Centre de Nanosciences et de Nanotechnologies

Soutenance de thèse

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Centre de Nanosciences et de Nanotechnologies
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Amphithéâtre

« Novel concepts for theoretical and applied problems of electromagnetism. Part 1: Absolute representation of the fields in the spacetime map. Part 2: Low-volume optical antennas for bolometer applications. »

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Abstract :
This thesis consists of two parts which, although very different from each other, both belong to the same field: electromagnetism and its modern problems.
In the first part, an absolute geometrization of the electromagnetic field in spacetime is presented, challenging the claim that the only way to present the electromagnetic field is an abstraction. It is demonstrated that with the absolute topology in spacetime, two scalar invariants are sufficient to describe the electromagnetic field. Particular attention is paid to the case of y-invariant p-polarised field, the topology of which can be represented in 3D spacetime by lines (electric spaghetti), the two scalar invariants then being reduced to one. Unlike the world lines of particles, which are always time-like, these lines transcend the boundary between space and time. This new approach of the electromagnetic field opens up new perspectives both for teaching and for research, in particular the analysis of the topological properties of these absolute structures in spacetime.
The second part is dedicated to a more applied problem, that of the development of nano-absorbers which could become the basis for a new generation of bolometers. In this work, it is demonstrated that thanks to the exceptional properties of plasmonic antennas (total absorption and strong confinement of the electromagnetic field), it is possible to design infrared absorbers whose volume is greatly reduced (several orders of magnitude) compared to those used in current microbolometers. These results pave the way for a major technological breakthrough which, by greatly reducing the thermal capacity of the absorbent, leads to a new sensitivity-speed compromise for bolometers whose performance should then be close to that of cooled photodetectors.