Second harmonic generation in spatially randonized crystals: application to ultrashort pulse characterization

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Abstract: The precise characterization of ultrashort laser pulses is a challenging task and a hot topic of research, since this kind of lasers are nowadays implemented in different applications. In We study and discuss the spatial distributed second harmonic generation obtained in a disordered nonlinear crystal, having a random size and distribution of nonlinear domains with homogeneous refractive index. The particular distribution of the nonlinear domains generate a transverse second harmonic signal emitted in all directions of the plane perpendicular to the propagation direction, with a similar efficiency over a very broad wavelength range, without the need of the phase matching condition. On the other hand, the crystal itself serves as a highly dispersive and ultra-broadband nonlinear medium, acting on the pulse propagating trough it.

We implement these particular nonlinear properties of such crystal to different configurations of a novel single shot auto- or cross-correlation technique, capable of measuring the most important parameters of an ultrashort laser pulse: pulse duration, chirp parameter, wave front tilt and, in a particular configuration, also the spectral phase. This method does not require phase matching condition nor sensitive alignment of thin nonlinear crystals and the same set-up can be used for the measurements of pulses with duration between 30 fs and 1 ps and wavelength in the range of 800 and 2000 nm.

We show that the same effect can be implemented to an indirect, non-destructive optical method for domain statistic characterization in random nonlinear crystals. We apply this technique to the characterization of different random media, with drastically different statistical distributions of ferroelectric domains.

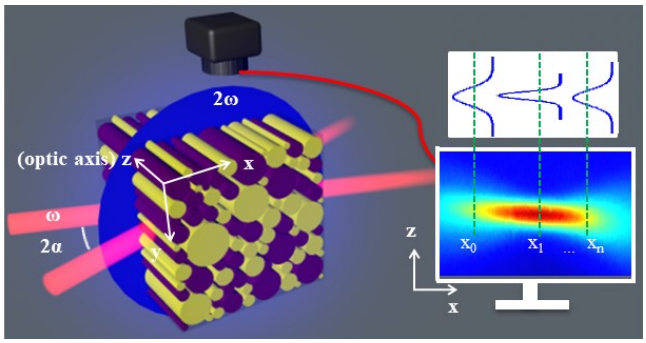

Figure 1: Schematic representation of the transverse auto-correlation trace in a media with spatially randomize quadratic nonlinearity

Biography:

Crina Cojocaru received her BSc and MSc in Physics from the University "Al. I. Cuza", Romania, in 1996 and the PhD degree in Physics from the Polytechnic University of Catalunya, Barcelona in 2002. After two years as a Marie Curie post-doc researcher at LPN - CNRS in Paris, she joined the Physics Department at Polytechnic University of Catalunya, Barcelona, first as post-doc researcher in 2004, later as a lecturer in 2006 and since 2008 she is an associate professor.

Her research covers different aspects of Photonics, focuses but is not limited to linear and nonlinear optics in a variety of materials, such as photonic crystals, metamaterials and random structures, ultrashort laser pulse characterization, laser beam shaping and control at micrometric scale using photonic crystals. These fields are reflected in more than sixty-five articles in peer reviewed journals, eighty international conferences with more than twenty-five invited talks. She is co-inventor in one European patent, and has authored two book chapters.

She has participated in a large number of research projects (six of them as PI) and has supervised 5 PhD thesis and more than 15 Master and Bachelor degree thesis. She is an active member of several steering committees of international scientific conferences and member of the Optical Society of America, European Physical Society, Royal Spanish Society of Physics and Catalan Society of Physics.

At academic level, she teaches different courses on nonlinear optics, photonics and experimental physics for BSc and Master program students. She is currently the director of the Inter-University Master in Photonics "PhotonicsBCN" and of the Joint Master Erasmus Mundus "Europhotonics-POESII" (Spain, France and Germany).