

EUROPHOTONICS-POESII MASTER COURSE

PROPOSAL FOR A MASTER THESIS

Dates: April 1st, 2016 – September 30th, 2016

Laboratory : Nonlinear Dynamics, Nonlinear Optics and Lasers (UPC) City, Country : Terrassa, Spain Title of the master thesis: Light orbital angular momentum conservation in random domain nonlinear crystals Name of the tutor of the master thesis: Prof. Jose Trull Email address : jose.francisco.trull@upc.edu Phone number : +34 937398949 Name of the co-tutor of the master thesis: Dr. Alex Turpin Email address : alejandro.turpin@uab.cat Phone number : +34 935811652

Summary of the subject (maximum 1 page) :

In 1992, Allen and co-workers realized that light beams carrying orbital angular momentum (OAM) can be easily generated in the lab [1]. This observation has started a new research field in optics, which is still generating a lot of interest nowadays. OAM beams are characterized by an on-axis nodal intensity point that is preserved upon propagation. On the other hand, second harmonic generation (SHG) is a nonlinear process where two photons with frequency ω are combined to generate a single photon at frequency 2ω following energy and linear momentum conservation. This conservation also holds for the orbital angular momentum of photons, as it has been reported by several authors [2,3].

In this master thesis we propose an experimental research that aims to investigate if the conservation of orbital angular momentum law in SHG is also valid for the case of nonlinear crystals with a random distribution of the nonlinear domains [4]. In this case, the nonlinear process has several peculiarities with respect to usual bulk nonlinear crystal and this may play a role in the nonlinear process of the OAM conservation, giving rise to possible interesting unknown phenomena.



Fig. 1 (a) Characteristic helical wavefront and transverse phase and intensity structure of a light beam carrying orbital angular momentum. (b) Sketch of second harmonic generation in a SBN crystal.

[1] L. Allen *et al*, "Orbital angular momentum of light and the transformation of Laguerre-Gaussian laser modes," Phys. Rev. A **45**, 8185 (1992).

[2] K. Dholakia *et al*, "Second-harmonic generation and the orbital angular momentum of light," Phys. Rev. A **54**, R3742(R) (1996).

[3] J. Courtial *et al*, "Second-harmonic generation and the conservation of orbital angular momentum with high-order Laguerre-Gaussian modes," Phys. Rev. A **56**, 4193 (1997).

[4] J. Trull, *et al*, "Second-harmonic parametric scattering in ferroelectric crystals with isordered nonlinear domain structures," Opt. Express **15**, 15868 (2007).

Keywords : Second harmonic generation, orbital angular momentum