Internship subject

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Frequency Comb and supercontinuum generation in hybrid Si photonics devices.

Optical communications are at the core of the Internet today, enabling the development of the interconnected society. However, in order to meet the requirements of the future communication system applications, optical circuits have to deliver ever-growing data rates, being faster, cheaper, smaller and less power hungry. Silicon photonics, due to its compatibility with large volume CMOS fabrication processes has a unique potential to implement ultra-compact optoelectronic chips meeting these requirements. In recent years, significant progresses have been achieved in the development of silicon photonics and hybrid silicon III-V nanophotonic devices. However, for the future generation of circuits, the developed approaches are not scalable to tens, even hundreds of wavelength channels. A promising alternative solution is to exploit Kerr optical frequency combs generation to provide hundreds of well-defined narrow-band optical channels using a single pump laser.

In this context, the objective of the internship is to explore a new approach to exploit the giant Kerr nonlinear coefficient, negligible nonlinear loss and versatile material engineering of chalcogenide materials integrated into Si photonics structures. The candidate will perform design and characterization in close collaboration with our partner (MIT – USA) to demonstrate frequency comb generation in hybrid Chalcogenide on Si source. The candidate will be fully involved in the nonlinear optical simulation and characterization.

The research activities will include:

- **Theoretical study and optical simulations** of nonlinear effects in hybrid Chalcogenide silicon photonic waveguides
- **Nonlinear characterizations** to demonstrate the Frequency Kerr Comb and supecontinuum generation

The work will be performed in the framework of the ERC POPSTAR project and in close collaboration with MIT - USA

During the internship, the student will be actively involved in the current research activity of the group, collaborating with PhD students, postdocs and researchers of different research backgrounds and nationalities.

VALUED QUALITIES IN THE STUDENT

- Curiosity for novel research experiences and fields.

- Creativity and pro-activity in the search for innovative solutions and approaches.

- Attractivity in experiments and simulations.

- Capability to communicate and share results in a multidisciplinary and multi-nationality environment.

BIBLIOGRAPHY RELATED TO THE TOPIC

- P. Damas et al., Bond orbital description of the strain-induced second-order optical susceptibility in silicon, Physical Review B, 93, 16 (2016)
- D. Benedikovic et al., Dispersion control of silicon nanophotonic waveguides using sub-wavelength grating metamaterials in near- and mid-IR wavelengths, Optics Express, Vol. 25(16), pp. 19468 – 19478, August 2017.
- M. Berciano et al., Fast linear electro-optic effect in a centro- symmetric semiconductor, Nature Communications Physics, 1(1) (2018).
- S. Serna et al, Engineering third-order optical nonlinearities in hybrid chalcogenide-on-silicon platform, Optics Letters 44, 5009-5012 (2019)

This project can be continued and expanded within the frame of a PhD.