

Appunti di Fisica '25

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su Microsoft Teams "Seminari di Appunti di Fisica"

Plasmonic nanoparticles with extraordinary optical properties: Nanolasing, artificial magnetism, and spatial dispersion

Ashod Aradian

(Centre de Recherche Paul Pascal, University of Bordeaux & CNRS)

Progress over recent decades in the controlled synthesis of nanoparticles with various shapes, materials, and internal structure has allowed to extend their properties into previously unexplored regimes of light-matter interaction at the nanoscale. In this talk, I will present two examples of plasmonic nanoparticles whose composite internal structures enable extraordinary optical properties.

My first example will be about nanolasing. We studied theoretically a hybrid nanoshell system made of an active (gain) medium core and a silver shell geometry. We provided the first full characterization of the dynamics of the lasing regime above the threshold, allowing us to calculate the maximal emission spectrum of the nanolaser.

The second example of complex nanoparticles concerns dense, spherical clusters made of hundreds of small gold nanoparticles, which are notoriously difficult to investigate due to multiple interparticle couplings. We studied the scattering of such clusters with high-precision T-matrix simulations and demonstrated that their electromagnetic behavior could be appropriately described as that of a homogeneous sphere made of an equivalent medium with spatial dispersion effects, such as artificial optical magnetism and longitudinal waves.