# Final PH 305A Lab Report

In the first part of the course, you should have become familiar with the equipment that is available in the lab and with some data collection and analysis techniques. In the final weeks, you will design an experiment that uses that equipment and those skills to address a physics question that interests you. By November 14, you should have a good idea of your topic and the general outline of the experimental procedure, and you should have those ideas in writing by that day. You can then use the last two lab periods as work time to refine the procedure and to collect and analyze your data.

For this independent project, you will produce a final laboratory report that will be much more complete and more formal than your weekly reports. The format of this report will be modeled on a published journal article, so it will include an abstract, an introduction that explains the scientific context, a detailed description of the procedure, data and results that are distilled into appropriate graphs and tables, and a scientific conclusion. I will plan to meet with each of you to review a draft of the report before you submit a revised version by the end of the final examination week.

## Report details

**Format:** The model format for your lab report should be that of a *scientific journal article*, although it will be understood that you are reporting on a student lab experiment rather than years of sophisticated measurements. Major sections of such an article include:

- **Abstract:** a very concise summary of the most important points of the report, condensed into a few sentences. This section should usually be written last, after you know what the report says. Each word in an abstract must be carefully chosen to serve a purpose. Busy scientists scan the abstracts of journal articles to decide which ones they want to read in more detail, so it must be in some sense an advertisement for the paper. Abstracts are often circulated separately from the rest of the paper, so they should make sense on their own. In physics, it is customary to include the most important quantitative results in the abstract.

  As an example, here is the abstract from one of your Dr. Gray's publications:

  > *The mean life of the positive muon has been measured to a precision of 11 ppm using a low-energy, pulsed muon beam stopped in a ferromagnetic target, which was surrounded by a scintillator detector array. The result,* $\tau_\mu = 2.197013(24)\ \mu s$*, is in excellent agreement with the previous world average. The new world average* $\tau_\mu = 2.197019(21)\ \mu s$ *determines the Fermi constant* $G_F = 1.166371(6)\times10^{-5}\ GeV^{-2}$ *(5 ppm). Additionally, the precision measurement of the positive muon lifetime is needed to determine the nucleon pseudoscalar coupling* $g_P$*.*

- **Introduction and background:** a section that describes the context in which you have performed your research. It should explain to your reader what questions you are trying to answer, and why they should find these questions interesting. You should briefly summarize and include references to any other researchers' work that might provide relevant background for your questions.

You should also explain any theoretical results that will be needed to interpret your experiment. These results tend to fall into two categories:

- the framework needed to translate your raw experimental data into the physical quantity that you're trying to measure, if it isn't obvious, and
- a calculation of the theoretical prediction against which you will compare your results.

You should not fill in every pedantic step in your derivations; your goal should be to provide enough of the high points that a motivated reader could fill in the rest. In this sense, the anticipated style is similar to that of a physics textbook.

- **Experimental method:** a description of the apparatus that you used, and of your experimental procedure. Your method should be explained as if you are telling a story here, though in a rather formal way. You should not simply enumerate steps or give commands.

  Diagrams or sketches of the apparatus can be very helpful in this part.

- **Data and results:** a presentation of your "processed" data. Long tables of raw data are not usually very useful; you should find a way to distill them down to the numbers that the reader will need to evaluate your conclusions. You should also think about the most appropriate way to present your data in graphical form.

  Figure and tables should be numbered, have titled and short captions to describe the information. Equations should be numbered and all variables should be explained. You should plan to spend some time making "nice" graphs. In any event, each axis of any graph should be labeled with the quantity and units.

- **Conclusion:** This short section should explain the outcome of the experiment. Basically, what do your data and results tell you about the way the universe works? (This is *not* the place for a "personal" conclusion about how your work on the project contributed to your own understanding of science.)

Here's a link to a relatively straightforward physics journal article (Dr. Gray was the primary author of this one) for reference:

https://doi-org.dml.regis.edu/10.1016/j.nima.2011.02.032