

PHY 353L Modern Physics Laboratory – Fall 2016

Class meetings and teaching assistants:

Unique number 56295: M W 2-5 PM, RLM 7.302, TA Natalie Foster

Unique number 56300: T Th 2-5 PM, RLM 7.302, TA Chris Reilly

Unique number 56305: T Th 5-8 PM, RLM 7.302, TA Andy Hutchison

There will be a weekly lecture common to all three sections, on Mondays 5-6:30 PM, in RLM 7.104.

Instructor: Daniel Heinzen, Office: RLM 10.324, Office Hours: F 2-3 PM, or by appointment.

Phone: 512-471-3960, e-mail: heinzen@physics.utexas.edu

Teaching Assistants:

Natalie Foster: nataliefoster93@gmail.com

Office hour F 9-10 AM RLM 7.302

Chris Reilly: reilly.Christopher@gmail.com

Office hour F 10-11 AM RLM 7.302

Andy Hutchison: hutchguy@gmail.com

Office hour F 11-12 AM RLM 7.302

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

Purpose of this course: This class is intended to develop your ability to perform more involved experiments, to become familiar with a variety of laboratory equipment and techniques, to carry out accurate error analysis, and to write up your results in a coherent, complete manner. The experiments are drawn from atomic, molecular, optical, and nuclear physics. A secondary course goal is to further your understanding of these topics. This course is also a writing flag course as discussed below.

Resources:

Books: The textbook for this course is *Experimentation*, by David Baird. There are a number of similar books, and Baird is not required for this course. However, we highly recommend that you have one of these books at your disposal. Another very useful book is *Data reduction and error analysis for the physical sciences*, by Philip Bevington. This book focuses exclusively on error analysis, and covers that topic in more depth than Baird does.

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, GnuPlot, MatLab, KaleidaGraph, a LaTeX package, and Microsoft Office.

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**.

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/>.

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.

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 two-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.

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 Word if you wish. Students wishing to use LaTeX may find this free 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 to specifically discuss ways to improve the writing quality of their first submitted lab report. Students wishing to resubmit that report based on the feedback may do so.
- You'll complete your lab 2 report by the due date Oct. 10-11. On those dates, we'll hold a lab 2 report workshop, which will consist of a peer evaluation and discussion of your report. Students wishing to resubmit their lab 2 report based on this feedback may do so.
- Students wishing to exercise their option to resubmit reports 1 or 2 must do so within three days of receiving their feedback. If you exercise this option, your grade for that report will be based on your resubmitted report.

Late reports: 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 during the weeks of Oct. 24 through Nov. 3 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 Friday, Oct. 20.

Oral presentation: You will be required to give an oral presentation to the class on either lab 4 or lab 5 (your choice). This is in addition to the written report on that lab. Oral presentations are to be 15 minutes in length, and will be given during the last week of class. Presentations will be scheduled using the Canvas calendar, and you must sign up by Friday, Nov. 17.

Lab book: You are required to have and keep a lab notebook. This must be bound and not have loose pages. A composition book is fine. You should develop the habit of writing in your lab book A lot. Diagrams and sketches are viewed with particular favor. The TAs will periodically check your notebook.

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: 2%
- Homework assignment: 6%
- Oral report: 6%
- Oral presentation: 6%
- Lab participation/lab book: 10%
- Written lab reports: 70%

List of labs

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

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.

** 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 – Fall 2016 Calendar

M-W dates apply to M-W section. T-Th dates apply to T-Th sections.

All assignments and reports are due at 11:59 AM

Monday	Tuesday	Wednesday	Thursday
Aug. 29 Equipment bootcamp	30 Equipment bootcamp	31 Equipment bootcamp Sign up for lab 1	Sept. 1 Equipment bootcamp Sign up for lab 1
Sept. 5 Labor Day	6 No lab	7 Start lab 1	8 Start lab 1
Sept. 12 Lab 1	13 Lab 1	14 Lab 1	15 Lab 1
Sept. 19 End work on lab 1 Homework due Sign up for lab 2	20 End work on lab 1 Homework due Sign up for lab 2	21 Start lab 2	22 Start lab 2
Sept. 26 Lab 1 report due Lab 2	27 Lab 1 report due Lab 2	28 Lab 2	29 Lab 2
Oct. 3 End work on lab 2 Sign up for lab 3	4 End work on lab 2 Sign up for lab 3	5 Start lab 3	6 Start lab 3
Oct. 10 Lab 2 report due Lab 2 report workshop	11 Lab 2 report due Lab 2 report workshop	12 Lab 3	13 Lab 3
Oct. 17 Lab 3	18 Lab 3	19 End work on lab 3 Sign up for lab 4	20 End work on lab 3 Sign up for lab 4 Sign up for oral report
Oct. 24 Lab 3 report due Start lab 4	25 Lab 3 report due Start lab 4	26 Lab 4	27 Lab 4
Oct. 31 Lab 4	Nov. 1 Lab 4	2 End work on lab 4 Sign up for lab 5	3 End work on lab 4 Sign up for lab 5
Nov. 7 Lab 4 report due Start lab 5	8 Lab 4 report due Start lab 5	9 Lab 5	10 Lab 5
Nov. 14 Lab 5	15 Lab 5	16 End work on lab 5	17 End work on lab 5 Sign up for oral presentation
Nov. 21 No lab Lab 5 report due	22 No lab Lab 5 report due	23 Thanksgiving holiday	24 Thanksgiving holiday
Nov. 28 Presentations	29 Presentations	30 Presentations	Dec. 1 Presentations