

Introduction

- I assume that you come to Physics Department because you fall in love with physics.
(Otherwise this will be a disaster!)
- Real love should cover every aspect. For physics, this includes all the boring parts which you do not like to learn. And you cannot just love what you don't understand.
- However, physics is a very difficult subject. You need to work very hard in order to master a wide range of fundamental knowledge & mathematical skill before you can enjoy its beauty & power.
- How to study physics properly in university?
The answer may be found at <http://www.ph.utexas.edu/~phy302k/how.html>
In brief, you need to be devoted to the study.

In high school, you may focus on examinations & ignore the experiments.

However, physics is an experimental science.

You need to understand what experiment is about.

Purpose of a physics experiment is:
in research:

- to discover something new, &
- to confirm whether a theory or model is correct;

in our **lab courses**:

- to verify a theory (or a law), &
- to reproduce a known experiment in order to learn skills.

Lab courses can help us better understand the theory you learn in lecture courses.

When do we start an experiment in research?

When we observe an interesting phenomenon, we try to understand it.

For better understanding, usually we need more experiments.

When we plan for an experiment,

- we first identify the system to be investigated,
- set an objective of the experiment,
- look for theory or model for explanation or analysis,
- simplify the problem & focus only on a few parameters.

You may use the **free fall experiment** as an example in order to understand these steps. (The free fall experiment is described in the file for error analysis.)



Can great physicists convince you that experimental physics is important?

John Bardeen (1908-1991) is a theorist but he believed that theorists should have an idea of what experimental physics was all about.

He won 2 Nobel prize in physics:

1956 Shockley, Bardeen, Brattain share the Nobel prize "for their researches on semiconductors and their discovery of the transistor effect"

1972 Bardeen, Cooper, Schrieffer share the Nobel prize "for their jointly developed theory of superconductivity, usually called the BCS-theory"



Enrico Fermi (1901-1954) may be the only physicist famous at both experimental and theoretical physics:

He won 1938 Nobel prize in physics

"for his demonstrations of the existence of new radioactive elements produced by neutron irradiation, and for his related discovery of nuclear reactions brought about by slow neutrons".



Workload guideline for 1-unit lab course:

Usually, we arrange 7 lab sessions for each 1-unit lab course.

It is based on the following consideration.

On the average, a student takes **17 units / semester**.

For 1 unit, we expect you to spend 3 hours/week for studying (including lecture, reading, homework and exercise class).

If you study 6 days / week,

$$\text{then the study time} = \frac{17 \times 3}{6} = 8.5 \text{ hours / day}$$

which is quite reasonable.

There are 13 weeks / semester.

Then your time spent on 1-unit lab course should be

$(1 \times 3) \left(\frac{13}{7}\right) = 5.6$ hours including (a) 1 hour for preparation, (b) 3 hours for experiment & analysis and (c) 1.6 hours for report writing.

PHY 2811 is a 2-units course

But the time-table does not allow us to arrange 14 lab sessions. In this year, we have 8 experiments and 2 short tests.

Exp. 4 is double-counted.

Exp. 7 is triple-counted.

Usually you can finish measurements within 2 hours.

Try to finish all data & error analysis in the Lab so that in case you have questions, TAs can help you.

The Labs are closed at 6:30pm.

Learning Outcomes (Objectives of PHY 2811/2822)

We teach students **basic skills** used in experimental physics:

- To learn basic instrumentation (conventional and digital oscilloscope, power supply, signal generator, digital multimeters, etc.)
- To learn how to collect, analyze, handle (plot) data by Excel and estimate errors by Excel.***
- To learn how to write a short report.

Also use experiments to illustrate the principles taught in the physics courses at the 2000-level.

*** Our PCs in the Labs have Excel 2003. Some PCs also have Excel 2007.

There are many skills & equipment in experimental physics. You will easily forget them if you do not use them frequently.

What is most essential & important in learning experimental skill?

- Attitude
- Patience
- Curiosity
- Critical thinking
- Like problem sets in textbooks, our experiments are highly simplified.
- It is not easy to finish even a simple experiment if you are not careful enough.
- When we wish to deal with real phenomena, we usually encounter difficulty & do not know how to handle it. We need simplifications & good physics to understand the problem.

Will we teach you how to design an experiment in this lab?

- The answer is “No”! We need experience first.
- But you can learn some design skills by studying carefully my manual.
- You may ask **how I designed the experiments**. Come to the Lab earlier. My consultation hours are 2:00-2:30pm.

You should read all the details in the Lab manual.

- The required **theory for each experiment** is explained in lab manual. It should be already learned in lecture courses or in high school. Ask earlier if you have questions.
- **Procedures** are suggested. Don't treat them as cookbook recipes. The **procedures** can be understood **only after you fully understand the theory**.

How to prepare?

- **Read lab manual carefully.**
- Answer Prelab Questions and check with the solutions available on the PHY2811 Web Page.
- **Write the first page of your lab report & submit it to TA at 2:30pm. TA will grade it in the lab. Get it back when you leave.**
- Download Data Sheets from PHY 2811 Web Page.
- Go to the lab earlier & get familiar with the equipment. Lab is open during office hours.
- **Do not start doing experiment even though you come earlier. We will start the experiment together at 2:30pm.**
- TAs are on duty from **2:00pm to 6:30pm** (Monday/Tuesday/Wednesday).

Always save data files to hard-disk first and then copy to your memory device.



Upload your data sheet to our Web Page before you leave.

Delete your data files in the lab PC.

Assessment

80%: Preparation, Performance in Lab & Lab reports.
20%: Two short tests.

Marking scheme is available in Download Area.

Report grading:

We have one TA for each lab session to grade your reports. The TA will come to the Lab to answer your questions at about 4:30pm after grading your reports.

Late reports: -10% marks for one day late.

Pass/Fail guideline:

A student will fail a lab course if he/she is
(a) absent in 3 lab sessions without compelling reason*, or
(b) unable to submit 4 lab reports.

* **Make-up experiments** can be arranged.

Here is a list of lab courses in Physics Department:

1st year: PHY 2811 (2 units)

PHY 2822 (1 unit)

2nd year: PHY 3811 (1 unit) required for physics program
(not required for theoretical enhancement program)

PHY 3822 (1 unit) elective for physics program

If you wish to do more experiments or learn more experimental skills, consider taking

Special Experimental Projects.

These are 1 unit courses & offered in every term:

First term: PHY 4711/4721

Second term: PHY 4712/4722

Summer: PHY 371S/372S

You can take up to 6 units.