

PHYS 451L
SENIOR LABORATORY
Spring 2018

Time: Wednesday 2:00 to 4:30

Location: Workman 224

Text: *Introduction to Error Analysis*, 2nd Ed, by J. R. Taylor

Auxiliary materials: Lab handouts, assorted equipment manuals, senior lab web site

References in lab: Some reference textbooks are located in the lab. The most helpful will probably be *The Art of Experimental Physics* by Melissinos, *Atomic Spectra and Atomic Structure* by Herzberg, and the *CRC Handbook of Physics and Chemistry*. Please do not remove any reference materials from the lab.

A senior lab web site put together by students many years ago (<http://www.nmt.edu/~krm/TEACHING/srlab/srlab.html>) contains an overview and sample results for some of the current experiments.

Safety: Safety hazards, if any, will be discussed during scheduled meeting times. You must attend the in-class briefings for an experiment before using any equipment associated with that experiment. Do not remove any equipment from the laboratory.

Security: The laboratory should remain locked at all times when not in use. You may obtain key cards from key control after filling out the senior lab key form with Alta. All students must sign in and out of the log book when working in the lab. Be sure the door is locked when you leave.

Experiments: You will be required to complete four experiments from the list below (your choice). Note that all of the experiments will not be available at the same time. Therefore, you will need to plan ahead to use certain equipment as it becomes available. The experiments, in approximate order of discussion, are

H_α Isotope Shift (mandatory), Nuclear Magnetic Resonance, Hall Effect, Milikan Oil Drop, Infrared Thermography, Diode Laser Spectroscopy, Molecular Spectroscopy of a Nitrogen Discharge

You will be expected to complete 4 of the above experiments (including the first mandatory one) and write a concise abstract for each. In addition, you must choose one experiment and prepare a complete report in the format of a scientific paper. The paper should include experimental procedures (standard set-up, any modifications, difficulties and work-arounds, etc), your results including error estimates, and your conclusions. Tables and figures should be presented where appropriate. A typical, but by no means mandatory, organization would contain the following sections: Abstract, Introduction, Theory, Procedures, Results, Discussion and/or Conclusions, and References. Your paper will be submitted to the *Journal of Advanced Undergraduate Physics Laboratory Investigation* (JAUPLI) for peer review, revision, and possible publication. You will also be asked to review at least two papers submitted by students from other institutions.

Approximately one-half of the lecture time will be devoted to background theory and operation procedures for each of the experiments. The remaining time will be spent discussing error analysis and uncertainties, writing abstracts and papers, and reviewing papers. Homework problems from Taylor will be assigned and discussed in class.

Grading: Each abstract (there are three standalone abstracts) will count towards 15% of your grade. The final paper will be worth 20%. Your reviews of other students' papers will be worth 10%. Homework problems will contribute 10%.

A final exam based on your knowledge of the experiments and underlying theory will complete the remaining 15%. You will be permitted to use your lab notebook (but no textbooks or printed lab handouts) for the exam.

Due Dates: The first draft of abstract 1 is due on **Feb 4** (before midnight) in pdf format, emailed to kenneth.minschwaner@nmt.edu. Reviews/comments will be returned to students on Feb 7, and the corrected/final version of abstract 1 will be due via email by **Feb 11**. All subsequent abstracts and reports should be in final form when submitted. A late penalty of 2 pts per day will be assessed, up to a maximum of 8 pts deduction out of a total of 15 pts.

The other due dates are:

Abstract 2, **Feb 25**

Abstract 3, **Mar 23** (note change in day of week due to spring break)

Paper submitted to JAUPLI, **Apr 15**

Submission of revised, final paper to JAUPLI by **May 6**.

You can expect to be asked to review papers any time during the last 3 weeks of class

The final exam will be held on **May 2**, during the last class meeting.