SAPIENZA Università di Roma
Laurea magistrale in Ingegneria delle Nanotecnologie
A.A. 2020-2021

Biophotonics Laboratory Course

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Facoltà di Ingegneria Civile e Industriale
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INTRODUCTION

All information about the course can be found at:

Classroom Code s5j6sg5
https://classroom.google.com/c/MTYyOTYwNjc2ODEy?cjc=s5j6sg5

SAPIENZA E-Learning Portal
https://elearning.uniroma1.it/course/view.php?id=11733

Teacher's Webpage
https://www.sbai.uniroma1.it/~francesco.michelotti/

Catalogue of the Sapienza Courses:
https://corsidilaurea.uniroma1.it/en/view-course-details/2020/30429/20200313105820/4c6fea58-fe3f-46ba-8d5f-42376c1b883d/d427ffe7-d71d-4cbd-9c7b-1e640a23a4e5/c5901fdf-21ea-4b68-8045-207b19a86db1/e9833e69-88bc-4c5f-ba8c-0fdbdced57da

Timetable

The lectures will be held with the following timetable:

Monday	8^{00}-10^{00}	(Hall 17)
Thursday	08^{00} - 12^{00}	(Hall 17) (SBAI Dept)

SBAI Dept Via A. Scarpa 16
Metro B - Policlinico

Course (6 CFU)

3 → 4 CFU – Lectures in a lecture hall

3 → 2 CFU – Work / Demonstration in a lab

→ **Individual laboratory reports → PASS / NO PASS**

→ **4 intermediate tests → 4 marks**

Average mark > 18 → Skip final written exam

→ **Final Stage in a lab → PASS / NO PASS**

(2-3 days) and short report (max 15 pages)

→ **Written exam → Only if did not pass the intermediate tests**

→ **Oral colloquium → on the content of the stage (± 3 points)**

The exams dates are available on INFOSTUD but extra dates are possible by arrangement with the teacher.

Lab work

The laboratory sessions will be held either at SAPIENZA or at some other research institution on THURSDAY. The participation to the lab sessions is compulsory.

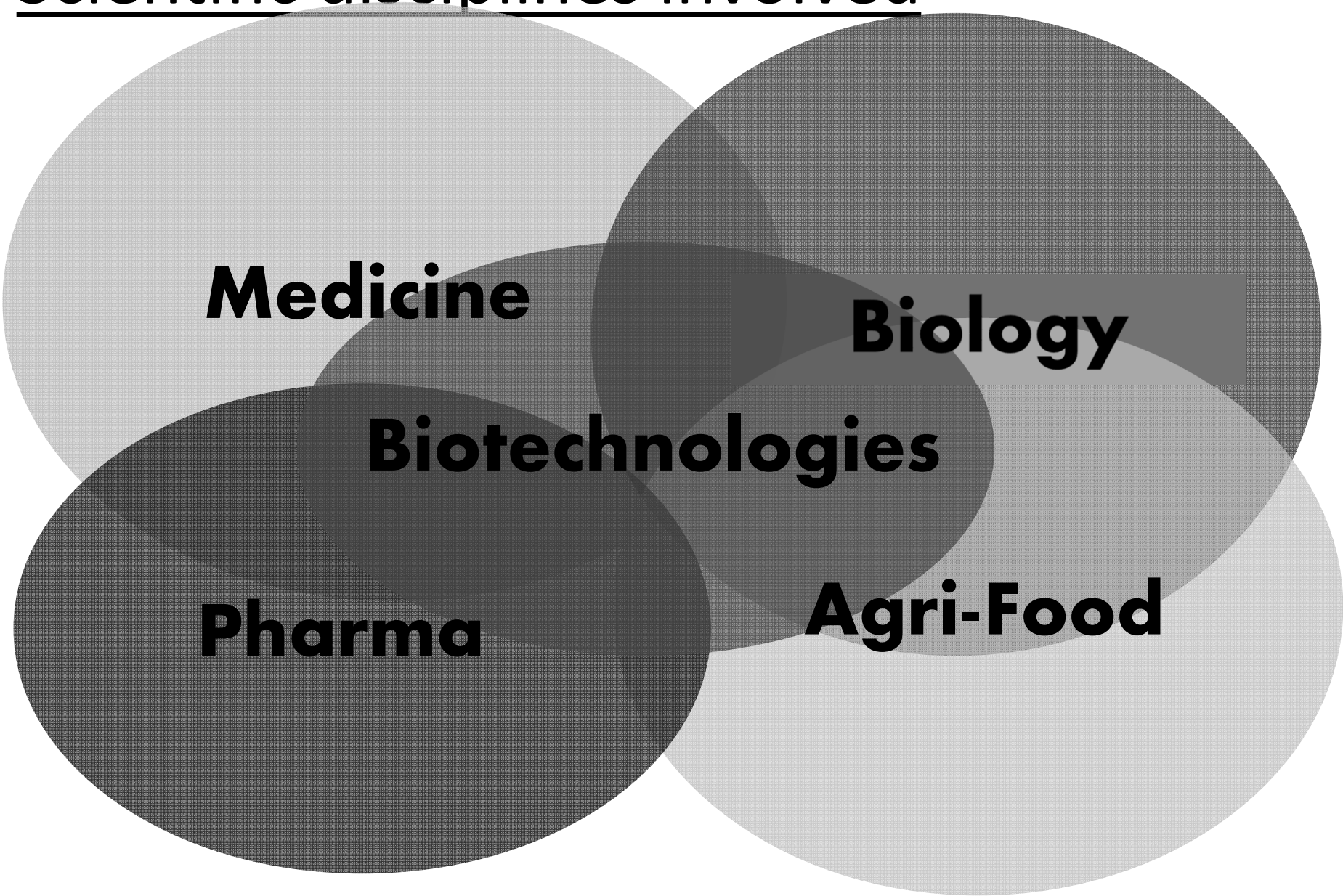
- Geometrical and Physical Optics
- Absorption Spectroscopy
- Fluorescence Spectroscopy
- Wide-Field and Confocal Microscopy
- Surface plasmon resonance biochips

Introduction to the course

The aim of the course is to provide an overview of the most important applications of spectroscopic, optical and photonic techniques in the field of life science.

In particular it will address those techniques that have been already implemented in some integrated photonic device/platform and that can be readily used.

Scientific disciplines involved



Applications of optics and photonics

Among all applications we shall not deal with those that are already extremely well established

Examples

Medicine	Surgery (laser)
	Ophtalmology (lenses, laser)
	Endoscopy (optical fibres)
	Dentistry (laser)
	Photodynamic Therapy (laser)

Applications of optics and photonics

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Examples

Biology Optical microscopy

Applications of optics and photonics

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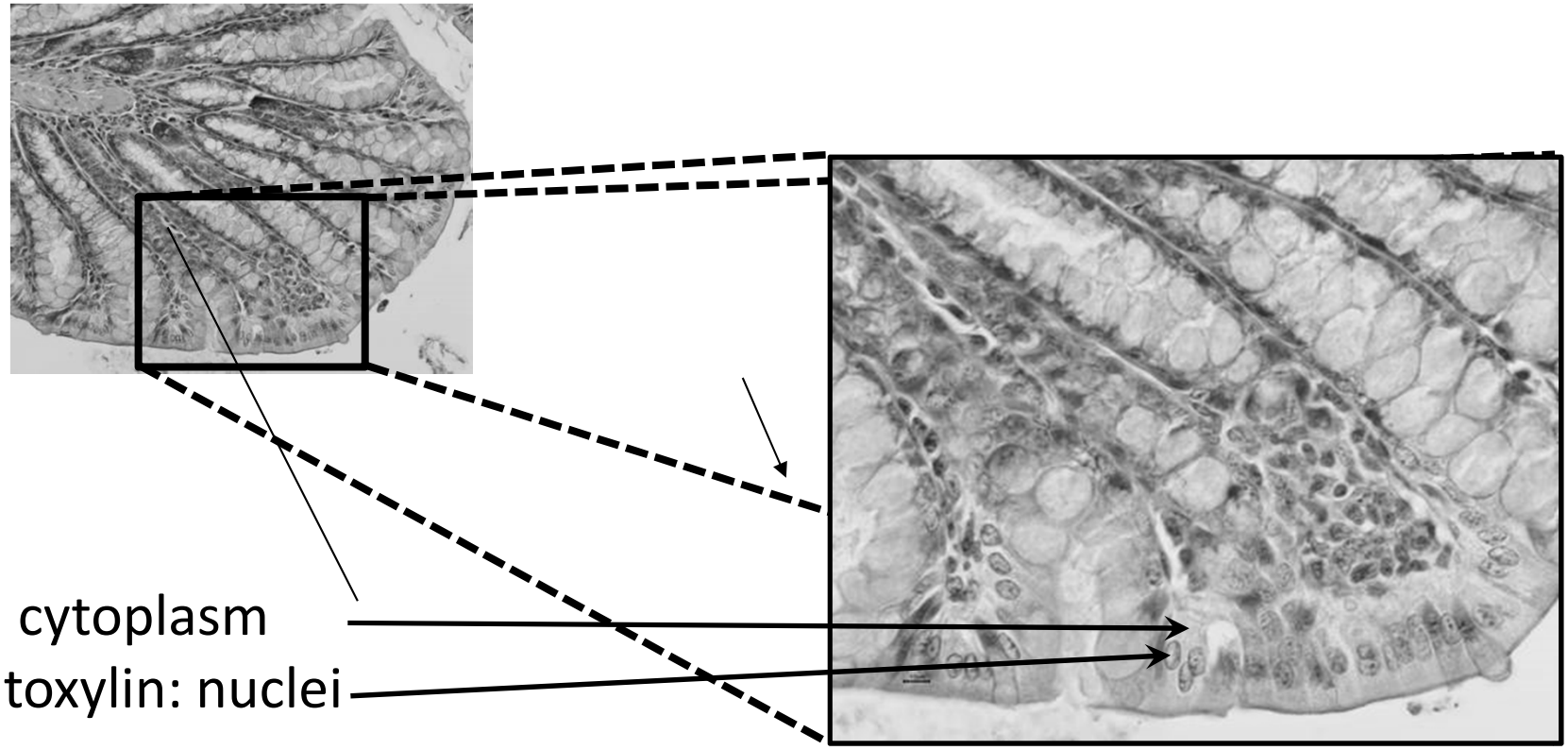
Examples

Agri-Food	Polarimetry (sugar content)

Applications of optics and photonics

Labelling of biological tissues and molecules with coloured dyes is the basis of almost all cited techniques.

Example Conventonial microscopy with stained tissues



Eosin: cytoplasm

Hematoxylin: nuclei

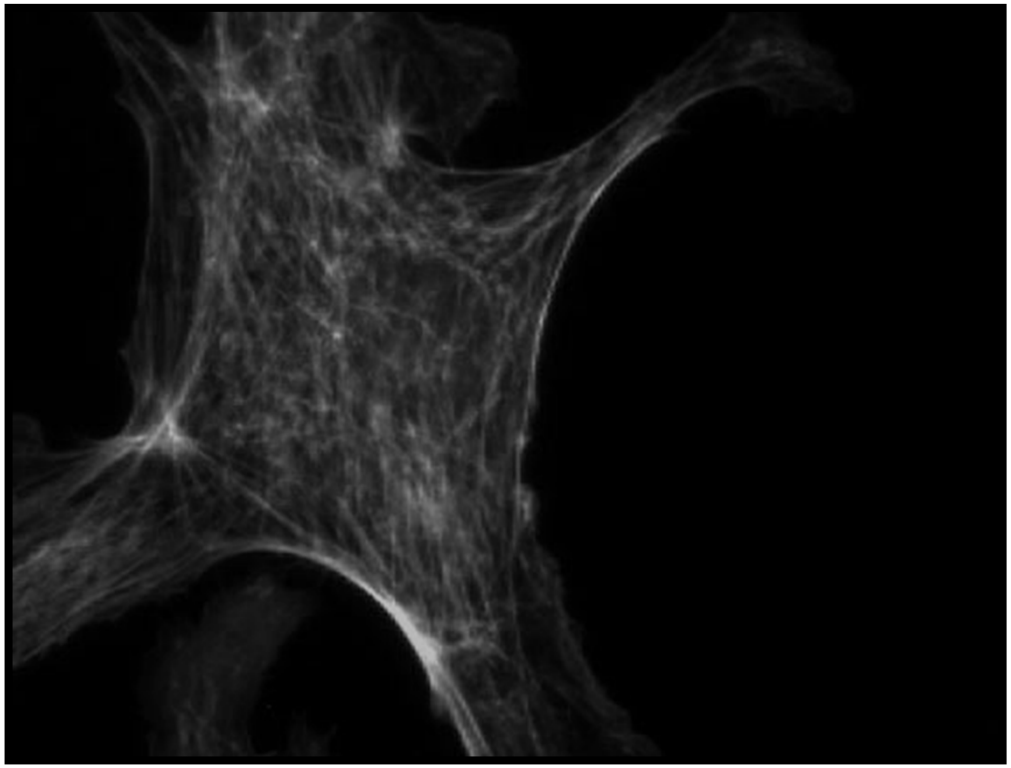
Applications of optics and photonics

Labelling of biological tissues and molecules with coloured dyes is the basis of almost all cited techniques.

Example Fluorescence microscopy on cells stained (labelled) with fluorescent molecules.

Endothelial cells stained with fluorescent molecules that bind selectively only to some cellular compartments

Red	Mitochondria
Green	F-Actin cytoskeleton
Blue	Nucleus



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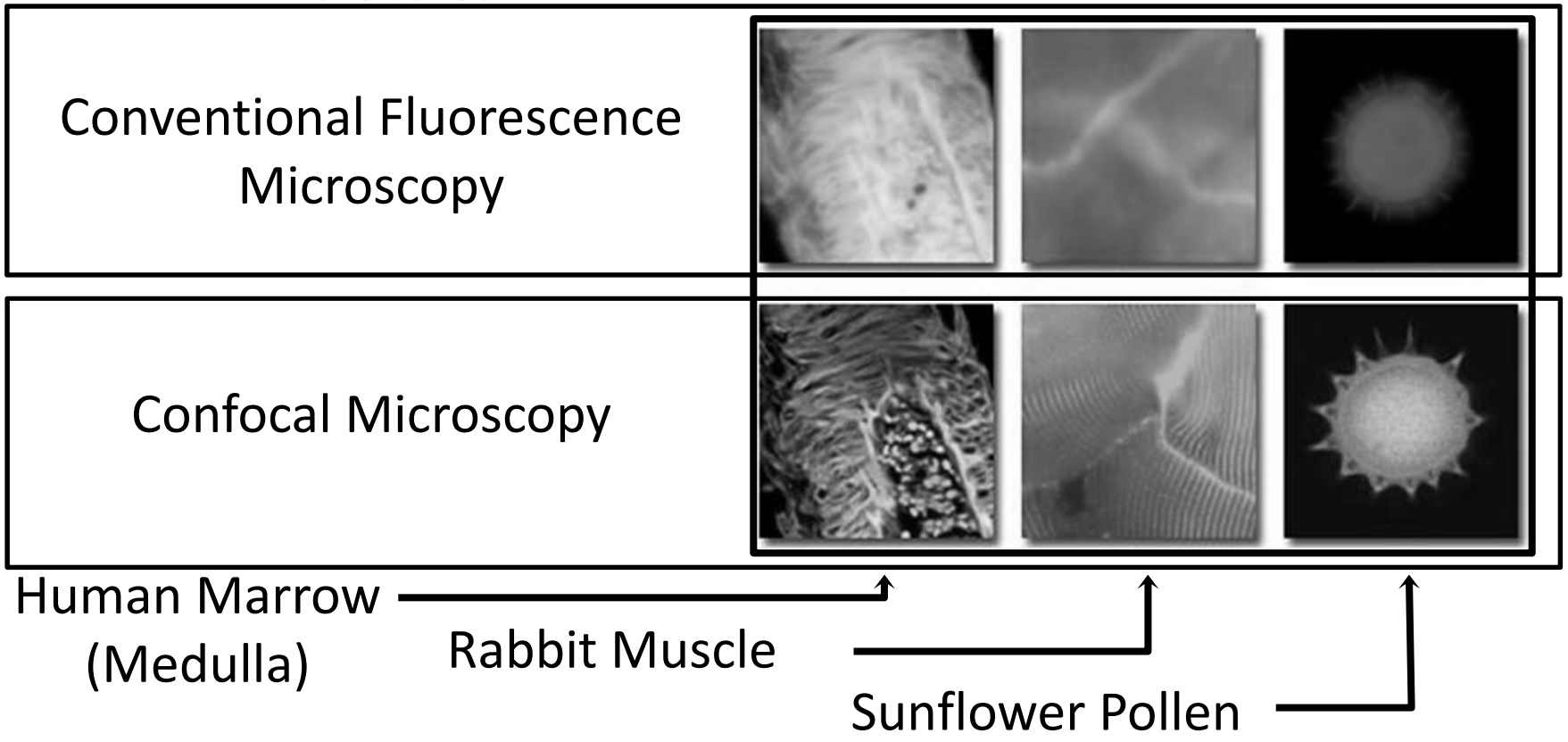
Example Confocal microscopy on cells labelled with fluorescent molecules



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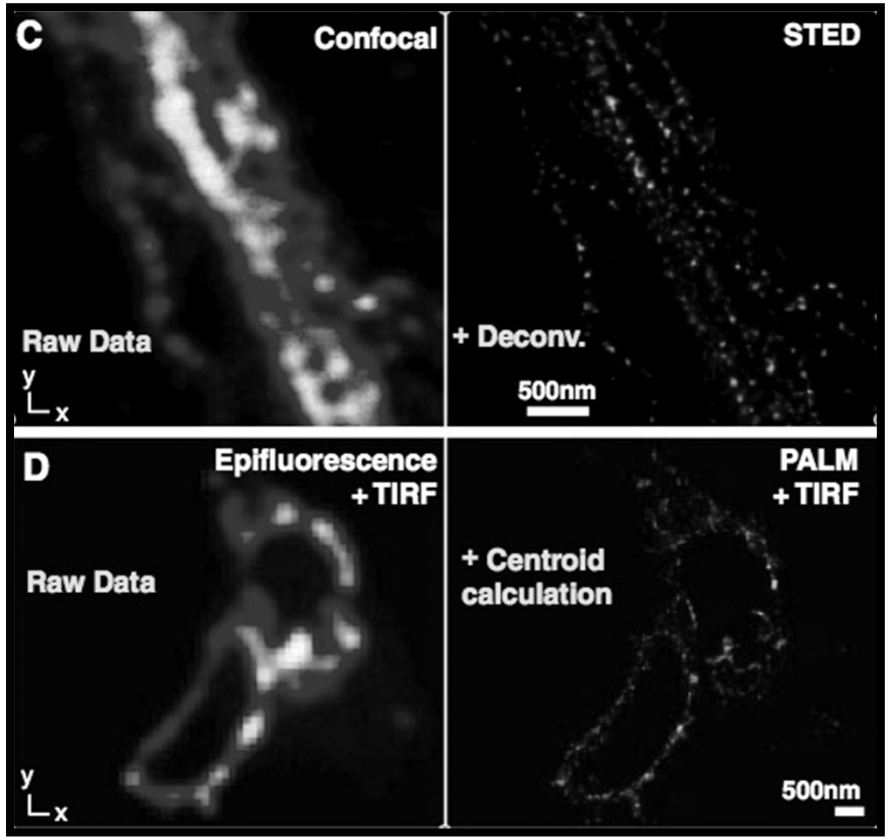
Example Super-resolution fluorescence microscopy

Comparison Confocal vs STED

Comparson Conv.Micr. vs PALM



Applications of optics and photonics

Microscopic Techniques
- Conventional Wide-Field Fluorescence
- TIRF
- FLIM
- FRET, FRAP
- Confocal
- Two-Photon
- Second Harmonic
- Super-resolution (SNOM, STED, PALM, STORM)

Non-Microscopic Techniques
- Citofluorimetry
- ELISA
- DNA-Chip
- Cycle-sequencing
- SOLID

Make use of the emission of luminescent markers (labels)

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Non-Microscopic Label-free
- Surface plasmon Polaritons (SPP)
- Photonic crystals (PC)
- Raman , CARS
- Quantum dots

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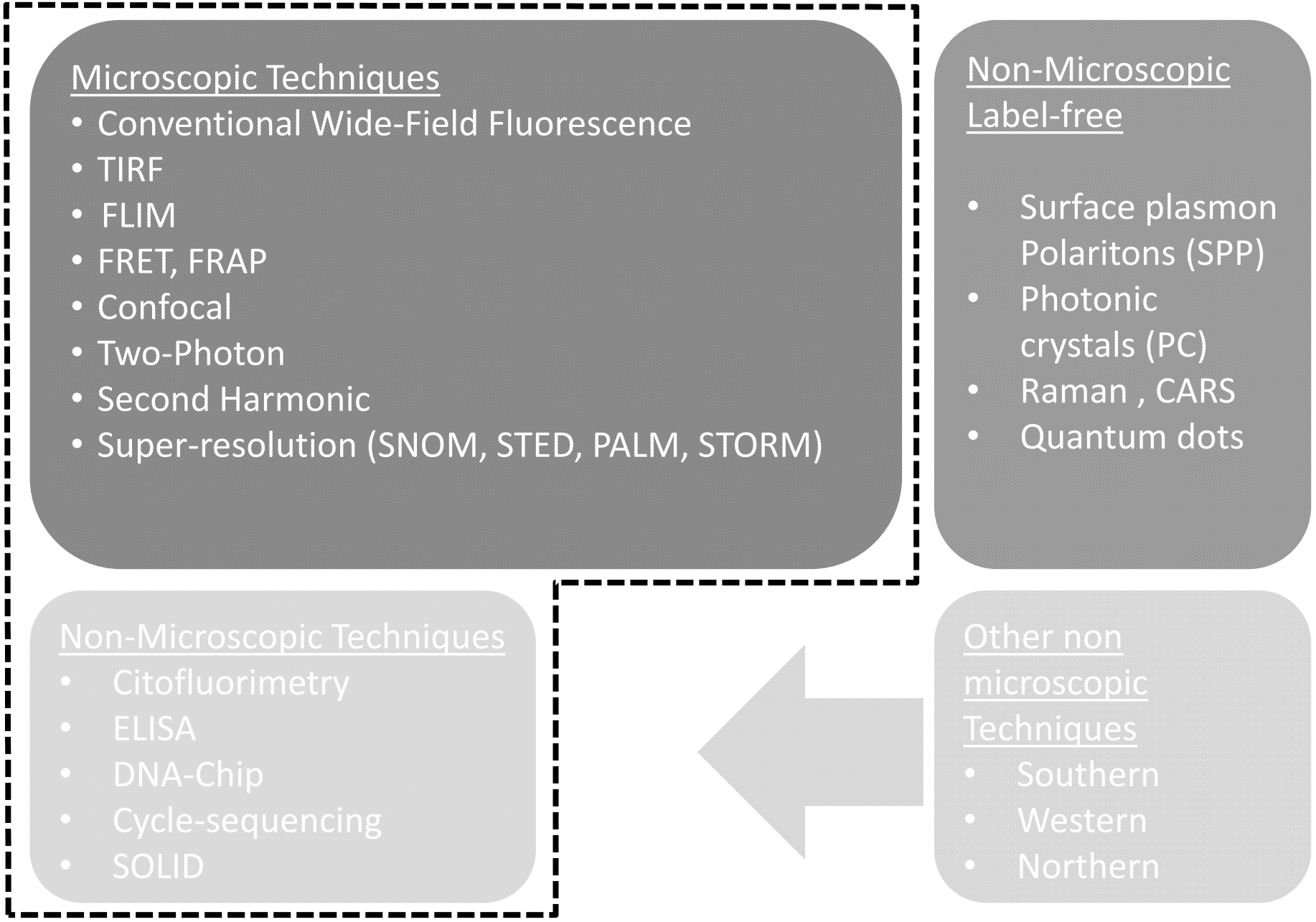
Make use of the emission of luminescent markers (labels)

Other non microscopic Techniques
- Southern
- Western
- Northern

Applications of optics and photonics



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All of them make use of the emission of luminescent markers (labels)