

Advanced Physics Laboratory

Catalog: A laboratory course focusing on advanced techniques and experiments drawn from the full range of physics classes. The student will understand the role of experimental design, advanced data analysis and reduction, error analysis, and the use of computers while investigating physical phenomena.

Hours: 3 credit hours (1 lecture/4 Lab)

Pre-requisites: Modern Physics (co-requisite)

Campus Numberings:

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|-------------------------------|-----------|-------------------------------------|-----------|
| Midwestern State University | PHYS 4403 | Texas A&M University-Corpus Christi | PHYS 3490 |
| Prairie View A&M University | PHYS 4103 | Texas A&M University-Kingsville | PHYS 4303 |
| Tarleton State University | PHYS 440 | Texas Southern University | PHYS 360 |
| Texas A&M University-Commerce | PHYS 441 | West Texas A&M University | PHYS 3450 |

Learning Objectives:

The objectives for the Advanced Physics Laboratory:

| Learning Outcome | Method Used for Assessment |
|---|----------------------------|
| <ul style="list-style-type: none"> Communicate physics topics to others effectively orally and in writing | Course embedded assessment |
| <ul style="list-style-type: none"> Demonstrate effective research skills | Classroom assessments |
| <ul style="list-style-type: none"> Display critical thinking skills in applying their knowledge to realistic problems and situations | Classroom assessments |

Detailed Course Description:

Upon successful completion of the course, the student will have learned to use a laboratory logbook done a literature search of information on modern physics experiments, and had experience in using computers in both experimental control and data analysis. The student will have a good understanding of the inclusion of experimental statistical and systematic uncertainty (error analysis) into data analysis and had experience in writing up experiments following publication guidelines.

These objectives will be accomplished by the students through completion of 6 experiments. Although the experiments may vary slightly from school to school, they will have the same objectives. For example in the fall of 2012, students completed the following experiments.

| Weekly Schedule | Date | Topic | Learning goal |
|-----------------|------------|-------------------|--|
| 1&2 | Sep 6 & 13 | Lens Analysis | Although a simple experiment, the student will learn how to propagate the error of individual measurements in a combined result. |
| 3&4 | Sept 20&27 | Particle Detector | At Kingsville, students will use a particle detector, while at WTAMU students used a Geiger counter. In both experiments students needed to design the experiment for best detection, using experimental |

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| | | | statistical and systematic uncertainty in the data analysis. |
| 5&6 | Oct 4 & 11 | X-ray and Electron Diffraction | This experiment uses either X-ray or Electron diffraction to demonstrate the wave characteristics of particles. In this and other experiments, a literature search for background information and recent progress will be required. |
| 7&8 | Oct 18 & 25 | Measurement of g | Students will use laboratory apparatus to measure this derived constant. Students will continue practicing writing experiments using publication guidelines |
| 9 & 10 | Nov 1 & 8 | Measurement of G | Students will use laboratory apparatus (Kingsville lent WT a copy of the apparatus) to measure this fundamental constant and discuss the level of precision. Both error analysis and writing skills will be assessed. |
| 11 & 12 | Nov 15 & 29 | Measurements with NMR | In this laboratory, students will use computers to collect and analyze data from Nuclear Magnetic Resonance (NMR) experiments located at both WT and Kingsville. This experiment will allow students to practice with a modern experimental technique frequently used in a research lab and in medical settings. |