PHY 690
Introduction to Quantum Information Technology
Spring 2016

Meeting Time and Place:

Mo-We 5:30-6:50pm S265

Instructor:

Prof. Eden Figueroa
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Office hours: Tu-Th 1:30-3:00pm A-104

Topics:

Nonlinear optics
Optical coherence
Quantum electromagnetic field
Single-photon qubit experiments
Atomic physics
Experimental implementation of Quantum Information
(atoms, ions, superconductors)

Textbooks::

Lasers, by P. W. Milonni and J. H. Eberly (Wiley Intersience, Second Edition)
Quantum Optics, by M. Scully and M. Zubairy (Cambridge Press, First Edition)
Reviews of Modern Physics articles

Grading:

HW 15%, Midterm Exam 30%, Final Exam 30%, Experimental Projects 25%

Projects:

Atomic physics/quantum optics: Quantum Technology Laboratory, S-142

Learning objectives

At the end of the term the student should have an understanding of the basic principles of the creation and propagation of quantum fields of light. Additionally he/she should have develop an understanding of the quantum physics governing the interaction of quantized light fields with complex atomic systems. Finally, the student will have learned several of the fundamental experimental techniques in in which the aforementioned concepts are realized and measured.

Schedule and assignments

(see topics guide, assignments will be divided into homeworks, paper reports and presentations)

HW is due in A-104 on Fridays following the week in which it is assigned, and it will be graded. You may work together on solving the problems, but cannot hand in the same solutions. Solutions will be posted after the homework is collected.

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Topics guide for Introduction to Quantum Information Technology Spring 2016

Lecture #	Topic
1	Kramers-Kronig relations
2	Classical theory of dispersion
3	Nonlinear susceptibilities and phase matching
4	Second harmonic and sum frequency generation
5	Nonlinear crystals and quasi phase matching
6	Hanbury Brown-Twiss effect
7	Second order coherence
8	Quantization of the electromagnetic field
9	Single-mode quantum states of light
10	Phase-space probability densities
11	Homodyne tomography
12	Parametric down-conversion, squeezing, and conditional preparation of photons
13	Quantum process tomography
14	Quantum cryptography
15	Quantum teleportation
16	Quantum computing with light
17	Rotating wave approximation
18	Two-level atom
19	Jaynes-Cummings model
20	Master equations and spontaneous emission

21 Three-level atom, Dark states and STIRAP

22 Electromagnetically-induced transparency and giant optical nonlinearity

23 Photon echo and Quantum memories

24 Cooling and trapping of atoms

25 Cooling and trapping of ions

26 Cavity quantum electrodynamics

27 Superconducting qubit experiments