# PHYS 2150: Experimental Physics II

**Fall 2019**

<table>
<thead>
<tr>
<th>Instructor:</th>
<th>Prof. Keith A. Ulmer</th>
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<tbody>
<tr>
<td>Email:</td>
<td><a href="mailto:keith.ulmer@colorado.edu">keith.ulmer@colorado.edu</a></td>
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<tr>
<td>Office:</td>
<td>DUAN F323</td>
</tr>
<tr>
<td>Lecture Time:</td>
<td>Mon. 4:00 – 4:50 pm</td>
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<tr>
<td>Lecture Location:</td>
<td>DUAN G1B20</td>
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<tr>
<td>Office Hours:</td>
<td>Wed. 1:00-2:30 pm, or by appt.</td>
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</tbody>
</table>

**Lab Coordinator:** Michael Schefferstein  
**Email:** scheffer@colorado.edu  
**Office:** DUAN G2B87

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<tr>
<th>Teaching Assistants:</th>
<th>email:</th>
<th>Lab Sections:</th>
</tr>
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<tbody>
<tr>
<td>Iona Binnie</td>
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<td>Tues. 3pm, Thurs. 1pm</td>
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<td>Sarah Stevenson</td>
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<tr>
<td>Hanqing Zhao</td>
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<td>Thurs. 10am, Thurs. 1pm</td>
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**Course Website:**

1. Canvas: [https://canvas.colorado.edu/courses/53929](https://canvas.colorado.edu/courses/53929)
   - Course schedule, syllabus, lab manuals, lecture notes, other helpful stuff, grades

**Course Introduction:** There will be one lecture and one 2-hour lab per week. The laboratory experiments include many experiments of modern physics, including atomic physics, solid-state physics, electron diffraction, radioactivity, particle physics, and quantum effects. In Physics 2150, the student is expected to compose clear statements of the objective, procedure, results and conclusions for each experiment. This requirement reflects reality: in science, communication is as important as laboratory work.

**Prerequisites:** You must have completed PHYS 1140 with a minimum grade of C-. PHYS 2150 is normally taken concurrently with PHYS 2130 or PHYS 2170 but students may take PHYS 2150 after taking PHYS 2130 or 2170.

**Supplies:** You should obtain a composition notebook to record all of your data and notes about the lab procedures. The textbook is “An Introduction to Error Analysis,” by John R. Taylor, University Science Books, Second Edition, 1997. Copies of the lab manuals are available on the canvas webpage as well as in the lab. An iClicker is required to answer questions during the lectures.

**Attendance:** To complete the work of this course you must attend 12 laboratory sessions and attend the lectures. If you will miss a lab class you must discuss the situation with your laboratory instructor before the
class and as soon as possible. Unexcused absences will result in a zero (no credit) for that lab. Students arriving to a lab class more than 20 minutes late will be considered absent and receive no credit for that lab. Students arriving 10 minutes late will have 2 points (10%) deducted from their score for that lab.

You are required to take all experimental data during your regularly scheduled lab period. If for some reason you must come to the lab outside your regularly scheduled lab time, then check with your lab instructor/coordinator first so that arrangements can be made.

Lectures: The lectures are on Mondays in Duane G1B20 at 4:00 PM beginning on August 26th, 2019. The lectures will be based on chapters 5 through 9 and chapter 11 of Taylor’s book, “An Introduction to Error Analysis.” It is expected that the material in chapters 1 through 4 was covered in PHYS 1140, but it may be a good idea to review it. The purpose of the lectures is to give a basic introduction to general experimental analysis and not just to cover the specific techniques needed in the laboratory experiments. There will be clicker questions on important concepts during the lectures.

Radiation Certification: All Physics 2150 students are required to complete radiation training for use of sealed sources. You must complete the training to remain enrolled in the course. Your first lab day will be dedicated to taking this quiz. You will receive a hard copy of the material for the quiz, and a link to it is provided on the course canvas page. Please read through this material in lab before taking the quiz. You only have one chance to pass the quiz. Failure to take the training will result in an administrative drop from the course.

Lab Partners: You may perform experiments either individually or with one partner. Groups larger than two are not permitted. When working with a partner, make sure you each have an equal share of the actual data taking responsibilities and that you each record the data in your own lab notebooks. You may collaborate on the data analysis, but in the end each person should write his or her own analysis and conclusions.

Selection of Experiments: There are descriptions for 12 experiments set up in the laboratory on the course canvas web page. You are expected to complete six of these experiments during the semester. There is a sign-up sheet for your laboratory section posted on the blue cabinets in G2B86 (computer lab). Reserve an experiment by placing your name and your partner’s name in the proper entry space for the relevant time period. Please sign up for only one lab in advance at a time. Remember to allow yourself two weeks for all experiments.

The Compton experiment is optional. It is more difficult and requires more time than the other experiments, and you should not select this experiment as either the first or last experiment of the semester. In addition, you should select this experiment only if you have good laboratory experience.

Preparation for labs: Since the time in which you have access to the laboratory is limited, you should prepare yourself for the lab by reading and studying the experiment instructions before coming to class. Links to short videos for each lab are available on the course canvas website.

Taking data in lab: You should record all of the data that you take in each lab period in your lab notebook. At the end of every period, your lab notebook must be signed by a TA or the Lab Coordinator. You may continue working on your data and analysis outside of class. You will be given one week in lab to collect data and a second week in lab to finish collecting data, to finish the comments in your notebook, and/or to work on your lab reports.

The report that you submit for the lab should include a scanned copy of your lab notebook (including the TA or Lab coordinator’s signature) at the end of the lab report. It is your responsibility to get the TA or Lab coordinator to check your data during class and sign off. Failing to do so will result in lost points on the lab grade.
Submitting lab reports: Lab reports are due at 10 pm on the Friday of the week following the completion of the lab. This semester the lab reports will be due on Sept. 27, Oct. 11, Oct. 25, Nov. 8, Nov. 22, and Dec. 12 (note that Dec. 12 is exceptionally a Thursday, which is the last day of the semester).

Reports will be submitted electronically to canvas. Each report should include a written report, including relevant data and plots, as well as scanned pages from your lab notebook. All pages should be combined into a single pdf file to submit. Some helpful tips about scanning and combining pdfs are included on our canvas page.

No late lab submissions will be accepted. Anything not turned in by the deadline will receive a zero (no points) for the lab. Please make sure to submit on time!

Grading: Each experiment is worth up to 20 points, for a total possible of 120 from the six experiments. An additional 20 points will be awarded based on the clicker questions for a total possible of 140 for the course. I will automatically excuse one absence from the lectures and not count the clicker points for that day. Additional absences will count as zero for the clicker questions that day. There are no homework assignments or exams for this course.

Accommodation for Disabilities: If you qualify for accommodations because of a disability, please submit your accommodation letter from Disability Services to your faculty member in a timely manner so that your needs can be addressed. Disability Services determines accommodations based on documented disabilities in the academic environment. Information on requesting accommodations is located on the Disability Services website. Contact Disability Services at 303-492-8671 or dsinfo@colorado.edu for further assistance. If you have a temporary medical condition or injury, see Temporary Medical Conditions under the Students tab on the Disability Services website.

Classroom Behavior: Students and faculty each have responsibility for maintaining an appropriate learning environment. Those who fail to adhere to such behavioral standards may be subject to discipline. Professional courtesy and sensitivity are especially important with respect to individuals and topics dealing with race, color, national origin, sex, pregnancy, age, disability, creed, religion, sexual orientation, gender identity, gender expression, veteran status, political affiliation or political philosophy. Class rosters are provided to the instructor with the student’s legal name. I will gladly honor your request to address you by an alternate name or gender pronoun. Please advise me of this preference early in the semester so that I may make appropriate changes to my records. For more information, see the policies on classroom behavior and the Student Code of Conduct.

Honor Code: All students enrolled in a University of Colorado Boulder course are responsible for knowing and adhering to the Honor Code. Violations of the policy may include: plagiarism, cheating, fabrication, lying, bribery, threat, unauthorized access to academic materials, clicker fraud, submitting the same or similar work in more than one course without permission from all course instructors involved, and aiding academic dishonesty. All incidents of academic misconduct will be reported to the Honor Code (honor@colorado.edu); 303-492-5550). Students who are found responsible for violating the academic integrity policy will be subject to nonacademic sanctions from the Honor Code as well as academic sanctions from the faculty member. Additional information regarding the Honor Code academic integrity policy can be found at the Honor Code Office website.

Sexual Misconduct, Discrimination, Harassment and/or Related Retaliation: The University of Colorado Boulder (CU Boulder) is committed to fostering a positive and welcoming learning, working, and living environment. CU Boulder will not tolerate acts of sexual misconduct intimate partner abuse (including dating or domestic violence), stalking, protected-class discrimination or harassment by members of our community. Individuals who believe they have been subject to misconduct or retaliatory actions for reporting a concern should contact the Office of Institutional Equity and Compliance (OIEC) at 303-492-2127 or cureport@colorado.edu. Information about the OIEC, university policies, anonymous reporting, and the campus resources can be found
on the OIEC website. Please know that faculty and instructors have a responsibility to inform OIEC when made aware of incidents of sexual misconduct, discrimination, harassment and/or related retaliation, to ensure that individuals impacted receive information about options for reporting and support resources.

**Religious Holidays:** Campus policy regarding religious observances requires that faculty make every effort to deal reasonably and fairly with all students who, because of religious obligations, have conflicts with scheduled exams, assignments or required attendance. In this class, please inform your instructor in the first two weeks of classes if you anticipate a conflict. See the campus policy regarding religious observances for full details.

*Any information in this syllabus is as accurate as possible at the time of writing. Announcements about changes of any kind will be made in class, and posted on the web, and will take precedence over this syllabus. You are responsible for what is said in class, whether or not you are in attendance.*