Coherence analysis of, and dual comb sources based on, fiber cavity solitons

Open PhD / Post-doc positions in Nonlinear Photonics

Localisation: OPERA-Photonics, École polytechnique de Bruxelles, Université libre de Bruxelles, Belgique.

Contract period: (PhD) 4 years; (Postdocs) (2+1) years

Expected date of employment: September-December 2023.

Application deadline: 15th of July 2023

The OPERA-photonics lab is looking for motivated researchers to work on the coherence of fiber temporal cavity solitons

Framework

These positions are funded the *Excellence of Science* (EOS) research project PULSE (pattern formation in integrated lasers for spectroscopy and Terahertz wave generation) as well as the ERC POC project VERSACOMB (versatile optical frequency comb).

Description

The main objective is to experimentally characterize (and theoretically investigate) the coherence of temporal cavity solitons and exploit it for applications such as dual comb ranging

Cavity solitons are short, robust optical pulses that travel indefinitely in optical resonators [1]. When they periodically exit the cavity, they form a frequency comb at the resonator output.

Their advantage over mode-locked laser solitons [2] is that the pulse trains are phase-locked with a highly coherent continuous-wave laser. The main objective of this project is to characterize the coherence characteristics of fiber soliton combs. The potential of fiber solitons for high coherence (quantum-limited jitter) has been discussed in [3] but has never been experimentally characterized.

This is important for applications that require mutual coherence, such as dual comb ranging [4]. To date, dual comb ranging has mainly been implemented using electro-optical combs or laser combs, but we believe that the coherence properties of CSs make them excellent candidates for such experiments.

Moreover, as we have recently demonstrated more general cases of driven solitons, namely active and parametrically driven Kerr cavity solitons [5,6], we also wish to extend our coherence analysis to these new types of solitons.

Profile of the applicant

At the PhD level, we are looking for a young scientist with a Master in Physics or Engineering. At the Post-doc level, the candidate should have some experience with experimental nonlinear ultrafast optics. Moreover, both candidates should have a very good background in optics (optical physics, electromagnetism, nonlinear optics, optoelectronics, lasers, …) and a good background in mathematics and general physics. Knowledge in laser dynamics or noise analysis is an asset. They will be able to work independently in a collaborative environment. As part of the OPERA department of the Ecole polytechnique de Bruxelles, the successful applicants may also be involved in student laboratories as well as student projects supervision.

Application:

Candidates are requested to send their application to Dr. François Leo (francois.leo@ulb.be) and Pr. Simon-Pierre Gorza (simon.pierre.gorza@ulb.be). Applicants must include a cover letter detailing their specific interest in this project and how it fits with their skillset.

[1] F. Leo et al., “Temporal cavity solitons in one- dimensional Kerr media as bits in an all-optical buffer”, Nature Photonics (2010), 4, pp 471 - 476.

[2] P. Grelu and N. Akhmediev, *Dissipative Solitons for Mode-Locked Lasers*, Nature Photonics **6**, 84 (2012).

[3] M. Erkintalo, *Got the Quantum Jitters*, Nature Physics **17**, 432 (2021).

[4] I. Coddington, W. C. Swann, L. Nenadovic, and N. R. Newbury, *Rapid and Precise Absolute Distance Measurements at Long Range*, Nature Photon **3**, 6 (2009).

[5] N. Englebert et al., “Temporal solitons in a coherently driven active resonator”, Nature Photonics 15, 536-541 (2021).

[6] N. Englebert *et al.*, “Parametrically driven Kerr cavity solitons”, Nature Photonics, 15, 857-861 (2021).