UNIVERSITÀ DI PAVIA

Anno Accademico 2020/2021

LABORATORY OF QUANTUM PHYSICS

Enrollment year	2020/2021
Academic year	2020/2021
Regulations	DM270
Academic discipline	FIS/01 (EXPERIMENTAL PHYSICS)
Department	DEPARTMENT OF PHYSICS
Course	
Curriculum	Fisica delle tecnologie quantistiche
Year of study	1°
Period	1st semester (05/10/2020 - 20/01/2021)
ECTS	6
Lesson hours	60 lesson hours
Language	Italian
Activity type	ORAL TEST
Teacher	GALLI MATTEO (titolare) - 6 ECTS
Prerequisites	Basic notions of quantum physics, electromagnetism, optics.
Learning outcomes	Learning of the basic concepts and principal methodologies of experimental physics, through the realization of some fundamental experiments in quantum condensed matter physics.
Course contents	Realization of some fundamental experiments in quantum condensed matter physics. (1) Hydrogen atom: study of the Balmer series, experimental verification of the Bohr hypothesis and determination of the Rydberg constant. Measurement of the isotopic shift and detrmination of the hydrogen/deuterium mass ratio. (2) Zeeman effect: study of the atomic level splitting of Sodium and Cadmium in a constant magnetic field and determination of the Bohr magneton. (3) Granger experiment and the Hanboury-Brown-Twiss interferometer: measurement of the second order correlation function g^2(0) for a single photon state and experimental demonstration of the existence of

	the photon. Experimental verification of the particle-wave dualism by means of single-photon interference. (4) Two-photon interference: Hong-Ou-Mandel effect and determination of the coherence length of a one-photon wave packet. Generation of polarisation entangled photon pairs by spontaneous parametric downconversion in a nonlinear crystal. (5) Experimental verification of entanglement: measurement of polarisation correlations and experimental verification of the Bell theorem. The course will also focus on some important experimental and theoretical aspects concerning optics, electronics, optoelectronics, experimental physics, noise reduction and data analysis.
Teaching methods	Frontal lessons and laboratory. Each one of the proposed experiments is preceded by the explanation of the basic theoretical concepts, of the experimental techniques employed and of its scientific/applicative relevance. Afterwards, the student is followed step by step in the realization of the experiments, with particular attention to the critical analysis of the experimental data and its contextualization within the theoretical model.
Reccomended or required readings	Course's notes A. C. Mellissinos and J. Napolitano," Experiments in Modern Physics", Second Edition 2003, Academic press. Bahaa E. A. Saleh, Malvin Carl Teich, "Fundamentals of Photonics", 2nd edition, Wiley. R. Loudon, "The Qauntum Theory of light", Oxford University Press (2008).
Assessment methods	A scientific report on each of the realized experiments will be required at the end of the course. The examination consists in the oral presentation of one of the scientific report, focusing in particular on the theoretical background and the experimental methodologies employed.
Further information	
Sustainable development goals - Agenda 2030	$lbl_legenda_sviluppo_sostenibile