

Physics 513 (Tentative) Syllabus

Lect.	Week	Dates	Topic
1	1	19-Jan	Introduction, admin., single photons, photoelectric effect, interference, delayed choice experiments
2	1	21-Jan	Interference calculations, interference of massive particles, Glauber theory of photodetection
3	2	26-Jan	HW1 discussion, $g(2)$ measurements, coherent states, quantum-dot based single-photon source
4	2	28-Jan	Hanbury-Brown Twiss with photons and atoms; photon bunching and anti-bunching; intro to squeezing
5	3	2-Feb	Amplitude, number, and phase squeezing, theory and experiment.
6	3	4-Feb	Squeezing data, effect of loss, Wigner tomography, Laser pointer, LIGO
7	4	9-Feb	Phillegor-Mandel-expt., BEC-interf.; SPDC
8	4	11-Feb	2-photon interference, Hong-Ou-Mandel interferometer, "railcross" experiments; single-photon Wigner function
9	5	16-Feb	Qubits, polarization, Bloch/Poincare sphere, Light-atom interactions, RWA, unitary transformations, π - and $\pi/2$ -pulses
10	5	18-Feb	Quantum Zeno effect (ions), quantum anti-zeno effect, quantum interrogation
11	6	23-Feb	Cavity QED a la Haroche/Kimble, lifetime enhancement/reduction
12	6	25-Feb	Cavity QED; (vacuum) Rabi oscillations, S. cat states, (de)coherence, Rabi vs. Ramsey fringes, photon QND
13	7	1-Mar	Complementarity, Railcross Q. Eraser, Bell's inequalities, basic theory, experiments; loopholes
14	7	3-Mar	BI versus relativity; Leggett inequality; other tests of nonlocality, GHZ and Hardy tests; entanglement in other systems
15	8	8-Mar	Quantum metrology, quantum lithography, super-phase resolution, entanglement-enhanced clocks
16	8	10-Mar	Quantum dense coding, quantum teleportation
17	9	15-Mar	No quantum-bit-commitment; basic quantum cryptography, security, single- and entangled photon;
18	9	17-Mar	Phase and polarization; records and optimal attacks; decoy-state protocol; quantum networks
19	10	29-Mar	Quantum measurements, projective and 'weak', POVMs
20	10	31-Mar	Quantum states and density matrices, tomography, entanglement measures, distillation, "bound" entanglement
21	11	5-Apr	Quantum information, single-qubit gates, CNOT gate, Hadamard gate, circuit model, Deutsch-Jozsa algorithm
22	11	7-Apr	Fault-tolerant threshold; quantum error correction; decoherence-free subspaces
23	12	12-Apr	Shor's algorithm, Grover's search algorithm and variations
24	12	14-Apr	<i>Linear optical quantum computing</i>
25	13	19-Apr	<i>Ion-trap quantum computing</i>
26	13	21-Apr	<i>Superconducting qubits</i>
27	14	26-Apr	<i>Neutral atoms (Rydberg + optical lattices), q. simulation</i>
28	14	28-Apr	<i>Topological quantum computing</i>
29	15	3-May	<i>Macroscopic Q. superpositions</i>
			<i>Titles in italics are student-presentation lectures</i>