ITMO University

Emission and Counting of Single Photons

Course Workload		Assessment form (examination/ graded test/ ungraded test)
ECTS	Hours	
6	216	Exam

This course represents basic information in the field of radiation and counting of single photons. The principles of single photons counting with time correlation, modern methods of time-resolved microscopy and correlation spectroscopy, as well as their application in physics and life sciences are described in details. The issues of experimental quantum nanophotonics associated with the use of various materials for generating single photons, controlling their radiation and creating quantum devices on a chip are also considered.

Course structure:

1. Single-photon counting

1.1. Introduction: historical background, confocal microscopy, fluorescence microscopy
1.2. Time-correlated single-photon counting (TCSPC): work principles
1.3. Toolkit for TCSPC: excitation sources, optical systems, electronics
1.4. Detectors for Photon Counting

2. Single-photon generation

2.1. Introduction: why do we need single photons?
2.2. Single Photon Source Characterization (HBT interferometer, Spectral Brightness, Intensity Correlation Functions)
2.3. Single Photon Sources (Diamond nanophotonics, Quantum dots and nanotubes, 2D materials, Advanced materials)
2.4. Single photon radiation control in nanophotonics. Quantum nanophotonics on a chip

3. Application of TCSPC Techniques

3.1. Fluorescence Lifetime Imaging (FLIM)
3.2. Fluorescence Correlation Spectroscopy (FCS)
3.3. Fluorescence Resonance Energy Transfer (FRET)
3.4. Stimulated Emission Depletion Microscopy (STED)