

**Institut Pascal – Axe Photon et Equipe ELENA**

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**Title of PhD subject: Electromagnetic simulations of photoluminescent metasurfaces**

**Summary:**

*Metasurfaces have the remarkable ability to control the phase, direction, and polarization of electromagnetic waves [1]. Current top-down fabrication methods enable the production of subwavelength-structured metasurfaces, providing precise control over photonic properties. However, these techniques are costly and limited to small-area fabrication. In contrast, bottom-up approaches allow the production of inexpensive large-area structures, although they typically result in disordered patterns.*

*The aim of this thesis is to explore photoluminescent metasurfaces [2] within the Elena team at Institut Pascal. These metasurfaces are developed through a novel bottom-up approach combining disordered plasmonic nanoparticles arranged in a periodic pattern, enabling innovative designs. Their electromagnetic properties are simulated at Institut Pascal [3–4], while the fabricated structures are optically characterized at Institut de Chimie de Clermont-Ferrand.*

*The PhD candidate will work closely with the team to simulate light extraction from the investigated structures, guiding experimental developments and contributing to the understanding of the mechanisms responsible for efficiency enhancement. This project offers strong application potential. We are seeking a motivated candidate eager to develop expertise in numerical methods. Prior experience with techniques such as RCWA, FDFD, or finite element methods is appreciated, but motivated candidates willing to acquire these skills in a collaborative research environment are encouraged to apply.*

**Reference :**

[1] A. Vaskin, R. Kolkowski, A. F. Koenderink, I. Staude, *Light-emitting metasurfaces*, *Nanophotonics* 8, 1151 (2019).

[2] M. Khaywah, et al. *Large and Versatile Plasmonic Enhancement of Photoluminescence Using Colloidal Metallic Nanocubes*. *The Journal of Physical Chemistry C*, 125 (14), 7780 (2021).

[3] E. Centeno, V. Kalt, R. Smaali, A. Moreau, *Disorder-induced effects on spontaneous emission from quasibound states in the continuum in regular and dimer gratings*. *Physical Review B*, vol. 112 (13), 134202 (2025).

[4] E. Centeno, et. al., *Enhanced Spontaneous Light Emission of ZnO Nanowire-Based Gratings*. *ACS Applied Optical Materials*, vol. 2(5), 725 (2024).