

PHYS 281L Experimental Techniques in Physics: Syllabus

The University of North Carolina at Chapel Hill

Fall Term, 2021

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General Information

Short Description: This course explores modern physics experiments, techniques, and data analysis to prepare students for collaborative research and advanced laboratory work. Assignments include written and oral reports with peer review, and in fulfillment of the *Communication Beyond Carolina* requirement, involve communication for three distinct types of audiences (expert, peer, and public).

Audience: PHYS 281L is designed for physics majors, and is required for the Physics B.S. and most Physics B.A. options. Students are encouraged to take this course in their second year following the introductory sequence, and are required to take it prior to PHYS 481L (Advanced Laboratory). Assuming the prerequisites are met, the course is also open to non-majors seeking to improve their scientific experimentation and communication skills.

Prerequisite: PHYS 119, or permission from the instructors

Course Website: <https://sakai.unc.edu/portal/site/phys281-fa21>

Syllabus Changes: The instructors reserve the right to make changes to the syllabus, including due dates. These changes will be announced as early as possible.

Experimental Physics during a Pandemic: In order to learn how to use scientific equipment, we are firm in our belief that it is best to get experience turning the knobs and flipping the switches with your own hands. As such, this course will be offered in a fully in-person instructional mode, in accordance with the university's [community standards](#). All students will be required to wear masks while in lab and lecture rooms, and indeed anywhere in Phillips hall. For your own safety and the safety of your classmates and instructors, you are *strongly* encouraged to get vaccinated as soon as possible. You can get your vaccine for free on campus by going to covidvax.unc.edu.

If you are sick, please do not come to class! You will not be penalized for missing class due to illness (COVID-19 or otherwise), and we will work with you to reschedule due dates as necessary. See the "Attendance and Late Assignment Policy" below for details.

Please keep in mind that we live in an uncertain time. We hope that in-person instruction will be possible for the duration of the term, but are ready to switch to remote instruction if necessary. If that happens, all hope is not lost! See [Ben's website](#) for some examples of how the class will be adapted for remote learning.

Course Goals

Welcome to the physics community! Like most groups, the physics community is defined by the shared **knowledge**, **skills** and **passions** of its members. Up to this point in your physics education, you have likely focused on building scientific knowledge (e.g. laws and equations). In PHYS 281L, for a change, we will focus more on honing some of these key skills and gaining an appreciation for some of physicists' passions. In this class, you will...

1. Learn to operate and implement *tools and techniques* used by experimental physicists in their research. You will learn to take measurements with devices such as calipers, oscilloscopes, and interferometers, and to quantify the associated uncertainties. (**knowledge**, **skills**)
2. Put the *scientific process* into practice by forming hypotheses, designing experiments, taking and analyzing data relevant to the experiment, and using this data to form concrete, well-supported conclusions. (**skills**)
3. Use *written and oral communication skills* to form persuasive arguments aimed at teaching and convincing peers, experts, and members of the public of the significance of findings. (**skills**, **passions**)
4. Read about and explore your own opinions on issues of *diversity, equity, and inclusion* in the physics community. (**passions**)
5. *Contribute to the success of your group* by sharing ideas and problem solving approaches. (**skills**, **passions**)

Instructor Information

	Prof. Yue Wu	Ben Levy	Tyler Kowalewski
Role	Lab Sec. 403/Lecturer	Lab Sec. 402/Lecturer	TA and Grader
Email	yuewu@physics.unc.edu	levyb@unc.edu	tyler.kowalewski@unc.edu
Zoom Link	unc.zoom.us/j/96200617931	unc.zoom.us/my/benphysics	N/A
Office Hours	Mon/Weds 10-11 am	Mon/Fri 3-4 pm	N/A

Course Meetings

Emphasis is placed on cooperative learning amongst peers rather than an instructor-centered environment. The “core” of the course comprises 8 laboratory experiments, and each will be completed as a group. Lecture sessions will include material and interactive activities designed to build data and uncertainty analysis skills needed for the labs. Due to the high percentage of group work, your attendance for all meetings is required unless you have been excused (see the “Attendance and Late Assignment Policy”).

Lectures*: Fridays 10:10 - 11:00 am in 247 Phillips Hall *or via Zoom if you are sick or have a valid excuse*

Labs: Students are split into two lab sections, each of which meets once weekly. If you forgot which section you enrolled in, please check ConnectCarolina.

- Section 402: Tuesdays 2:00 - 4:50 pm in 177 Phillips Hall
- Section 403: Wednesdays 2:30 - 5:20 pm in 177 Phillips Hall

A complete daily [course calendar may be found here](#), or in the sidebar of the Sakai site.

*Lectures are known as “recitations” on ConnectCarolina. These terms may be used interchangeably here.

Assignments and Due Dates

All assignments and due dates are listed in the assignments section of Sakai, and on the [course calendar](#).

Lab Reports: You will work in groups to complete 8 laboratory experiments. The experiments will be organized into two rotations: “A” and “B.” During the first half of the course, groups will rotate through the four A labs (A-I, A-II, A-III, and A-IV). During the second half of the course, new groups will be formed, and you will rotate through the four B labs (B-I, B-II, B-III, and B-IV). Following each lab, you will write a lab report detailing your findings. There are two types of lab reports:

Journal Article-Style Lab Reports: Five full lab reports will be assigned to help you practice technical scientific writing for a peer audience. Reports will be written in the typesetting language L^AT_EX. Details on lab report content expectations may be found in the [Lab Report Guidelines](#) document on Sakai. Two of these lab reports will be completed individually, while the other three will be completed as a group.

“Letters Home” The remaining three lab reports will be much shorter documents intended for a general audience. These will be written individually and emailed to someone you know (e.g. a parent, grandparent, sibling, teacher, or friend). Details on lab report content expectations may be found in the [Letter Home Guidelines](#) document on Sakai.

Due 30 minutes before the start of the next lab via Sakai.

Reflection Essays: Although you may see studying physics as learning theories and applying those theories to solve problems, professional physicists are concerned with a wide range of issues that impact what we do and how we do it. These issues include, but are not limited to, educating the next generation, public understanding of physics as it relates to relevant political decisions, increasing participation in physics, etc. Therefore as part of this course, you will explore your own thoughts about physics and a selection of issues that physicists think about via six short (500-750 word) reflection essays. Essays

will be graded on a pass (100%)/fail (0%) basis, and you must pass all essays to pass the course. If you fail any essay, you may modify and resubmit it for regrading without penalty.

Generally due 30 minutes before lab via Sakai in weeks where no full lab report is due

Warmups: Prior to each lab, you will read through the lab manual and answer four short essay questions on an online warmup questionnaire (available via the assignments section of Sakai). The questions will be designed to promote careful reading of the manual which will, in turn, lead to more expedient experimentation. Warmup grades will account for 5% of each lab report grade, and will be based on the thoughtfulness of the responses.

Due 30 minutes before the start of the next lab via Sakai

Chalk Talks: You will give a single 3-5 minute “chalk talk” on their your for one particular lab. The goals of chalk talks are to test and hone oral presentation skills, and to share knowledge with classmates so that future labs are easier for everyone. More information may be found in the [Chalk Talk Assignment](#) document on Sakai.

To be presented at the beginning of the next lab

Peer Review For two lab reports, you will have the opportunity to review a lab report by peers and to have your own report reviewed by others. You will work individually and later as a group to provide feedback. Authors will then revise their reports, and the second draft will be the version graded by the instructors. Peer review grades will be assigned based on feedback quality.

Peer review will occur during lab time (in place of an experiment) on the day the report is due

Homework: Six homework assignments will be given throughout the course. Each assignment is designed to teach a new technical skill such as a programming language, or to reinforce concepts learned during lecture. More details may be found in the assignments section of Sakai.

Generally due 30 minutes before the start of the next lab via Sakai

Final Project: You will be given an imaginary budget, and as groups you will be asked to propose a redesign to improve one of the labs they have completed in the course. Groups will present their proposal before an expert panel of judges (acting as “lab managers”) during the final exam period.

Final project presentations will occur during the regularly-scheduled finals period: Sec. 402: 12:00 pm on Tues 12/7, and Sec. 403: 8:00 am on Thurs 12/9.

Required Course Materials

No textbook is required for this course, although several will be provided by the instructor for use as reference material. Several pieces of software will be required, all of which are made available by the university free of charge or are freeware. These include Zoom, MATLAB, Logger Pro, Microsoft Excel, and a \LaTeX editor. Installation instructions will be provided when needed. An internet connection capable of reliable videoconferencing is also required. Please check your email at lest daily.

Grading Policy

Assignments will be graded and scores will be posted to the Sakai grade book as quickly as possible. Final course grades will be obtained by taking a weighted average of assignment grades with the following weights:

- 50%: Lab Reports (including journal article-style reports and letters home)
- 20%: Final Project
- 10%: Homework Assignments
- 5%: Reflection Essays
- 5%: Chalk Talk
- 5%: Peer Review Assignments
- 5%: Participation

The final letter grade will be assigned by comparing the numerical grade with the following list. Numerical grades will be rounded to the nearest integer using traditional mathematical rounding (e.g. 89.49 \rightarrow 89, and 89.50 \rightarrow 90), and then a letter grade will be assigned.

≥ 93 :	90-92:	87-89:	83-86:	80-82:	77-79:	73-76:	70-72:	67-69:	60-66:	<60 :
A	A-	B+	B	B-	C+	C	C-	C+	D	F

Note: All final course grades will be posted to ConnectCarolina within 72 hrs of the final project presentation. At that point, all grades are final and cannot be changed except for instances of clerical errors.

Attendance and Late Assignment Policy

Students are expected to attend all lecture and lab sessions: In cases of illness, UNC sanctioned absences, or other emergencies, students may request their absence be excused by emailing or otherwise communicating with their instructors as soon as possible in order to provide documentation. Acceptable forms of documentation include (but are not limited to) a letter from a doctor, dean, or coach.

- Labs missed due to an excused absence must be made up promptly. If necessary, a time will be scheduled to make up the lab outside of class. If a student misses a lab, *they will receive no credit for the group lab report unless the lab is made up.*
- Labs missed due to an unexcused absence cannot be made up, resulting in an automatic grade of 0 on the lab report.

Unexcused absences may additionally count against a student's participation grade. Excused absences will not count against a student's grade, but missing an excessive number of classes may result in an Incomplete or other alternative action.

If you are sick, do not feel as though you need to be a "hero!" Consult with a medical professional and send your instructor an email when you can. The instructors will work with you once you are feeling better to make up missed course components. Students who are able may also attend lecture via Zoom, and recordings will be made available on Sakai. Remote attendance is available to students feeling ill or with a another valid excuse only (see above). Others will be marked as absent.

Students are expected to turn in all assignments by the due date posted on Sakai. In order to both encourage on-time submission and to prevent unforeseen events from having an outsized impact on students' grades, late assignments will be accepted, but will receive a grading penalty.

- Unexcused late assignments will receive a grading penalty of 10% of the original assignment point value. The penalty will increase by 10% for every additional 24 hour period until the assignment is turned in. For example, an assignment due on Monday at 1 pm and turned in on Wednesday at 2 pm will receive a 30% deduction.

Exception: *Unexcused, late warmup questionnaires* will not be accepted after the beginning of lab and will receive 0 points.

- Students who receive an excused absence may be given a due date extension by the instructors if an assignment was difficult or impossible to complete because of the absence. The instructors will work with the student in order to agree upon a new due date. If necessary, group lab report due dates may be extended for the entire group. No grading penalty will be applied.

Honor Code Policy and Plagiarism

The Honor code and the Campus Code, embodying the ideals of academic honesty, integrity and responsible citizenship, have for over 100 years governed the performance of all academic work and student conduct at the University. Acceptance by a student of enrollment in the University presupposes a commitment to the

principles embodied in these codes and a respect for this significant University tradition. Your participation in this course is with the expectation that your work will be completed in full observance of the Honor Code.

Academic dishonesty in any form is unacceptable. A breach in academic integrity, however small, strikes destructively at the University's life and work, undermining the community's intrinsic commitment to respect and mutual trust. If you have any questions about the Honor Code, please consult with someone in the Office of the Student Attorney General or the Office of the Dean of Students.

Students are expected to abide by the Honor Code in all classroom activities and assignments. Collaboration is explicitly allowed and encouraged in class and on assignments that are designated as group submissions. Discussion with other students prior to submitting individual assignments is also permitted. Graded assignments for which the instructors restrict the types of aid permitted must be submitted without any aid not explicitly authorized by the instructors.

According to the Oxford English Dictionary, *Plagiarism* is “the action or practice of taking someone else’s work, idea, etc., and passing it off as one’s own.” Plagiarism is a violation of the UNC honor code, and is not allowed or tolerated in PHYS 281L. Failure to abide by this standard may result in zero credit on the assignment in question, an honor court violation, or other disciplinary action.

In courses centered around problem sets and exams, the rules are simple: do not copy other peoples' answers. Avoiding plagiarism becomes more nuanced in courses such as PHYS 281 where the emphasis is on group work and writing. For guidance, the following (non-exhaustive) list contains some examples of plagiarism that you will need to avoid:

- Copying *text or figures* from an on-line or print source, lab manual, or peer into your lab report without attribution is plagiarism. If you want to include a figure or particularly trenchant line of text that you did not create, *you must cite it*.
- Copying text or figures from an on-line or print source, lab manual, or peer, *and changing a few words or graphical elements* before pasting it into your work is also plagiarism. You are free to use any sources you want in building your argument, but be sure to put away those sources when you start writing so as to avoid copying (or nearly copying) the language.
- Using *ideas* that you did not come up with in your work without proper citation may also be plagiarism, unless the ideas fall under the category of “general knowledge.” For example, if your classmate shows you that a certain obscure equation on page 745 of an old textbook may be used to analyze your data, both the classmate and the textbook should be cited. On the other hand, if your classmate reminds you that you can use the quadratic formula to solve a quadratic equation, no citation is needed as the quadratic formula and its applicability are general knowledge. If you are confused whether or not something is “general knowledge,” it probably is not! If you are still unsure, please ask your instructors.
- In this class you are strongly encouraged to provide help for each other on any and all assignments. Collaboration is an important part of education in general, and the scientific process in particular. That said, avoid putting yourself in situations in which your work may be copied, as this could reflect negatively on you. For example, if you finish your assignment early and share it with a classmate prior to the due date, be aware that your classmate could plagiarize your work. In this situation, your instructors may have no choice but to blame both of you equally. To avoid this, ask to see your classmate’s completed work in return for sharing yours, or simply offer to help them directly rather than sharing your work.