Spécialité de Master « Optique, Matière, Paris »

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

Proposition de stage (ne pas dépasser 1 page)

Date de la proposition : 05/11/2018

Responsable du stage / *internship supervisor*:

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Code d'identification : UMR 7010 Organisme : CNRS

Site Internet / *web site*: http://www.inln.cnrs.fr/activites/themesrecherche/atomes-froids

Adresse / *address:* 1362 Route des Lucioles, Sophia Antipolis, 06 560 Valbonne

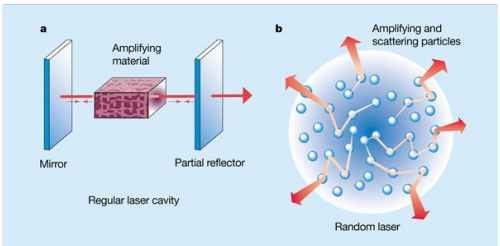
Lieu du stage / *internship place*: Valbonne Sophia-Antipolis

Titre du stage / *internship title*:**Intensity correlations: from cold atoms to astrophysics**

Résumé / *summary*

The measurement of the **coherence properties** of a light is important to characterize the source itself. This measurement is usually done with interferometric technique, corresponding to the measurement of the electric field correlation. But it is also possible to go to higher order with the study of the **intensity correlations**. Applied for the first time in astrophysics via the measurement of spatial intensity correlations, with the well-known Hambury Brown and Twiss's experiment, it allowed measuring the diameter of several stars. When performed in the temporal domain, this technique is particularly powerful, in particular in quantum optics to characterize non-classical states of light.

In our group, we study the properties of light scattered by a disordered medium. This medium can go from very simple setup, with for example milk, to more complex systems such as a cell with an atomic vapor or a cold atomic cloud. The peculiar properties of the last diffusive media (strong resonances, quantum internal structure of the scatterers, mechanical effects of light on the atoms, quantum effects…) give rise to a very rich physics.



Random laser principle, D. S. Wiersma, Nature 406, 132 (2000)

Different kinds of experiments are currently done on this subject. The goal of the first one is to characterize the coherence properties of the **random laser observed with cold atoms** (see Fig. above) [1,2]. The other experiments, simpler with milk or hot atoms, allow us to study the influence, in the multiple scattering regime, of the optical interference on the intensity correlations. All these experiments are finally an important step towards the improvement of this technique in astrophysics, which we are currently investigating at the observatory in Calern. The goal of the internship will be to work on one or more of these projects.

This internship can be continued by a thesis.

References :

[1] **The physics and applications of random lasers**, D. Wiersma, Nature Phys. **4**, 359 (2008).

[2] **A cold-atom random laser**, Q. Beaudoin *et al.*, Nature Phys. **9**, 357 (2013).

[3] **HBT interferometry revival: temporal correlation on three bright stars**, W. Guérin *et al.*, MNRAS **472**, 4126 (2017).

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*: Ecole doctorale, financement ANR

Lumière, Matière, Interactions	√	Lasers, Optique, Matière	√

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