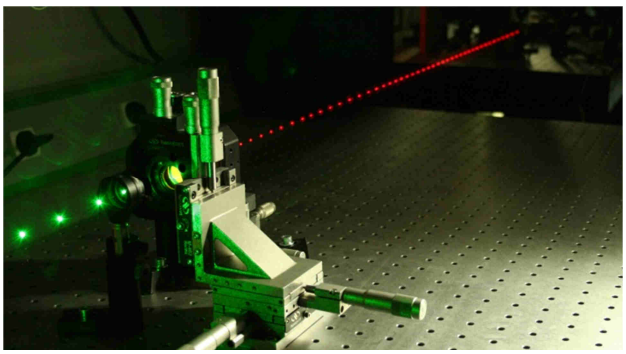
PhD position available starting September 2018.

Required background: master in photonics. Master2 internship possible.
Once your application has been selected, PhD funding is guaranteed.

What is Organic Photonics?

Conventional photonic or optoelectronic devices are difficult to manufacture, require complex and costly growth techniques, and are based on a few chemical elements that are not sustainable. An *organic* photonic device can be made by low-cost techniques such as spin-coating or inkjet printing, and is basically made from a carbon-based optically active material like an organic semiconductor. A wider definition may include all the so-called *excitonic* materials that share the property to be solution-processable (colloidal quantum dots, perovskites,…) and whose optical properties are governed by excitons. Organic photonics is all about generating, detecting and controlling light: devices under consideration in this field are Organic light-emitting diodes (OLED), organic photovoltaic cells, but also photodiodes, scintillators or *lasers* [1,2,3]. In the Laser Physics Lab, our team specifically investigates organic lasers.

What are organic lasers?



In an organic laser, the gain medium is a thin film of a solution-processed active medium, such as a dye-doped polymer. It makes a compact and low-cost laser that emits directly in the visible range with a tunable wavelength. Because organic emitters may react strongly and selectively with the environment, they can make efficient and portable on-site sensors for pollution, drugs or explosives, or for point-of-care biomarker detection. Research on organic lasers is still burgeoning, as many important challenges remain to be solved. For instance, making an organic laser diode (that is, an electrically-pumped organic semiconductor laser) remains an unsolved challenge after 20 years of research. Under optical pumping, many challenges remain, but recent progresses in GaN-based device technologies enabled organic lasers to be pumped by diode lasers and even by LEDs, opening up new application perspectives and enabling the quest towards new spectral or temporal regimes that were not possible before. Obtaining a true CW laser is still today an unsolved quest, and other lasing regimes have never been demonstrated to date in such lasers.

What are we working on ?

We introduced in 2010 the concept of Vertical External Cavity Surface-emitting Organic Laser (VECSOL), an organic version of the semiconductor VECSEL. External cavities bring to organic lasers the faculty to produce high energies, high beam quality, and the highest conversion efficiencies. We have shown that they also enable building organic lasers that emit in otherwise unattainable spectral domains for organics such as the deep UV. Recently, we published in *Light* the lowest linewidth obtained in an organic laser (< pm) by using Volume Bragg gratings.

Our current topics of interest are the following:

- **Managing triplet excitons**. Many issues arise in organic lasers because optically pumping an organic emitter causes the molecules to end up piling up in the triplet state, leading to extra losses (triplet absorption, singlet-triplet annihilation) that eventually shut off lasing. Understanding triplet dynamics and controlling it is the key towards CW lasing action.
- **Exploring new lasing regimes**. Our general strategy is to get inspired from laser engineering recipes that apply to "classical" lasers and translate them to the organic laser world.
- **Investigating new solution-processed media** that are promising for lasing (based on national collaborations that are already active in our group) such as colloidal quantum dots.
- **Developing a new family of integrated photonic circuits** (e.g. integrated sensors) based on the combination of a robust and efficient LED array and a **luminescent concentrator** playing the double role of conveyor and concentrator of the light emitted by LEDs. This work on LCs, leaded both experimentally and theoretically, has also important applications in the pumping of solid-state lasers and in solid-state lighting in general.

The objectives of your PhD will be fixed in accordance with your specific skills in order to address one or several of these strategic goals.

The team

Our team comprises two associate professors (S. Chénais, S. Forget) and a full-time engineer (O. Mhibik), + PhD students and post-docs. It has gained international recognition in the field of organic lasers in the past years, especially thanks to our pioneering works in external-cavity organic lasers. In 2013 we published the first textbook dedicated to organic solid-state lasers. We work in collaboration with many other laboratories, in France (Institute of Optics in Palaiseau, ENS Cachan, Nantes, Bordeaux) and in the US (CREOL, University of Central Florida). Our lab is located in Université Paris 13, a green campus conveniently located a few miles north of downtown Paris, and is easily accessible by public transportation.

How to apply ? How will my PhD be funded ?

If you are interested by our research topics and consider preparing a PhD under our supervision, please send an e-mail with your academic references and motivation letter to:

Sebastien Chénais : sebastien.chenais@univ-paris13.fr

And Sébastien Forget : sebastien.forget@univ-paris13.fr

PhD may start early September or October 2018. If you're available before (from March), a predoctoral internship (or master thesis) is possible also in our team and is even highly encouraged.

We expect you to have a strong background in optics and photonics, especially laser science; an additional competence in materials science would be appreciated but is not mandatory. You should speak and write English with ease; speaking French is not required.

Funding for a 3-years PhD on our topics has been granted by the doctoral studies department ("Ecole Doctorale Galilee").

Note that if you wish to inforce your teaching experience (in French), teaching physics is possible at University during your PhD.