INTERMEDIATE LABORATORY - PHYX 3870-3880

List of Experiments
Fall 2015

MECHANICS

M1. ***Kater's Pendulum***

A straightforward lab using a reversible physical pendulum to measure the local acceleration of gravity, g, to less than 0.01%. Emphasis is given to detailed error analysis and error propagation and to high precision measurements. Computer interfacing with photogates and motion sensors. A good beginning lab.

M2. ***Coupled Pendulum***

Investigation of two pendulums coupled by a spring between them. Lab emphasizes comparison of measured results of the periods and damping to values derived from a theoretical model using differential equations. Completion of Analytical Mechanics is recommended. Computerized data collection with voltage probes and motion sensors and data reduction are used.

ELECTRICITY & MAGNETISM

E2. ***Thompson's e/m Experiment***

Measures the ratio of the charge to mass of an electron (e/m) by investigating the trajectory of electrons in electric and magnetic fields. The British physicist J. J. Thompson received a Nobel prize for the experiment. Good preparation for *Electron Diffraction from a Crystal Lattice* and subsequent Advanced Laboratory experiments. Emphasis is on determining the interdependence of experimental parameters (e.g., accelerating voltage, magnetic field, radius, charge) through the Lorentz Force Law. A good beginning lab.

THERMODYNAMICS/STATISTICAL MECHANICS

T1. ***Velocity and Gravitational Distributions***

An excellent introduction to the kinetic theory of gases. Uses an air table to investigate the statistical distribution of the velocity of particles. Compares the results with Statistical Mechanics velocity distribution functions. Also explores the effect of an external field (gravity) on the statistical distribution of particles. Emphasizes statistical modeling. Computer interfacing uses a video camera.

T2.** ***Thermionic Emission.

Measurements of rate of emission of electrons from a filament as a function of temperature. Theoretical curves from the Richardson-Dushman equation based on kinetic theory and statistical mechanics will be compared to measurements. Emphasis on non-linear curve fitting and high temperature techniques.

T3. ***Avagadro's Number: Electrolysis and Brownian Motion***

Investigates the use of hydrogen fuel cells, energy conversion and efficiency through a series of closely related experiments. Uses studies of hydrolysis and Brownian motion to determine Avagadro's number. Emphasizes simple modeling and error analysis.

T4. ***Blackbody Radiation.***

Measurements of the intensity and spectrum of a blackbody radiator as a function of temperature. Theoretical curves from the Wein and the Stefan-Boltzmann T^4 laws will be compared to measurements. Emphasis on non-linear curve fitting and high temperature techniques.

ATOMIC PHYSICS

A1.** ***Franck-Hertz Experiment

Classic experiment which demonstrates the quantized nature of atomic electron orbitals. Good practice in use of electronics test equipment. Emphasizes experimental design and data analysis methods. Extensive computerized data collection.

A2. ***Photoelectric Effect***

Explores the interaction of light with matter through the photoelectric effect. Determines the dependence of the photo current on the physical parameters of the experiment. A very simple experiment. Emphasizes determination of the relation of the experimental parameters in Planck's relation.

A3a. ***Speed of Light***

The first part measures the speed of light using the pulsed laser method. The second part measures the propagation time of a light pulse through a fiber optic cable and compares this with the propagation time of an electron pulse through a wire. A third part uses rotating mirrors to measure the speed of light. Emphasis is on contrasting different methods to determine the same physical quantity. A simple experiment.

A3b. ***Fiber Optics***

A simple set of experiments in the use of fiber optics. Compliments the use of fiber optics in the Speed of Light Experiment

A4. ***Atomic and Solar Spectra***

Investigates the atomic spectra of elements using a computer automated diffraction spectrometer and interferometry. Study the solar spectrum as a blackbody with absorption lines.

OPTICS

O5.** ***Fresnel and Fraunhofer Diffraction and Spatial Filtering

Investigates diffraction from single and double slits in the Fresnel and Fraunhofer limits. Computerized data collection is used. Detailed analytical and numerical data analysis. Use of spatial filtering of diffraction plane images.

SOLID STATE PHYSICS

S1.** ***Hall Effect

Determines the sign and concentration of charge carriers in semiconductors by studying carrier mobility in magnetic and electric fields. Provides good background for *The Diode and Its Applications* and *Electron Paramagnetic Resonance*. Emphasizes physical principles of semiconductor physics. Computer automation of data collection.

S2. ***Electron Diffraction from a Crystal Lattice***

Investigates the diffraction of electrons from a thin polycrystalline carbon film. Analysis of diffraction pattern allows determination of the crystal structure and lattice spacings of graphite. A suggested prerequisite for the *X Ray Diffraction* Advanced Laboratory experiment. Emphasizes diffraction physics principles and determination of the experimental parameters related to Bragg's Law.

S5. ***Reflection/Transmission Spectroscopy***

Measure the visible and ultraviolet reflection spectra of conductors, semiconductors and insulators. Explores the underlying solid state physics of photon interactions with matter, including interband transactions and plasmons. Uses a computer interfaced spectrometer to obtain nice data.

S2. ***Ultrasonics***

Explore the acoustic properties of solid materials using a new ultrasonic test unit. Can measure the speed of sound in materials, measure sample thicknesses, locate and characterize defects and many other experiments.

*** Optional Experiments**

Important Dates

Experiments selected	9/3/14
Preview meetings	9/3/14 to 9/15/14
Experiment 1	9/10/14 to 10/10/14
Experiment 2	10/13/14 to 11/3/14
Experiment 3	11/5/14 to 12/5/14
First Revisions Due	
Final Oral Presentation	12/3/14 and TBD