Statistical and Biological Physics

Module No.: MN-P-SP-StatBio, MN-P-PN-StatBio, MN-P-WaMa Version: 11.10.2016 PB

Course: Introduction to Statistical Optics

Lecturers: P. Born, M. Sperl
Email: philip.born@dlr.de, matthias.sperl@dlr.de

Category	Type	Language	Teaching Hours	CP	Semester
Specialized Course	Lecture	English	2	3	SuSe

Requirements for participation:
Geometric and wave optics on the bachelor level

Type of module examinations:
Oral Examination or Term Paper

Duration of the course:
1 semester

Aims of the course:
Optical probes and scattering techniques are fundamental methods for investigation of soft and biological media. They noninvasively give access to in-situ structure and dynamics within bulk samples and are capable of probing many length and time scales. Still, many measurements require correct interpretation of the statistical light propagation through the medium of interest. The course gives the fundamental aspects of wave propagation in complex media and lays the foundation for experimental soft matter and biophysical studies.

Contents of the course:

- Maxwell's equations, matter, and free space solutions
- Lorentz-Lorenz formula, Ewald-Oseen extinction theorem
- Lorenz-Mie scattering theory, Born approximation
- Thermal light, coherence and speckles
- Central limit theorem
- Random walk propagation and phasor sums
- Applications:
    - Noise
    - Imaging and speckles
    - Time correlation methods
    - Scattering methods
    - Diffraction and coherence tomography

Recommended literature:

C. F. Bohren, D. R. Huffman: Absorption and Scattering of Light by Small Particles (Wiley-VCH, 1983, 2004)
J. W. Goodman: Statistical Optics, 2nd Ed. (Wiley-VCH, 2015)