MASTER DE PHYSIQUE ET APPLICATIONS - 2ème année
Spécialité Sciences des Matériaux et Nano-objets
International Nanomat Master Program

Internship proposal 2009-2010

Laboratory : Applied Electromagnetic Lab University "Roma Tre"

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Design of optical devices based on metamaterials to dramatically enhance the transmission through a sub-wavelength aperture

Scientific project:
The student will start the research activity gaining some skills about the definition and the concepts of the extraordinary optical transmission through a single sub-wavelength aperture. The transmission through sub-wavelength aperture is limited by the diffraction limit and goes as $(a/\lambda)^4$, where a is the linear size of the aperture. Acceptable transmission through sub-wavelength apertures, beating the diffraction limit, will have benefits in several application fields: high-precision lithography, high-capacity optical storage devices, high-capacity optical switches, etc. Recently, it has been shown that metamaterials, artificial engineered materials with unusual properties that cannot be found in natural materials, may be successfully used to dramatically enhance the optical transmission through sub-wavelength aperture (of the order of 30-40 dB).
The core of this scientific project will consist in the design of a metamaterial cover to be placed on top of the sub-wavelength aperture, in order to enhance the transmission by several orders of magnitude. The first step will be the design of the suitable metamaterials to be used for the proposed application. The second step will be the implementation of the cover. The third step will be the characterization of the cover in terms of robustness to the polarization, to the angle of incidence, and to possible losses affecting the metamaterials.
The Applied Electromagnetic Lab is member of the Virtual Institute on Advanced Electromagnetic Materials and Metamaterials (www.metamorphose-vi.org) and is involved in several national and international research projects in the field of metamaterials. The student(s) working on this project will interact with the members of the Virtual Institute and participate in the research projects.

Techniques in use :
Theoretical analysis and numerical simulations

Applicant skills :
Electromagnetic field theory, electrodynamics of complex and dispersive materials.

Granted internship: yes
C'nano IdF laboratory (France only):
Possibility for a thesis: yes , financial support possible after selection according to national rules.
Amount of the grant: approximately 13640 €/year (prevedential contribution shall be deducted).