## Module

**Near-Field Optics and Plasmonics**

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<thead>
<tr>
<th><strong>Code</strong></th>
<th>71422</th>
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<tbody>
<tr>
<td><strong>Instruction language</strong></td>
<td>English</td>
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<tr>
<td><strong>ECTS credits</strong></td>
<td>3</td>
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<td><strong>Credit hours</strong></td>
<td>3</td>
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<tr>
<td><strong>Duration</strong></td>
<td>1 semester</td>
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<td><strong>Cycle</strong></td>
<td>Each winter semester</td>
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<tr>
<td><strong>Coordinator</strong></td>
<td>Prof. Othmar Marti</td>
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<tr>
<td><strong>Lecturer</strong></td>
<td>Dr. Manuel Rodrigues Gonçalves</td>
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### Allocation to study programs
- Advanced Materials M.Sc., elective module, 3rd Semester
- Physics M.Sc., elective module, 1st or 2nd Semester

| **Formal prerequisites** | None |

| **Recommended prerequisites** | Knowledge of geometrical wave optics, Maxwell’s equations and electromagnetism, fundamentals of algebra and mathematical analysis. |

### Learning objectives
- Students who successfully passed this module
  - understand the mathematical description of electromagnetic waves in near- and far-field
  - know the physical basis of surface plasmons and the preparation of plasmonic nanostructures
  - can operate optical scanning near-field microscopes
  - can simulate optical properties of nanoparticles

### Syllabus
- Concepts of near-fields and far-fields
- Principles of confocal and SNOM microscopy
- SNOM probes and near-fields probing methods
- Fresnel formulas
- Light scattering, absorption and extinction of isolated nanoparticles
- Mie theory
- Plasmons in films and nanoparticles
- Fabrication techniques of noble metal nanostructures
- Simulation of optical properties of plasmonic particles
- Surfaces-enhanced Raman scattering
- Near-field enhancement and fluorescence
- Optical forces and thermal effects of plasmons
- Quantum plasmonics

### Lab experiments:
- Fabrication of plasmonic nanostructures
- Confocal microscopy: reflection and transmission modes
- SNOM in illumination/transmission mode
- Angle-resolved spectroscopy
- Light scattering and surface-plasmon resonance
- Surface enhanced Raman scattering

**Literature**
- Nanoplasmonics, V. Klimov, Pan Stanford Publishing 2014
- Modern Introduction to Surface Plasmons, D. Sarid and W. Challener, Cambridge 2010
- Journal papers and lectures script

**Teaching and learning methods**
Lecture with practical course (2 hour per week)

**Workload**
30 hours lab and exercise (attendance time)
60 hours self-study and examination preparation
Total: 90 hours

**Assessment**
Written examination and lab work.

**Examination**
- 11981 Near-Field Optics and Plasmonics (AMS, FSPO 2012)
- 11516 Surface Plasmon Photonics (PHYS, FSPO 2014)

**Grading procedure**
The module grade is the examination grade.

**Basis for**
Research in Nanosciences