

General Information

PHYS 405: Advanced Experiments

Spring 2011

Physics 405 is an advanced undergraduate laboratory course for physics majors with experiments from many fields of modern physics. Students have full access to the experimental equipment and establish their own work schedules and methods under the guidance of faculty and staff. Emphasis is on independent experiment preparation, data acquisition, data analysis, and scientific report preparation. There is an oral presentation at the end of the course.

PREREQUISITE: Physics 375

LECTURES: Wednesday 12:00-1:00 PM, **Room 3112** (Physics)

LABORATORY: 09:00 AM – 05:00 PM (Mon to Thu)

09:00 AM – 04:00 PM (Fri)

Rooms **3206, 3210 and 3211** (Physics)

COURSE WEB SITE: <http://elms.umd.edu> , Select link for Physics 405.

INSTRUCTORS:

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TEACHING ASSISTANT:

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LABORATORY STAFF:

Mr. Allen Monroe

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Mr. Tom Baldwin

Phone: 301-405-6004; Office: 3202 (Physics); 9:00 am – 5:30 pm (M-F)

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LABORATORY SCHEDULE:

The laboratories, rooms 3206, 3210 and 3211 (Physics), are open Monday through Thursday from 9:00 a.m. - 5:00 p.m. and on Friday from 9:00 a.m. to 4:00 p.m. If you arrive before the door is open, ask Mr. Monroe or Mr. Baldwin to open the laboratory for you. If you are the last person to leave any one of the laboratory rooms, please close the door. If you are returning, have Mr. Monroe or Mr. Baldwin open the door again when you return. You must be finished with your work when the laboratory closes. If you are not finished taking data at 5:00 p.m. and you are signed up for the following day, leave a note on your experiment so that a staff member does not disassemble your experiment.

TEXT and MATERIALS:

Physics 405 Laboratory Manual – Department of Physics, Fall 2008 edition.

This will be available electronically on the Physics 405 web site. This version is not available in print.

Data Reduction and Error Analysis for the Physical Sciences - Phillip R. Bevington and D. Keith Robinson (McGraw Hill, Inc., 2003, ISBN 0-07-247227-8), or

An Introduction to Error Analysis: The Study of Uncertainties in Physical Measurement – John R. Taylor (University Science Books, 1997, ISBN 0-935702-75-X).

LECTURES:

There will be a 1-hour lecture from 12:00 – 1:00 p.m. in room 1219 (Physics) on Wednesdays. We will cover error analysis, laboratory measurement techniques, vacuum technology, detector operation, basic electronics, signal analysis and any other topics germane to the course. You will be responsible for understanding the material presented in lecture and, when appropriate, expected to include some of this material in your notebook reports and in your final formal report. If you miss a lecture you are responsible for finding out from a classmate what was covered. During the latter part of the course, the lecture period will be used for 12-minute student presentations.

Attendance at the presentations is mandatory. You will not pass the course if you do not attend all presentations unless you have a valid excuse approved by an instructor. You are responsible for knowing the presentation schedule, which is subject to change.

EXPERIMENTS:

In order to pass the course, 6 units of work must be completed, which will typically consist of 4 to 6 experiments. **Failure to complete all 6 units will result in failing the course; completion is defined as performing the experiments and submitting the laboratory notebooks for grading on or before the specified deadlines.** Each student is required to work on the experiments entirely by herself/himself. At the completion of each

experiment, you will need to hand in the laboratory notebook for grading. Every attempt will be made to grade your experiment promptly so that you will be able to improve your next report before handing it in. The notebook reports are meant to be your notes and documentation of your work in the laboratory, and are not meant to be a formal write-up. Of the 12 experiments available in the laboratory, 4 are 2-unit experiments. **Your first experiment should be a 1-unit experiment.** In order to total 6 units, you must therefore complete at least one other 1-unit experiment. You may do either zero, one, or two 2-unit experiments. From time to time, a few experiments may not be available due to technical issues.

LIST OF EXPERIMENTS:

1. Measurement of the Speed of Light (1 Unit)
2. Experimental Atomic Spectroscopy (2 Units)
3. The Franck-Hertz Experiment (1 Unit)
4. Measurement of Planck's Constant (1 Unit)
5. Hyperfine Structure of Rubidium (1 Unit)
6. The Charge to Mass Ratio (e/m) of the Electron (1 Unit)
7. Introduction to Nuclear Spectroscopy (1 Unit)
8. Not Working
9. Gamma-Gamma Angular Correlation (2 Units)
10. The Hall Effect in Metals (2 Units)
11. Cosmic Rays
12. Nuclear Magnetic Resonance (2 Units)

SCHEDULING EXPERIMENTS:

There will be an online sign-up sheet that can be accessed from any computer with an internet connection or the computer in Rm. 3210. The url is <http://www.physics.umd.edu/cgi-script/courses/p405.pl> You must request time each week to perform your experiments. Time slots are available in ½-day periods. In order to save your experimental setup, you must sign up for two consecutive periods. Also, dismantle your setup when you have completed your data taking.

LABORATORY NOTEBOOKS

You are required to have TWO (2) laboratory notebooks. Two are required so that you can work in one notebook while the other is being graded. Acceptable laboratory notebooks should be 8.5" x 11" or larger, should be bound, and have numbered, quad-ruled pages. Pages should be permanent and unperforated.

Prior to carrying out an experiment, you are required to write the answers to the preparatory questions in one of your notebooks. **You must have your notebook with the answers to the preparatory questions examined and initialed by either the instructor or the TA before you enter the laboratory and start handling the apparatus for the experiment.**

DUE DATES FOR THE NOTEBOOK REPORTS:

Notebook reports are due according to the schedule shown below.

	PreLab Initials	Lab Notebook
Experiment # 1	Fri. 1/28/2011	Mon. 02/14/2011
Experiment # 2	Fri. 2/11/2011	Mon. 02/28/2011
Experiment # 3	Fri. 2/25/2011	Mon. 03/14/2011
Experiment # 4	Fri. 3/11/2011	Mon. 04/04/2011
Experiment # 5	Fri. 4/01/2011	Mon. 04/18/2011
Experiment # 6	Fri. 4/15/2011	Mon. 05/02/2011

They may be turned in personally in class or by dropping them in the box outside of Tom Baldwin's office in the slot marked 'Phys 405'. **Late reports will not be accepted. You must plan ahead sufficiently to meet the deadline. All 6 units must be completed by May 2, 2011. Failure to do so will result in a failing grade for the class.**

GRADING OF NOTEBOOKS:

Your lab notebook should give a complete description of how you did your experiment and how you analyzed your data. Another person should be able to take your notebook and duplicate your experiment.

Grading Scheme for lab reports per unit:

Description of procedure (including prep questions)	 3 pts
Raw data (including tables, plots, etc.)	 5 pts
Analysis (including errors and final results)	 8 pts
Everything else on above list	 4 pts

Late report: No credit

No notebook for one or more labs, F for the course!

FORMAL REPORT:

One of the 4 to 6 experiments completed by you is to be rewritten as a formal report and is to be turned in by Friday, May 7, 2010. Please refer to the laboratory manual and the information on the Blackboard page for the format of the formal report.

ORAL PRESENTATION:

You are required to give a 12-minute presentation on an experiment of your choice during one of the lecture sessions on Wednesdays. The presentation may be followed by questions from other students, the TA or the instructors.

COURSE GRADE:

Notebooks (20 per unit)	70%
Formal report	15%
12-minute talk	15%
TOTAL	100%

VALID EXCUSES:

If you have a valid excuse for missing a due date for a notebook report or the 12-minute presentation (e.g., a medical emergency), please see one of the instructors to make alternate arrangements, preferably beforehand, if possible. Ex post facto (after the fact) excuses will require validation and may not be acceptable. You must speak to one of the instructors.

ACADEMIC DISHONESTY:

Academic dishonesty is a serious offense that may result in suspension or expulsion from the university. In addition to any other action taken, the normal sanction is a grade of "XF", denoting "failure due to academic dishonesty," and will normally be recorded on the transcript of the offending student. Remember, you are required to perform all experiments, analysis, and write-up independently. It is OK to discuss the experiments with other students but **you** must do the work.

TIPS FOR DOING WELL:

Read the laboratory manual carefully before attempting an experiment. Answer the preparatory questions in your notebook and have them checked by one of the instructors or the TA before you begin the experiment. Keep a complete log for the experiment, including experimental diagrams of measurement configurations used to obtain data, results, estimates of various errors and limitations of the measurements, analysis used to obtain final

results and a proper estimate of all systematic as well as statistical errors. Show clearly the reasoning used to arrive at the conclusions. If the experimental results do not agree with the known or accepted values, your documented reasoning may be the only clue that the TA or the instructor has for determining what went wrong. ***Good time management is essential for success in this class. Don't fall behind! Don't wait until the last day to do an experiment!***

IMPORTANT DATES:

First Class Lecture	Wed, Jan 26, 2011
Last Day for Schedule Adjustment	Fri, Feb 4, 2010
Last Day to Drop with a "W"	Fri, Apr 8, 2010
Spring Break	Mar 21-25, 2010
Last Lab Notebook Due	Mon, May 2, 2010
Final Report Due	Fri, May 6, 2010; 5:00pm

For a good notebook report, you must do the following:

- Write in a real lab notebook: notebooks should be quad ruled, with numbered pages.
- Write in ink. If you make a mistake, draw one line through it - don't erase it, scratch over it, or use white-out.
- Staple/paste/tape all graphs and analysis in notebook. Label axes. Include any formulas, derivations, etc. needed to understand your graph.
- Give a brief description of theory behind experiment.
- Provide the actual circuit diagram you used to do the experiment.
- Provide a clear description of the procedure used to take data.
- Provide the units of all numbers.
- Provide and explain your estimate of the random and systematic errors in all important quantities effecting your final result. Must use proper error analysis techniques.

- Pay attention to significant figures.
- Analyze your data. Write down the methods you used. If you use *Mathematica*, do not simply paste your *Mathematica* notebook into your lab notebook - write down in your lab notebook your analysis steps. Compare statistical error with random error (reduced χ^2). Discuss.
- Quote your results with final total error (including systematic errors).
- When appropriate, compare your answer to the expected value and discuss discrepancies.
- Be sure you have answered all the questions asked for in the lab manual, including **discussion questions** at the end of a unit.
- Be sure you have done all the parts of the experiments that you were asked to do.

CourseEvalUM Spring 2010

Your participation in the evaluation of courses through CourseEvalUM is a responsibility you hold as a student member of our academic community. Your feedback is confidential and important to the improvement of teaching and learning at the University as well as to the tenure and promotion process. CourseEvalUM will be open for you to complete your evaluations for about a week at the end of the semester. Please go directly to the website (www.courseevalum.umd.edu) to complete your evaluations. By completing all of your evaluations each semester, you will have the privilege of accessing online, at Testudo, the evaluation reports for the thousands of courses for which 70% or more students submitted their evaluations.
