University of Crete
Department of Physics

Physics Colloquium

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Aspects of Quantum Nanophotonics: From quantum informed plasmonics to strong coupling

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ABSTRACT

Benefiting from groundbreaking advances in nanofabrication and characterisation, nanophotonics has experienced an explosion of interest over the past couple of decades. The possibility of extreme confinement of light in subwavelength regions through its interaction with nanometric metallic or dielectric nanostructures has enabled the design and implementation of numerous applications, ranging from (bio)sensing and catalysis to optical and quantum communications, envisaging the development of quantum nanophotonics. At the same time, operating on a mesoscopic scale, in the uncharted territory between few-electron quantum mechanics and macroscopic electrodynamics, has been calling for hybrid theoretical methods that combine the best aspects of both fields, unveiling in the process exciting new physics.

In this talk I will revise my recent theoretical activities in quantum plasmonics and nanophotonics, focusing on i) quantum-informed plasmonics and ii) the interaction of quantum emitters with nanophotonic environments. I will first discuss the quantum effects that become relevant when free-electrons are excited in few-nm metallic nanoparticles, and the different models proposed to treat those effects in a semiclassical, computationally efficient manner. I will then explore how such nanoparticles, which can be considered as (poor, open and lossy) cavities, affect the properties of nearby quantum emitters (atoms, quantum dots, excitonic layers) in the weak- and strong-coupling regime, in the absence or presence of quantum corrections in their optical response. Finally, I will discuss my recent efforts to design alternative strong-coupling environments based on the Mie resonances of dielectric nanoparticles, in an attempt to fully exploit their magnetic resonances and lower Ohmic losses.