Spécialité de Master « Optique, Matière, Plasmas »

Stage de recherche (4 mois minimum, à partir de début mars)

Proposition de stage (ne pas dépasser 1 page)

Date de la proposition : 22/10/2014

Responsable du stage / *internship supervisor*:

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Nom du Laboratoire / *laboratory name*: LABORATOIRE AIME COTTON

Code d'identification : UPR3321 Organisme : CNRS/ENS Cachan/Univ. Paris Sud

Site Internet / *web site*:

Adresse / *address:* Bâtiment 505 – Campus d'Orsay – 91405 ORSAY Cedex

Lieu du stage / *internship place*: Labo Aimé Cotton, Orsay, and Thales Research & Technology, Palaiseau

Titre du stage / *internship title*: PHOTONIC BANDGAP FIBER OPTICAL GYROMETER

The objective of this project, which is led in collaboration between *Laboratoire Aimé Cotton* and *Thales Research & Technology*, is to assess the feasibility of a new kind of optical gyro based on an innovative architecture of passive resonant fiber optic gyro (R-FOG) using a hollow-core fiber (HCF). The basic principle of an R-FOG is to measure, using an external probe laser, the eigenfrequencies of two counter-propagating modes of a fiber ring cavity, their difference being proportional to the angular velocity of the device (Sagnac effect). While the first proof-of-principle of an R-FOG was made as early as 1983, it has not led to any practical application so far, because Kerr effect puts a strong limitation on the bias stability of this device. A key innovation that has changed things recently is the advent of hollow-core fibers with relatively low loss, where light propagates mostly in air (>98%), resulting in a strong reduction of Kerr effect (and Brillouin effect as well, although it is not usually the dominant source of bias). A first proof-of-principle has been achieved in the United States very recently (2012), but did not reach the medium-performance target. To achieve this goal, we are building a new prototype of R-FOG with the following significant improvements:

- implementation of an innovative modulation/demodulation scheme designed to optimize the gyro performances (including suppression of the lock-in zone and real time measurement of the scale factor), which we have recently patented;
- use of a free-space technique to close the hollow-core fiber cavity in order to reduce coupling losses and improve the finesse of the cavity;
- development a new generation of HCF specially designed for minimizing backscattering and improve gyro performance. To this aim, in collaboration with XLIM in Limoges, we are exploring two HCF technologies: Kagome fibers and photonic bandgap fibers.

A successful project would be a breakthrough in the field of optical gyros. The resulting device would not only be compact, robust and cheap for this class of performance, but also have minimal radiation and magnetic sensitivity (respectively 50 times and 100 times better than a conventional fiber-optic gyro). Moreover, the developments achieved in the framework of this project could benefit to several other scientific projects having a strong technical overlap with ours, such as the study of magneto-electro-optical effects in molecules with ring cavities or the metrology of Earth rotation rate with giant ring laser gyros, with potential applications in the fields of biophysics, geosciences and photonic bandgap fibers by itself.

The aim of the present internship is to implement the innovative modulation/demodulation scheme that we have recently patented on the hollow-core fiber cavity, and to characterize the resulting gyro under rotation. The work will be performed in laboratoire Aimé Cotton (Orsay) and in Thales Research & Technology (Palaiseau), in close collaboration with XLIM for the fiber design and fabrication.

Ce stage pourra-t-il se prolonger en thèse ? *Possibility of a PhD* **? : YES**

Si oui, financement de thèse envisagé/ *financial support for the PhD***: THALES GRANT**

Lasers, Optique, Matière	**X**	Lumière, Matière, Interactions	**X**
Plasmas : de l'espace au laboratoire			

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