NANO OPTICS WITH FAST ELECTRONS

Mathieu Kociak
Laboratoire de physique des solides (LPS), CNRS , Université Paris Saclay

Jeudi 23 mai à 11 h 00
Séminaire ISL
Amphithéâtre de l'Institut d'optique
2 Av Fresnel, 91127 Palaiseau
Également en ligne
https://uvsq-frzoom.us/j/98608491667?
pwd=QlZ1SXF3cHBjNXlneGFLNmRjeUkvQ

Hunting optical phenomena at the nanometer scale, namely performing nanooptics is paradoxical On the one hand, the typical length scale relevant for optics is of the order of a visible radiation wavelength few hundred of nanometers On the other hand, optical

properties of nano objects become to depart from bulk properties when the nano objects become smaller than a few hundred of nanometers This is for example the case of plasmons in metallic nanoparticles In this case, the optical properties depend on minute variations of the size and shape of the nano objects Even more, the morphology or structure of nano objects may have to be known with atomic resolution, such as in the case of quantum dots or quantum wells Therefore, techniques that are not limited by the optical diffraction limit have been developed in the last 15 years to make possible to study novel optical nanomaterials and the novel physics they brought.

In this talk, I will introduce a family of such techniques They use free electron beams such as delivered in a transmission electron microscope to perform optical spectroscopy at the nanometer scale I will show how they can be used to map plasmons excitons photonic modes and even phonons with unbeatable spatial resolution Beyond their impressive success in generating nice images, I will show how it is now possible to quantitatively understand such experiments in pure optical terms, such as extinction and scattering cross sections or electromagnetic local density of states Then, I will present the use of free electron beams to perform quantum optical measurements, and introduce very recent techniques that ally the spatial resolution offered by free electrons and the spectral resolution given by lasers