

Modern Physics Lab, Course 50:750:238

Rutgers University Camden

Department of Physics

Fall Semester 2022

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Office Hours: By appointment
COREQ: 50:750:232

Course Outline and Goals

Modern Physics Laboratory (50:750:238) is designed to provide students with an experimental application to illustrate the principles of modern physics. Students will learn various experimental and instrumental techniques pertaining to such topics. Additionally, students will learn how to acquire, process, analyze, and present experimental data. The first half of the semester will include exemplar experiments performed early in scientific history to establish the fundamentals of quantum mechanics. The second half of the semester will transition away from traditional labs and be more research based. Since this is an upper level laboratory, this course will be designed to teach students how to perform on a research laboratory level. There will be a strong focus on analyzing data, error analysis, and presenting data through both technical writing and oral presentation, with standards set to those seen in the peer-reviewed scientific community.

Specific Student Learning Outcomes

- Demonstrate the existence of electrons
- Verify quantization for both electrons and light
- Learn safe laser practices and beam alignment techniques through the use of optics
- Practice modern experimental research techniques, including instrumentation and data analysis
- Develop skills for presenting experimental data through technical writing and oral presentation

Access to Course Materials

There is no required text book for this course. I will post all course material, announcements through Canvas. It is important to check Canvas regularly.

Attendance

Attendance is required for all labs. Unexcused absences will result in a zero for that lab and no make-up lab will be granted. In the event of an emergency or illness, please contact me ASAP.

Extreme Weather/COVID-19 cancellations

Please pay attention to official announcements regarding campus operation. If it is necessary to cancel lab due to these circumstances, I will send out an announcement through Canvas.

Course breakdown

Experiments: Each experiment will have an associated write-up in one of the following formats:

Notebook (all): Over the courses of the semester, we will be working to develop your lab notebook skills. All of your lab experiments should be formatted as a high quality laboratory notebook. This will include a detailed procedure, pertinent MSDS information, notes taken while performing the lab, and raw data. Your notebooks will be checked randomly throughout the semester and collected at the end of the semester. Please see guidelines for details.

Data analysis (all): As this teaching lab is supposed to prepare you for research level experimentation, we will place a strong emphasis on data and error analysis. Our lab meets on a Monday evening, and I ask that you analyze your data and send it to me by Friday night to determine if you had a good experimental outcome. Along with your analyzed data, you should decide whether or not the data is acceptable or unacceptable. If the data is acceptable, you can move onto your lab write-up and we will start a new experiment the following week. If your data is flawed, you should explain why you believe this to be the case, propose a way to improve the data, and we will repeat the experiment the following week.

Lab write-ups (all): Lab reports will be written in either pairs or groups of three (depending on the particular experiment). Each experiment will have a write-up, due electronically as a PDF before the next lab meeting. Please see guidelines for details.

Oral presentation (1): At the end of the semester, each student will sign up for one experiment to present orally to the class. This presentation will be 10-15 minutes in length and should

include an overview, detailed background information needed to understand the concepts pertaining to the lab, procedure, results, and conclusions. A detailed handout with expectations will be provided and discussed.

Grade breakdown

Lab write-ups	50%
Data analysis	10%
Notebooks	10%
Oral presentation	20%
Technique	10%

Safety

You will not be permitted in the experimental lab without appropriate lab attire. This includes long pants, closed toe shoes, a lab coat, and safety goggles. If you are not dressed appropriately, you will be asked to leave. It is expected that you behave with laboratory safety in mind at all times. Anyone that is intentionally creating an unsafe environment in the lab will be asked to leave permanently. Masks are required in lab at all times due to the University imposed mask mandate for COVID-19.

Group Work

You will be working in groups of your choice for most of the experiments. Although you will be working collaboratively, each group member should have an individual notebook for grading. Lab write-ups will be completed and submitted in groups, but you do have the option to make an independent submission. If you choose to submit independently, you must inform me and your group members before submission.

Academic Integrity

Rutgers University Academic Integrity Policy (<http://academicintegrity.rutgers.edu/policy-on-academic-integrity>) will be strictly enforced, and there will be a zero tolerance policy for violations. Scientific integrity will be strictly enforced in this lab.

Tentative Schedule

Week #	Date	Room	Lab Title	Assignment
1	Sep 8	CNS-213	Syllabus review Notebook guidelines	Notebook
2	Sep 15	CNS-213	e/m	Notebook Group Report
3	Sep 22	CNS-213	Photoelectric effect	Notebook Group Report
4	Sep 29	CNS-213	Millikan oil drop	Notebook Group Report
5	Oct 6	CNS-213	Millikan oil drop	Notebook Group Report
6	Oct 13	CNS-213	Blackbody radiation	Notebook Group Report
7	Oct 20	CNS-213	Blackbody radiation	Notebook Group Report
8	Oct 27	CNS-213	Laser safety training (online) Beam alignment workshop	Notebook
9	Nov 3	CNS-213	Interferometer	Notebook Group Report
10	Nov 10	CNS-102	Speed of light	Notebook Group Report
11	Nov 17	CNS-102	Particle in a box	Notebook Group Report
12	Nov 24	TBA	No lab (Wednesday classes)	N/A
13	Dec 1	--	TBA	TBA
14	Dec 8	TBA	Oral Presentations All late work due	N/A