PHYS2007 for Term Fall 2025

Second Year Physics Laboratory

We, the people of the Faculty of Science at Carleton University, acknowledge that our campus is located on the traditional, unceded territories of the Algonquin Anishinabeg people. Miigwetch for your hospitality and stewardship of this territory and the teachings that come from it. We are grateful for this land, the air that we breathe, and the water that sustains us all as well as for the animals, plants and other living beings: these enable us to research, teach, mentor, support, study, and learn. We recognize our responsibility to our natural environment and to reconciliation with Indigenous peoples.

Course Instructor: Prof. Jesse Heilman

How to address me: Professor Heilman

Gender Pronouns: (he/him/his)

Email: Jesse.Heilman@carleton.ca

Best Ways to be in Touch: via email

Course TAs: TBD (will be announced on Brightspace)

Office Location: Room 3314, Herzberg Laboratories

Class Location: Please check Carleton Central for the room location.

Class Times:

Section A: Tue/Thur, 8:35-11:25

Section B: Tue/Thur, 13:05-15:55

Section C: Wed/Fri, 8:35-11:25

Section D: Wed/Fri, 13:05-15:55

Prerequisites: PHYS1002 or PHYS1004

Lab Supervisor: Julie Sutton

How to address me: Julie

Gender Pronouns: (she/her)

Email: jsutton@physics.carleton.ca

Office Location: Room 3368, Herzberg Laboratories

Best Ways to be in Touch: in class or via email

Lab Supervisor: Jesse Lock

How to address me: Jesse

Gender Pronouns: (he/him)

Email: jesselock@cunet.carleton.ca

Office Location: Room 3368, Herzberg Laboratories

Best Ways to be in Touch: in class or via email

Welcome to PHYS 2007!

THIS COURSE FOCUSES ON IMPROVING YOUR SKILLS AS EXPERIMENTAL SCIENTISTS. THE SCIENTIFIC METHOD IS BASED ON THE INTERPLAY BETWEEN HYPOTHESIS, MEASUREMENT, AND INTERPRETATION AND RIGOROUS TREATMENT OF THE MEASUREMENT AND INTERPRETATION STEPS ARE PARAMOUNT TO A HEALTHY SCIENTIFIC COMMUNITY. IN THIS COURSE YOU WILL DEVELOP GOOD PRACTICES AROUND DATA COLLECTION, UNCERTAINTY EVALUATION, AND STATISTICAL ANALYSIS. YOU WILL GRADUALLY GAIN MORE AUTONOMY IN THE DEVELOPMENT AND EXECUTION OF YOUR EXPERIMENTAL PROCEDURES OVER THE COURSE OF THE TERM.

Calendar entry: Students complete a number of experiments selected from classical physics and geometric optics, modern physics, etc. Seminars on relevant experimental topics will be included.

Prerequisite(s): PHYS 1002, or PHYS 1004 (PHYS 1008 is also acceptable provided a minimum average grade of B- is presented).

Course delivery: This course focuses on synchronous laboratory experiments that you will perform with lab partners during three-hour laboratory sessions, twice a week. These synchronous activities are paired with asynchronous preparation, analysis of the data you have collected in lab, and production of scientific reports on your laboratory activities. You will also focus on building collaborations within the scientific community of our class by working with different lab partners at different times throughout the semester. Your laboratory supervisor will assist you in forming collaboration groups at the appropriate times.

As some of the topics explored in the experiments will not necessarily have been covered in your other classes by the time of the relevant experiments, your instructors will deliver seminars to introduce you to the concepts you will need to have been exposed to in order to interpret the data you will collect in the experiments. You will use the Python programming language and learn to use packages and libraries that are useful in analyzing your data.

Topics Covered and Learning Outcomes

Science is for everyone. We are committed to fostering an environment for learning that is inclusive for everyone regardless of gender identity, gender expression, sex, sexual orientation, race, ethnicity, ability, age, class, etc. All students in the class, the instructors, and any guests should be treated with respect during all interactions. It is our hope that our class will support diversity of experience, thought, and perspective. We will continually strive to create inclusive learning environments and would therefore appreciate your support and feedback. We welcome emails or in-person communications to let us know your preferred name or pronoun. Please see the Faculty of Science Equity, Diversity, and Inclusion (EDI) statement: https://science.carleton.ca/about/edi/

Topics by Week

Week	Start date	Topic/Content	Readings/Prep for Class
0	Sept. 1	No Labs	Course Syllabus, Introduction Lab Manual
1	Sept. 8	Introduction	Introduction Lab Manual
2	Sept. 15	Optics	Lenses Lab Manual
3	Sept. 22	Optics	Prism Lab Manual
4	Sept. 29	Optics/Waves	Interferometry Lab Manual or Diffraction Lab Manual
5	Oct. 6	Waves	
6	Oct. 13	Waves	Polarization Lab Manual
7	Oct. 20	Waves	Interferometry Lab Manual or Diffraction Lab Manual
8	Oct. 27	Waves/Modern Physics	
9	Nov. 10	Modern Physics	Photoelectric Effect Lab Manual
10	Nov. 17	Modern Physics	Bohr Atom Lab Manual
11	Nov. 24	Modern Physics	
12	Dec. 1	Make-Up Labs	

Important dates and deadlines can be found here: https://carleton.ca/registrar/registration/dates/academic-dates/, including class suspension for fall, winter breaks, and statutory holidays.

Course Level Learning Outcomes:

1. **Demonstrate** experimental techniques learned in first-year laboratory classes.
2. **Operate** standard laboratory equipment independently.
3. **Observe** various physical phenomena in a controlled environment.
4. **Analyze** the validity of experimental methods, data, and trials.
5. **Apply** the least squares method to determine best fits of theory to data.
6. **Use** statistical tools such as Poisson Statistics, Normal distributions, and χ^2 tests to **evaluate** the validity of experimental results.
7. **Explain** the impact of random uncertainties on experimental results.
8. **Record** an effective scientific logbook.
9. **Communicate** your experimental methods and findings by **writing** scientific reports.
10. **Utilize** the Python programming language to analyze data and create scientific figures.

Assessments

Grade Breakdown

COMPONENT	GRADE VALUE
INTRODUCTION EXPERIMENT	5%
LENSES EXPERIMENT	10%
PRISM EXPERIMENT	10%
INTERFERENCE EXPERIMENT	15%
POLARIZATION EXPERIMENT	10%
DIFFRACTION EXPERIMENT	10%
PHOTOELECTRIC EFFECT EXPERIMENT	15%
BOHR ATOM EXPERIMENT	25%

Laboratory Experiments

During the laboratory sessions, you will follow the procedures outlined in the lab manual for the appropriate experiment. As the course progresses, the detail of the procedures will decrease and you will be expected to use what you have learned in previous experiments to fill in the gaps. You will be assessed on your progress through the lab by the laboratory staff, who will mark down your progress and provide feedback on your procedures and the organization of your logbook. These, completion style assessments will be worth 5% of the total marks available for that experiment. 85% of the marks will be awarded based on the quality of the scientific report you turn in, one week after the conclusion of the experiment. The remaining 10% will be awarded for completing a post report reflection.

Logbook

During this course, you will keep a physical logbook of your progress, observations, data and reflections. Keeping this log organized and appropriately detailed is a critical skill for experimental scientists and you will receive regular feedback from the laboratory staff as to the quality of your logbook. Be sure to purchase a log

book from the campus store before coming to the first laboratory session. The campus store has appropriate logbooks earmarked for physics labs. Ask for help from the store staff if you are having trouble finding one.

Short and Long Reports

For the Lenses, Interference, Photoelectric Effect, and Bohr Atom experiments, you will produce a detailed scientific report on your experimental methods, data, and results. Guidelines and examples can be found on Brightspace. Additionally, the laboratory sessions are designed to allow you time to work on your analysis and reports in a collaborative environment where you can receive feedback on your work from both your peers and the laboratory staff. Attendance to lab sessions is mandatory.

For the Introduction, Prism, Polarization, and Diffraction experiments, you will instead complete a guided, shorter report in the form of writing responses to several guiding questions. These questions will be posted on Brightspace and will be due a week after the conclusion of the relevant experiment.

Post Report Reflections

You will receive feedback and marks on your reports one week after the relevant due date. Once the feedback has been returned to you, you will have 48 hours to submit a reflection on your experiment, report, and the feedback you received from the laboratory staff. This written reflection does not need to be extensive but should be taken seriously. Reflexivity about our merits and shortcomings is the best way to improve your practice as an experimental scientist and is critical to successfully implementing the scientific method.

Late and Missed Work Policies

Late Work

Without a specific accommodation granted by Professor Heilman, late work will not be accepted. Please contact Professor Heilman at least 24 hours prior to a due date if you would like to ask for an accommodation.

Missed Work

Short-term (5 days or less): For extenuating circumstances beyond your control , you should fill out the academic considerations form and send it to Professor Heilman within 24 hours of the passing of a deadline or missing a course session. There will be two sessions in the final week of the term dedicated to allowing students who have been granted an accommodation to complete work they may have missed. However, there is only time for one experiment to be completed during this week. If you must consistently use this accommodation, then you must make an appointment with Professor Heilman to discuss your situation as below for Long-term accommodation.

Long-term (> 5 days): For longer term accommodations, fill out the longer-term accommodation form and schedule an appointment with Professor Heilman to discuss your situation.

Learning Materials and Other Course Related Resources

Learning Material	Options for Purchasing	Approximate Cost
Laboratory Notebook	Campus Store	$10.95+HST

Academic Accommodations and Regulations

Carleton is committed to providing academic accessibility for all individuals. You may need special arrangements to meet your academic obligations during the term. The accommodation request processes are outlined on the Academic Accommodations website (https://students.carleton.ca/course-outline/).

Statement on Chat GPT/Generative AI usage

As our understanding of the uses of AI and its relationship to student work and academic integrity continue to evolve, students are required to discuss their use of AI in any circumstance not described here with the course instructor to ensure it supports the learning goals for the course.

AI use in this course: Students may use AI tools for basic word processing and formatting functions, including:

- Grammar and spell checking (e.g., Grammarly, Microsoft Word Editor).
- Basic formatting and design suggestions (e.g., Microsoft Word's formatting tools, PowerPoint Design editor).

Documenting AI use: It is not necessary to document the use of AI for the permitted purposes listed above. If you have questions about a specific use of AI that isn't listed above, please consult Professor Heilman.

Why have I adopted this policy? This policy ensures that student voices and ideas are prioritized and authentically represented, maintaining the integrity of the work produced by students while allowing basic support to enhance clarity, correctness, layout, and flow of ideas. The goal of adopting a limited use of AI is to help students develop foundational skills in communication and critical thinking by practicing substantive content creation without relying on AI support.

Limitations: Students may not use AI for developing analysis code as this is one of the primary learning objectives for the course. Copying and pasting or paraphrasing any generated AI output into laboratory assignments or reports is considered plagiarism.

Statement on Academic Integrity

Students are expected to uphold the values of academic integrity, which include fairness, honesty, trust, and responsibility. Examples of actions that that compromise these values include but are not limited to plagiarism, accessing unauthorized sites for assignments or tests, unauthorized collaboration on assignments or exams, and using artificial intelligence tools such as ChatGPT when your assessment instructions say it is not permitted.

Misconduct in scholarly activity will not be tolerated and will result in consequences as outlined in Carleton University's Academic Integrity Policy. A list of standard sanctions in the Faculty of Science can be found here.

Additional details about this process can be found on the Faculty of Science Academic Integrity website.

Students are expected to familiarize themselves with and abide by Carleton University's Academic Integrity Policy.

Student Rights & Responsibilities

Students are expected to act responsibly and engage respectfully with other students and members of the Carleton and the broader community. See the 7 Rights and Responsibilities Policy for details regarding the

expectations of non-academic behaviour of students. Those who participate with another student in the commission of an infraction of this Policy will also be held liable for their actions.

Student Concerns

If a concern arises regarding this course, **your first point of contact is me**: Email or drop in during student hours and I will do my best to address your concern. If I am unable to address your concern, the next points of contact are (in this order):

Note: You can also bring your concerns to Ombuds services.