

PHYS 212 LAB SYLLABUS: FALL 2021

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Office hours: TBA based on student schedules. In addition, if my door is open, you are welcome to stop by or email for a specific time if the announced hours don't match with your schedule.

Required lab materials: a bound, numbered notebook, a pen, and access to J.R Taylor's text Introduction to Error Analysis. Other materials will be online on Blackboard.

Lab time: W. or Th. 1:30-4:20 pm, Wright 214

Description/Overview

Physics 212 lab provides a bridge between the more “cook-book” oriented labs you may be accustomed to and the more exploratory and self-directed upper level physics labs. You will find that post-Oberlin lab work will likely be more like the self-directed style. In addition to introducing you to some interesting physical phenomena, 212 lab is designed to strengthen your lab documentation skills, teach you about errors and uncertainty, and expand your abilities to analyze data. You will note that while these labs derive from the material in Modern Physics—the lab is NOT connected explicitly to the class portion. Prof. Styer and I have coordinated to avoid clashing major deadlines (e.g. midterms not at same time reports), but the materials are not otherwise in sync.

Learning Goals

The key learning goals for the laboratory include:

- Develop skills in gathering and documenting experimental procedures and data.
- Develop skills in working with a partner to take experimental data and analyze it.
- Understand and be able to estimate uncertainties associated with physical measurements and propagate errors into calculated quantities.
- Learn how to apply simple statistical calculations to handle random errors including mean, standard deviation, standard deviation of the mean, and linear regressions.
- Develop graphical and spreadsheet methods to test a theoretical prediction against experimental measurements so as to confirm or reject a particular theory.
- Develop technical writing skills to be able to produce a concise report that accurately describes your work and its relevance in the broader literature.

Lab Preparation

Each week you should read the relevant instructions and other material on Blackboard BEFORE coming to the lab session and answer the relevant pre-lab questions, some of which pertain to the specific experiment, others of which match to the data analysis questions we are discussing. Pre-lab questions will be graded on a 5-pt scale (with typically scores of 4 or 5 if you have answered the questions.) **Your answers should be submitted on Blackboard before 1:00 pm and we'll discuss at 1:30 pm.**

Note in the first half of the semester, you will perform the lab with a partner, with the entire class doing the same experiment (Group I experiments) that week. For the second half of the semester, you and a lab partner will select experiments from Group II. There is only one setup for each of these Group II experiments, and you can do them in any order. You will sign up for a Group II experiment a week before doing a lab. In general, you should expect to have a different partner each week.

Laboratory Notebooks

You will be expected to keep a notebook which is a record of the semester's lab work. A suitable notebook is the blue, bound, lined notebook with numbered pages that you might have used in PHYS 111. Other similar notebooks are fine, provided they: 1) are dedicated to this class 2) are clothbound (so pages cannot be added) 3) have page numbers printed on all pages (not written by you) All tables and graphs that you create as part of your lab work should be taped into your lab notebook during the lab period.

Your notebook should be a running record of all of **your** experimental work in the lab. You do not need to reproduce the instructions in the lab manual, but rather need to note the specifics of what you did—voltage settings, oscilloscope readings, etc. NOTE: your notebook should accurately reflect what occurred—if you ask me a question about some aspect of the lab, then you should write something down after we talk (e.g. whoops, we wired this up incorrectly and the multimeter should be outputting AC voltage...or the fuse went or we needed a new battery...) You should **NEVER ERASE ANYTHING IN YOUR LAB NOTEBOOK!** If it turns out, you have recorded a number incorrectly, strike it out and write your new number (it may well turn out that the first number was correct).

You should discuss your work with me toward the end of each lab session, **leaving your notebook with me at the end of lab.** The graded lab notebooks (5 point scale, typically should be between 4 and 5) will be available for your pick-up in the mailboxes outside the lecture hall (W201), by Monday's 11 am class time at the latest. (If you need it earlier, you can contact me/ask for a screenshot.)

Lab Reports

During the semester you are required to hand in two lab reports. One of these reports is due at the middle of the semester (**Fri. Nov. 19 at noon, submit on Blackboard**) and the other must be turned in at the end of the semester classes (**Fri. Jan. 14 at noon, submit on Blackboard**). Lab reports should be roughly 4-5 pages in total length (including figures and diagrams) and should be written solely by the person handing it in. The main idea is to describe clearly, coherently and briefly the basic techniques used in the experiment, the theory used, your results and their significance. You should assume that the reader of the report has a physics background like Physics 212 and is NOT interested in replicating your experiment (doesn't want explicit instructions) but rather would like to learn your key findings in a concise fashion.

A particular note on lab reports with respect to the Honor Code: When you write your lab report, it is very important that the report represent your words. You can (and should) read other sources, and you can learn from them and paraphrase – but be sure to give appropriate credit (i.e., reference) to the source. It is never acceptable to “cut and paste” someone else's material

into your paper and represent it as your own. Any quotation (or very close to a quotation) must be properly referenced. These should be used sparingly – because the report is supposed to be your report – not “clippings” from other sources.

The same is true with regard to copying drawings, graphs, or images. If you copy someone else’s graphic into your paper, not only must you properly cite the source, but you must also have their permission to do so. You and your lab partner should only have identical figures if you **both** worked on the figures together.

One final comment about referencing the laboratory instructions. You have been given detailed instructions for each experiment, and these instructions include some background explanations. No doubt you will occasionally refer to the lab manual in your paper. You should avoid, however, simply quoting or paraphrasing the laboratory manual. And the laboratory manual, while having gotten you started, should not be your primary reference.

Lab Schedule

The tentative lab schedule is as follows:

Week	Lab Topic
1: Oct. 6,7	Intro to the class and error analysis
2: Oct. 13,14	Stefan-Boltzmann Law
3: Oct. 20, 21	Photoelectric Effect
4: Oct. 27, 28	Radon Decay
5: Nov. 3, 4	Spectroscopy I
6: Nov. 10, 11	Spectroscopy II
7: Nov. 17, 18	Work on Lab Report 1: report due Fri. Nov 19
Nov. 24, 25	No lab during Thanksgiving break
8: Dec. 1, 2	Group II
9: Dec. 8,9	Group II
10: Dec. 15,16	Group II
11: Dec. 22	No lab in the partial week/Jan 15 makeup
12: Jan. 5, 6	Group II
13: Jan. 12,13	Work on Lab Report 2: report due Fri. Jan 14

There are no labs the week that reports are due—instead the class time is for you to ask questions about your report, such as how to complete the data analysis or make better plots.

You’ll note that there are some peculiarities to this late start semester. In response, I’ve cancelled lab in the two partial weeks—no lab for Wed. Dec 22 (as there’s no lab on Dec. 23) and then we won’t have lab for the Saturday Jan. 15th makeup for the Thursday lab section.

Lab Attendance

Lab attendance is mandatory; as you are working with partners and equipment that's not standard, making up a lab is a very tricky affair. If you cannot make a lab due to illness or a major event (e.g. death in the family, etc), please contact me via email as soon as possible to determine what would be the most appropriate course of action. Unexcused absences will not be made up; you will receive a zero for that week's associated work.

Lab Grade

Your lab grade will be based on your work as follows: 1/5 on pre-lab questions, 1/5 on lab participation/performance (e.g. working with partners), 1/5 on laboratory notebooks, and 2/5 on laboratory reports. From this, I will forward on to Prof. Styer a lab grade (most typically an A- or B+) which will be factored into your final grade for PHYS 212 overall.

Lab Accommodations

If you are a student with a disability or other special needs, I encourage you to talk with me early in the semester about how it might impact your lab performance. We may need some advance notice to work with Disability Resources in the Office of Student Success to assure that the proper paperwork is in place so that necessary accommodations can be made.