Lab project M2 PPN

Monday & Tuesday from Nov. 2026 to March 2027

Title of the project: Tellurite glass fiber for high power mid IR supercontiuum generation

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Laboratory / Department / Team : Dijon - Mirande aile D 3ème, ICB, Photonique , SAFIR

Collaborations:

Summary:

Infrared (IR) supercontinuum (SC) light sources are of great interest for a wide range of applications, including molecular spectroscopy, medicine, and defense. Significant research efforts have been devoted to the development of such sources at ICB, leading to broadband mid-IR SC sources spanning from 1 to 5 µm using tellurite fibers, and extending up to 18 µm with chalcogenide fibers [1]. However, the output power of these sources remains limited, typically to below 1 W, which is insufficient for many applications requiring high-power mid-IR radiation.

During this internship, we will investigate an approach for scaling up the output power of IR SC sources by increasing the pump power and exploring tellurite glass compositions combining a high glass transition temperature (Tg > 400 °C) with low optical losses. A high Tg is expected to provide improved resistance to laser-induced damage, enabling higher pump powers to be coupled into the fiber. In particular, the TeO_2–Y_2O–BaF_2 fluorotellurite glass system is of interest because of its favorable combination of thermal and optical properties [2]. A fiber fabricated from this glass system has recently demonstrated more than 10 W of SC generation when pumped with a high-repetition-rate laser [3].

The SAFIR team at ICB has extensive expertise in high-purity tellurite glass synthesis and low-loss optical fiber drawing [1]. During this internship, a tellurite glass composition combining a high glass transition temperature and low optical losses will be investigated. The dedicated glass fabrication and characterization facilities available at ICB will be employed, including the controlled-atmosphere glass synthesis setup, mid-IR refractive-index measurement facilities, and fiber-drawing tower. The resulting fibers will then be tested using the mid-IR SC generation experimental setup based on a tunable, high-peak-power mid-IR optical parametric amplifier (OPA) available in the ICB laboratory.

The repetition rate of the available pump source (tunable from 10 kHz to 1 MHz) will allow the generation of watt-level of average SC power. Moreover, it will provide a suitable platform for investigating the influence of the glass composition and fiber opto-geometrical parameters—such as the refractive indices of the core and cladding glasses and the core diameter—on the SC generation and power-scaling potential.

The SC dynamics and their dependence on the fiber opto-geometrical parameters will also be investigated through numerical simulations based on the nonlinear Schrödinger equation. The combined experimental and numerical approach will provide a better understanding of the key parameters governing high-power mid-IR SC generation and will help identify suitable glass and fiber designs for future power scaling.

This internship is highly multidisciplinary, combining materials science, optical glass and fiber characterization, nonlinear optics, experimental photonics, and numerical modelling.

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1. Serrano, E., Bailleul, D., Désévédavy, F., Béjot, P., Gadret, G., Mathey, P., Smektala, F., and Kibler, B. *Photon. Res.* **13**(5), 1106–1115 May (2025).
2. Yao, C., Jia, Z., Li, Z., Jia, S., Zhao, Z., Zhang, L., Feng, Y., Qin, G., Ohishi, Y., and Qin, W. *Optica* **5**(10), 1264–1270 (2018).
3. Zhang, Q., Zhang, C., Lv, C., Jia, Z., Wang, F., Wang, C., He, S., Meng, F., Qin, W., and Qin, G. *Advanced Photonics Research* **7**(9) (2026).

Type of project (theory / experiment): experiment

Required skills: knowledge in material characterizations and optics - hands-on approach