The course will be centred on several topics covering the application of optics in study of biological objects like cells, tissues. In particular, in this course we suppose to consider the ability of a light beam to exert mechanical forces on objects like living cells and to manipulate its position as well as to measure mechanical properties of single living cells and biological molecules (force spectroscopy). We consider techniques of nonlinear microscopy that permit gain new information on living cells that can not be achieved by conventional microscopy. Linear optical microscopy beyond the diffraction limit as well as scanning probe microscopy will present the hottest topics in imaging of biological objects in the last years. Background will be giving first on theory of the physical processes involved, as well as on experimental tools needed for realization the techniques. We propose that during the course students will perform several basic experiments at the ICFO labs that help to understand more deeply physical mechanisms involved in the techniques.

### Teaching staff

<table>
<thead>
<tr>
<th>Coordinator:</th>
<th>DMITRI PETROV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Others:</td>
<td>NIEK VAN HULST</td>
</tr>
<tr>
<td></td>
<td>PABLO LOZA</td>
</tr>
</tbody>
</table>

### Teaching methodology

Presencial teaching + activities

### Learning objectives of the subject

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## Content

- **Introduction**
  Degree competences to which the content contributes:

- **The mechanical action of light \(\xi\) theory of optical trapping**
  Degree competences to which the content contributes:

- **Experimental aspects of optical trapping**
  Degree competences to which the content contributes:

- **Combining the optical trap with Raman spectroscopy and fluorescence**
  Degree competences to which the content contributes:

- **Applications of optical trapping in Physics, Chemistry, and Biology**
  Degree competences to which the content contributes:

- **Molecular fluorescence and nonlinear optics**
  Degree competences to which the content contributes:

- **Microscope, image acquisition and fluorescence imaging**
  Degree competences to which the content contributes:

- **Nonlinear microscopy**
  Degree competences to which the content contributes:

- **Imaging of living cells**
  Degree competences to which the content contributes:
-Microscopy beyond the diffraction limit (optics at the nanometric scale)

Degree competences to which the content contributes:

-Scanning probe microscopy (STM, AFM, NSOM)

Degree competences to which the content contributes:

-Single-molecule biophysics

Degree competences to which the content contributes:

-Experiments in the ICFO labs

Degree competences to which the content contributes:

Qualification system

- Assistance at the lectures and participation in discussions
- Elaboration, presentation, discussion, and defence of a small project from a list suggested by professors.

Regulations for carrying out activities

The usual in University teaching

Bibliography

Basic:


