Phys 312 - Experimental Physics
Spring 2008 - Princeton University

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Lectures: Tuesday 12:30-1:20 , Room Jadwin 343
Labs: Afternoons by arrangement with TAs
Webpage: http://www.princeton.edu/~romalis/PHYS312/

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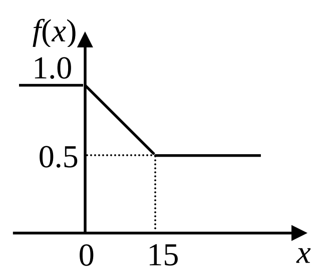
In this class you will learn a variety of experimental techniques and perform experiments illustrating some of the concepts discussed in advanced physics classes. Each week we will have a lecture discussing general experimental and data analysis techniques, but the main focus will be on lab work. You will need to complete 6 labs working in pairs, each taking approximately two weeks.

A sign-up board will be available on the forth floor in Jadwin to schedule your labs. You can choose any combination of labs, except that everyone has to complete the electronics labs. Lab instructions will be available online. You will get keys for the lab rooms and can work independently after getting initial instructions from the TA responsible for that lab. For labs involving radioactive sources you will need to pass an online radiation safety course and will be issued a radiation-monitoring badge.

A lab report will be due at the end of each two week period. Each person has to submit his or her own report. You can discuss data specifics but analysis and interpretation of data should be done independently. In performing the labs your main goal should be to master the experimental apparatus and collect the best possible data. This generally will require at least two iterations. In the beginning of the first week you will meet with the TA and get introduced to the experimental apparatus. By the end of the first week you should collect for first set of data. By the beginning of the second week you should analyze the data and identify ways in which they can be improved. In the second week you can then collect better data and write the lab report. Lab reports should contain a brief general discussion of the physics, schematic of the experimental apparatus, data, analysis, quantitative discussion of uncertainties and limitations of the experimental apparatus and references. Reports should have an abstract, resemble in style a research article and should be roughly 2000-4000 words. You can use any software for preparing reports, but points can be taken off for unscientific-looking reports (e.g. cheesy bar chart graphics made by Excel). To get a perfect score on the report you need to demonstrate that you have understood all features and limitations of the apparatus and optimized collection of data.

The late policy for lab reports will be as follows: $S = S_0 f(d - 3 - p)$, where S_0 is the sum of all lab report scores, d is the sum of the number of days late for all reports and p is the number of personal extensions granted for justifiable causes such as sickness



or serious equipment failure. The function $f(x)$ is shown in the figure.

In addition to lab reports we will have oral exams, one around midterms and another during the exam week. You will be asked questions on the material covered during lectures and on the labs that you have performed. The grade in the class will be based roughly 60% on written reports and 40% on oral exams.

Approximate Lecture Schedule

Date	Lecture	Date	Lecture
February 5	Introduction and electronic circuits	March 25	Cryogenics
February 12	Data analysis techniques	April 1	Nanofabrication
February 19	Radioactivity	April 8	Medical Physics
February 26	Vacuum Technology	April 15	Quantum computers
March 4	High energy particle detection	Aril 22	Particle acceleration
March 11	Lasers and Optics	April 29	TBD

Labs

Experiment	TA	Description
Electronics lab (required)	Mike	Building a two-way radio
Muon Decay	Ben	Measurement of the lifetime of cosmic muons stopped in liquid scitillator
NMR	Fiona	Nuclear Magnetic Resonance, Spin echo and measurements of transverse spin relaxation time
Optical pumping	Mike	Demonstration of optical pumping of Rb atoms and optical detection of magnetic resonance.
Mössbauer	Ben	Demonstration of the Mössbauer effect : recoilless emission and absorption of gamma rays
Holography	Ben	Recording of photographic laser holograms
β spectrum	Ben	Measurement of the energy spectrum of beta decay electrons
E-coli	Ben	Study of the motion of E-coli bacteria
Two-slit interference	Mike	Double-slit single photon interference measurements
Positron decay	Fiona	Measurement of the momentum distribution of gamma rays from positron decay
Electron Diffraction	Fiona	Measurement of electron diffraction by metal crystals
Photoelectric effect	Fiona	Photoelectric effect: study of the photoemission of electrons
Coulomb force	Fiona	Test of the $1/r^2$ nature of the Coulomb force