

PhD Course: Optics at the Nanoscale

Lecturers:

Sergey Bozhevolnyi, Thomas G. Pedersen, Kjeld Pedersen and Thomas Søndergård

Dept. of Physics and Nanotechnology, Aalborg University, DK-9220 Aalborg Øst, Denmark

Horia Cornean

Dept. of Mathematical Sciences, Aalborg University, DK-9220 Aalborg Øst, Denmark

At the nanoscale, optical phenomena change. Two main factors contribute to this fact: (1) quantization effects for electrons and (2) geometrical effects for photons. In semiconductor nanostructures, the first effect is especially important whereas the second often dominates for metallic nanostructures. In this course, both aspects will be covered by considering a range of cases: nanoscale plasmonic components, carbon nanotubes, semiconducting nanowires, metallic nanoparticles and photonic crystal structures. The theoretical tools and framework will be covered and practical numerical methods will be explained.

Lecture plan:

1. Basic concepts of surface nonlinear optics (KP)
2. Nonlinear optical spectroscopy: semiconductor surface states(KP)
3. Nonlinear optical spectroscopy: ZnO nanowires and metallic quantum wells (KP)
4. Models of excitons (TGP)
5. Optical properties of low-dimensional semiconductors (TGP)
6. Carbon nanotubes and semiconductor nanowires (TGP)
7. The Feshbach projection method and its applications for carbon nanotubes (HC)
8. Integral equations. General theory (HC)
9. The Lippmann-Schwinger equation in optics and scattering theory (HC)
10. Fundamentals of surface plasmon polaritons (SB)
11. Fundamentals of near-field microscopy (SB)
12. Plasmonic nanoguides and circuits (SB)
13. Green's function integral equation methods for plasmonic nanostructures (TS)
14. Optical scattering resonances of metal nano particles and related structures (TS)
15. Planar photonic crystals and photonic crystal optical fibers (TS)

Lecture Plan:

Uge 43:	Mandag	Tirsdag	Onsdag	Torsdag	Fredag
Formiddag	KP	KP	TGP	TGP	HC
Eftermiddag	KP	TGP		HC	HC
Uge 44:	Mandag	Tirsdag	Onsdag	Torsdag	Fredag
Formiddag	TS	TS	SB		
Eftermiddag	TS	SB	SB		

Place: Room 3.102, Skjernvej 4A (room 2.104 on Thursday morning), Aalborg University.