

MAP-fis Essay Proposal, 2015-2016

(please write in English)

Supervisor

Name: Mário F. S. Ferreira

e-mail: mfernando@ua.pt

Title

Nonlinear optics in hollow-core waveguides

Area

(Materials, Optics, Condensed Theory, High Energy Theory,...);

Optics

Summary of Proposal

This project aims to investigate several nonlinear optical effects in different nonlinear hollow-core waveguides, paying a special attention to the case of hollow-core photonic crystal fibers (HC-PCFs). These fibers display great versatility in terms of hosting nonlinear materials and have been instrumental in pushing the boundaries of nonlinear optical applications [1-7]. They provide ultra-long single-mode interaction lengths, high intensities (due to the small core diameter), a high optical damage threshold, and the possibility of controlling their dispersive characteristics. Such features have been utilized in different situations, namely in the demonstration of solitary waves and self-similarity in stimulated Raman scattering (SRS), well controlled coherent atomic physics experiments, delivery of intense, high-energy optical solitons, physical transport of particles, etc. Gas-filled kagomé PCF, in particular, has shown almost perfect dispersion and loss properties for ultrafast nonlinear fiber optics along with the ability to guide high intensities without glass damage. This offers the potential for moving conventional nonlinear fiber optics both into extreme regimes – such as few-cycle pulse compression and efficient deep ultraviolet wavelength generation – and into regimes hitherto inaccessible, such as single-mode guidance in a photoionized plasma and high-harmonic generation in fiber. A systematic investigation of these and other ultrafast nonlinear processes will be performed in this project.

(to allow students first look at topic)

[1] A. Bhagwat and A. Gaeta, Opt. Express 16, 5035 (2008)



Universidade do Minho

U.PORTO



- [2] J Travers et al. JOSA B, 28, A11 (2011)
- [3] F. Belli et al. Optica, 2, 292 (2015)
- [4] K. Mac et al. Opt. Express 21, 10942 (2013)
- [5] F. Tani et al. JOSA B 31, 311 (2014)
- [6] A. Nazarkin et al, Phys. Rev. Lett. 105, 173902 (2011)
- [7] P. Londero et al. Phys. Rev. Lett. 103, 043602 (2009)