Department of Physics
University of Regina

PHYS-471
Modern Experimental Physics II
Fall 2012

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Introduction

This course will introduce you to some of the experimental work which has contributed to the development of the modern physics. Some of the goals of the course are:

1) To allow you to reproduce and understand some of results and techniques which are the underpinnings of modern physics.
2) To provide you with an opportunity to develop critical writing skills and understand how to effectively present your scientific work to a larger audience.
3) To expose you to some of the realities of the laboratory experience, where things don't always work, where the issues are not always clear, and where progress depends on perseverance, ingenuity and judgment.
4) To learn and appreciate some of the ethical and social issues that are involved in scientific research. These include the handling of proprietary information, respect for colleagues and adherence to high standards of honesty in reporting scientific results.

You should be prepared for a fundamental difference in philosophy between this course and preceding physics labs. Here, you will be exposed to "problem solving", as opposed to following "cook book" instructions.

- You may have to teach yourself how to use and calibrate different kinds of test equipment.
- You may have to search for weak signals in the presence of noise.
- You may have to use statistical techniques to extract results from ambiguous data sets.

Your success with the experiments, and with this course, will depend on the dedication and initiatives that you apply to solving whatever puzzles arise. This is simply part of the reality and joy of experimental physics.

The Experiments

The experiments to be covered are:

- **Transmission Lines** (~3 laboratory period)
  The goal is to understand some properties of electromagnetic waves propagating in transmission lines.

- **Compton Scattering** (~5 laboratory period)
  This is a classical experiment which shows the particle nature of light, confirming that photons have energy and momentum as any other particle.

- γ-γ **Angular Correlation** (~6 laboratory period)
  This experiment gives insight on the internal spin structure of nucleus by examining the angular correlation between photons emitted in the cascade decay of a nucleus.

- **Muon Mean Life-Time** (~7 laboratory period)
  In this experiment you will be able to measure an important intrinsic property, the mean life time, of a subatomic particle called muon.

Your Duties

It is expected that your work will be as independent as possible. Your instructor will be present to guide you, but you should in principle be able to set up each of your experiments, understand the goals, solve (or attempt to) the problems that will naturally occur along your labs, interpret your results and search for references and material in the literature. If for any reason you are not able to deliver a good result, you should at least try to understand possible reasons for your failure, and suggest how you could have approached the problem in order to improve the method used in your measurements. Also, you are more than welcome to suggest new experimental methods, or improve the existing ones.

You are expected to perform the experiments during the 2:15 hour laboratory period dedicated to these activities, but you are also free to develop such activities at any time upon arrangement with the course instructors. There will be two laboratory periods plus a 50 minutes class every week. The latter can be dedicated to lectures or clarifications regarding the labs.

Class Grading

As your activities for each experiment progress, you are expected to enter all your developments and observations, including failures and successes, into a logbook, and to write a final report once each experiment has been completed. Be clear and organized, for the entries into your logbook and the reports will account for your final grade as follows:

- Logbook: 50%
- Reports: 50%

The reports are due within a week from the completion of each experiment. The logbook will be inspected, and pages signed, each session by your instructor.

Text Book

There is no official text book assigned to this course, but *"Experiments in Modern Physics", Adrian C. Melissinos, Jim Napolitano, Second Edition, Academic Press* is highly recommended. This book covers all the experiments and many of the techniques used in this course.