

PHY 353L Modern Physics Laboratory – Summer 2017

Class meeting: Unique number 88230: M T W Th 1-4 PM, RLM 7.302

There will be no lecture sessions for this summer course.

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Teaching assistants:

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Office hours:

Aaron Foote: F 10-11 AM, RLM 7.302 Dan Heinzen: F 11-12 PM, RLM 7.302

Adam Vinall: F 12 AM – 1 PM, RLM 7.302

Acknowledgement: Much of the course material we are using was written by Greg Sitz. I'll thank Greg for this here, and use this material without further acknowledgement.

Prerequisites: PHY 315, Wave Motion and Optics. Credit for PHY 355 is recommended but not required.

Purpose of this course: This class is intended develop your ability to

- perform experiments that are more involved and difficult than the ones you completed in introductory labs,
- use a variety of laboratory equipment and techniques,
- properly document your work in a lab book,
- carry out accurate error analysis,
- write up and present your results in a coherent, complete manner,
- and to learn more about atomic, molecule, optical, and nuclear physics.

It is also a writing flag course as discussed below.

Resources:

Course web site: Background information on the individual experiments can be found at <http://www.ph.utexas.edu/~phy3531>. The username is **phy3531** and the password is **juniorlab**. This site will be your primary resource for selecting and performing experiments.

Canvas: Some tutorials, a LaTex report template, and a guide to report writing will be placed on the course Canvas site. A detailed document (written by a former 353L student) dealing with data analysis and report preparation will be posted: filename **skillmanual.pdf**. A short introduction to the GnuPlot plotting program will be posted: filename **GnuPlot_Primer.pdf**. Grades will be posted on Canvas.

Online: The material from a student-led course, PHY 110C, covering Mathematica, LaTex, and data analysis, can be found at <http://www.evanott.com/data-analysis/>.

Books: There is no required textbook for this course. However we highly recommend that you have one or more books at your disposal that cover the following topics:

- 1) Elementary modern physics, including statistical physics, quantum physics, and relativity
- 2) Experimental design and techniques
- 3) Description of specific modern physics experiments
- 4) Data analysis
- 5) Preparing your results for presentation in scientific journals and scientific talks

Suggested books including the following:

[Modern physics](#), by Kenneth Krane, or [Modern physics for scientists and engineers](#), by John Taylor and Michael Dubson, or [Modern physics, 2nd ed.: for scientists and engineers](#), by John Morrison. Covers (1)

[Experimentation](#), by David Baird. Covers (2), (4), and (5).

[The art of experimental physics](#), by Daryl Preston and Eric Dietz. Covers (2), (3), (4), and (5).

[Experiments in modern physics](#) by Adrian Melissinos and Jim Napolitano. Covers (2) and (3).

[Data Reduction and error analysis for the physical sciences](#), by Philip Bevington and D. Keith Robinson. Covers (4).

[An Introduction to error analysis: the study of uncertainties in physical measurements](#), by John Taylor. Covers (4).

PMCL: The PMCL down the hall from the lab has a number of software packages installed that you can use for data analysis and report preparation. These include Mathematica, MatLab, KaleidaGraph, a LaTex package, and Microsoft Office.

Homework: You will complete one practice data analysis homework during the first few weeks of the course. The due date and time for this homework is given in the calendar below.

Lab work: You'll do your lab work in groups of two, although we will allow one group of one or one group of three if a section has an odd number of students. You'll start with a one-day "experiment bootcamp" which covers basic electrical measurements. The bootcamp lab will be graded on a credit/no credit basis. After that, you'll carry out five experiments. You'll pick experiments from the list of available experiments given below. You should choose one of the easier experiments for the first experiment, and you should include more difficult experiments towards the end of the semester. You should choose experiments on a variety of topics. Note that only one group in a given section can do a particular lab each week, so look over the available labs and sign up promptly for the ones that interest you. Experiment choices are subject to instructor approval.

Some labs are more difficult than others or have flexible experimental goals. Students who elect to do more difficult labs or to take on more ambitious experimental goals for a particular lab may receive a higher lab report grade than students who stick to easier labs or experimental goals.

Lab book: You are required to have and keep a lab notebook. This must be bound and not have loose pages. A [quadrille, composition-style lab book](#) is ideal. You should develop the habit of writing in your lab book. A lot. Diagrams and sketches are viewed with particular favor. The TA will periodically check your lab book.

Written reports: You will complete a written lab report for each experiment. For your lab work, you will work together with your partner. But you must complete your data analysis and write your report on your own. You will submit your reports electronically to Canvas. You are encouraged to prepare your report using LaTex, but you may use MS Word if you wish. Students wishing to use LaTex may find this web site to be useful: <https://www.sharelatex.com/>. You should use a scientific plotting program such as GnuPlot to prepare your graphs. You may NOT prepare graphs with Excel. Other guidelines for your report are posted and will be discussed in the course. Reports are due at the dates and times on the schedule below.

Writing flag; revision of lab reports: This is a writing flag course, designed to give students experience with writing in an academic discipline. In order to meet the requirements of a writing flag course, we'll do the following:

- Your grades for all lab reports will be based in part on your writing quality, and you'll receive feedback on that writing quality.
- We'll meet briefly with each student June 14-15 to specifically discuss ways to improve the writing quality of their first submitted lab report. Students wishing to resubmit their Lab 1 report based on the feedback may do so, and we will base your Lab 1 report grade only on the revised report. Any revised report is due June 21.
- After your Lab 2 report is due, you will complete a peer evaluation of another students' Lab 2 report. We will select pairs of students at random to complete each other's review. Your peer review is due on June 22 and you will be graded on the quality of your review. Students wishing to resubmit their Lab 2 report based on this feedback may do so; any revised report is due June 28. We will grade only the final version of your Lab 2 report.

Late reports: Please don't go there. We are on a tight schedule in the summer and it can be impossible to catch up if you fall behind. But, for purposes of having a definite policy: late reports will be docked by 5% for up to two days late, and 10% for two days to one week late. Reports will not be accepted more than one week late except for documented cases of illness or family emergency.

Oral report: You will be required to give an oral report on one lab. This is in addition to your written report on that lab. Oral reports will be conducted June 27-29 on either lab 2 or lab 3 (your choice). These will be one-on-one with the instructor. Reports will be scheduled using the Canvas calendar, and you must sign up by June 20.

Lab participation/lab book grade: You will receive a lab participation/lab book grade. The following factors will increase your participation grade: shows up to lab prepared, shows up to lab on time, actively works on experiment rather than leaning on partner, shows interest and initiative on experiments, does extra reading on topics, has a careful and methodical approach to experiments, does more than the minimum measurements required, follows directions, takes good care not to damage equipment. Also, at the end of the semester you'll turn your lab book in, and we'll base the lab book part of your grade on that.

Religious observance/illness/family emergency: Students are entitled to make up work or to turn in work late without penalty if this is needed for observance of a religious holy day, illness, or the serious illness or death of a close family member. Students who wish to exercise this right must inform us in advance to the extent reasonably feasible. We may ask for documentation of an illness or family emergency, and set reasonable limits on the make-up time.

Disabilities: Students with disabilities may request appropriate academic accommodations from the Division of Diversity and Community Engagement, Services for Students with Disabilities, 512-471-6259, <http://diversity.utexas.edu/disability/>.

Grading: Course grades will be assigned using the following weight factors:

- Bootcamp lab (CR/NC): 3 %
- Homework assignment: 6 %
- Peer review of other student's report: 3 %
- Oral report: 6 %
- Lab participation: 6 %
- Lab book: 6 %
- Written lab reports (14 pts. each): 70 %

List of labs

Hydrogen-deuterium*	(1/1)	Franck-Hertz*	(1/1)
Ramsauer-Townsend*	(1/2)	LED*	(1/3)
High T _c superconductivity*	(1/3)	Solar spectrum*	(1/3)
Radioactive decay*	(2/2)	Semiconductors*	(2/2)
Speed of light (pulsed laser)*	(3/1)	Radioactive half-life*	(3/1)
Blackbody radiation*	(1/4)	Electron diffraction*	(2/3)
Ideal gas law*	(2/3)	Double slit*	(3/2)
Relativistic dynamics	(2/4)	Brownian motion	(3/3)
Photoelectric effect	(3/4)	X-ray diffraction	(4/3)
Gamma-gamma coincidence	(5/2)	Speed of light (rotating mirror)**	(5/2)
Millikan oil drop	(4/4)	Chaotic dynamics	(4/4)
Pulsed NMR	(5/4)	Positronium	(5/4)
Mie scattering	(5/5)	Your chance for immortality***	(6/6)

Subjective difficulty ratings are given in parentheses (experiment/write-up) 1-easy to 5-hard

* A lab that would be suitable for your first lab.

** Can be done by only one group in a given week in *both* summer sections. The two sections will alternate first choice on the experiment.

*** A new lab created by you that could potentially be added to the list of labs. Students wishing to exercise this option must prepare a detailed proposal at least two weeks in advance and discuss their proposal with the instructor. Funds available for new equipment are very limited. Such a new lab is subject to instructor approval.

PHYS353L Modern Physics Laboratory – Summer Calendar

All assignments and reports must be submitted online by 11:59 AM on the due date.

Monday	Tuesday	Wednesday	Thursday
			June 1 Equipment bootcamp Sign up for Lab 1
June 5 Start Lab 1	6 Lab 1	7 Lab 1 Sign up for Lab 2	8 Lab 1/finish bootcamp Homework due* →
June 12 Start Lab 2 Lab 1 report due	13 Lab 2	14 Lab 2 Sign up for Lab 3 Lab 1 writing feedback	15 Lab 2 Lab 1 writing feedback
June 19 Start Lab 3 Lab 2 report due	20 Lab 3 Sign up for oral exam time slot	21 Lab 3 Sign up for Lab 4 Resubmit Lab 1 report (optional)	22 Lab 3 Lab 2 report peer evaluation due
June 26 Start Lab 4 Lab 3 report due	27 Lab 4 Oral exams	28 Lab 4 Sign up for Lab 5 Resubmit Lab 2 report (optional) Oral exams	29 Lab 4 Oral exams
July 3 Start Lab 5 Lab 4 report due	4 Holiday – no lab	5 Lab 5	6 Lab 5**
July 10	11 Lab 5 report due	12	13

* The Homework is due Friday, June 9

** Since only three days are available for lab 5 on the regular schedule, we will open the lab on Friday afternoon, July 7, for those who need the extra lab time.