



Course unit English denomination	Structured light: from principles to modern applications
SS	PHYS-03/A
Teacher in charge	Gianluca Ruffato Filippo Romanato
Teaching Hours	24
Number of ECTS credits allocated	3
Course period	March - June 2026
Course delivery method	<input checked="" type="checkbox"/> In presence <input type="checkbox"/> Remotely <input type="checkbox"/> Blended
Language of instruction	English
Mandatory attendance	<input checked="" type="checkbox"/> Yes (50% minimum of presence) <input type="checkbox"/> No
Course unit contents	<p>The course covers the following topics:</p> <ul style="list-style-type: none">- Recap of wave optics and electromagnetism.- Fourier optics: description of the propagation of a light beam in the paraxial regime.- Orbital angular momentum of light: families of optical vortices and their properties.- Polarization and combination with spatially structured light: vector beams.- Refractive, diffractive optical elements, and metasurfaces: physical principles, design methods, and realization.- Spatial modes in multimode optical fibers and their applications in classical and quantum regimes.- Methods for generating, measuring, and controlling the orbital angular momentum of a light beam.- Design and fabrication of optics for the generation of structured light.- Nanostructuring of matter to achieve nano-optical effects.- Basics of nanofabrication for nanostructured optical devices.- Design and fabrication of metalenses and diffractive optics.- Optical characterization and applications of metalenses and diffractive optics.- Applications of light with innovative devices, such as quantum computers and trapping, optical computers, metaguides, and quantum optics.



Learning goals	<p>At the end of the course, the student will be able to:</p> <ul style="list-style-type: none">- describe the propagation of an optical beam in free space or in an optical fiber- describe the effect of an optical element on the propagation of a light beam- design standard optical elements (refractive or diffractive) and metasurfaces to perform specific optical operations- understand the physical mechanisms underlying optical devices used in the field of information and communication technologies, particularly for encoding and transmitting information on the spatial modes of light, both in the classical and quantum regimes- apply concepts of modeling, simulation, and computation to the design of nanostructured optical devices- understand and describe the correlations between the nanostructuring of matter and the effects on nanostructured light- understand and describe processes and protocols for nanofabrication.
Teaching methods	Lessons in presence and analysis of case studies
Course on transversal, interdisciplinary, transdisciplinary skills	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
Available for PhD students from other courses	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
Prerequisites (not mandatory)	
Examination methods (if applicable)	Final seminar on a topic agreed upon with the teachers
Suggested readings	Slides of the lessons, books and articles suggested by the teachers
Additional information	



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