Program (per 18.10.2005)
3rd European Short Course on Principles & Applications of Time-Resolved Fluorescence Spectroscopy, Berlin, October 31-November 4, 2005

Monday

Joseph R. Lakowicz: „Basic definitions and principles of fluorescence“
(2 h 45 min, 9:30-10:45, 11:15-12:45)

- Jablonski diagram and stokes shift
- Basic spectral properties
- Excitation and emission spectra
- Fluorescence anisotropy
- Fluorescence lifetime
- Energy transfer

Rainer Erdmann: „Instrumentation (1)“ (1 h 45 min, 13:45–15:15)

- Overview of steady state fluorometer design
- Light sources: lamps, LEDs, lasers
- Wavelength selection: monochromators, filters
- Detectors: PMTs, MCP-PMT, SPAD, CCD
- Electronics
- Analog and photon counting
- Design rules
- Sources of error in fluorescence
- Introduction to time domain measurement
- Introduction to frequency domain measurement
- Special considerations for NIR applications

Matthias Patting : „Introduction to data analysis“ (30 min, 15:45-16:15)

- Typical approaches in TCSPC data analysis
- Common artefacts and how to handle them
- Spoiled data and how to avoid them
- Choosing appropriate models
- Step by step example

Zygmunt Gryczynski: „Introduction to Hands-on experiments“ (30 min, 16:15-16:45)

- Physics behind the experiments

Companies: „Introduction to Hands-on experiments“ (15 min per company, 16:45-18:15)

- Instrumental aspects of the experiments

Tuesday

Joseph R. Lakowicz: „Time-resolved fluorescence“ (1 h 45 min, 8:15-10:00)

- Resolution of complex decays
- Multi-exponential anisotropy decays
- Transient effects in quenching
- Time-Resolved Emission Spectra (TRES)

Joseph R. Lakowicz: „Time dependent phenomena“ (1 h 30 min, 10:30-12:00)

- Multi-exponential decays
- Time domain lifetime measurements
- Frequency domain lifetime measurements
- Quenching: static, dynamic, transients
- Anisotropy decays
- Energy transfer – distance distribution
- Time-dependent spectral relaxation
- Excited state reactions

Zygmunt Gryczynski: „Analytical applications of fluorescence“ (1 h 45 min, 13:15-15:00)

- Analytical determinations by fluorescence
- Ratiometric determination based sensing
- Anisotropy-based sensing
- Fluorescence lifetime-based sensing
- Modulation based sensing
- Energy transfer-based lifetime sensing of metal ions
- Visual polarization sensing
- Error sources in fluorescence assays

Wednesday

Michael Wahl: „Instrumentation (2) for time-correlated photon counting and fluorescence lifetime imaging“ (2 h 00 min, 8:15-10:15)

- Advantages and difficulties of the TCSPC method
- Modern excitation sources
- Specifics of sample compartments and detection optics
- Detectors for TCSPC
- Compact photon counting electronics incl. multi-photon counting
- Electronics for multidimensional TCSPC (including routers)
- Electronics for Time-Tagged Time Resolved (T^3R) data acquisition
- TCSPC instrumentation for Fluorescence Lifetime Imaging (FLIM)

Stefan Hell / Lars Kastrup: „Modern nonlinear fluorescence microscopy“ (1 h 45 min, 10:45-12:30)

1. Prinicples of confocal microscopy
   - Advantages of confocal microscopy
   - 2-Photon excitation
   - 3-Photon excitation
   - Pulsed excitation
2. Resolution improvement
   - 4Pi confocal microscopy
   - Stimulated Emission Depletion Spectroscopy (STED)

Peter Czerney: „Fluorescent markers, probes and labels“ (1 h 30 min. 13:30-15:00)

1. Fluorescent labels
   - Intrinsic fluorescence
   - Labels: wavelength and decay time considerations
   - Labeling biomolecules
   - Purification and characterization of conjugates
   - Specific features of protein labeling
   - Specific features of DNA labeling
   - Representative examples of labeling via reactive groups
   - Quantum dots, GFP / RFP
2. Fluorescent probes
   - Definitions
   - Probes for pH, pO_2, reactive oxygen species, Ca^{2+}, Cl^-, etc.
   - Features of metal ligand probes
   - Probes for sensing purposes
3. Applications of fluorescent probes and labeled species
   - in microscopy and imaging
   - in arrays and High Throughput Screening (HTS)
   - in cellular biophysics
   - in FRET studies
   - in optical fiber sensors
   - in immunoassay and hybridization assay

Thursday

Jörg Enderlein: „Fluorescence fluctuation and single molecule spectroscopy” (2 h 00 min, 8:15-10:15)

1. Physical principles of single molecule fluorescence spectroscopy
   - General properties of molecular light absorption and emission
   - Fluorescence lifetime and polarization
   - Single-pair Förster Resonance Energy Transfer (spFRET)
2. Fluorescence fluctuation spectroscopy
   - Confocal epi-fluorescence microscopy
   - Time-Tagged Time-Resolved photon counting
   - Fluorescence Correlation Spectroscopy (FCS)
   - Fluorescence Intensity Distribution Analysis (FIDA)
   - Single molecule burst analysis
3. Single Molecule Imaging
   - Wide-field fluorescence imaging microscopy
   - Single molecule tracking
   - Imaging single molecule orientations
   - Monitoring the interaction between individual molecules
   - Stoichiometry of molecular complexes

Thursday	**Martin Hof: ”Solvent relaxation techniques: Application in studies of biomolecules“** (1 h 30 min, 10:45-12:15)
	■ Solvent relaxation (SR) and steady state spectra ■ Time-resolved emission spectra ■ SR in biomembrane research ■ Protein-Membrane interactions studied by SR ■ Lipid systems for drug delivery protocols studied by SR ■ SR in protein and DNA research
Friday	**Matthias Patting: „Advanced data analysis“** (1 h 30 min, 8:15-9:45)
	■ Fundamentals of TCSPC fitting ■ Decay models ■ Advanced error analysis ■ Fluorescence Lifetime Imaging (FLIM) analysis ■ Förster Resonance Energy Transfer (FRET) analysis
	Manfred Auer: „High throughput screening“ (2 h 15 min, 9:45-10:30 and 11:00-12:30)
	■ The drug discovery process ■ General aspects of high throughput screening ■ Ensemble averaging fluorescence technologies in high throughput screening ■ Single molecule spectroscopy technologies in high throughput screening ■ Affinity selection, chemical genomics, chemical genetics in drug discovery