

Lab Report Guidelines

Style: Your lab report should be written in the style of a journal article, including sufficient tables, figures, equations, and captions. 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 including figures and references. I strongly encourage you to use LaTeX, since it is the format of the vast majority of scientific articles, because it can handle all of the required formatting easily. If you are not already familiar with LaTeX, then consider using Overleaf, an online LaTeX editor, which makes it easier to get started. Example templates for journal articles include:

<https://www.latextemplates.com/cat/academic-journals>
<https://www.overleaf.com/latex/templates/aastex-template-for-submissions-to-the-astrophysical-journal/bpkjwktvsqwp>

Grading: Minimum length is approximately 4 pages, ~ 2000 words. Your lab report will be graded on the inclusion of all sections and relevant content, and also on overall length/completeness, clarity, proper grammar and spelling, appropriate scientific language, inclusion of appropriate figures and captions, and appropriate and sufficient references. Use your own words in writing your lab report. Your report should demonstrate original thought, and highlight your mastery of the experiment and the underlying physics being studied.

The required sections of your lab report are:

Abstract - summary of the main findings (~ 100 words)

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 - background and motivation on the science, including references

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 - technical details of the experiment performed and the observations and data taken.

The Methods section describes how the data was collected including 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 – if relevant

If your experiment warrants a separate calibration section, include the calibration procedure and results. This section can be included as a subset of Methods, in which case do not include specific results.

Data: Give a narrative describing the results shown in tables and graphs with explanatory captions. 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. Use tables sparingly.

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 – Description of data analysis methods and appropriate reporting of analyzed results, including sources of error.

Discussion - Discussion of implications of the results, limitation of methodology or analysis techniques. Compare your results with expected or past results, and suggest improvements for future work.

Conclusions – Brief summary of interpretation of results, and comparison with literature data or relevant concepts. Summarize the experimental approach, the primary result and why anyone should care, i. e. state the importance of your results

References – Organized list of all references cited throughout lab report. Many possible styles, but there should be numbered citations throughout the text with numbered list in references section.

Other Comments

Sections: Sections from Data, Analysis, Results, Discussion and Conclusion are sometimes grouped (e.g. Results and Discussion) depending on the particular study. You may do so in your lab report as you see fit, but be sure to clearly label these combined sections. Data does not always need a section of its own, and can be included primarily in plots and tables and references in the Analysis or Results section.

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.

Tables and graphs should be numbered and cited in order.

Lab report due dates can be found on the class webpage. Reports submitted after the deadline will have 20% deducted, with an additional 20% for each week that it is late.