Atomic and Optical Physics (Physics 721)

Time: Wednesday/Friday 2:30 – 3:45

Room: ATL 1109

Instructor:
Alicia Kollár, akollar@umd.edu, PSC 2112

TA: To be announced

Course Goals:
This course will provide a graduate level introduction to atomic and optical physics.

Grades:
Grades will be derived from homework. There will typically be one problem set per week due Wednesday before the start of class. Homework may be either hand written or LaTeXed, but should be submitted electronically. Single pdf documents only with problems in order. (No collections of individual camera shots.)

There will be a total of approximately 10 HW sets. The highest 8 scores will be counted toward your grade, and the remaining scores will be dropped. Late homeworks will not be accepted and will automatically count toward your allowed drops.

Text:
This course will not use a specific textbook. Instead it will draw from a variety of sources. Recommended references are:
-Quantum and Atom Optics [Steck, online and unpublished]
-Quantum Optics [Scully & Zubairy]
-The Quantum Theory of Light [Loudon]
-Physics of Atoms and Molecules [Bransden and Joachain]
-Atom-Photon Interactions[Cohen-Tanoudji, Dupont-Roc, Grynberg]
-Laser Cooling and Trapping[Metclaf and van der Straten]

An extended list of recommended references for the course material and further reading will be circulated separately.

Course Outline:

Light

-Quick review of E&M, modes, momentum, Poynting vector
-Quantization of the Electromagnetic Field
-Classical theory of coherence, correlation functions
-Hanbury Brown and Twiss, quantum theory of coherence
-Quantum measurement of light, photon counting and homo/heterodyne
-Coherent states, squeezing, Hong-Ou-Mandel

Atoms

-Spectroscopic notation
-Fine structure and Lamb shift
-Helium and multi-electron atoms
-Wigner-Eckhart
-Hyperfine structure
-Atoms in external fields: Zeeman and Stark

Atoms & Light

-2-level atoms, Einstein A & B coefficients, Rabi spectrum
-Optical Bloch equations, master equations
-Dipole approximation, dipole radiation
-Selection rules
-Line shapes
-Lamb-Dicke effect
-3-level systems. EIT/Raman
-Dressed states
-Non-linear optics, SHG and 4-wave mixing

Atomic Motion in Light Fields

-Light shifts, Doppler cooling
-Subdoppler cooling

Non-class days:

-There will be no class during the thanksgiving recess (Nov 27, Nov 29).

-The university has cancelled classes on the afternoon of Friday September 27th to make way for a special event. If possible, this lecture will be rescheduled to an alternate time, but class will not meat at the regular time.