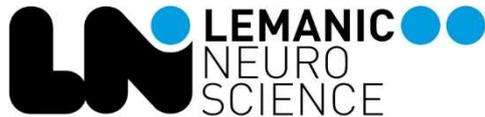


Introduction to Biophotonics



(2.5 ECTS)



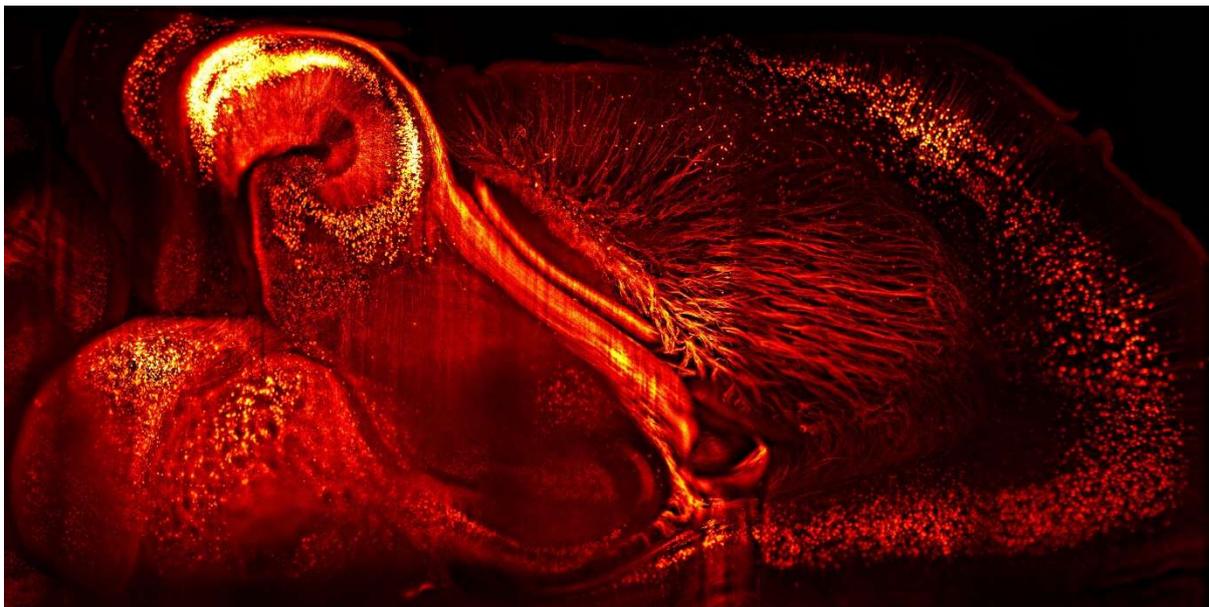
**UNIVERSITÉ
DE GENÈVE**

GENEVA UNIVERSITY
NEUROCENTER

Master in Neuroscience

(3 ECTS)

Organizers: Ronan Chéreau (RC) and Luigi Bonacina (LB)



Biophotonics can be described as the collection of methods that utilize light (or photons) to image, track and manipulate biological materials. This very large and rapidly expanding toolbox might be, at first, overwhelming for biologists when it comes to selecting the right method to approach a biological question or even capturing the methodological details from the literature. This course aims to introduce/deepen students' knowledge of the physical principles and biological applications of these methods. For example, we will cover the concepts of fluorescence, describe the main types of microscopes (confocal, 2-photon, etc...), understand how an image is obtained and how it can be analyzed. The course is composed of two parts: 1) Principles and theory and 2) Biological applications (mainly focusing on neurobiology examples).

Schedule and course content in 2023

Wednesday, February 22nd	13H00-13H15 (A04.2906 (CMU)): Introduction to the course LB & RC 13H15 -16H00 <i>Molecular Physics</i> (Theory: Structure of matter – Born Oppenheimer approximation – Morse potential – HOMO – LUMO – Orbitals – FC principle, Absorption, Emission, Fluorescence) with LB
Wednesday, March 1st	13H00-16H00 (B04.2222 (CMU)): <i>Linear Microscopy</i> (Theory: Magnification, Resolution, Image Contrast, Selectivity, Sensitivity, Speed image depth – Image formation, microscope, intro to fluorescence microscopy, fluorescent proteins, scanning fluorescence microscopy, confocal, spinning disk) with LB
Wednesday, March 8th	13H00-16H00 (A04.2906 (CMU)): <i>Multiphoton Microscopy</i> (Theory: Principles of 2P-absorption and scattering (SHG, THG), Pulse duration effect, Tissue Scattering and Absorption, bleaching) with LB
Wednesday, March 15th	13H00-14H00 (A04.2906 (CMU)): Journal Club (topic: what is an image?) 14H00-16H00: <i>Optical imaging: considerations in Neuroscience</i> (Theory: What is a digital image? Imaging modalities, spatial and temporal resolution, non-linear aspects of imaging in deep tissue – sensitivity and effect of depth, applications, vibrational techniques [not necessarily non-linear], models for fluorescence imaging in neuroscience, molecular tools for expression of fluorescent probes) with RC
Wednesday, March 22nd	13H00-16H00 (B04.2222 (CMU)): <i>Super resolution</i> (Theory: STED, PALM, Structured Illumination) with LB
Wednesday, March 29th	13H00-14H00 (A04.2906 (CMU)): Journal Club (topic: 2-photon microscopy) 14H00-16H00: <i>Imaging intracellular protein dynamics</i> (Theory: Speed of displacement, protein diffusion. Imaging methods like FRAP, FCS, tracking of receptor tagged with QDs. Application of superresolution techniques, FLIM (with RC))
Wednesday, April 5th	13H00-14H00 (A04.2906 (CMU)): Journal Club (topic: superresolution imaging) 14H00-16H00: <i>Functional Imaging in Neurons</i> (Theory: Voltage sensitive dye imaging, Ca-imaging, pH imaging, sodium imaging, application of second harmonic imaging, pros and cons in various applications) with RC
Wednesday, April 12th	13H00-16H00: Introduction to Light Sheet Microscopy and visit @ the Campus Biotech of the Advanced Light Sheet Imaging Center (ALICe) with Stéphane Pagès
Wednesday, April 19th	13H00-14H00 (A04.2906 (CMU)): Journal Club (topic: functional imaging) 14H00-16H00: <i>Controlling neurons with light</i> (Optogenetic excitation and inhibition (e.g., ChR2, NpH, Arch), photoactivable receptors, CRACM) with RC
EXAM	- 2h; date to be determined

Course location [CMU Geneva](#) and online (except for the on-site visit of the Light Sheet imaging facility at Campus Biotech)!

Registration The course is limited to 20 participants. **Register before February 10, 2023**, by writing a mail to ulrike.toepel@unil.ch (LNDS) or delphine.jochaut@unige.ch (Masters Neuro) putting your supervisor in copy) and stating the course title as subject.