LaTeX Report Template

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Abstract

Write the abstract here. State concisely what you did, how you did it, and your main result(s). You should also provide some context for understanding the importance of what you found. The abstract should be typically three to five sentences long. If yours is longer, you may want to make it more concise.

1 Introduction

This section should set the scene, giving some background motivation for the experiment.

You should also describe the theoretical background needed for the experiment. Provide relevant formulae, either as in-line equations such as $e^{i\phi} = \cos\phi + i\sin\phi$, an unnumbered centred equation [1]:

$$B_\nu(T) = \frac{2h\nu^3}{c^2}\frac{1}{\exp(h\nu/kT) - 1},$$

where T is ...

or as a numbered centred equation [1]:

$$F = G\frac{m_1 m_2}{d^2}, \tag{1}$$

where d is ... .

Note the use of the comma between the equation and the text defining the equation's variables. Also note that the citation always comes before the equation itself. See Section 1.1 for more advice on citing references. Finally note the repeat use of the same citation – each individual citation does not require a unique entry in the reference list.

It is not necessary to start a new paragraph (or even a new sentence) when introducing a centred

equation. All variables from formulae should be defined in the text and they should have the same font and style (normally in *italics*) as in the equation. **Avoid indenting the line straight after a centred equation** (having a blank line in LaTeX will end one paragraph and start a new paragraph), unless of course it really is meant to be a new paragraph. Vectors are written in **bold** and not italicised. Reference to the equation is given by eqn. 1. Note the lack of brackets around the equation number. Reference to an equation, is only ever backwards, never refer to an equation by its number before presenting the equation itself.

1.1 Previous work in the field

It is also very important to properly cite your sources for this background information. There are two main ways to reference sources in a document: physics papers often reference by number, whereas astrophysicists usually reference by author name and date. This LaTeX template has instructions on how to do either.

1.1.1 Referencing by number

In this style, a reference to a book [1], research paper [2], website [3] or thesis [4] is done using square brackets. If it is required to cite more than one reference at the same time, then all the reference numbers share a single set of square brackets [1–3]. Note that the package "cite" automatically compresses the number of references listed between parenthesis by employing a hyphen. A particular piece of previous work is referred to in the text by Ref. 1, as "in Ref. 1 it was claimed" – again there should be no parenthesis around the citation number. Also note that quotation marks should be pointing the correct way round – see how the first set of quotation marks here, and around cite above, are facing the correct way.

1.1.2 Referencing by author and year

If you want to reference by author and year, chose this option in the LaTeX file by (un)commenting the appropriate lines:

```
%\RefByNumtrue
\RefByNumfalse
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1.1.3 Bibliography information

The information for the full reference (e.g. author names, journal name, page number, etc) can either be included manually at the end of the document in a LaTeX section that is contained within \begin{thebibliography} and \end{thebibliography}, or it can be generated using BibTeX. For the former case, see the end of the LaTeX file that generates this document.

To choose between using BibTeX and entering the references manually into your LaTeX file, you need to (un)comment these lines appropriately (true is for BibTeX, false is for manual entry):

\UseBibTeXtrue
%\UseBibTeXfalse

If you want to use the author/date style for references you MUST use BibTeX (it can be done manually, but it is not easy!).

To use BibTeX, you need a separate bibliography file that ends in ".bib" that contains all the reference information – one item per reference. There is an example included with this document. To get the BibTeX item for each reference, you can usually obtain it from an online source. Astronomers typically use the NASA/SAO Abstract database (this also has a lot of Physics papers too, if you check the "Physics" check box):

http://adsabs.harvard.edu/abstract_service.html

Once you've found the right paper, there is a link beneath the abstract that gives the "Bibtex entry for this abstract". You can copy and paste this into your ".bib" file.

Another method is to use Google Scholar. If you want to, you can sign up for this for free, using your Google account if you wish. Once you've found the right article using a Google Scholar search, underneath the entry there is a symbol that is a pair of quotation marks. If you click on this, you get the reference information, in a variety of formats, and there are also links to give BibTeX and other entries. Again, if you get the BibTeX entry, just copy and paste it into your ".bib" file.

Once you have a BibTeX file, you have to reference it at the end of your LaTeX document using \bibliography{bibfilename} where "bibfilename.bib" is the name of your BibTeX file.

Using BibTeX and LaTeX together, generating your document becomes a multi-step process. Typically you will run LaTeX first. This will produce a document with "?" in place of the citations, and will find what identifiers you have referenced. Then you will run BibTeX. This will take the identifiers that you have used, find the appropriate records in the ".bib" file, and generate a ".bbl" file. Then you will run LaTeX TWO more times and it will use the ".bbl" file to generate the references section of your document and replace the ?'s with the appropriate citations (i.e. numbers or author and year of publication).

Note that if you change from reference by number to reference by author (or visa versa, or you change between BibTeX and manual referencing) you should start the above sequence from a 'clean' state. You should remove all the files that are generated by BibTeX and LaTeX (i.e. the .aux, .bbl, .blg, .log, and .synctex.gz files). This is because the intermediate files will not be compatible with the new way of doing references, so they need to be regenerated. Depending on how you are running LaTeX, there may be an easy way to do this (e.g. in TeXShop, there is a 'Trash Aux Files' button). **Be VERY CAREFUL** not to remove your .tex or .bib files of course!

1.2 Ending the introduction

At the end of the introduction section you should explicitly write down the main aims and methods of the experiment, along with some motivation for these.

2 Experimental method

This section describes the experiment you conducted, and will normally include a diagram of the experimental setup as shown in Figure 1.

It is essential that every figure is referred to in the text of the report and is described and explained in detail in the text. Avoid wrapping text around a figure – much better to have the figure centred on the page (column) with text above and below.

It is also important to outline your plans for the experiment and how the equipment is applied, but avoid including lists of apparatus.

Figure 1: This figure caption should contain a very concise description of the figure and all its parts and insets so that the figure can be understood without reference to the text.

Don't forget to also include a discussion of anticipated sources of errors, and potential hazards and safety procedures involved in the experiment. These points should be addressed in separate paragraphs.

3 Results

This section is arguably the most important, as it is where your measurements are presented, usually in graphical form (Figure 2). Make sure graphs are well presented, each with a figure

Figure 2: If the two-column option has been chosen in documentclass, a figure can be made to span both columns using the figure* environment.

caption and legend. No need for a title as the figure caption plays the role of the title. It is convention that data measurements are plotted as points or symbols with error bars, while theoretical fits are plotted as lines. If you have more than one dataset in the same graph, make sure that they can be distinguished, for example by using different symbols for the different sets of data points. Note that it should be possible to distinguish different datasets even when the report is printed in monochrome.

Final values obtained from data analysis (e.g. from a fit of theory to your data) should always be presented with their experimental errors (sometimes referred to as uncertainties), e.g. $(2.99.6 \pm 0.02) \times 10^6$ ms^{-1} or $2.99.6 \times 10^6 \pm 0.02 \times 10^6$ ms^{-1}. Describe briefly how your results were obtained, making sure that you refer to the relevant parts of Section 1 and Section 2.

Generally it is always best to plot your data when at all possible – graphs are far more appropriate for presenting and comparing large amounts of data. Occasionally it may be more appropriate to present data in a tabulated format. These should be presented with a self-explanatory title and column and/or row headings. The data should be reported with their experimental errors.

Table 1: Title of your table

Name	RA (degrees)	Dec (degrees)
NGC 2419	114.5 ± 0.03	+38.9 ± 0.01
Palomar 3	151.4 ± 0.02	+00.1 ± 0.05
Palomar 5	229.0 ± 0.06	−00.2 ± 0.07
Draco dwarf	260.1 ± 0.09	+57.9 ± 0.08

4 Discussion

This is where you present a discussion of your results. You refer to results using Table 1 or Figure 1 etc. In some experiments it is useful to compare your result with results from a previous measurement or from a referenced literature source. Make sure you always quote the experimental error in your own result; then you can state whether it lies within experimental uncertainty of other results.

For experiments which contain multiple parts, it is often easier to present your results and discussion simultaneously in one section called 'Results and Discussion'.

Conclusions

This section should contain a brief summary of the experiment and a report of your MAIN results and conclusions. In practice, the conclusion is usually a reworded and longer version of the abstract. However, it may also contain a brief discussion of key limitations of the current experiment and possible improvements which could be made.

Never introduce new information in the conclusions. This always belongs earlier in the report.

Help LaTeX with suggestions for where to hyphenate long words such as Hochspannungelektronenmikroskopie to avoid overrunning lines.

References

[1] J. Frank, A. King, and D. J. Raine, *Accretion Power in Astrophysics: Third Edition*. Cambridge University Press, Cambridge UK, Jan. 2002.

[2] L. Pollack, E. N. Smith, J. M. Parpia, and R. C. Richardson, “Novel low temperature cross relaxation in nuclear quadrupole resonance,” *Physical Review Letters*, vol. 69, pp. 3835–3838, Dec. 1992.

[3] P. Smith, “Web page title.” https://www.latex-project.org/, accessed 6 October, 2009.

[4] J. Doe, *Title of thesis*. PhD thesis, University of Exeter, Exeter, U.K., 2018.