

**Physics 350: Advanced Lab I, Fall 2009**  
Thurs. 2:30-4:20, Science 108

**General Info**

Dr. James van Howe, Science 205, 794-3403, [jamesvanhowe@augustana.edu](mailto:jamesvanhowe@augustana.edu)  
Course web page: <http://helios.augustana.edu/~jvh/courses/350>

**Course Description**

The aim of the year-long course is to prepare you with the skills needed for experimental research, be it in academia or industry. In PH 350 we will be emphasizing error analysis, record keeping, graphing and fitting of data, and the presentation of results in formal reports similar to a white-paper or a journal publication.

**Course Goals**

The main goal of the course is to guide you in becoming an independent learner of experimental physics- a physics researcher. Hopefully this course will give you some tools and strategies on how to formulate good questions, and how to come to a solution or deeper questions using quantitative and analytical tools.

**Textbooks**

*An Introduction to Error Analysis*, John R. Taylor, 2<sup>nd</sup> Ed. (1997).

Strictly a book on error analysis covering more information than Squires in this area. Perhaps more intuitive in sections.

**Supplementary text**

*Numerical Recipes in C*, William H. Press, 2<sup>nd</sup> Ed. (1992).

Free at: <http://www.nrbook.com/a/bookcpdf.php>

A graduate/research level guide to numerical simulation and data analysis. More detail than you may want, but well-written and to the point. The first three sections of chapter 15 may help for some of the labs. Ignore the code and stick to the explanations.

**Grade Distribution**

<b>Four Write-up Foundations (4x15%)</b>	<b>60 %</b>
<b>Web assignments and Homework</b>	<b>10 %</b>
<b>Formal Write-up, 1<sup>st</sup> Revision</b>	<b>10 %</b>
<b>Peer Evaluation</b>	<b>5 %</b>
<b>Final Revision</b>	<b>15 %</b>

**Homework**

Homework will mainly consist of web assignments through the course moodle site <http://moodle.augustana.edu/course/view.php?id=1557>. The passkey is *Error*. Note that web

assignments will be given full-credit for thoughtful answers. The goal is to have you do some critical thinking and active reading prior to lab so we can make better use of the time we have together

## Experiments

### **Dartboard and Gaussian Statistics**

#### **Modeling radioactive decay with dice: Poisson statistics**

**TBA**

**TBA**

You will have two periods to complete each lab. For many of them, particularly the dartboard and radioactive decay lab, you will complete data taking well within one period. Regardless, you are required to come to each subsequent session to check-in with me on your progress, analysis, and writing. Portions of some lab sessions will serve as mini-seminars or will consist of group work pertaining to writing up the lab and analysis (see schedule below).

## Partners

Collaboration is invaluable to scientific research. For these labs, you will be working in groups of two or three. Data collection should be done together in a collaborative effort. Please split the work and take turns “at-the-wheel.” Write-ups, however, must be done independently.

## Lab Notebook

Your data collection and analysis should be recorded in a bound lab notebook. I would suggest purchasing the higher quality National Brand lab notebook at the Runestone Bookstore on campus. Ideally, you will use this notebook for the entire year through the different terms of advanced lab to record all of your experiments. In this way the price is really worth it. However, I leave the choice of notebook up to you.

Proper record keeping will be a portion of your grade for every lab write-up. Use pen. Be sure to date the top of every page on which you write. Sketch experimental setups. Among hand-written data, notes, and calculations, notebooks could include pasted-in print-outs of tables, figures, spread-sheets, or any kind of electronic media that could be useful for the record. Be as neat as you can but not overly-worried about making mistakes. Simply cross them out and move along. Filling out the notebook should be a real-time process. You can see some samples on the course website.

## Writing

An often painful but vital part of research. If you cannot successfully communicate your results, there is not much sense in performing research in the first place. You will be turning in **four write-up foundations** and **one full write-up** which will be a revision of one your labs.

### **Write-up foundation:**

For the write-up foundations you will be responsible for certain sections of a full write-up. The remaining sections you will just leave blank. See the template on the course website. Note that we will be working together on the first one in class during week three. Grading will be lenient at first and gradually get harder as you gain experience.

## Formal Write-up:

This is worth approximately twice as much as the write-up foundations. I have placed four examples of formal write-ups on the course website:

1. One of my write-ups for an advanced lab course in undergrad
2. One of my write-ups for an advanced lab course in graduate school
3. Professors Sieglaff's PH 351 formal write-up example (very nice! A+)
4. One of my publications in *Optics Letters*.

You'll note that the format of all are extremely similar, if not exact. Though none are perfect, these are good examples and here to help you in your writing.

## Course Outline

Week	During lab session:	Assignment due at the start of lab session:
Week 1	<b>Lab 1: Data collection and analysis.</b>	<b>Reading:</b> Manual for today's lab; any related supplementary reading.
Week 2	Check in with me. Work in groups on finishing analysis. Re-take any data if needed.	Lab 1 notebook record. Web assignment
Week 3	<b>Lab 2: Data collection and analysis.</b>	<b>Reading:</b> Manual for today's lab; any related supplementary reading. <b>Lab 1 Write-up Foundation:</b> full set-up, discussion & conclusion.
Week 4	Check in with me. Re-take any data if needed.	Lab 2 notebook record. Web assignment
Week 5	<b>Lab 3: Data collection and analysis.</b>	<b>Reading:</b> Manual for today's lab; any related supplementary reading. <b>Lab 2 Write-up Foundation:</b> full set-up, discussion & conclusion.
Week 6	Check in with me retake any data.	Lab 3 notebook record.
Week 7	<b>Lab 4: Data collection and analysis.</b>	<b>Reading:</b> Manual for today's lab; any related supplementary reading. <b>Lab 3 Write-up Foundation:</b> full set-up, discussion & conclusion.
Week 8	Check in with me retake any data.	Lab 4 notebook record. <b>Copy of lab you wish to revise for peer evaluation.</b>
Week 9	Individual conference with me on which lab you will revise.	<b>Lab 4 Write-up Foundation:</b> full set-up, discussion & conclusion <b>Peer evaluation.</b>
Week 10	Individual conference with me on revision.	<b>First Revision</b>
Finals		<b>Final Revision</b>