

Physics 251: Experimental Atomic Physics

Instructors

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Office Hours: We'll conduct a poll to find good times. Or just come find me in my office or our labroom.

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Office Hours: TBD

Website: We'll use Blackboard. <https://blackboard.wm.edu>

Class Times: WR 1400-1650 R 900-1150 [three sections], Small 133. Prof. Mikhailov will be the instructor of record for R morning, and Prof. Kordosky will do WR afternoons. We may switch up on occasion.

Lab Assistants: Kevin Braga (kbraga@email.wm.edu), Carlos Pernas (cpernas@email.wm.edu), Kevin Scheuer (kscheuer@email.wm.edu).

Text: There is no required text for this class, aside from the lab manual provided on Blackboard. However, as supplements we suggest:

- Melissinos and Napolitano, *Experiments in Modern Physics*, 2nd Ed., Academic Press.
- G. L. Squires, *Practical Physics*, 4th Ed., Cambridge.
- J. Taylor, *Introduction to Error Analysis*, 2nd Ed., University Science Books

We have placed copies of these books on reserve at Swem.

Sections: There are three independent sections for this class. In general, you cannot switch between the three after the first experiment since you will have a lab partner and some of the experiments require at least two people.

Physics 201: Physics 201 is a pre- or co-requisite of this class. However, unlike Physics 101/102, the two classes are separate and we do not try to keep them in sync or make sure that 201 covers the theory behind a topic before 251 does the experiment. This is, more or less, how progress in physics really occurs! Experimenters often do their work at the frontier where there is no well established theory or where there are multiple competing theories.

Schedule: You'll be conducting a new experiment every two weeks, using the 170 minutes we have in class. **You must attend both weeks.** The first week is, roughly, intended for understanding the experiment and taking data, while the second is for analysis and collection of new data, if necessary.

Standard Experiments: These are canonical experiments that everyone will do and then write a report on. In general, we do not have more than 4 setups of each experiment. This means that while one half of the class is experiment A, the other half will be on experiment B. And the next week you'll swap. The standard experiments are:

1	optical interferometry	4	thermal radiation
2	Faraday rotation	5	double slit experiment
3	superconductivity		

Special Project: During the final two weeks you'll do an experiment that isn't documented in the lab manual.

Presentations: At the end of the semester, in place of a final exam, we'll have a mini-conference in which your group will give a short presentation on your special project. *Please plan to be here for the final exam dates:* December 21, 1400-1700 for Wednesday; December 15, 1400-1700 for Thursday morning; and December 14, 1400-1700 for Thursday afternoon. We may offer other assignments in lieu of a talk, stay tuned.

Pre-lab reading and exercise: The standard experiments have lab "manuals" which we will post on Blackboard. You should reserve about half an hour to read over them before coming to lab. There will also be a pre-lab exercise that you will need to complete and submit before coming to lab. That exercise will be coarsely graded and the score will be included in the score for your lab report.

Labbook: You need to keep a good labbook, with your raw data, sketches or pictures of the equipment, notes on your experimental methodology, calculations, etc. Everything you do goes into this book and it provides the foundation for your lab reports. We'll look at it twice during the semester, assigning a grade each time. Only the highest of the two grades counts (so you can improve). The labbook can be a paper one or digital. We'll discuss this in class on the first day.

Lab Reports: You will need to write a report for each of the standard labs. Though you will do the experiments in collaboration with a partner, your lab report is your own work. They are due at the start of class the following week. Late reports will be docked 5% per day.

In physics and mathematics L^AT_EX is the standard program used to format papers. It's great, especially for mathematical formulae, figures with captions, and tables. It's available on Windows/Mac/Linux. A previous student says:

Just letting you know I used LaTeX using TeXnicCenter as my editor. At first I was a bit skeptical because I felt Word could do just as much without having to build the document to view it. But as experiments began to need more figures and equations I really started to enjoy latex because it was so simple. I could make gigantic equations like the Schrodinger's equation in just a minute whereas word would have taken me quite a while. Anyways I'm really happy I learned to use LaTeX and look forward to using it in the future.

There are various L^AT_EX distributions that run on your computer. But, the easiest way to get started is to use Overleaf (<https://www.overleaf.com/>). Overleaf is a cloud service that you use via a web-browser.

Analysis Software: You will need to make graphs, histograms and do computations on the raw data. There are two choices. The first is Matlab <http://www.wm.edu/offices/it/services/software/licensedsoftware/mathstats/matlabstud/index.php>. It's a well known commercial product and W&M has a license. Second is Matplotlib (and friends, like Numpy): <https://matplotlib.org/>. It is python based and open source. It turns out many of the Matplotlib commands are derived from Matlab commands and they work in a similar way. PHYS 256 will be using Matplotlib. I believe it's also used by CSCI and Data Science. We'll use Matplotlib via Google Collaboratory <https://colab.research.google.com/>.

Grading: The grade will be based on the lab reports (60%), the pre-lab exercises (10%), the special project (25%), and an evaluation of your labbook (5%). In order to pass the class, **you must do and turn in a report for all labs.** You must also do the special project. Makeup labs are only allowed with prior

permission and for a good reason or due to illness with a doctor's note. Unlike 101/102 labs there is no reserved date. We'll just deal with this as necessary.

Letter Grades: Letter grades will be assigned as follows:

	A > 93 %	A- 90-92
B+ 87-89	B 83-86	B- 80-82
C+ 77-79	C 73-76	C- 70-72
D+ 67-69	D 63-66	D- 60-62
F < 60		