Quantum Physics I

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    office hours: M W Th 3:00-3:40 and by appt.

Lecture Room: PSH 356

Lecture Times: MWF 12:40-1:30

Required Text: J. Brehm and W. Mullin, Introduction to the Structure of Matter
Recommended Text: D. Griffiths, Quantum Mechanics

Grader: ?????

Prerequisites: PHY 201 (math methods) and 252 (Physics III) or equivalents.

Corequisites: PHY 302 (math methods) and 310 (Classical Physics I) or instructor approval.

Grades: Grades will be based upon homework (150 pts), three midterms (3x100 pts) and a final examination (150 pts). All examinations are closed-book, but you may bring one 3”x5” note card to each examination.
Exam schedule:
    Exam 1: F. Sept. 20
    Exam 2: W. Oct. 16
    Exam 3: W. Nov. 13
    Final Exam: Dec 13 12:20-2:10 PM
Now is the time to make sure that these dates do not conflict with anything in your datebook.

Homework: Equivalent to 1.5 midterm examination. You are free to discuss homework problems with other students in the class, but the final product must be your own work. Do not share solutions. Content is the most important, however I will deduct significant credit if the work is not clear, clean and legible. A collection of formulas and numerical values is not enough! You should include a discussion of your work so I will be able to understand your motivations and reasoning. If I do not get a grader, I will grade only a selection of the assigned homework problems.
# Tentative Schedule for PHY-314

## Introduction to Special Relativity

| Aug.  | M 26: Experimental underpinnings of relativity; Einstein’s postulates  
|       | W 28: Light Clocks, Time Dilation, Length contraction  
|       | F 30: Doppler shift for light; Lorentz transformation  
| Sept. | M 2: Labor Day Holiday  
|       | W 4: How to add velocities; the four-velocity  
|       | F 6: The Dynamics of fast particles in EM fields  
|       | M 9: Energy and Momentum; the four-momentum  
|       | W 11: Conservation of four-momentum; Collisions and Reactions  

## The Particle Properties of Light

| F 13: Blackbody radiation and Planck’s formula  
| M 16: Brief Review of Statistical physics  
| W 18: Microstates, Macrostates and Maxwell distribution  
| F 20: Examination I  
| M 23: Planck/Einstein postulate, and a derivation of Planck's law  
| W 25: The Photoelectric effect; photons  
| F 27: X-rays, continuous and discrete spectra  
| M 30: Photons as particles; the Compton effect  

## Simple Models of the Atom

| Oct.  | W 2: Thompson’s “discovery” of the electron (e/m), and Millikan’s measurement of its charge  
|       | F 4: The Nuclear Atom: Rutherford scattering and the Geiger-Marsden experiment  
|       | M 7: Cross section; the discovery of the atomic nucleus  
|       | W 9: The quantization of atomic energy levels; atomic spectra  
|       | F 11: Bohr's theory of the hydrogen atom  
|       | M 14: X-ray spectra, the atomic number and the periodic table  
|       | W 16: Examination II  
|       | F 18: Einstein coefficients and the Laser  

## The Wave Properties of Matter

| M 21: Wave Properties of Matter; DeBroglie wavelength; the Davisson/Germer Expt.  
| W 23: Wave-Particle Duality; probability distributions for photons  
| F 25: The Uncertainty Principle; Heisenberg's microscope; zero-point energy  
| M 28: Wave packets; phase and group velocity (Combined with free particle motion)  
| W 30:  

## Introduction to Quantum Mechanics

| F 1: The wave function; Born's interpretation, The Schroedinger equation  
| M 4: probability densities and currents; averages and expectation values  
| Nov.  | W 6: States with definite energy; Schroedinger's time-independent equation  

## Quantum Systems in One Dimension

| F 8: Bound states of a particle in a square well (infinite; finite)  

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"Experimental underpinnings of relativity; Einstein’s postulates"  
"Light Clocks, Time Dilation, Length contraction"  
"Doppler shift for light; Lorentz transformation"  
"Labor Day Holiday"  
"How to add velocities; the four-velocity"  
"The Dynamics of fast particles in EM fields"  
"Energy and Momentum; the four-momentum"  
"Conservation of four-momentum; Collisions and Reactions"  
"Blackbody radiation and Planck’s formula"  
"Conservation of four-momentum; Collisions and Reactions"  
"How to add velocities; the four-velocity"  
"The Dynamics of fast particles in EM fields"  
"Energy and Momentum; the four-momentum"  
"Conservation of four-momentum; Collisions and Reactions"  
"Thompson’s “discovery” of the electron (e/m), and Millikan’s measurement of its charge"  
"The Nuclear Atom: Rutherford scattering and the Geiger-Marsden experiment"  
"The quantization of atomic energy levels; atomic spectra"  
"Bohr's theory of the hydrogen atom"  
"X-ray spectra, the atomic number and the periodic table"  
"Einstein coefficients and the Laser"  
"Wave Properties of Matter; DeBroglie wavelength; the Davisson/Germer Expt."  
"Wave-Particle Duality; probability distributions for photons"  
"The Uncertainty Principle; Heisenberg's microscope; zero-point energy"  
"Wave packets; phase and group velocity (Combined with free particle motion)"  
"The wave function; Born's interpretation, The Schroedinger equation"  
"probability densities and currents; averages and expectation values"  
"States with definite energy; Schroedinger's time-independent equation"  
"Bound states of a particle in a square well (infinite; finite)"
M 11: Veteran’s Day Holiday
W 13: Examination III
F 15: Quantum Oscillator I
M 18: Quantum Oscillator II
W 20: Quantum Scattering Theory in one-dimension I
F 22: Quantum Scattering Theory in one-dimension II

Quantum Systems in Three Dimensions

M 25: Quantum Boxes and Oscillators in 2 and 3 dimension;
W 27: Three-dimensional Problems with spherical symmetry; Central forces
F 29: Thanksgiving Holiday
M 2: Angular momentum I; separation of variables
W 4: Angular momentum II; spherical harmonics
Dec. F 6: The radial equation and its properties
M 4: The Hydrogen atom