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 PHYSICS – CHEMISTRY
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NANOSCIENCE – PHOTONICS – MATERIAL SCIENCE & CHARACTERIZATION

Ph.D. proposal: “Flexible Ultrafast Fiber Lasers for Biomedical Applications”

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Location: Université Bourgogne Europe, ICB Photonics Department, Dijon Campus

Project description:

Ultrafast fiber lasers have transformed material processing and biomedical applications, owing to their remarkable compactness and efficiency. Yet, most laser-based applications are employing either a *one-size fits all* approach, which often leads to sub-optimal performance, or complex multi-stage devices, such as a series of laser oscillator, compressor, pulse shaper, and power amplifier. By revisiting soliton dynamics in fiber laser oscillators, our recent proposal of *energy-management* enhances both the energy efficiency and the flexibility in pulse delivery from a single ultrafast laser oscillator [1,2].

This Ph.D. proposal aims at fully developing the flexibility of fiber laser output (pulse energy, duration, repetition rate etc.) with the goal of targeting applications in the biomedical sector. To this end, innovative fiber lasers and amplifiers will be developed around the operating wavelength of 2 microns, within the frame of a 3-year project between France (ICB) and India (IITH) through CEFIPRA/IFCPAR [3]. This project, oriented toward concrete applications, is also deeply rooted in the investigation of nonlinear ultrafast dynamics in special optical fiber waveguides. Besides, the project involves the field of artificial intelligence in the laser design optimization as well as in the control of laser dynamics.

Candidate profile:

We are looking for a bright and motivated Ph.D. candidate, ideally with a solid M.Sc. background in nonlinear optics and ultrafast lasers and a proven taste for experimentation. We value competences in numerical simulations or data processing (Matlab/Python). Recommendation letters by former lab supervisors are appreciated. Since the project involves working in an international team environment, a good command of English is mandatory (level B2/C1).

Funding: a 3-year Ph.D. grant will be requested from the French Ministry of Higher Education, Research and Innovation. Such competitive grant is reserved for students having excellent academic results.

Application deadline: 30/04/2025

References

- [1] M. I. Mohamed, A. Coillet, and Ph. Grelu, *Energy-managed soliton fiber laser*, Nature Commun. **15**, 8875 (2024). <https://doi.org/10.1038/s41467-024-52954-7>
- [2] M. I. Mohamed, A. Coillet, and Ph. Grelu, *2- μ m energy-managed soliton fiber laser*, Optics Lett. **49**, 6537 (2024). <https://doi.org/10.1364/OL.544054>
- [3] A. Jose, M. Guasoni, A. Coillet, P. Tchofo-Dinda, Ph. Grelu, and N. Kanagaraj, “Towards a broadband gain-flattened thulium doped fiber amplifier,” Optics Commun. **578**, 131452 (2025). <https://doi.org/10.1016/j.optcom.2024.131452>