Course Information for Physics 575
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Brief course description: Condensed matter and atomic experimental physics, including: classical and modern state-of-the-art experimental methods, experimental design and philosophy, the intellectual content and excitement of experimental physics, and the current frontiers.

Required Text: There will not be a formal textbook for this course. Instead we will use a set of lab binders. There is one binder for each experiment. Each one contains a wide variety of information for that lab.

Each binder starts at the introductory level---similar to that of Scientific American or Physics Today. Next it moves to the physics textbook level. Finally it moves to physics journals. You don't have to read the entire binder !!! In fact, there will be more material than you can easily read. The binders are intended to serve as comprehensive references that you can consult as you do the lab---especially as you write your lab report.

Grading: There will not be any exams in this course. Your grade will be based on your lab report grades.

How to get the most out of this class

What happens during the various meeting of each lab?

There will be four meetings for each lab, the goals of the first lab meeting are for you:

(1) to get familiar with the equipment---i.e., you should play with it for a while to make sure that you really know how it works!!!

And once you do....then,

(2) to take some data quickly, so that you can go away and analyze it before the next meetings. Only by taking some data, and by analyzing it before you write your lab report, can you be sure that you have decent meaningful data worth writing up!!!

What's with all the reading?

If you have looked through your thicklab binder, you're probably thinking: "He can't possibly expect us to read all this?!?" If you are, you are correct! I don't expect anyone to read everything in any of the binders! So, why have I given you "too much" material? The material that I've given you is a rather complete reference manual that would be a good start if you wanted to work seriously on one of these experiments. I'm going to give you some very specific recommendations for the pieces that I think everyone must/should read, and then I'm going to explain briefly what all the rest of it is, so everyone can read the bits and pieces that they find particularly interesting. Since you may, or may not, be able to get your hands on a book or articlefrom the library that helps you with the lab, I'm giving you the best things I've found for the students after teaching the course numerous times. If you find something better, please let me know!!! In particular, there are lots of new lab resources on the internet that I have not yet located/identified.

So please do not mess up your copy of the binder, and please return at the same time that you turn in your lab report!!!

Your fellow students are counting on you to keep it clean and to return it on time, and you are counting on them!!! You may xerox anything you want to keep out of the binder, but you must return the original material to the binder.

The first lab meeting:

(1) **Read** at least one of the articles in the introductory section---so that you will have some understanding of, and feeling for, the physics behind the lab, before jump in!

R**ead** the one page list of goals for the lab---so you will have some idea of what to do!

Teach the next group how to do the lab that you did the previous cycle.

(2) Of course, there will be things that you do not understand about each lab, and you won't have time to figure them all out before starting the lab! So make a **list of questions**, e.g., about the physics behind the lab, about the equipment used in the lab, about the experimental procedure for the lab, about the error analysis for the lab, about the best experimental art used in the lab, etc. The group teaching you (and Diedrich and I) will be glad to try to answer these questions.

The second lab meeting:

(1) Quickly **analyze** the data that you took during the first meeting, and think about the lab and your analyzed results: Are there things you need to figure out before you can take your "publication quality" data? Do you have a clear plan for what you need to measure, and exactly how you are going to do it?

(2) You will probably find it very useful to re-read some of the prelab reading, and to browse through the other material---for example, to start to understand how to do the analysis!

(3) Make a list of **questions** that you want to ask during the second meeting. Again, the group teaching you (and Diedrich and I) will be glad to try to answer these questions.

The third lab meeting:

Well, one idea for the third meetings is for you to try to do something creative!!! It will work out best if we talk during the before hand about what you'd like to do during the third meeting. The other important things for you to do during the third meeting are:

1) Ask your teaching groups (and Diedrich and I) to answer your questions at that point.

2) If you have analyzed some of your data, ask your teaching group (and Diedrich and I) to help you understand and interpret it. You can do this anytime before you turn in your lab report....

The fourth lab meeting:

1) Get your teaching group to give you their minilecture on the physics of the lab.

2) Finish analyzing your data so that your teaching group (or Diedrich or I) can check it for clarity and veracity.

After each lab....doing your lab report!!!

You must prepare a brief written lab report and turn it in on (or before) the due date! I will be glad to try to answer the additional questions that you will inevitably discover as you try to write your lab report. The reason that I'm asking you to write a lab report on each lab, is that I know you'll learn a lot more if you have to write it down and turn it in!!! **I want you to learn as much as you can about physics in general, and about experimental physics in particular, during this class!!! What I really want to see from your lab reports is that you've learned some physics by doing the lab and by writing it up.**

Learning is the most important thing in this class; clarity, simplicity, and quality are the next most important things!!!

You don't need to write a long report; I'm much more interested in quality than quantity! As noted above, I want you to learn as much as possible while doing the write up! I am interested in your ideas, thoughts, and suggestions about these experiments; please do not simply copy descriptions line-by-line, word-by-word from some book or article. However, I do want you to learn the facts....and I know that one good way for you to learn the facts is for you to write them down in your own words by following and working through one (or several) of the standard discussions!

Here are some suggestions about some of the things that you might want to discuss in your lab report:

(1) What is the most important physics behind the lab?
I really want you to learn the physics---that it is the most important thing!!!
(2) Briefly describe the equipment used in the lab.
I really want you to learn what the hardware does!
(3) What did you do during the lab?
Please tell me the important canned things, but I also want to hear the unusual things!
(4) What did you find?
Crystal clear, short, and sweet, is fine for this one!
(5) Describe your error analysis
You don't need to do a formal error analysis, but you should explain how well you trust your results, and why! Also, what don't you trust, and why?
(6) What was the most artistic thing about the lab?
What did you find particularly beautiful, elegant, and artistic about the physics behind the experiment and/or about the experimental physics?
(7) What did you learn about the physics behind the lab?
What didn't you know before the lab that you know now?
(8) What did you learn about experimental physics?
What didn't you know before the lab that you know now?

There's no maximum or minimum limit on the number of pages....the best lab reports typically contain 4-8 pages of text. Please explain your ideas about some of the 8 topics above. Summary plots, pictures, and figures are also very important components of a good report! Please turn in a copy of your data!

I want to hear your thoughts, impressions, and ideas!!! I do not want you to simply regurgitate standard textbook material!!! Translate the words and ideas in the books and articles into your words and your ideas---i.e., LEARN IT!!!

Teaching Methodology

We will use the same teaching methodology that medical schools traditionally use:

Watch One---You will watch the previous group show you how to do the experiment.

Do One---You will do the experiment with help as needed from the previous group.

Teach One---You will teach the next group how to do the experiment.

The previous group will be available to help you understand the experiment and to do it successfully---so, if you get stuck, please ask them for help. That will help them learn. You, in turn, will teach the next group both how to do the experiment and how to understand the physics.

You will discover that one of the very best ways to really learn something well is to teach it !!!