

Lab project M2 PPN

Monday & Tuesday from Oct 2025 to March 2026

Title of the project: Fabrication and characterization of tellurite ring-core fibers

Supervisor(s): Pierre Béjot/ Frédéric Désévéday/ Bertrand Kibler

Laboratory / Department: ICB Lab. / Photonics Department

Teams: *Processus Femtosecondes et Lasers intenses* (PFL)

& Solitons, lAsers, Fibres et photonique InfraRouge (SAFIR)

Summary:

Advancements in optical fiber technology have sparked renewed interest in using multimode waveguides to overcome limitations associated with single-mode propagation. In particular, using multimode fibers to increase the number of data-transmitting channels allows us to envisage overcoming the expected data-carrying capacity crunch of single-mode fibers. In this regard, specially designed multimode optical fibers called ring-core fibers (or vortex fibers) have recently been developed to minimize spatial mode coupling [1]. On the other hand, there is currently growing interest in developing innovative fibers that can transport light in the mid-infrared region. In this context, our laboratory has developed state-of-the-art expertise in the fabrication of fibers made with infrared tellurite glasses. The aim of this project is to optimize the fabrication of tellurite vortex fibers [2]. The student will be responsible for optimizing the fabrication processes of the fibers, from preform elaboration to fiber drawing. This work will involve some modal calculations to design and confirm the modal properties of the fabricated fibers. Secondly, the student will attempt to couple laser pulses into the fabricated fibers to first study linear propagation and then possibly the nonlinear optical phenomena expected to occur in vortex fibers [3–4]. This latter objective may be achieved during the second-semester internship.

References

- [1] S. Ramachandran and P. Kristensen, *Optical vortices in fiber*, Nanophotonics vol. 2, pp. 455–474 (2013).
- [2] C. Strutynski, J. Picot-Clément, A. Lemiere, P. Froidevaux, F. Désévéday, G. Gadret, J.-C. Jules, B. Kibler, and F. Smektala, *Fabrication and characterization of step-index tellurite fibers with varying numerical aperture for near- and mid-infrared nonlinear optics*, Journal of the Optical Society of America B vol. 33, pp. D12-D18 (2016).
- [3] B. Kibler and P. Béjot, *Azimuthal modulation instability, breathers and solitons in ring-core optical fibers*, ACS Photonics vol. 11, pp. 3140–3149 (2024).
- [4] P. Béjot, *Space-time multimode helical light bullets in ring-core fibers*, Journal of the Optical Society of America B vol. 42, pp. 1430-1436 (2025).

Type of project (theory / experiment): Experiments

Required skills: Fiber Optics / Nonlinear Optics / Matlab