8.13-14 Experimental Physics I & II "Junior Lab"

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Purpose and Format of Junior Lab Introductory Experiments

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1. INTRODUCTION

Students who have not acquired basic experimental skills before going into the complex experiments of 8.13 are at some disadvantage. Therefore, the first four regular sessions of Junior Lab are devoted to a vareity of introductory one-session experiments aimed at familiarizing you with concepts, apparatus, and procedures you will use in the experiments of the following sessions. Students with extensive laboratory experience may demonstrate their prowess by exceptionally skilled execution of these simple experiments.

The four introductory experiments are concerned with geometrical and physical optics, Poisson statistics, transmission and reflection of electrical pulses and the Photoelectric effect. Each requires adjusting equipment, making measurements, analyzing data, estimating physical quantities, and assessing random and systematic errors. Each experiment is designed to require three hours in lab and about 6 hours of homework to obtain presentable results. (The credit hours for the course are 18 - 6 hours in class, and 12 hours of homework per week).

2. THINGS TO DO BEFORE COMING TO LAB

There are no regular lectures in Junior Lab. Only cursory explanations of the relevant theory are generally presented in the lab guides. Therefore, you will find it essential for a proper understanding of the experiments to dig the theoretical background out of the course text (Melissinos), your other textbooks, or the references available from the Junior Lab electronic library, the Physics Reading Room, and the Science Library. Before starting a a new experiment, you should read the guide, consult the references, and write out the answers to the preparatory problems, which are to be handed in before you start the experiment. Considering the limited time available for your work in the laboratory, it is advisable to plan your work ahead of time:

1. List the Objective(s);
2. Make a list of the things you have to do and the data you must obtain;
3. Identify required calibrations;
4. Attempt to forsee how particular problems can be cirumvented.

2.1. Example: Photoelectric Effect

Objectives Measure the relationship between photon energy, retarding voltage (between anode ring and cathode), and photoelectron current using a mercury discharge lamp, thin film interference filters (for selecting specific mercury emission wavelengths and an integral photocell.

Tasks

1. Capture and focus the light from the mercury lamp inside of the anode ring.
2. Ground the apparatus to make it insensitive to interfering signals and currents.
3. Explore the effects of stray light entering the apparatus on the measured photocurrents.
4. Measure the photocurrent as a function of retarding voltage for several different wavelengths and repeating several times to build up meaningful statistics.

Calibrations
Calibrate the electrometer and voltmeter against the best available meters

Possible Problems Changing lamp intensities, ground loops, electromagnetically induced noise

Starting with these experiments, you must record in your lab notebook sufficient information about what you have done so that you could write a complete and publishable account of your experiments days or years later without having to do anything over again. That means your lab notebook must have dates, diagrams, narratives, tables of raw data, formulas, computations, reduced data, error analysis and conclusions in a neat, compact, and orderly arrangement. Your Junior Lab notebook should have a respectable place on the shelf next to your later research notebooks.