UNIVERSITÀ DI PAVIA

## Anno Accademico 2018/2019

# LABORATORY OF QUANTUM PHYSICS I

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| **Enrollment year** | 2018/2019 |
| **Academic year** | 2018/2019 |
| **Regulations** | DM270 |
| **Academic discipline** | FIS/01 (EXPERIMENTAL PHYSICS) |
| **Department** | DEPARTMENT OF PHYSICS |
| **Course** | |
| **Curriculum** | Didattica e storia della fisica |
| **Year of study** | 1° |
| **Period** | 1st semester (01/10/2018 - 18/01/2019) |
| **ECTS** | 6 |
| **Lesson hours** | 72 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. Measurement of the energy levels of orto-helium and para-helium. (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) Laser light propagation in a ruby crystal: study of the effect of coherent population oscillation, measurement of the speed of light in the "Slow light" (v=10 |

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| | m/s) regime. (4) Nonclassical states of light: photon pairs generation by spontaneous parametric down-conversion in a nonlinear crystal, measurement of time-coincidences using single photon detectors. 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<br><br>A. C. Mellissinos and J. Napolitano," Experiments in Modern Physics", Second Edition 2003, Academic press.<br><br>Bahaa E. A. Saleh, Malvin Carl Teich, "Fundamentals of Photonics", 2nd edition, Wiley.<br><br>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** | 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. |
| **Sustainable development goals - Agenda 2030** | $lbl_legenda_sviluppo_sostenibile |