IB04

Fostering Authentic Communication in an Intermediate Physics Lab Course

February 21, 2017

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Outline

- Overview of Intermediate Labs
- Overview of Grading
- Abstracts
- Set-up and data taking
- Analysis
- Writing*
- Challenges to improve this lab course

Labs

- **Millikan Oil Drop Experiment (PASCO) –** *measure electron charge*
- **Fraunhofer Diffraction –** *determination of particle size and hair width*
- **Measuring the Specific Charge (e/m) of the Electron**
- **Specific Heat of Gases –**

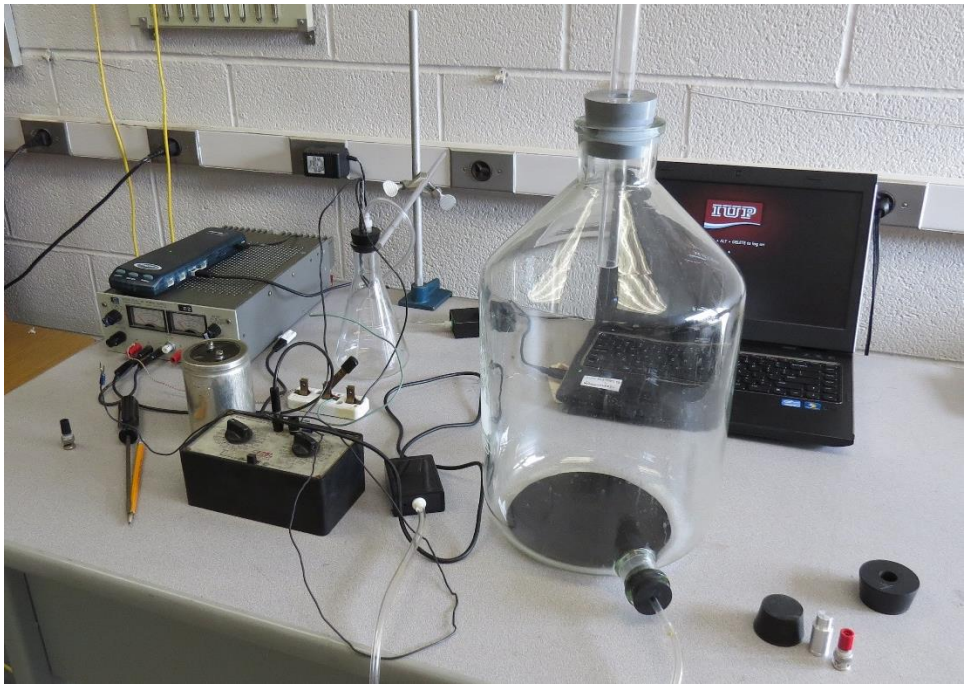
  (a) Ruchardt's Method (C_v) and (b) Rinkel's Methods (C_p/C_v) for air
- **Cavendish Balance (TEL-Atomic) –** *determine Universal Gravitational Constant*
- **The Emission Spectra of Elements –** *measure and analyze hydrogen spectrum; investigate emission spectra of other gaseous elements; measure dispersion of refractive index of a prism*
- **Monochromator Applications (ORIEL) – emission spectra of LEDs & gaseous elements**
- **Coulomb Balance (PASCO) – verification of inverse square law**
- **Motorized Molecules (J.J. Prentis AJP 68 (12) 2000) – experiments in stat mech.**

Overview of Grading

- **Written Lab Reports*** – 50% (5 reports, 10% each)
- **Abstracts** – 15%
- **Term Paper** – 20%
- **Chalk Talk** – 15%

*** "writing intensive" course as part of a "writing across the curriculum" program**

Ruchardt's method to determine Cv
Rinkel's Method for Cv/Cp of air



Lab Abstracts

- **Part 1:** Read the lab material
- **Write a Lab Abstract:**
  - **What is the point** of the lab?
  - What are the **essential equations / physics** involved
  - **What** are the necessary **quantities to measure**?
  - **How do I go about measuring** them?
  - **How will I analyze** the data to realize the point of the lab?
- **How do I know I am taking "good" data?**

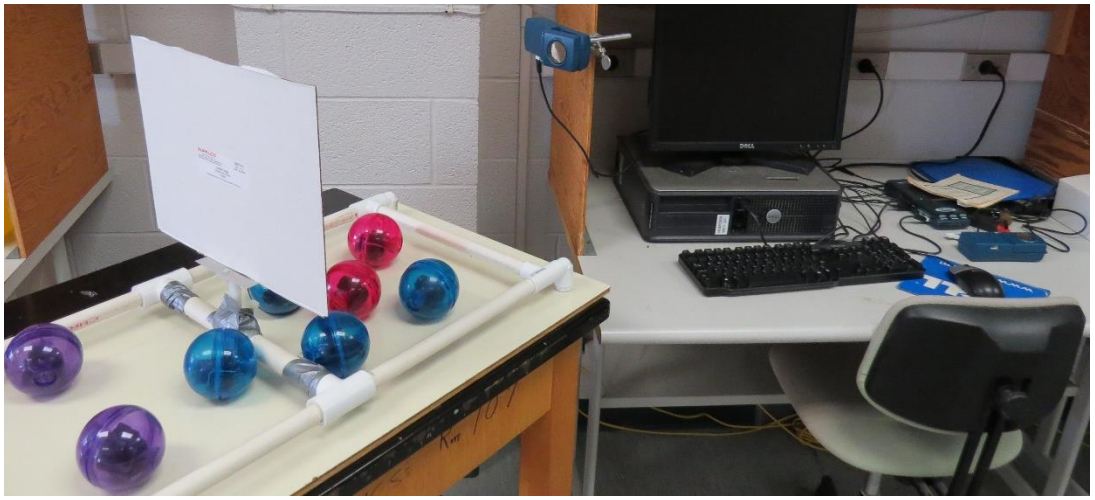
Experiment Design and Details

- What quantities do you have to measure?
- How do you know it's working?
- Tricks to increase precision and avoid mistakes
- How will you know to stop taking data*?

* "quickie" data analysis to know that the data is giving you what you need

Analysis

- Quickly get to the point (Do I have good data?), then
- Stop and go write, or
- Go back and do better



"Motorized Molecules" Experiment

"Chalk Talks" (one / semester)

- This is an oral communication of the lab to peers
  - What's the point?
  - What are the basic equations?
  - What's the essential data needed?
  - How to check if the data is good enough
- Q & A session after (and during) the talk
  - Experimental pitfalls and work-arounds
  - Traps and Tips for future lab groups

Writing the Lab Report

- **Abstract –** *What is the point of this experiment ?*
- **Background –** *To provide context; history only as necessary*
- **Theory –** *"Freshman" level equations should be derived*
- **Procedure –** *Use diagrams and **integrate** them **into** the **text***
- **Data –** *use tables and diagrams to improve the presentation and **integrate them into text /narrative***
- **Analysis**
  - *graphs, graphical analysis, calculations with **integration into** the **text / narrative***
- **Error Analysis**
- **Discussion, Summary and Conclusion**

Challenges

Successes – **"good students"**

- *good grasp of graphical analyses*
- *good grasp of error analysis*
- *modeling details of experiment*

Failures – ***"not as good students…"***

- *something goes wrong in the experiment and it is undiscovered until report writing*
- *poor grasp of graphical analysis*
- *poor error analysis*

Challenges, cont.

To Improve –

Abstracts – *we need more critical thinking at the writing the abstract stage*

"Chalk talks" – *some students were intimidated*

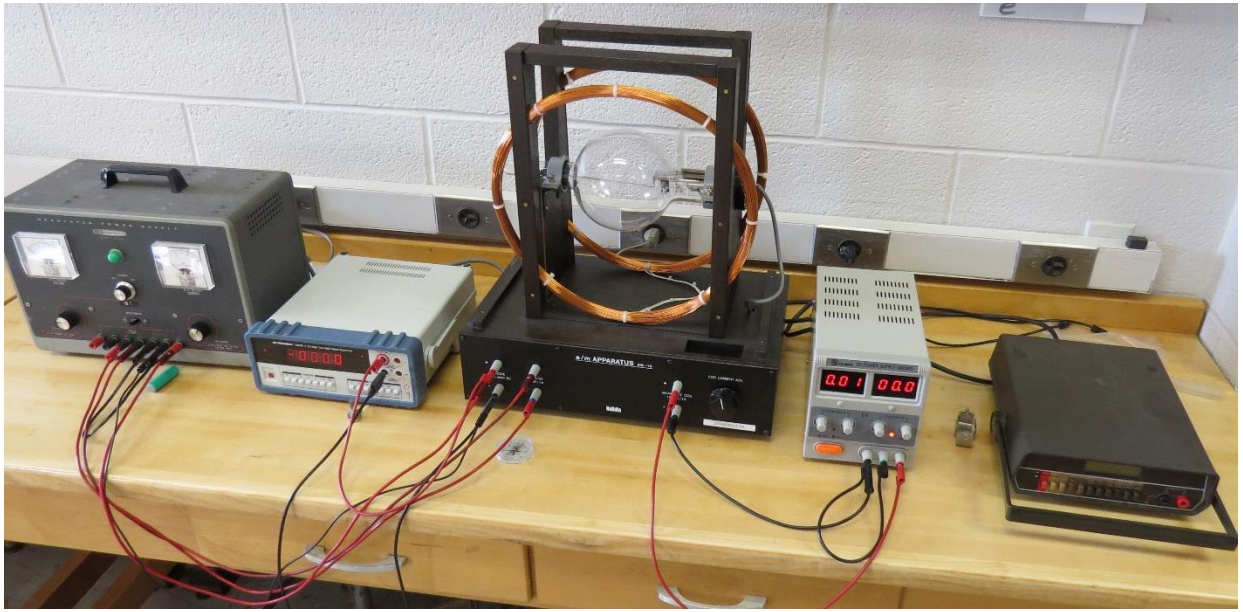
– *more detailed guidelines requested*

– *less questioning by instructors requested*

Lab Notebooks – *need more emphasis on importance of lab notebooks and* ***notebook discipline***

Questions and Comments…

to help us improve our Intermediate Physics Laboratory



Additional Labs

- **Magnetic field and Hall effect** – conductivity as a function of temperature
- **Velocity of Sound in Gases and Solids**
- **Four Point Probe Method** – Temperature Dependence of Resistivity of Semiconductors and Determination of Band-Gap
- **Michelson Interferometer** – index of refraction of liquids and gases