

## Guide for Writing Lab Reports

**Style:** Lab reports should follow the style of a scientific journal article. Reports should have a neat appearance and be concise. It should not be apparent that you have followed a lab manual in performing the experiments. Any physicist should be able to understand the motivation, methods and results without any prior specific knowledge of the experiment. Use a font size between 10 and 12 pt, and do not use margins less than 0.5 inch. All reports should be about 4-5 pages including figures and references.

Lab reports should consist of the following sections:

**Abstract:** The abstract is a brief statement of your methodology and results and summarizes what is contained in the article. It should briefly mention the motivation, the method, and the quantitative result with errors. If the result was the measurement of a specific quantity, such as the muon lifetime, the value should be included in the abstract with the estimate of the uncertainty. The abstract should never begin with "In this experiment we..." or "The purpose of this experiment was..."

**Introduction:** The introduction should contain discussion of the background and motivation for the experiment to put your work in a broad context in physics, and contain a summary of the experimental approach for your work. Include a summary with references of the relevant physics; provide theoretical results with equations that are fundamental to the physics or measurement; and state the importance of your experimental work.

**Methods:** The Methods section describes how the data was collected including a detailed experimental procedure. It includes the description of the main components of the experiment and how they work, identifying the features that are essential to your measurement and the most important signal processing steps. It should include a detailed diagram of the experimental setup and important components, followed by a description of the data-taking procedures and measurements. The methods section does not contain theory, motivation, specific results, or discussion of results, but shows your understanding of the experimental techniques.

**Calibration:** This section can be included as a subset of **Methods**, in which case do not include specific results. If your experiment warrants a separate calibration section, include the calibration procedure and results that are analyzed in depth in your lab notebook.

**Data:** Give a narrative describing the results shown in tables and graphs with explanatory captions. Tables and graphs should be numbered and cited in order. Give the specific conditions under which your data was collected (**Methods** already describes how data was collected). Show the results of your measurements clearly and in a concise manner. Consider combining plots when possible.

**Analysis:** Describe how your data was analyzed to get the results. Show relevant equations to make the analysis procedure clear. Identify the dominant sources of error (systematic and statistical) and describe the methodology of your error analysis and propagation of uncertainties. *Note that complete derivations of equations and all the detailed calculations for error analysis should be in the lab notebook. Lab reports should have only the description of the data analysis procedure that was performed in the lab notebook, but with just enough details to be clear and self contained.*

**Results:** Describe the results of the data analysis along with the results of the error calculations.

**Discussion:** Compare your results with expected or past results. Explain the relevance or significance of your results. Comment on limitations of the experiment. Suggest improvements for future work.

**Conclusion:** Summarize the experimental approach, the primary result and why anyone should care, i. e. state the importance of your results. Two sections from **Data, Analysis, Results, Discussion** and **Conclusion** can sometimes be grouped (e.g. **Results and Discussion**) depending on the particular journal guidelines and needs of the particular study. You may do so in your lab report as you see fit.

#### Other Comments

**Figures:** Figures must be labeled with a figure number and the figure numbers must increment in the order in which the figures appear in the text. All figures must be referenced in the text.

All figures must include a caption with enough detail that the main concept of the figure is understandable from just the figure and caption. Plots must have axis labels with units. The text of the caption should be delineated from the main text. Do not include figure titles- the information the caption should include all the relevant information. The font size for axis labels and numbers must be large enough to be legible (8 point font or larger). Figures used from other sources must be accompanied by the appropriate reference. No hand drawn figures are allowed.

**Use of tables:** Whenever possible, present data using plots, rather than in tables, with dots corresponding to data points with error bars. For example, if you have a calibration data set where you expect points to follow a linear relationship, show the results in a plot with statistical error bars, not a table.

**References:** References should be cited in the main text and the list of references should appear at the end of the manuscript.

Use a space between value and unit: "Data was collected for 10 s." not "Data was collected for 10s."

Note: Use your own words in writing your paper. Your report should highlight your mastery of the experiment and the underlying physics being studied. Copied sections will result in a null grade.