

Course Syllabus: Physics 515

(rev.8/17/09)

General Information.

The Advanced Laboratory contains equipment similar to that used for a number of important experiments of modern physics. In this course you will perform some of those experiments, learn about experimental methods in general and, most importantly, acquire the ability to think as an experimenter. You also have the opportunity to explore the techniques of observational astronomy, by acquiring and analyzing your own data or archival data. You will have ample room in designing and carrying out the studies - within the limits set by the apparatus, the available time and your knowledge of physics and astronomy. Your questions will be answered in one-to-one discussions with the professors and assistants teaching the course. A very important part of this course is for you to learn how to make a convincing case for the experimental results you present. This involves understanding and using experimental cross-checks and error analysis—both statistical and systematic—as well as learning how to present your results in a clear and logically compelling way in both formal reports and group presentations. The equipment in the Advanced Laboratory is used by more than one class.

Sources of Detailed Information

There is a wide range of information available for you to prepare for your work in this course:

- Information for this course is posted on the **Blackboard (Bb)** web site.
- Write-ups detailing each of the experiments are posted on the Blackboard site along with supporting information for the experiment. Each write-up contains essential references for the experiment, which you must read.
- You are **required** to have a book on error analysis. R. Bevington and D.K. Robinson, *Data Reduction and Error Analysis for the Physical Sciences*, 2nd. edition (McGraw-Hill, NY, 1992) is available in the bookstore.
- The “*Course Notes*” on this site contain a great deal of essential information about the course. You are responsible for reading and understanding all of this.
- Other useful **recommended** texts are
 - Melissinos & Napolitano – Experiments in Modern Physics, 2nd Edition
 - Kitchin, *Astrophysical Techniques*
 - A book on your programming language
 - Excel – Berk and Carey, *Data Analysis with Microsoft Excel*
 - B.V. Liengme, *A Guide to Microsoft EXCEL for Scientists and Engineers*
 - C – Kernighan and Ritchie, *Ansi C*
 - Python – Martelli, *Python in a Nutshell*
 - IDL – Company manuals (in lab)

- D.W. Fanning, *IDL Programming Techniques*

Other sources of Help and Information

The course has 3 or 4 faculty and several TAs (see the “Staff Information” section of this site). Each faculty member is responsible for 1 group of experiments. Much of the instruction in the course is through one-on-one discussions with the staff. We encourage you to take the initiative in seeking us out when you have questions about the apparatus or physics of the experiment you are working on. You should read the preparatory material first though. If it is clear you have not, you will most likely be asked to go do some reading and then come back to discuss what you have not understood.

Frank Chin from the Instructional Labs office (A-132, 2-8069) provides technical support for the Advanced Laboratory. He is a very valuable resource when you are having equipment problems or need supplies you cannot find.

Requirements and Grading.

To pass this course, i.e. to receive a grade > F:

- You must complete 3 experiments, submit the reports along with your log book and receive a passing grade, i.e. > F, on each. No reports will be accepted (even with late penalty) after the last day of classes.
- You must present a poster to the class explaining the results of one of your experiments, again receiving a passing grade.

Each lab report will count for 30% of your grade. The poster presentation will count for 10%. The posted grades are in two parts. Part one is a letter grade that evaluates your work, i.e. what you did in the lab, what is in your log book, the quality of your data and analysis and finally your report. Part two is a number from 10—0 and reflects how well you complied with the various rules we set up to try and get you to work in a productive way. You start with a 10 and then lose points, e.g. for a late report. 1 point is deducted if the report is not in on time and 1 additional point is deducted for each period it is late. Faculty may well deduct additional points, e.g. for late or poor mid-labs, etc.

You will, in general, work with a lab partner on the experiments. The preparation, experimental work, and rough "in-lab" data analysis during the course of the experiment will be done with your partner. However, each student must have a separate log book, and your final analysis (after the data taking) and your report must be done individually.

The experiments are organized into 4 groups (A-D) representing different areas of research. Each of your experiments must be from a different group.

If you are signed up for an experiment, and for some (good) reason you are unable to come to lab or will be late, make sure that your partner and the staff know this. Work out with your partner in advance how/when you will make up for the lost time. Make sure that you and your partner exchange telephone numbers, email addresses, etc. *before* the start of each experiment. If you know several days in advance that you cannot be in lab on a date for which you have signed up, you should release that date and sign up for another.

Plan to get most of the experimental work done during the normal lab periods. Do not assume that you will be able to gain access to the lab whenever you want. Some experiments will require you to come early or to stay late to take data, e.g., when you fill a liquid helium Dewar to cool down a sample. Talk to one of the staff members if you want to come early or stay late and inform him/her about your specific reasons. Ask for assistance to get in the lab. If you enter the lab outside of regular lab hours you must sign in (and out) using the sign-up sheet (located on the lab door) and list the name of the staff member who authorized you to be in the lab. *For safety reasons, at least two people must be in the lab at all times; no experimental work may be carried out if you are alone.*

You must keep a careful, reasonably neat log book, which must be bound. Actually, you will need two log books, one for experiments 1 and 3, and another one for experiment 2. This way the instructors have enough time for grading your work while you are doing the next experiment. You must have your lab book any time you work in the laboratory.

You may use the computers in the lab or any other computer to which you have access. You may use any programming language or software package you choose, but you are responsible for knowing what a "canned" data-analysis software package does and *demonstrating* before you use it that it gives correct results.

Each experiment consists of only one setup. If it breaks, then that experiment will not be available for further work. Be careful with the equipment.

Lab reports must be turned in on or (preferably) before the due dates listed in the course calendar. Late reports will reduce your grade in the course. Further you cannot sign up for your next experiment until your report has been accepted. In addition to the printed report and log you submit to your instructor, you must also submit an electronic copy of the report using the "safe assign" feature of Bb. This must be a pdf or Word file. Bb records that time of submittal, which must be before the time given in the course schedule to avoid a late penalty.

Read the safety instructions in the course notes. You will have to pass a written or oral test before starting the experiments to demonstrate that you are aware of the safety procedures and the theory behind the experiment.

Getting started

First week of classes

- Attend the organizational meeting on the first day
- Find a lab partner. We will help match you up with one if needed.
- Check your e-mail address on the Bb site to be sure it is correct.
- Decide, with your partner which experiment you will do first and sign up for it.
- Read the Course Notes and the write-up for the experiment you have signed up for.
- Read the essential background information as discussed in the write-up to prepare for your experiment and pre-experiment discussion with the faculty member in charge of your experiment.
- Meet with the faculty member in charge of your experiment to get your pre-lab approval. This is required before you can sign up to use the apparatus.
- Sign up the apparatus (max. of 8 periods for exp. #1 and 7 periods for exp # 2 or 3). (see course schedule and sign-up instructions)

Before starting lab work:

- Get yourself a lab book (each student must have one when in the lab) and re-read the section of the Course Notes on keeping a log book
- Show up in the lab, at the beginning of the lab period, on the first date you have signed up for.
- One of the staff members will go over the equipment with you to be sure you understand enough to get started. You want to be sure you do not damage the equipment or vice versa. Do not turn anything on until this is done.

Logbooks (briefly)

- You will need two.
- Number and date the pages
- Maintain an index or table of contents.
- *All* daily activity should be logged:
 - Settings on instruments
 - Apparatus diagrams
 - Raw data, or files names
 - Daily graphs and data analysis, for sensibility checks
 - What are you doing? Why? How? What happened? Why did it go wrong? What did you conclude?
 - Software flowchart or progress or explanation of tricky bits
- A bad logbook is an easy way to get a bad grade.....

The key to a good logbook is that another physicist must be able to understand your lab procedure (and reproduce your steps) based upon the information in the logbook. There must be enough information so that your complete analysis can be repeated using the logbook. See the Course Notes for more detail.

Computers and data analysis.

- Several computers are available in lab. Astronomy experiment computers all have IDL, C. These may be used when not in use for an experiment. At least one has Excel installed. The computers may not be used for web surfing, e-mail, or games. The lab has an internet connection to allow portable computers to access the campus network.
- There is a scanner and PDF file creation software on one of the lab computers.
- Computers are available to undergraduates in the SYNC labs. Graduate students have access to computers through the physics department.
- *'The DOS ate my homework'* Sorry, this is not an excuse for anything. **MAKE BACKUPS** at end of each lab period. Why not make two?
- Data analysis for physics can be done with any software in any language (e.g. Handwritten by you, Excel, Origin, Root, PAW, IDL)
 - Make sure you know how to use it!
 - You are responsible for your results. That means you must verify that the software you use is providing a correct results. This must be done by creating test data and showing that a trial data analysis gives the expected answers. This trial analysis must be described in your log book.
- Data analysis for astronomy can be done using IDL for image processing and IDL or C for number crunching, fitting, etc. Programs you write must be part of your report.
- Experiments are done with a partner, but final data analysis and your entire lab report must be done independently.

Lab Reports (briefly)

The most important aspect of a report is the data and analysis that it contains. However, poor organization, logic and style can destroy great data. An important aspect of this course is learning to present your results clearly and convincingly. But, do not get carried away with beauty at the expense of content when preparing your report.

- Turn in your lab report on time!
 - There is a penalty for being late. We insist that reports be on time since the feedback you get from the grading is an essential learning tool in the course. After all the work you did on the experiment it is silly to lose credit for a late report.
- Also, you must hand in your log book (so buy two!).
- Turn in all relevant computer readable data, if appropriate
 - But note: Your written report must be self-contained without referral to disks.
 - Data may be placed on an accessible web page, or turned in on a CD.
- Organization must be as a typical Physical Review article (NOT Letter):
 - Cover sheet
 - Abstract
 - Introduction
 - Experimental Details and/or Methods
 - Results

- Interpretation/Discussion/Conclusions
- References
- Tables and Figures, with Captions *May be in text, if enough space is taken*
- Appendices (e.g., programs, lengthy derivations,...)
- You can download the APS Style and Notation Guide from their web site:
publish.aps.org

See the Course Notes for more detailed information of lab reports.

Academic Honesty

We have, in recent years, had a few cases of academic dishonesty. This has taken either the form of plagiarism, handing in reports that were partly or entirely the work of someone else, or even of forgery, invention, and massaging of data. As you must know, such behavior is utterly unacceptable. One needs to think only briefly about Piltdown Man, Cold Fusion, or Sir Cyril Burt's identical twin IQ studies to realize that fraud is the one thing that can bring physics down. The response to any such transgressions in the lab will therefore be Draconian (i.e., an F on the course will probably be the least of your problems). Please, take the time to review the [APS Guidelines for Professional Conduct](#) on this site. Internalizing them is a very important part of your education, and you are bound by it for this lab and any other work here. Make sure you ask questions and discuss borderline issues with your colleagues and teachers whenever you feel uncertain about its meaning or implications.

The University Senate Undergraduate and Graduate Councils have authorized that the following required statements appear in all teaching syllabi (graduate and undergraduate courses) on the Stony Brook Campus.

Americans with Disabilities Act:

Stony Brook University Syllabus Statement:

If you have a physical, psychological, medical, or learning disability that may impact your course work, please contact Disability Support Services at (631) 632-6748 or <http://studentaffairs.stonybrook.edu/dss/>. They will determine with you what accommodations are necessary and appropriate. All information and documentation is confidential.

Students who require assistance during emergency evacuation are encouraged to discuss their needs with their professors and Disability Support Services. For procedures and

information go to the following website:
<http://www.sunysb.edu/ehs/fire/disabilities.shtml> .

Academic Integrity:

Each student must pursue his or her academic goals honestly and be personally accountable for all submitted work. Representing another person's work as your own is always wrong. Faculty are required to report any suspected instances of academic dishonesty to the Academic Judiciary. Faculty in the Health Sciences Center (School of Health Technology & Management, Nursing, Social Welfare, Dental Medicine) and School of Medicine are required to follow their school-specific procedures. For more comprehensive information on academic integrity, including categories of academic dishonesty, please refer to the academic judiciary website at <http://www.stonybrook.edu/uaa/academicjudiciary/>

Critical Incident Management:

Stony Brook University expects students to respect the rights, privileges, and property of other people. Faculty are required to report to the Office of Judicial Affairs any disruptive behavior that interrupts their ability to teach, compromises the safety of the learning environment, or inhibits students' ability to learn. Faculty in the HSC Schools and the School of Medicine are required to follow their school-specific procedures.