Exotic optical properties of complex plasmonic nanostructures

Three-year PhD position in the group “Light in Complex Nanostructures” at LP2N

Controlling the interaction of light with metallic nano-objects is the spearhead of modern nanophotonics. Thanks to the development of nanofabrication techniques, the last decade has witnessed a proliferation of optical nanoparticles of varying shape and composition, exhibiting new optical properties. For instance, one can create nanoparticles that strongly scatter light at wavelengths that are tunable on the entire visible range and with a controllable directivity. Furthermore, when these nanoparticles are self-assembled (randomly) in a thin-film stack, new optical phenomena can take place due to the interaction between the individual nanoparticle and the planar geometry, and between the nanoparticles themselves, such as a strong light confinement in very small volumes or a very efficient extraction of light confined in the stack towards free space. These complex systems have a very strong scientific and technological potential.

To date, however, the physical understanding of these nanostructures remains very limited. This is largely due to the difficulty to model such complex systems, that mix optimized nanoparticles and engineered disorder. Our research team has the ambition to develop the theoretical and numerical tools that will allow modeling and designing complex nanostructures possessing exotic optical properties, and to validate experimentally our most interesting findings.

The PhD thesis proposed here belongs to this dynamic. The PhD student will tackle advanced concepts in electromagnetic modeling and participate to the development of new numerical codes and of optical setups to optically characterize the nanostructures fabricated by our collaborators. This project is one of the key topics of the team for the coming years.

The PhD student should have a solid background in physics, especially in electromagnetism, and a pronounced interest for theory and numerical simulations. In return, he/she will receive a top-level expertise that is very interesting to many academic and industrial partners (our team has regular collaborations with Saint-Gobain Recherche and PSA Peugeot-Citroën) and that has essentially been developed on the experimental level so far, the theoretical and numerical efforts being rare.

Candidates should send their application, including CV and last academic transcripts, to kevin.vynck@institutoptique.fr and philippe.lalanne@institutoptique.fr.

Starting date: October, 1st 2017

Location
LP2N, Institut d'Optique d'Aquitaine, rue François Mitterrand, 33400 Talence, France
LP2N is a Joined Research Unit (JRU 5298) between Institut d’Optique Graduate School (IOGS), University of Bordeaux and CNRS. It has been created on January 1st 2011. It forms one of the elements of the Bordeaux site of the IOGS within the Institut d’Optique d’Aquitaine, where training, research and innovation coexist. Its research concentrates around complex systems integrating optics and computer science.

LP2N, which gathers almost 70 people in 2016, is a young, dynamic structure already rewarded several times. It is involved in several large national and international projects.

**Philippe Lalanne** is Directeur de Recherche at CNRS and is an international expert in nanoscale electrodynamics. With his colleagues, he has launched new and powerful tools and models in computational electrodynamics, has provided deep insight into the physical mechanisms involved in key nanoscale optical phenomena and devices, and has designed and demonstrated novel nanostructures with record or completely novel performance in their time. To date, he has co-authored about 170 publications in peer-reviewed journals and filed 10 patents. He was the supervisor of 15 PhD candidates and has co-supervised 5 PhD candidates. He is currently working on computational electrodynamics, slow light, quantum plasmonics, and complex optical systems.

**Kevin Vynck** is a young Research Scientist (Chargé de Recherche), recruited at CNRS in October 2013. His research activity concerns the theoretical and numerical modelling of wave transport and scattering in complex media, including periodic structures (photonic crystals, metamaterials) and disordered media (disordered photonic structures, media with fractal heterogeneity, ...). He has co-authored 32 papers in peer-reviewed journals, 1 book chapter and 2 international patents. He is currently working on coherent wave phenomena in complex ensembles of plasmonic nanoparticles.