



UNIVERSITÀ  
degli STUDI  
di CATANIA



DIPARTIMENTO DI FISICA E ASTRONOMIA  
“ETTORE MAJORANA”

DOTTORATO DI RICERCA IN FISICA  
CICLO XXXIX A.A. 2023/2024

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## Advanced fluorescence microscopy methods

2 CFU

### Teaching staff

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**Reception hours:**

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### Program of the course:

- Description of the fluorescence process. Probes for fluorescence. Techniques for labeling biological structures: Labeling proteins, Labeling DNA, Labeling membranes, Quantum dots, Ions indicators, Labeling “in vivo” with fluorescent proteins. Advanced fluorescence microscopy setups. Characterization of the Point Spread Function (PSF) of the microscope. Widefield versus confocal microscopy.
- Fluorescence Lifetime Imaging Microscopy (FLIM) and applications. FLIM acquisition setups. Data analysis in time and frequency domain. The phasor analysis of FLIM images. FLIM detection of Forster Resonance Energy Transfer (FRET). FRET imaging and applications. Imaging of environment-sensitive fluorescent probes and applications.
- Advanced fluorescence correlation techniques. Analysis of temporal fluctuations. Fluorescence Correlation Spectroscopy (FCS). Analysis of spatio-temporal fluctuations. Image Correlation Spectroscopy (ICS) and Image Cross Correlation Spectroscopy (ICCS). Applications.
- Super-resolution microscopy techniques. Stochastic switching versus targeted switching. Stimulated Emission Depletion (STED) based techniques. Time-resolved STED techniques: gated-STED, Separation of Photons by Lifetime Tuning (SPLIT). Applications.

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### Bibliography:

Scientific papers and slides provided by the teacher