

**SCIENTIFIC AND METHOD MODULES**

<b>Module name</b>	<b>Hybrid systems - Metamaterials</b>
<b>Number</b>	<b>2016-T6</b>
<b>Aims</b>	This module teaches the principles of and modern developments in metamaterials.
<b>Basics</b>	covered in basic modules B3 (wave optics), see also J.D. Jackson, Classical electrodynamics (Wiley)
<b>Contents</b>	Metamaterials are artificial materials with specific optical properties, typically evoked with sub-wavelength structures (periodic or non-periodic) in order to manage the dielectric function in particular ways such as negative index of refraction. While structural features are easy to fabricate for the micro-wave regime, structural features acting in the visible spectral range are typically $\lambda/4$ (about 100 nm) with even higher precision (few nm) require nano-fabrication tools.
<b>Methods</b>	Theoretical calculations of Maxwell's equations in the sub-wavelength regime, calculation of effective dielectric functions, nanofabrication of structures, ion beam fabrication, lithography-based processing
<b>Type</b>	Two-day block course/ bi-yearly recurrence with modification
<b>Date (month/year)</b>	29/30 September 2016
<b>Time</b>	10:00-20:00; 9:00-16:30
<b>Work load</b>	15 hours presence/ 45 hours self-study
<b>Examination</b>	Poster presentation about a self-chosen topic about "Hybrid Systems – Metamaterials" (own research or from literature) and discussion (oral) in front of the poster with the organizer(s)
<b>Credit points</b>	2
<b>Responsible scientists</b>	Prof. Grundmann, Prof. Cichos
<b>International guest lecturers</b>	Dr. Geoffroy Lerosey, Institut Langevin, ESPCI Paris Tech and CNRS, France; Dr. Patrice Genevet, CRHEA, Valbonne, France; Prof. Dr. Mikhail Belkin, The University of Texas at Austin, USA
<b>Industrial partners</b>	-
<b>Recommendations for literature, e-learning</b>	Metamaterials - Theory, Design, and Applications, Cui, Tie Jun, Smith, David, Liu, Ruopeng, eds. (Springer) Nanophotonic Materials: Photonic Crystals, Plasmonics, and Metamaterials, R.B. Wehrspohn, H.-S. Kitzrow, K. Busch eds. (Wiley-VCH) Electromagnetic Metamaterials: Physics and Engineering Explorations, N. Engheta, R.W. Ziolkowski eds. (Wiley)

## SCHEDULE for Module 2016-T6

Time	Lecturer	Programme	Location
<b>Day 1</b>			
<b>Day 2</b>			

**Didactic elements:**

Lecture, discussions, practical training – lab demonstration, etc.

**Expected performance:**

Active participation in discussions during lab demonstration etc.