

## MAP-fis Essay Proposal, 2013-2014

(please write in English)

### Supervisor

**Name:** *Mário Fernando dos Santos Ferreira*

**e-mail:** *mfernando@ua.pt*

### Title

Nonlinear optical phenomena in hollow-core microstructured optical fibres

### Area

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

Nonlinear optics

### Summary of Proposal

This proposal aims the study of several nonlinear phenomena occurring in hollow-core microstructured optical fibres (HC-MOFs), also called hollow-core photonic crystal fibres (HC-PCFs). HC-MOFs allow guided propagation of light in a diversity of conditions that are not possible with conventional fibres, such as, modified dispersion conditions, low or high nonlinearity, and guided propagation in gaseous media. The mechanisms of guidance of light in the HC-MOFs can be the photonic band gap effect and/or the low density of states. This program will cover the design of novel photonic crystal fibres, the calculation of propagation modes, dispersion characteristics and nonlinearity coefficients, the modelling of nonlinear effects and the simulation of signal propagation using beam propagation methods. We aim to provide a deep understanding of the mechanisms of guidance of each studied fibre and to study various nonlinear physical phenomena that can occur when the light is guided through those gas filled HC-MOFs, such as supercontinuum generation, tunable ultraviolet light generation, laser-plasma interaction and resonances related nonlinearities.

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## References

(to allow students first look at topic) .

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J.C. Travers, W. Chang, J. Nold, N.Y. Joly, and P.St.J. Russel, “Ultrafast nonlinear optics in gas-filled hollow-core photonic crystal fibers”, *JOSA B*, vol. 28, issue 12, pp. A11-A26 (2011).

K.F. Mak, J.C. Travers, P. Hölzer, N.Y. Joly, and P.St.J. Russell, “Tunable vacuum-UV to visible ultrafast pulse source based on gas-filled kagome-PCF”, *Optics Express*, vol. 21, issue 9, pp. 10942-10953 (2013).

P. Holzer, W. Chang, J.C. Travers, A. Nazarkin, J. Nold, N.Y. Joly, M. Saleh, F. Biancalana, and P.St.J. Russel, “Femtosecond nonlinear fiber optics in the ionization regime”, *Phys. Rev. Lett.*, vol 107, issue 20, 203901 (2011).