Modulbezeichnung:	**Nano-Optics (PW-NanoOptics)** (Nano-Optics)	**5 ECTS**
Modulverantwortliche/r:	Peter Banzer	
Lehrende:	Peter Banzer	

Startsemester: SS 2018	Dauer: 1 Semester	Turnus: unregelmäßig
Präsenzzeit: 60 Std.	Eigenstudium: 90 Std.	Sprache: Englisch

Lehrveranstaltungen:

Nano-Optics (SS 2018, Vorlesung, 2 SWS, Peter Banzer)

Inhalt:

0. GENERAL CONCEPTS AND BUZZWORDS
1. NOTATIONS
2. A HISTORICAL VIEW ON NANO-OPTICS
3. BASICS AND FUNDAMENTALS
3.1. LIGHT'S POLARIZATION AND ANGULAR MOMENTUM
3.2. MAXWELL'S EQUATIONS AND THE WAVE EQUATION
3.3. BOUNDARY CONDITIONS
3.4. THE PARAXIAL WAVE EQUATION AND GAUSSIAN BEAMS
3.5. PROPAGATING VERSUS EVANESCENT FIELDS
4. NONPARAXIAL PROPAGATION AND TIGHT FOCUSING
4.1. THE ANGULAR SPECTRUM REPRESENTATION
4.2. VECTORIAL DIFFRACTION THEORY
4.3. FOCAL FIELDS
4.4. STRUCTURED LIGHT AND FOCAL FIELD ENGINEERING
4.5. PECULIARITIES OF SPATIALLY CONFINED ELECTROMAGNETIC FIELDS
4.5.1. PHOTONIC WHEELS
5. LIGHT-MATTER-INTERACTIONS AT THE NANOSCALE
5.1. PLASMONIC VERSUS DIELECTRIC SCATTERERS
5.2. MULTIPOLE DECOMPOSITION AND DIPOLE EMISSION
5.2.1. OTHER NUMERICAL/THEORETICAL METHODS
5.3. INTERACTION OF STRUCTURED LIGHT WITH INDIVIDUAL NANOSTRUCTURES
5.4. SELECTED APPLICATIONS:
5.4.1. METAMATERIALS - FROM NEGATIVE REFRACTION TO INVISIBILITY CLOAKS
5.4.2. NANOPARTILCE-BASED COLORING
5.4.3. TRAFFIC-CONTROL FOR LIGHT AT THE NANOSCALE
5.4.4. MEASURING LIGHT AT THE NANOSCALE
5.5. QUANTUM EMITTERS
6. MICROSCOPY AND NANOSCOPY
6.1. RAYLEIGH'S CURSE AND (LINEAR) RESOLUTION LIMITS
6.2. 'FAR-FIELD' MICROSCOPY
6.2.1. SELECTED TECHNIQUES AND THEIR WORKING PRINCIPLE
6.3. (NONLINEAR) SUPERRESOLUTION AND LOCALIZATION-BASED MICROSCOPY
6.4. NEAR-FIELD SCANNING OPTICAL MICROSCOPY (NSOM)
6.4.1. THE HISTORY OF NSOM IN A NUTSHELL
6.4.2. DIFFERENT CATEGORIES OF NSOM
7. TRACTOR BEAMS AND OPTICAL TWEEZERS
7.1. OPTICAL FORCES AND TORQUES
7.2. TRAPPING AND MANIUPULATING MICROPARTICLES WITH LIGHT FIELDS
8. SNEAK PEEK: THE WORLD OF THE FIELD OF PLASMONICS
8.1. INTERACTION OF LIGHT WITH METALS
8.1.1. OPTICAL PROPERTIES OF METALS - THE DRUDE MODEL
8.1.2. PERMITTIVITY AND DIELECTRIC FUNCTION

8.2. SURFACE PLASMON POLARITONS (SPP)
8.2.1. EXCITATION OF SPPS AND PLASMON DISPERISON
8.3. LOCALIZED PARTICLE PLASMONS
8.3.1. LOCAL FIELD ENHANCEMENT
9. NANOFABRICATION IN A NUTSHELL
9.1. ELECTRON-BEAM LITHOGRAPHY (EBL)
9.2. FOCUSED ION-BEAM MILLING (FIB)
9.3. PICK-AND-PLACE HANDLING OF NANOSTRUCTURES

Lernziele und Kompetenzen:

Die Studierenden

- erläutern die wesentliche Inhalte der Vorlesung
- wenden die Methoden auf konkrete Beispiele an

Literatur:

Principles of Nano-Optics by Lukas Novotny and Bert Hecht, Cambridge University Press, ISBN: 978-1107005464

Verwendbarkeit des Moduls / Einpassung in den Musterstudienplan:

Das Modul ist im Kontext der folgenden Studienfächer/Vertiefungsrichtungen verwendbar:

[1] **Physics (Master of Science): ab 1. Semester**
(Po-Vers. 2015s | NatFak | Physics (Master of Science) | Master's examination | Physics elective courses)

Studien-/Prüfungsleistungen:

Nano-Optics (Prüfungsnummer: 939191)
(englische Bezeichnung: Nano-Optics)

Prüfungsleistung, mündliche Prüfung, Dauer (in Minuten): 25
Anteil an der Berechnung der Modulnote: 100% Prüfungssprache: Englisch

Erstablegung: SS 2018, 1. Wdh.: SS 2018 (nur für Wiederholer)
1. Prüfer: Peter Banzer

Organisatorisches:

Lecture starts April 18, 2018