Master Physique fondamentale et applications
Nanophotonics

Informations

Composante : Faculté des Sciences

Responsables

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Langue(s) d'enseignement

Anglais

Contenu

Part 1: Periodic Nanophotonics (10h)
• Electromagnetic Prerequisites : Maxwell's equation in matter and constitutive relations, wave equations in 1D, 2D and 3D
• Modal analysis in Nanophotonics : dispersion relation
• Total/scattered field formulation of a typical Nanophotonic scattering problem
• Finite element computation of modal and direct nanophotonic problems
• Hands on 1: the dispersion relation of a photonic crystal
• Hands on 2: scattering by photonic crystal slabs and metasurfaces

Part 2: Resonant Nanophotonics & Metasurfaces (10h)
• Survey of plasmonics (Wood's anomalies, light absorbers)
• Pole and zero of the reflection coefficient
• Dispersion curves of SPP, Excitation of SPP (Kretschmann, Otto, Near field excitation), SPR biosensing
• Diffraction grating. Grating's law, Excitation of SPPs with gratings
• Basics of light scattering (Rayleigh & Mie scattering)
• Mie coefficients, polarizability of sub-wavelength sized particles
• LSPR : Plasmons on metallic nanospheres
• Near, intermediate and far fields scattered by electric dipoles
• Electric & magnetic Mie resonances on high refractive index particles
• Structural colors
• All-dielectric nanophotonics & Mie resonant nanophotonics
• Metasurfaces

Part 3: Nanophotonics (8h) : Green's functions, Density of States, Optical Antenna Theory
- Introduction to Green function theory
- Local Density of States and photonic Lamb shift (from Green functions)
- Spontaneous and stimulated emission of quantum emitters
- Optical antenna theory
- Decay rate enhancement, Photonic Lamb Shift

Compétences à acquérir

- Learn the physics and some computational aspects of today's Nanophotonics and some applications.
- Learn how to formulate and calculate Green functions and use them in optical antenna theory
- Lean how to calculate the poles of reflection coefficients and scattering coefficients, plot the dispersion relations

Modalités d'organisation

This course is a classical lecture with some computer work and practical work.

Bibliographie, lectures recommandées

Lukas Novotny, Principles of Nano-Optics, 2012, Cambridge
Jian-Ming Jin, Theory and Computation of Electromagnetic Fields, 2010, John Wiley & Sons
S.Enoch, N. Bonod, (Eds.). (2012). Plasmonics: from basics to advanced topics (Vol. 167). Springer.
Maier, S. A. (2007). Plasmonics: fundamaentals and applications (Vol. 1, p. 245). New York: springer.

Pré-requis obligatoires

Basic knowledge on electrodynamics and numerical analysis

VOLUME HORAIRE

- Volume total: 28 heures
- Cours magistraux: 28 heures

Codes Apogée

- SPFCU43J [ELP]

Pour plus d'informations

Aller sur le site de l'offre de formation...

Dernière modification le 18/06/2024