

PHYSICS 535 – experiments in optical, atomic and nuclear physics.

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| Instructor: | Tim Gorringer |
| Office: | CP273 |
| Phone: | 257-8740 |
| e-mail: | gorringer@pa.uky.edu |
| Web page | www.pa.uky.edu/~gorringer/phy535 |
| Lab hours: | T/R 1:00 - 2:50 |
| Office hours: | W/F 2:00 - 3:00 |

1 Course Objectives.

PHY535 is an upper division laboratory involving experiments in optical, atomic and nuclear physics. In PHY535 you will (i) develop skills in conducting laboratory measurements and using laboratory instruments in optical, atomic and nuclear experiments, (ii) develop skills in data analysis and data interpretation including the careful evaluation of experimental uncertainties, and (iii) learn to effectively write-up your experimental work. Moreover, in PHY535 you will conduct experiments that were landmarks in the development of our modern, quantum-mechanical picture of the microscopic, sub-atomic world.

2 Course Prerequisites.

The prerequisites for this course are modern physics (PHY361) and data analysis (PHY335).

3 Course Organization.

The laboratory work will begin Tuesday, Jan 15. The course consisting of two 2-hour laboratory sessions on T/R 1:00-2:50 pm each week. During the laboratory sessions you will typically complete six experiment (most experiments will take two weeks to complete but a few experiments will take four weeks to complete). At the first class meeting on Thursday, Jan 10, we will cover the organization of the course, some important remarks on safety issues, and a short review of data analysis.

4 Laboratory manuals.

The laboratory manuals will be distributed on a CD. The manuals contain equipment descriptions, project descriptions and other related materials. Each item is designated as either primary (P) reading material or secondary (S) reading material. All primary reading material must be carefully read and thoroughly understood before starting an experiment. The “*to do list*” in each manual lists all the activities to be completed in the course of the experiment. This includes the instructions for setting-up the experiment, collecting the data, analyzing the results, *etc.* It also includes some supplemental questions to be answered in your write-up.

5 Laboratory notebooks.

You are required to purchase a bound, gridded paper, notebook that are supplied by the Dept. The cost is \$6.00. The notebook is used to record your initial preparations, experimental setups, experimental methods and data collection for each experiment. These notebooks are the journal for your work and must include:

- a plan comprising a short summary of the aims of the experiment and the procedures to be used. The plan is written before starting the experiment by reading the manual.
- a “procedures record” that is written during the project and that acts as a record of all experimental work. It will contain notes, diagrams, *etc.*, on how you set-up and performed the experiment and notes, tables, *etc.*, on the measurements you made and data you collected.
- an “analysis record” that is written both during the project and after the project and that acts as a record of all calculational work. It will contains notes, calculations, graphs, *etc.*, as needed to interpret your measurements.

No need for beautiful sentences or full sentences here – the emphasis is fully documenting all experimental work – but it must be legible and readable for the instructor.

6 Experiment write-ups.

The experiment write-up should be a clear, concise and well-written write-up of the experiment. It should be modeled on research articles for research journals and should comprise a title, abstract, introduction, a description of the experimental methods (including figures/tables where appropriate), a description of the data analysis, (including tables/graphs where appropriate), and a conclusion. A sample write-up will be distributed on the manual’s CD.

7 Laboratory grading.

Your grade will be determined from a notebook grade (33%) and and a write-up grade(67%) for each experiment. Four week projects will carry double the grade weighting of two week projects. For each experiment the notebook and write-up grade will be scored out of 10 and 20 points, respectively,

Students must submit their lab notebooks for grading immediately after the final laboratory session of the corresponding experimental project. Notebooks will be returned to the student with 24-hours. Students must submit their laboratory write-ups for grading within one week of the final laboratory session of the corresponding experimental project. The write-ups should be submitted in .pdf format to gorringe@pa.uky.edu. Late submission of notebooks or write-ups will not be accepted and will be recorded as zero points.

Students are required to attend all Tuesday and Thursday lab session unless the instructor has verified all measurements are completed by the early grading of the student's notebook. If you either get sick or get 'stuck' while conducting an experiment it's important to alert the instructor quickly to avoid falling-behind.

The falsifying of data or "borrowing" of data is cheating. You must collect your own data, perform your own analysis, and write your own report.

8 Experimental projects.

The available experiments are listed below.

| experiment. | key |
|---|-----|
| Millikan oil drop (e) | A1 |
| Electron magnetic deflection (e/m) | A2 |
| Photo-electric effect (h/e) | A3 |
| Franck-Hertz experiments (E_i-E_f) | A4 |
| X-ray scattering/absorption (\hbar) | A5 |
| Electron spin-resonance (g-factor) | A6 |
| Gamma-ray absorption | N1 |
| Gamma-ray spectroscopy | N2 |
| Alpha-particle spectroscopy | N3 |
| Rutherford scattering | N4 |
| Compton scattering | N5 |
| ^{60}Co gamma-gamma correlations | N6 |
| Two-slit interference | O2 |
| Microwave optics | O3 |
| Optical dispersion | O7 |

All experiments listed are two week experiments with the exceptions of the N5 and N6 which require four weeks.

9 Course evaluations.

Course evaluations are an important component of our instructional program. Our on-line course evaluation was developed to allow each student ample time to complete the evaluation of the course and the instructor. The evaluation window for Spring 2006 will open on Monday, Apr. 03 and close on Friday, Apr. 21. To access the system go to the physics department web page at www.pa.uky.edu and click the course evaluations link.

10 Important dates.

Classes begin on Wednesday, January 11 and end on Friday, April 25. During the semester there are several academic holidays: Martin Luther King Birthday - Monday, Jan. 21, and Spring Break - Monday through Friday, Mar. 10-14. The last day to drop a course is Friday, Mar. 7.