**Name of the hosting institution in France**  
CNRS Centre National de la Recherche Scientifique

**Name of the host laboratory / research team**  
Institut des Nanotechnologies de Lyon

**Address**  
INL – UMR 5270 Ecole Centrale de Lyon – 36 av Guy de Collongue 69134 Ecully Cedex, France

**Website**  
https://inl.cnrs.fr/

**Name of the supervisor**  
Christelle Monat & Christian Grillet

**Function**  
Professor Ecole centrale de Lyon

**Email**  
Christelle.monat@ec-lyon.fr / Christian.grillet@ec-lyon.fr

**Phone number**  
+33 4 72186253

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**Internship offer**

**Topic of the internship (title)**  
Integrated nonlinear optics with 2D materials

**Proposed dates of the internship**  
Start 01/10/2023  
End 31/03/2024

**Scientific and academic objectives of the internship:**

Chip-based nonlinear optical devices at around 1,55um wavelength have been successfully developed in the past two decades using silicon photonics, so as to open new technologies for all-optical signal processing devices that could sustain, for example, a new generation of fast and compact optoelectronic routing devices for datacom/ telecom applications. Yet, silicon is intrinsically limited at telecom wavelengths, since this material is plagued by two-photon absorption and free carrier penalty, which both restrict the speed and power consumption of the resulting devices. With the advent of graphene and other 2D materials late 2010, hybrid integration of material platforms appears as a new and promising solution for creating more efficient nonlinear devices, with both compact size and low power consumption, while still benefiting from the mature fabrication of the underlying dielectric material platform. Following this route, several demonstrations of graphene and graphene oxide hybrid devices with enhanced nonlinear properties have been reported in the last few years [1-5].

The goal of the present project will be to move beyond the simple integration of 2D materials and Si or SiN waveguides that have been mainly reported so far, so as to create more efficient nonlinear devices. Resonant structures, for instance, will be designed and fabricated, so as to increase the interaction between light and 2D material deposited on top. Additionally, novel functionalities such as frequency comb generation or broadband supercontinuum will be demonstrated with hybrid devices coated with 2D materials. The unique properties of the 2D material (graphene, graphene oxide...) will be adjusted to provide the best trade-off in terms of their nonlinear properties, so as to achieve optimized nonlinear devices.

There will be opportunities to travel and interact with our partners on a national and international level (both Europe/France and Australia) including European industry (CEA-LETI and others).


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**Industrial partner**

**Does the project involve a French industry partner?**  
No

**Name**  
[Insert here]

**Role of the industrial partner in the internship project**  
[Insert here]

**Main contact**  
[Insert here]

**Email**  
[Insert here]
| **Main contact industrial partner’s branch in Australia** | [Insert here] |
| **Email** | [Insert here] |

**Australian partner**

| **Is the internship project proposed in the framework of an existing collaboration with an Australian partner university?** | Yes |
| **Name of the Australian partner institution** | Swinburne University |
| **Lab/department/team involved in the collaboration** | Center for Micro photonics |
| **Main contact in the Australian partner institution** | David J Moss |
| **Function** | head |
| **Email** | dmoss@swin.edu.au |

| **Outside of this ongoing collaboration, will students from other Australian universities be considered by the hosting institution in France?** | Yes |

**Expected profile of applicant**

| **Level of study** | Master |
| **Discipline** | Photonics |

| **Prerequisite knowledge, qualities and skills** | The required skills for the intern will be a good knowledge and a solid background in the field of optics, nonlinear optics, solid-state physics, and semiconductor devices. S/he should work towards his/her Masters/honours or Engineering degree in a field appropriate to one of these areas. An experience in photonics, clean-room fabrication, material deposition or optical modeling and characterization will be strongly appreciated. |

| **Other specific eligibility criteria** | [Insert citizenship requirements, language requirements or other preferences here] |