FDITE69 Optical spectroscopy for photosynthesis research

(Petar Lambrev)

Description:

The course covers basic concepts, theoretical principles, and applications of optical spectroscopy in photosynthesis research. It begins with an introduction to the physical properties and treatment of electromagnetic radiation and light-matter interactions, basics of quantum mechanics and the processes of light absorption, energy transfer and charge separation from a physical and quantum mechanical perspective. In the second part of the course, modern spectroscopic methods that can be applied to photosynthesis research are introduced: steady-state absorption and fluorescence spectroscopy, fluorescence induction, polarized light spectroscopy and ultrafast time-resolved spectroscopy methods.

Topics:

Theoretical aspects

- Properties of the electromagnetic radiation
- Quantum mechanical description of light-matter interaction
- Absorption of electromagnetic radiation
- Excited-state decay
- Characteristics of fluorescence emission
- Exciton coupling
- Excitation energy transfer
- Electron transfer

Practical approaches

- The generic spectrometer
- Photon energy
- Absorption spectroscopy
- Fluorescence spectroscopy
- Polarization techniques
- Vibrational spectroscopy
- Chlorophyll fluorescence
- Time-resolved fluorescence

Pump-probe absorption spectroscopy

Kinetic modelling

Multidimensional spectroscopy

Recommended literature:

Hammes G.G.: Spectroscopy for the Biological Sciences, John Wiley & Sons, 2005

Parson W.W.: Modern Optical Spectroscopy, Springer, 2007

Roduner E et al.: Optical Spectroscopy – Fundamentals and Applications, World Scientific, 2018