EUROPHOTONICS-POESII MASTER COURSE

PROPOSAL FOR A MASTER THESIS

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

Laboratory: Image Processing Laboratory of the Optics Group in the UAB.
City, Country: Bellaterra, Spain.

Title of the master thesis: In-line complete Stokes polarimeter based on a single biaxial crystal

Name of the tutor of the master thesis: Angel Lizana, Juan Campos
Email address: angel.lizana@uab.es, juan.campos@uab.es
Phone number: 932104714
Mail address :Departamento de Física, Facultad de Ciencias, Universidad Autonoma de Barcelona. Edificio Cc. 08193 Bellaterra (Barcelona)

Summary of the subject (maximum 1 page): (see below)

Keywords : Polarimetry, polarimeters, biaxial crystal, conical refraction, polarization metrology

Additional information :
The proposed work is basically experimental, based on theoretical designs. The control of the set-up (ccd cameras) and evaluation of the results will be performed in LabView

Exploiting the polarization properties of beams and polarizing materials is of interest in a large number of applications as in biology, astronomy, remote sensing, images for cancer diagnosis, materials characterization, data encryption, among others. For instance, polarization of light reflected or transmitted in thin film monolayers or stacks encloses important information of the constituent materials, as their thickness, composition, crystallinity, surface inhomogeneities, etc. Other example is found in medical imaging. In fact, light reflected in tumoral tissues presents different polarization than that reflected in healthy tissues, this fact being used for the enhancement of image contrast. Under this scenario, the use of polarimeters, the main devices to perform polarimetric measurements, becomes essential.

Nowadays, there exist a widespread number of polarimeters configurations. By considering some of their specific functionalities, polarimeters can be grouped in complete (full polarimetric information) or incomplete (partial information) polarimeters, Stokes (measuring light polarization) or Mueller (measuring polarizing materials) polarimeters, time-sequential or snap-shot polarimeters, etc. This latter type of polarimeters, the snap-shot polarimeters (which are based on amplitude-division or wavefront-division configurations), are indispensable for dynamic applications, where fast polarization variations must be tracked.

Recently, we have proposed a new type of amplitude-division polarimeter based on the conical refraction phenomenon. In particular, when a focused Gaussian beam traverses a biaxial crystal along one of its optical axes, a ring-like intensity distribution is obtained at the focal plane. More importantly, light in such a plane is linearly polarized, satisfying that each diametrically opposed points of the ring always present orthogonal linear polarizations (see Fig. 1). Therefore, this configuration constitutes a basis of linear analyzers that we have used to successfully implement different polarimeter configurations based on the CR phenomenon.

CR based polarimeters arises very interesting because they present some improved features when compared with other amplitude-division polarimeters: large redundancy data without an increase of measuring time, less intensity losses and better performance in low intensity conditions. In this proposal we want to go a step beyond by designing, optimizing and implementing a new in-line configuration, this being able to perform complete polarimetric measurements (previous proposed configurations were bulky systems or were limited to linear polarization measurements). In addition, we also want to study the potential of CR polarimeters to be used with different wavelengths, even out of the optical range, for instance, in the near-infrared. This last configuration may be of great utility for material characterization processes.

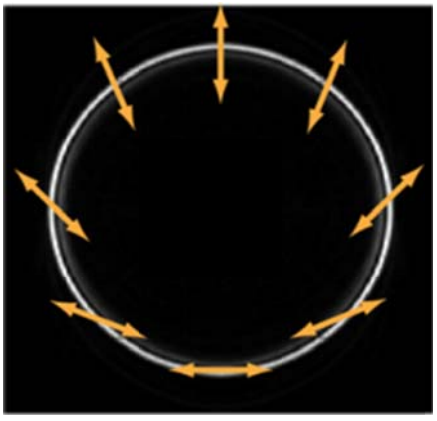

Fig.1. Ring-like intensity distribution obtained at the focal plane when illuminating a biaxial crystal with circularly polarized light. Orange arrows denote the specific polarization at certain ring positions.