Joint PhD proposal SUPELEC & ANU
Nonlinear Photonics in Discrete and Dissipative Media

Context **–** Photonic systems that are commonly encountered in daily applications, such as lasers, amplifiers and waveguides, exhibit complex nonlinear light-matter interactions that impact the temporal and spatial dynamics of light propagation. This area of science, here summarized as "nonlinear photonics" is of great current interest in that it paves the way towards innovative approaches for next generation of all-optical systems for signal processing and communication. On a more fundamental basis, the interplay between nonlinearity and light generation and propagation processes has lead to the discovery of many today important issues such as optical chaos, temporal and spatial solitons, optical patterns, noise-sustained dynamics. The two groups as partners of this joint PhD proposal have each and in collaboration demonstrated recent new physics and applications in this field.

Thesis **–** The purpose of the present proposal is to focus on the peculiar spatio-temporal dynamics that arise in dissipative nonlinear optical cavities. Optical feedback and, in a more general sense, counter-propagating interaction of light beams in extended media gives rise to optical patterns which may break up into so-called dissipative solitons (or light localized peaks) when gain-loss interaction comes also into play. The physics of these dissipative solitons is not yet clear since it depends also strongly on the type of nonlinearity and on the propagation length. In particular dissipative solitons in single feedback photorefractive crystals still await for experimental confirmation. These dissipative solitons are interesting for all-optical delay lines and optical buffers, but these applications call for a precise and reproducible control of the generated optical patterns. We have demonstrated recently for the first time how discreteness in the nonlinear optical medium – through an optical lattice – can interplay with the optical pattern instability and finally allows its control. The technique needs still to be applied to dissipative solitons and would finally also lead to the first discovery of discrete dissipative solitons.

Profile of the candidate **–** The thesis will make use of both experimental and theoretical skills. Therefore the candidate is expected to have an already good knowledge of photonics and ideally should come from a photonics master program. English regular practice (written & oral) is required.

Salary **–** The salary will be fixed by the partner institutions according to their own regulations and following evaluation of the candidate's CV.

How to apply **–** email to the thesis co-advisors, including a detailed CV, a one-page letter of motivation and a copy of the exam marks obtained at Master level:

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