# 5th International Conference on Bioinspired and Biobased Chemistry and Materials

# 2nd International Conference on Optics and Photonics

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# Nonlinear Optics and Complex Dynamics (OA-4)

**Optical Fibers and Propagation**

**October 12, 2020**

**16 :00 – 17 :40**

**Venue : Baie des Anges A**

**Session Chair : Benjamin WETZEL**

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|---|---|---|---|---|---|
| 12 Oct (16:00-16:25) | VALLEY | George C. | Radio frequency signal classification using laser speckle in multimode waveguides | Keynote | OA-KN-21 |
| 12 Oct (16:25-16:50) | WABNITZ | Stefan | Nonlinear multimode fiber optics: recent advances | Keynote | OA-KN-05 |
| 12 Oct (16:50-17:15) | COUDERC | Vincent | Spatio-temporal reshaping in multimode fibers | Keynote | OA-KN-08 |
| 12 Oct (17:15-17:40) | TONELLO | Alessandro | Spatial beam reshaping and spectral broadening in quadratic crystals | Keynote | OA-KN-07 |

# Nonlinear multimode fiber optics: recent advances

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We start by providing an overview of the emerging field of nonlinear optics in multimode optical fibers [1]. These fibers provide a simple testbed for observing complex wave propagation dynamics, in analogy with other fields of physics ranging from two-dimensional hydrodynamic turbulence and Bose-Einstein condensation. In addition, nonlinear multimode optical fibers enable new methods for achieving the ultrafast, light-activated control of temporal, spatial and spectral degrees of freedom of intense, pulsed light beams, for a range of different technological applications.

Next we describe recent advances in the study of nonlinear spatiotemporal beam dynamics in multimode fibers. We studied both experimentally and theoretically the process of high-energy multi-soliton fission in a graded-index (GRIN) multimode fiber [2]. A novel nonlinear propagation regime is observed, where multimode solitons produced by the fission have a nearly constant Raman wavelength shift and same pulse width over a wide range of soliton energies. We also obtained a new exact solution for the nonlinear evolution of first and second order moments of a laser beam of arbitrary transverse shape carried by a GRIN fiber [3]. We experimentally directly visualized the longitudinal evolution of beam self-imaging by means of femtosecond laser pulse propagation in both anomalous and normal dispersion regimes. Light scattering out of the fiber core via visible photo-luminescence emission, permits us to directly measure the self-imaging period and the beam dynamics. Spatial shift and splitting of the self-imaging process under the action of self-focusing are also observed. All of these beam propagation effects are associated to, and revealed thanks to a novel regime of high peak power spatiotemporal pulse propagation in optical fibers, originating from up-conversion luminescence from multiphoton absorption by Germanium and Oxygen defect centers.

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