

# Physics 307L

Spring 2021

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Lecture 2: Lab Notebooks

# Course webpage

Microsoft Teams General -> Class Materials Folder  
Course Syllabus, Lecture Content, Remote Lab Manuals

Course Wiki: editable pages on experiments and schedule

<https://ghz.unm.edu/juniorlab/>

I'm working towards having everything on the wiki, but content will get posted to Teams first.

Let me know if you find any conflicting or out-of-date info on websites, which are re-used each year.

**Please check your email regularly for course announcements and updates.**

# Lecture Content

- Last week: overview of course
- This week: Keeping a lab notebook
- Next: Error Analysis

# Preparing for Labs

- You need to independently prepare for in-person lab sessions by reviewing the lab manual ahead of time, as well as reviewing any relevant safety training.
  - Lab manuals can be found on wiki (look at PDF):  
[https://ghz.unm.edu/juniorlab/index.php?title=Main\\_Page](https://ghz.unm.edu/juniorlab/index.php?title=Main_Page)
  - Poisson Statistics – Radiation Safety
  - Speed of Light - Laser Safety
- Note any questions in your lab notebook
- Data-taking for Poisson Statistics, Speed of Light, and Balmer Series should be able to be completed in 1 lab session.

# Lab Safety Trainings

- [https://ghz.unm.edu/juniorlab/index.php?title=Required Safety Trainings](https://ghz.unm.edu/juniorlab/index.php?title=Required_Safety_Trainings)
- Review the safety training material linked, if you don't have access to Learning Central
- We will also do a safety briefing at the start of each lab session involving high-powered lasers or radioactive sources.

# Keeping A Lab Notebook

- Keeping a detailed lab notebook will count for 25% of your grade in this course
- What to include?
  - What you did
  - How you did it
  - Why you did it
  - Why it was different than what was expected/calculated
- Order should be chronological, can leave some space to add in info later (add in a later printout, finish a calculation later)

# Purpose of lab notebook for this class

- To communicate to the instructors how you performed an experiment and what result you got (and why)
  - Should be able to hand us your notebook and we can re-create exactly what you did
  - Should be able to answer questions about what you did that day at the end of semester, based on lab notebook
  - **Should stand independent of provided experiment info**
- To document for yourself what you did, especially between lab sessions
  - Especially important to make sure you can finish data-taking in 1 week, and have enough info to complete analysis and lab report
  - Order of notebook should be mostly chronological
- To practice scientific documentation
  - Make sure you have plenty of blank pages each week

# Other purposes of lab notebooks

- Used for strict record-keeping for certain kinds of scientists, especially for patent verification
- Shared documentation in a collaboration
  - Shared lab notebook for an experimental setup
- Long-term record keeping
  - In graduate school and beyond, experiments last for months and years, and need to have a system to record all relevant information (not just important information)
- Reproducibility
  - For others, or for yourself (how did I do that?)
- Historical records



# What format to use?

- Handwritten notebooks still have advantages over digital notebooks, but it usually depends on the context
- In normal semesters, you would use 100% physical lab notebooks, with some content printed and taped into the notebook
- For this semester, you can use a combination of physical and digital notebook (appropriately cross-referenced), or 100% digital (not recommended)
- The submitted notebook must be a single pdf

# During and after labs

- Keep a detailed lab notebook
  - In-person: on paper (scan/picture to submit)
  - Remote: Using OneNote through Microsoft Teams's Class Notebook
  - Include photos, diagrams, cartoons, screenshots, data tables, plots, equations, etc
  - Leave space to fill in details, answer questions, or complete analysis after the lab session
- Identify all questions from lab manual, and information needed to answer them
- Take data as described in lab manual
- Do preliminary analysis during session, but will have to spend some time outside of class completing analysis

# Lab Notebook Grading Rubric

Category	Proficient (2)	Developing (1)	Insufficient (0)	Weight	Score
<b>Organization and Presentation</b>	Experiment contains a title and clearly labeled sections with date. All observations, recorded data, and calculations are clearly labeled and legible.	Experiment is missing a key section, or insufficient detail is given for context. Some sections are not clearly labeled.	Experiment is missing or doesn't clearly label more than one key section (intro, procedure, data). Multiple sections are not labeled or not legible to reader.	x1	
<b>Description of experiment</b>	Procedure is clearly described in detail with figures (diagrams, cartoons, photos) to complement text to aid in understanding and reproducing setup.	Procedure is adequately described but missing key details	Procedure is not described in sufficient detail to understand basic elements of setup. Reader is unable to understand experiment without lab manual information.	x2	
<b>Answers to questions from lab write-up</b>	Correct and complete answers to all questions from lab write-up, including brief context for question.	All questions from lab write-up are answered but some answers are incomplete or incorrect.	Missing answers to questions from lab write-up, or mostly incomplete, incorrect answers without any context for answer.	x2	
<b>Data collection</b>	All data is recorded and neatly presented, including units and appropriate number of significant figures.	Data is recorded but is not presented neatly or is sometimes missing units and appropriate significant figures.	Recorded data is not present or illegible, completely unlabeled, missing units and appropriate significant figures.	x2	
<b>Analysis</b>	Methods of analysis are described with appropriate detail. Calculations and graphs are explained and labeled appropriately. Sources of error are explained and quantified.	Data analysis methods are not explicitly recorded or described. Incomplete calculations, or incomplete graphs of data. Sources of error are included but not described or quantified in sufficient detail.	Data analysis is not included. Calculations are missing. Graphs are missing or incorrect. Sources of error are not explored.	x3	

# Lab Notebook Deadlines

- For first half of semester (almost all 1-session labs)
  - Completed lab notebook for each week must be submitted to Teams as PDF by Wednesday at noon, the week following the lab session.
  - 10% late penalty for each day it is late, up to a max of 50%
  - Assignments post to General Channel.
  - LAST week's notebooks are due this Friday
  - THIS week's notebooks are due next Wednesday Feb 10
  - Some of class has 2-week Chua's Circuit lab. Lab notebook is still due, will not be graded on % completed
- For second half of semester, lab notebook will be due the week following the completion of an experiment (submit every ~ 2 weeks)

# Resources

- <http://www.unm.edu/~mph/307/notebook.pdf>
- <http://web.mit.edu/meugoffice/communication/labnotebooks.pdf>
- [https://phys.libretexts.org/Bookshelves/Ancillary Materials/Demos%2C Techniques%2C and Experiments/The Laboratory Notebook](https://phys.libretexts.org/Bookshelves/Ancillary_Materials/Demos%2C_Techniques%2C_and_Experiments/The_Laboratory_Notebook)
- <http://pmaweb.caltech.edu/~phy003/notebooks/notebooks.html>

# Lab Notebook

- “Don't be embarrassed to describe what you think is a sloppy or poor technique. Your results hinge on what you actually do, not on how nicely you tell everyone it was done.”
- **<https://files.eric.ed.gov/fulltext/ED344734.pdf>**

# Further Reading on Lab Notebooks

- <http://web.mit.edu/meugoffice/communication/labnotebooks.pdf>

# Looking ahead - Lab Reports

- Just like how your lab notebook is practice for real-world scientific documentation, the lab reports should be used as practice for writing scientific papers
- You will need to use the information recorded in your lab notebook to write the lab report



# Elements of a scientific paper

**ABSTRACT:** A series of measurements were performed to measure the charge of the electron. An experimental value of  $1.6 \pm 0.2 \times 10^{-19}$  C was obtained, in good agreement with the established value.

**INTRODUCTION:** The charge of the electron is a fundamental constant of physics. It was first measured by R. Millikan and co-workers in 1913 [1]. As experimental techniques improved, the accuracy...

**EXPERIMENT:** A sketch of the experimental setup is shown in Figure 1. A mist of drops is injected...

**RESULTS AND DISCUSSION:** Results are summarized in Table I. Experimental errors are attributed to...

**CONCLUSIONS:** The experiment gives the fundamental electron charge with an accuracy of approximately 12%. This is limited by...

## REFERENCES:

[1] R.A. Millikan, "On the Elementary Charge and the Avogadro Constant", Phys. Rev., **2**, 109 (1913).