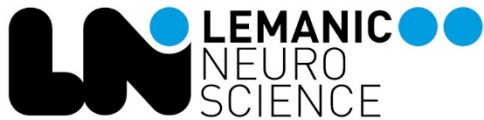


# Introduction to Biophotonics



**UNIVERSITÉ  
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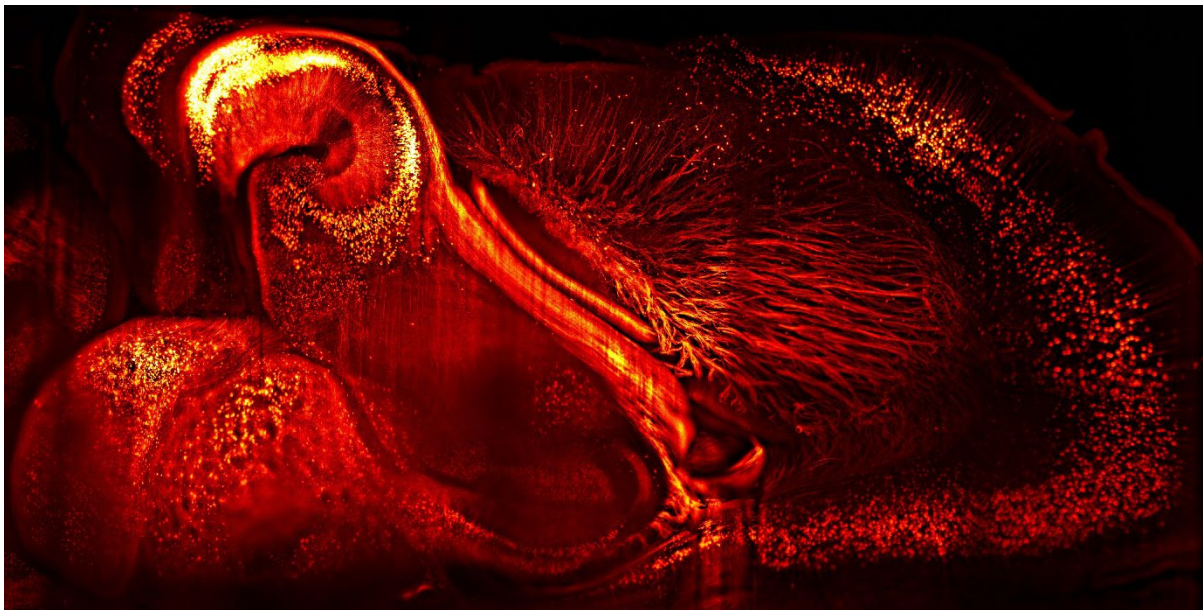
Master in Neuroscience

3 ECTS

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

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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 2024

<b>Wednesday, February 21</b> salle	13H00-13H15: Introduction to the course <b>LB &amp; RC</b> 13H15 -16H00 <i>Molecular Physics</i> (Theory: Structure of matter – Born Oppenheimer approximation – Morse potential – HOMO – LUMO – Orbitals – FC principle, Absorption, Emission, Fluorescence) with <b>LB</b>
<b>Wednesday, February 28</b> salle	13H00-16H00: <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 <b>LB</b>
<b>Wednesday, March 6</b> salle	13H00-16H00: <i>Multiphoton Microscopy</i> (Theory: Principles of 2P-absorption and scattering (SHG, THG), Pulse duration effect, Tissue Scattering and Absorption, bleaching) with <b>LB</b>
<b>Wednesday, March 13</b> salle	13H00-16H00: <i>Super resolution</i> (Theory: STED, PALM, Structured Illumination) with <b>LB</b>
<b>Wednesday, March 20</b> salle	13H00-14H00: 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 <b>RC</b>
<b>Wednesday, March 27</b> salle	13H00-14H00: 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 <b>RC</b> )
<b>Wednesday, April 10</b> salle	13H00-14H00: 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 <b>RC</b>
<b>Wednesday, April 17</b> salle	13H00-14H00: 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 <b>RC</b>
<b>Wednesday, April 24</b> Campus Biotech	13H00-16H00: Introduction to Light Sheet Microscopy and visit @ the Campus Biotech of the Advanced Light Sheet Imaging Center (ALiCe) with <b>Stéphane Pagès</b>
<b>TBD</b> Holtmaat lab (CMU)	Hands-on session (2P imaging in vivo, confocal microscope design) Limited number of spots (half a day)
<b>EXAM</b>	- 2h; date to be determined (May 27-31 ?)

**Course location** [CMU Geneva](#). Possibility to attend online for outsiders only, except for the on-site visit and hands-on session)!

**Registration** The course is limited to 20 participants. Register before February 15th, 2024, by writing a mail to [ulrike.toepel@unil.ch](mailto:ulrike.toepel@unil.ch) (LNDS) or [delphine.jochaut@unige.ch](mailto:delphine.jochaut@unige.ch) (Masters Neuro) putting your supervisor in copy and stating the course title as subject. Register to the Moodle (<https://moodle.unige.ch/course/view.php?id=1379>)

