

Instructor: James Jacobs  
Office: Science Complex Office SC 119  
Phone: 243-4986  
Text: *Data Reduction and Error Analysis for the Physical Sciences* by Philip R. Bevington & D. Keith Robinson. Short title: *Bevington*  
Lecture: M, 3:10 – 5:00. SC Room 012  
Lab: Time: 1-5PM. Day: TBD. Location: SC Rooms 012, 020 and environs.  
Office Hours: Tu 10-11AM, W 11-noon, F 9-10 AM, or just drop in or make an appointment.

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**Description:**

This is a course in advanced experiments in classical and modern physics, including optics, spectroscopy, laser science, atomic, nuclear, and particle physics, and data reduction techniques for experimental scientists. It is recommended for students entering graduate school in any experimental science.

**Prerequisites:**

PHYS 341 (Modern Physics) or equivalent, PHYS 325 (Optics) or equivalent; PHYS 321 (Electronics for Scientists) suggested but not required. Students may **not** audit this class.

**Lecture:**

Each week, Monday will be dedicated to a lecture on one or more laboratory experiments you will be asked to perform. Methods of data reduction and error analysis will also be covered. Occasionally you will be asked to carry out homework assignments based on readings in *Bevington*.

**Laboratory Experiments:**

Weekly labs will be performed on Tuesdays, with students working in pairs. Labs will be carried out in rotations of three, since there will be 3 teams (6 students / 2). Thus in a given three week period, three labs will be set up for each pair to carry out, different pairs working on different labs on a given Tuesday. Over the course of the semester, students will perform 13 labs. Students are expected to maintain a quadrille-ruled notebook in which all experiment notes and hand-recorded data should be written.

**Laboratory Reports:**

A formal typeset report is required for each lab. Each report must include a statement of purpose, theoretical background, a diagram of the apparatus, a description of the experimental procedure, data tables, data analysis, and conclusions. Computer analysis of data is encouraged and many labs will require detailed error analysis. Lab reports are due by class-time (3:10 pm) on Mondays. A 5% per day fee will be assessed for late reports.

**Final Report:**

In lieu of a final exam, students will be asked to choose one of the experiments to write a more detailed, comprehensive report citing articles from the professional literature or expand the experiment in some way. This report will be due at 5pm on Wednesday May 7, 2008. Arrange with me in advance which experiment you choose.

**Grading:**

Weekly Lab Reports: 80 %  
Final Report: 20 %

## List of Laboratory Experiments

The experiments you will perform are listed below. This list should be close to final but is subject to change.

Rotation 1: (Weeks 2-4). Write-ups are due Friday Feb. 15<sup>th</sup> at the 5:00 pm.

1. Measuring the Charge-to-Mass Ratio of the Electron
2. Ebert Mount Spectrometer: precision determination of optical wavelengths
3. Measuring the Speed of Light

Note: Monday February 18<sup>th</sup> is a holiday; but we will still have lab on Tuesday, Feb. 19<sup>th</sup> at the regular time for the first experiment of Rotation 2.

Rotation 2: (Weeks 5-7). Write-ups are due Friday March 7<sup>th</sup> 5:00 pm.

4. Index of Refraction of Air / Wavemeter
5. Measuring the Muon Lifetime
6. Compton Scattering

Rotation 3: (Weeks 8-11). Write-ups are due Friday April 4<sup>th</sup> at 5:00 pm. Note that spring break is March 26-30 (Week 10).

7. Verifying Fresnel Equations: Reflectivity of Quartz
8. Building and Temperature Stabilizing a Helium-Neon Laser – Exploring Polarization
9. High-Resolution Spectroscopy: Hydrogen spectroscopy, the Sodium Doublet and Isotope Shift in deuterium.

Last 4 experiments to be determined from the following list: (Weeks 12-15). Write-ups are due Friday May 2<sup>nd</sup> at 5:00 pm.

10. Inverse Photo-Electric Effect: Determining Planck's Constant
11. Higher-Resolution Spectroscopy: Saturation Spectroscopy in Rb
12. Zeeman effect.
13. Superconductivity and the Superconducting quantum interference device (SQUID).

Week 16 (Exam Week): Final report due at 5:00 pm, Wednesday, May 7<sup>th</sup>.

*All students must practice academic honesty. Academic misconduct is subject to an academic penalty by the course instructor and/or disciplinary sanction by the University.*

*All students need to be familiar with the Student Conduct Code. The Code is available for review online at <http://www.umt.edu/SA/VPSA/index.cfm/page/1321>.*