INTERNSHIP PROPOSAL

(One page maximum)

Laboratory name: Laboratoire Kastler-Brossel
CNRS identification code: UMR8552
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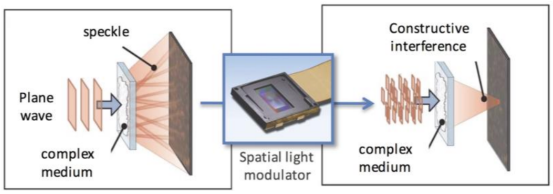
Internship location:Physics Department, ENS, 24 rue Lhomond, 75005 PARIS

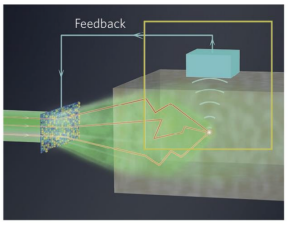
Thesis possibility after internship: YES
Funding: YES If YES, which type of funding: Grant

Light in Complex Media : from imaging to computing

Scattering of light in heterogeneous media, for instance the skin or a glass of milk, is usually considered an inevitable perturbation or even a nuisance. Through repeated scattering and interferences, this phenomenon seemingly destroys both the spatial and the phase information of any laser illumination. It gives rise to the well-known "speckle" interference patterns. From an operative point of view, scattering greatly limits the possibility to image or manipulate an object with light through or in a scattering medium. Multiple scattering is a highly complex but nonetheless deterministic process: it is therefore reversible, in the absence of absorption. Speckle is coherent, and can be coherently controlled. By « shaping » or « adapting » the incident light, it is in principle possible to control the propagation and overcome the scattering process. This concept has been exploited in the last decade to focus and image through and in complex media, and opens important prospects for imaging at depth in biological media.

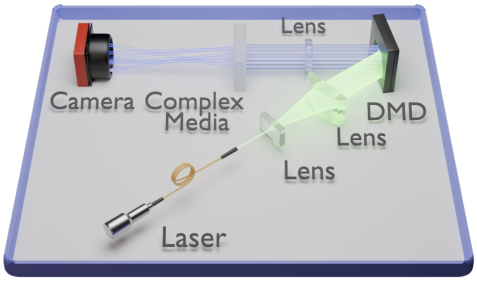


Principle of wavefront shaping in complex media



Concept of non-invasive imaging

In the group we are currently exploring two main topics, combining synergistically optical design and numerical studies for : (a) non-invasive coherent (SHG, Raman) and incoherent (multiphoton fluorescence) imaging, leveraging computational microscopy concepts and (b) exploiting random mixing induced by the propagation of light through a complex medium for various computational tasks, allowing the intriguing concept of computing with disorder.



Our platform for optical computing

We have multiple funded ongoing projects along these two directions and welcome motivated applicants for internship, with a solid background in physics, and an interest in machine learning, optics, imaging and computing.

Condensed Matter Physics: YES/NO Soft Matter and Biological Physics: YES/NO
Quantum Physics: YES/NO Theoretical Physics: YES/NO