INTERNSHIP-THESIS PROPOSAL

Laboratory name: C2N Center for Nanoscience & Nanotechnologies
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Internship location: C2N lab, 10 bd Thomas Gobert, 91120 Palaiseau, France

Thesis possibility after internship: **YES**/~~NO~~
Funding: **YES**/~~NO~~ If YES, which type of funding: ANR

Chaotic graphs in silicon photonics

Chaotic systems have a peculiar quantum behavior and several conjectures remain to be proved concerning their spectrum and their wavefunctions [1]. Graphs can be chaotic or not depending on the network of bonds and vertices (Fig.1a), and allow a relatively simple theoretical study of the classical and quantum limits. These experiments are easier to carry out in photonics and the formalism fits well to the **ray-wave correspondence for light**. We have therefore produced graphs (chaotic or not) where light circulates in silicon waveguides (Fig. 1b). Our setup is able to image their wavefunctions with unprecedented accuracy by third harmonic generation (THG) in silicon (Fig. 1c) [2].

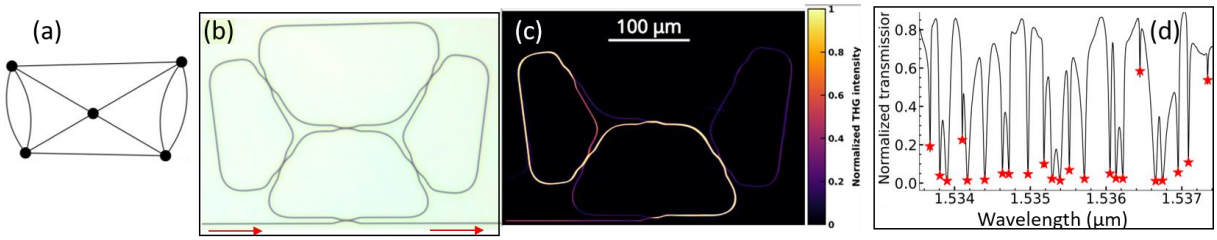

Figure 1: (a) Chaotic graph with 5 vertices. (b) Visible-light photo of the graph in (a) implemented with silicon waveguides. Same scale than in (c). Laser light is injected from the left into the bus waveguide in the lower part of the device, and the transmitted light is collected on the right. (c) Experimental wavefunction at 1530.5 nm of the graph in (b). (d) Experimental transmitted spectrum of the chaotic graph in (b). Red stars indicate resonances.

The objective of the internship and the thesis is to investigate the combined effect of **nonlinearities** and complex interferences in these optical graphs, particularly regarding the formation and dynamics of **soliton states**. In a second time, we will inject **non-classical light** (squeezed light or entangled photons) to test if entanglement is sensitive to chaos.

The silicon graphs are fabricated in the C2N cleanroom. Their design requires numerical simulations and the experiments are carried out on a dedicated characterization setup at C2N. The theory is developed in collaboration with Barbara Dietz (Dresden). The student may be involved in one or several of these tasks, depending on his/her preferences.

Please, indicate which speciality(ies) seem(s) to be more adapted to the subject:
Condensed Matter Physics: **YES**/~~NO~~ Soft Matter and Biological Physics: ~~YES~~/NO
Quantum Physics: **YES**/~~NO~~ Theoretical Physics: **YES**/~~NO~~