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ATLAS Style Guide

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Eric Eisenhandler

Queen Mary, University of London

This is a compendium of rules, recommendations, information and advice for writing papers and notes within the ATLAS Collaboration at the CERN Large Hadron Collider. It covers what to include in the paper, and some general guidelines and specific points about writing a scientific paper. There are sections on the use of English (though it is not a guide to grammar), punctuation, and typography. Advice about the use of LaTeX is given in the main text, and there is an appendix on software tools containing general comments about LaTeX and information on using Microsoft Word.

Version History

Version	Date	Changes
1.0	18/6/08	First official version.
1.1	1/7/08	Corrected errors in references to atlasphysics.sty. Some small additions, clean-up and minor corrections.
1.2	9/9/08	Merged glossary with Computing Workbook glossary and others to make overall ATLAS glossary, on separate twiki page. Added some capitalization items. Recommended double quotation marks. Minor corrections and wording improvements.
1.3	25/9/08	Fixed minor error and strengthened recommendations about graphics formats. Added recommendation to distribute as PDF.
1.4	27/11/08	Added explicit flagged recommendations, so numerous small wording changes. Abstract 1/4 or 1/3 page maximum. Four subsection levels too many. Strengthened recommendation for italic particle symbols. Recommend *parameterize* and *parameterization*. Reworded comment about \ after symbols due to removal of \xspace from atlasphysics.sty. Links to LaTeX templates and atlaspaper.bib.
1.5	16/4/09	References to CERN style-related web pages. Corrections (many from Susan Leech O'Neale): Align table entries on decimal points. Four heading levels ok if complex document. Don't mix digits and written numbers. Unit names (except Celsius) not capitalized. Apostrophes ok for plurals of single letters. Rearranged and expanded Appendix A. Replaced Appendix B with reference to CERN web page. Minor spelling and wording changes.
2.0	18/4/11	Heavily modified version—moved the Software Tools chapter and all advice on using Microsoft Word from the main text to an appendix. Added various suggestions from Klaus Mönig and Isabel Trigger, including updates on various rules and procedures for ATLAS papers and notes. Updated several references and improved some wording.
2.1	17/5/11	A few points corrected and improved, based on comments by Isabel Trigger and Klaus Mönig, in Sections 3.3.4, 3.4.2, 4.2.2, 5.6.7 and Appendix B.1 and B.2. Section 5.2.2 cleaned up and added to.
2.2	30/8/11	Section 3.6.2 updated to say that references to ATLAS and CMS use only the collaboration name, without a first author.
2.3	28/11/12	Section 5.1.2 modified to discourage use of personal pronouns. Small modifications to Sections 5.4.1 (hyphenation of *cross-section* and *next-to-leading-order*), 5.6.6 (abbreviations at ends of sentences), 5.6.7 (τ, *Monte Carlo* and *CL*) and 5.6.9 (allows vs. allows for).
2.3.1	4/1/13	Moved *next-to-leading-order* from 'fused' to 'modifiers' (same page).
2.4	23/7/13	Numerous changes, based on paper-editing experience, from Michel Vetterli and David Stoker. The most serious changes added material to Sections 2, 3.3.3, 3.7, 4.3.8, 5.1.1 and 5.6.7.
2.5	18/5/16	Changed convention to disallow 'Fig.' for 'Figure'. Changed gluon–gluon fusion convention for Higgs. Added references to other ATLAS documents on rounding, figures, etc.
2.6	3/3/17	Comments on using a journal's templates replaced by recommendation to use standard ATLAS preprint style. Other minor updates.

Contents

1 Introduction

ATLAS is one of the most complex scientific experiments ever built. Papers presenting physics results, or technical aspects of the experiment and its associated data analysis, have a challenging job to explain things clearly. The purpose of this document is to help with producing papers and notes within ATLAS that are as well-written as possible. It contains a collection of rules, recommendations, information, and advice about many aspects of preparing good papers, so that readers can understand them easily and concentrate on the content. This Guide is meant to evolve as we gain experience, so comments on useful material to add, inadequate explanations, or errors are very welcome; please contact the author at e.eisenhandler@qmul.ac.uk. The aim of the Guide is to help—it is not just a collection of rigid rules, nor does it mandate the use of specific tools. However, the information provided is based on experience, and ignoring some of the points can certainly lead to difficulty in getting the paper approved and published, as well as wasting time and effort in fixing unnecessary problems.

The officially approved rules and procedures for submitting a paper for approval by ATLAS and then getting it published are spelled out on the Publication Committee (PubCom) web pages [1]. The PubCom home page also includes links to further documentation with more detailed discussions concerning number rounding, figures and plots, referencing and acknowledgements. Information concerning author lists [2] is also available, and is not repeated here.

A basic choice to make when writing a paper concerns software tools. A decision should be made early on between **LaTeX** and **Microsoft Word** (or other 'office' packages). ATLAS physics papers and notes use **LaTeX**, and an ATLAS template and supporting files for **LaTeX** are available [3]. This includes a file, **atlasphysics.sty**, providing many useful macros to help standardize how a variety of symbols are written. Although journals often provide their own **LaTeX** and/or **Word** templates, the **standard ATLAS preprint format** should be used. Some ATLAS project and technical papers and notes do use **Word**, so Appendix B provides useful advice on using it. Other word processors, such as FrameMaker or Apple Pages, have fewer users and so are not generally acceptable to journals in their native formats.

The Guide is organized as follows. Section 2 gives some general rules for document preparation, and Section 3 describes the contents of a typical paper. Section 4 discusses many points about layout, styles, typography, and units. Section 5 has information on the correct use of English, including a discussion of British and American spelling. This guide is not, however, a comprehensive grammar text, as many good ones are already available. Appendix A lists SI and other units, abbreviations and symbols relevant to ATLAS, and Appendix B presents general points about **LaTeX** and some detailed advice about the use of **Microsoft Word**. The Guide uses hyperlinks to aid navigation, since it is meant to be used mainly as a reference rather than something to read cover to cover.

A comprehensive **ATLAS Glossary**, defining ATLAS terminology and abbreviations as well as giving standard ways of writing them, is available [4].

Recommendation boxes: Where this Guide makes clear recommendations among various choices, they are labelled and put in a box. The only strong reason to override a recommendation is when you are writing for a specific journal and it has a strict rule (not just a preference) that is different.

2 Basic rules

There are some basic rules ***always*** to bear in mind when writing any scientific document.

- **Take account of the likely audience.**
  Think about who is going to read the paper, and why. Do not give a lot of detail about aspects that are not the main subject of the paper unless they have an effect on the results. Define non-standard jargon and abbreviations unless they are very widely known and understood.
  Examples: (a) Someone reading a physics paper would not normally need some of the finer details of the instrumentation, but an instrumentation paper on part of the detector does need details. (b) An article in a popular scientific magazine should explain particle physics jargon in a way that is not necessary in a scientific journal.
- **Be consistent.**
  As you will see, there are many areas where the rules are not fixed, with several valid choices, and which to choose might depend on the publisher. To make your writing clear, easier to understand, and less irritating for the reader, make a conscious choice of which of the options to use, and do it ***everywhere***.
  Example: Do not mix 'endcap', 'end-cap', 'Endcap', 'End Cap', etc.—choose one standard version (according to ATLAS standard usage, and satisfying the publisher if possible) and always use it.
- **Think about the logical flow of your presentation.**
  Take time to think about how best to order the presentation of the work. A detailed outline of the analysis techniques, the results, and the conclusions drawn can be very useful, and should be discussed with the EdBoard before producing the first draft. It is easier to move things around at this stage than after a draft has been written.
- **Read the publisher's guidelines for writing and submission.**
  Although some of the rules may be optional, others will not be. Following the rules carefully is especially important if the document is being submitted in final form and will not be edited further by the publisher. Many publishers also provide their own style guides and advice. Physicists should not have to read long tracts on how to prepare a paper. However, if you write a paper without following the rules, then the publisher will be annoyed because this can mean extra effort and expense, and you will be annoyed because publication will be delayed and there may be more errors introduced en route.
  Examples: (a) Do not submit a **LaTeX** or **Word** file if PDF is asked for. (b) Read what the publisher says about American versus British spelling; some spellings may be required while others may be optional choices.

RECOMMENDATION: If you are writing a document or report that is not (yet) aimed for a specific journal, or if the journal does not have a strict rule to the contrary, then follow the recommendations and advice in this Guide.

RECOMMENDATION: In Section 3 and Section 5 there are several lists of rules, for figures, tables and references. These carry the same weight as specific recommendations.

RECOMMENDATION: If you are using **LaTeX**, then use the ATLAS template [3] and associated files such as **atlasphysics.sty** to achieve the ATLAS standard style.

3 Elements of a typical scientific paper

This section lists the different elements of a scientific paper, together with brief guidelines on what they should contain. Although different types of papers, notes and reports may change the relative emphasis or require somewhat different organization, what is presented here could also serve as a checklist to ensure that nothing obvious is left out.

3.1 Front page matter

3.1.1 Title

The title should be concise, clear and descriptive, and should include the word 'ATLAS'. For titles some journals capitalize only the first word and all proper nouns, e.g. 'Search for large extra dimensions in ATLAS' ('regular' capitalization), while others capitalize all the important words, e.g. 'Search for Large Extra Dimensions in ATLAS'.

RECOMMENDATION: If you have the choice, capitalizing only the first word and proper nouns is preferred, not least because it indicates which words are proper nouns.

Since the title is the first thing a potential reader will see, it should be attention-grabbing if possible—but without overstatement.

3.1.2 Authors

The ATLAS 'Publications Policies' document, on the Publications Committee web pages [1], lists the rules and procedures for papers and other types of ATLAS notes and reports, and explains the rules defining authorship.

All ATLAS papers ***must*** use the standard ATLAS author list, provided in **LATEX** by the Authorship Committee on their web pages [2].

All ATLAS public notes ***must*** have as authors 'ATLAS Collaboration', without explicit names.

For publications from specific ATLAS projects, which may have a restricted author list, the style of the author list (such as the indexing of names with institutes) depends on the journal being used for publication. For notes and reports where this is not specified, there are two common styles. If the list is fairly short you might group names by institute. However, and especially if the list of authors is fairly long:

RECOMMENDATION: List all the names together followed by all the institutes together, using superscript numbers or letters after each name to indicate institute affiliations.

RECOMMENDATION: It is customary in particle physics to list authors alphabetically, so the name of the first author does not indicate a dominant contribution.

Journals usually ask for someone to be designated as the corresponding author, with that person's email address given in a footnote. The standard ATLAS procedure is to submit papers centrally, giving the contact address atlas.publications@cern.ch. However, if the journal insists on a named individual, or there is a very good reason to give a specific name, it should be someone who knows at least enough about the paper to direct any queries to the relevant expert(s), and who will be connected to the collaboration for some time to come. This person should copy in the physics office (atlas.publications@cern.ch) on any correspondence with the publisher.

3.1.3 Abstract

RECOMMENDATION: The abstract should be just one paragraph—clear, descriptive, and concise—and no more than a quarter to a third of a page long. It should stand on its own and, similarly, the main text of the publication should not depend on information given solely in the abstract.

For physics papers, the abstract should state:

- what was measured;
- where it was done;
- with what data set and integrated luminosity;
- what method was used; and
- what the primary results and main conclusions were.

Instrumentation and other papers can follow a different style, but should still have a clear and complete structure.

References, abbreviations, symbol definitions and jargon should all be avoided in an abstract. If only Monte Carlo data are used in the work described, this should be stated explicitly.

Remember that many potential readers (especially if doing searches on arXiv or other websites) will look at the title, and then read or quickly skim the abstract in order to decide whether to read the paper itself. If we want people to click on the link to the paper, it is worth putting in some effort to make the abstract as readable, motivating and inviting as possible—but of course without overstating the significance of the results.

3.2 Body

Here we list suggested sections for the main body of a physics publication. Depending on the nature of the paper, some of these might assume great importance while others may not be needed or could be very brief. Obviously, other types of papers and notes (e.g. instrumentation) will differ.

3.2.1 Introduction

This should be fairly brief, so start with about one page as a target length. State the measurement being made, and its importance both experimentally and theoretically. Summarize what is known to date. If the results supersede previous ATLAS results then say so, but do not give the results explicitly. If the outline of the paper does not follow the obvious formula of theory, detector description, data samples used, data analysis, summary of the results, and conclusions, then it is often worth including a brief outline of the rest of the paper.

3.2.2 Theory, models, and definition of important quantities

Give a brief explanation of the relevant theory and/or models. Some discussion of the need for measurements, and definitions of important quantities or relevant equations that will be used, should be given. Sometimes this material need not be in a separate section and can, for example, be covered in the introduction.

3.2.3 Experimental setup

Give a condensed description of the ATLAS detector, focusing on the elements essential to the analysis. Describe when the data were taken, any special circumstances, and the integrated luminosity and running conditions of the data set.

3.2.4 Monte Carlo model

Any Monte Carlo modelling should be described, and names of the programs used given. Any corrections or special parameter settings should be clearly explained. The statistics used should be given if this results in a non-negligible uncertainty.

3.2.5 Event selection

This should describe and justify the selection criteria and analysis methods, such as trigger requirements, offline cuts and selections, etc. Give the statistics obtained. Discuss the backgrounds, any unusual features, etc.

3.2.6 Statistical and systematic uncertainties

It is important to have a detailed list of the uncertainties, both statistical and systematic. The methods by which they were obtained, and a justification of the resulting values, is crucial to the significance of the results.

3.2.7 Results

The experimental results should be stated, but usually without interpretation at this point.

3.2.8 Discussion

Make comparisons with fits and other measurements, and discuss how well they agree. Put the results into the context of theories or models, and interpret what can be learned.

3.2.9 Summary and conclusions

Reiterate the main points of the paper, the primary results, and what they might mean. Summarize the importance of the paper, reflecting the abstract, but do not overstate it.

Do not refer to figures, tables or references.

Readers who have been attracted by the title and abstract very often jump straight to the conclusion, so it should be interesting enough to make them want to read the whole paper!

3.3 Figures

It is very important to note that all figures ***must*** be approved explicitly by the collaboration, and cannot then be edited without being re-approved. Documents with more details concerning ATLAS recommendations and advice for figures can be found on the PubCom home page [1].

3.3.1 File formats

Whether you are using **LATEX** or a conventional word processor such as **Word**, the figures will end up embedded in the document output file.

RECOMMENDATION: Individual source files for the figures, in their original formats and resolutions, should always be kept available in case they have to be edited, and for general use in talks and other documents.

A wide range of file formats can be used, and it helps to have some feeling for their strong and weak points. The preferred format for **LATEX** remains encapsulated postscript (EPS), but this is often derived from other formats that are easier to edit. Modern versions of **LATEX** can also handle other graphics formats such as PNG, JPEG and PDF. The primary distinction is between bitmaps (e.g. photographs or raster graphics) and vector graphics (e.g. line drawings).

For photographs and other bitmap (i.e. non-vector) material JPEG is a common choice, with the advantage that the file size can be reduced if very high resolution is not needed. For example, if a photograph is to be printed quite small you should not preserve the resolution and file size needed to make a big print. (If a fairly simple-looking document containing photographs has a huge file size this is often the cause.) Be aware that JPEG is a lossy format, and simply saving a picture repeatedly can degrade the quality. Other common bitmap formats are BMP, GIF, PNG, TIFF, and WMF.

For vector drawings do *not* use JPEG, GIF or other bitmap formats—better choices include SVG, EPS, or PDF. EPS has the strong advantages of being publication quality and perfectly scalable. If vector images are converted to a bitmap format, not only do you irreversibly lose the scalability, but also all information about objects in the figure.

Drawing programs have their own proprietary formats, but using these prevents colleagues and editors who do not have the right software from editing the drawings.

RECOMMENDATION: In general, simple line diagrams work better in a paper than elaborately shaded ones with pseudo 3-dimensional effects that might look good in an oral (e.g. PowerPoint) presentation.

RECOMMENDATION: Convert the final document to PDF, which can handle both vector and bitmap images and is readable using free software on all major operating systems.

3.3.2 General RULES and RECOMMENDATIONS for figures

- All figures appearing in a paper must be mentioned in the text. The figures should appear in the same order as referred to in the text, and should be placed reasonably close to where they are first mentioned. Guidelines for producing figures can be found on the PubCom web page [1].
- Always use the full word ‘Figure’, not ‘Fig.’, and capitalize it. For example, ‘This distribution is shown in Figure 7 in Section 4.3’. Use a non-breaking space (see Section 4.3.4) between ‘Figure’ and the number so they stay together on the same line.
- If a figure has two or more parts, refer to it as ‘Figure 1(a)’ and ‘Figure 1(b)’, etc. Both ‘(a)’ and ‘(b)’ should appear in the text, in the figure (preferably in the top right-hand corner), and in the caption.
- Try to make the figures with a uniform style and size throughout the paper.
- Try to make the figures work in both colour and monochrome. Since figures are approved only once, it is very helpful if they are suitable both for conference presentations (colour) and journal publication (monochrome). In addition, even when documents are designed mainly for on-screen viewing, some readers will print them or make photocopies (usually monochrome!), either because they find it easier to read from paper, or they want to read them in situations where a screen is not available.

- The caption and text should not mention colours, nor require any colour distinctions in order to interpret the figure (e.g. 'the red curve corresponds to …').
- Note that figures may be reduced in size for publication, and that readers do not all have superb eyesight or excellent printers. As a guide, numbers and capital letters should be at least 2 mm high. Very thin lines may become difficult to see. A good test is to reduce figures by 50% and then check to make sure that all lines, letters, and numbers (especially subscripts and superscripts!) are still clearly visible.
- Check carefully that any labels used in figures are consistent with both the caption and the text in terms of spelling, nomenclature, etc.
- Although there are no strict rules for resolution of figures, approximate targets are 250–300 lines per inch (~100 lines per cm) for photographs and 600 lines per inch (~250 lines per cm) for line drawings.
- A good place for figures is at the tops of pages, except when a main heading would normally be there. (In **LATEX** ensure this with \begin{figure}[t].) This also avoids having isolated text trapped above a big figure at the top of a page.

3.3.3 General RULES and RECOMMENDATIONS for graphs and plots

- If a figure presents data or results, the word 'ATLAS' (or 'ATLAS Preliminary' if appropriate) must appear prominently somewhere in the figure. This becomes important when the figure is photocopied and/or shown out of context.
- All axes must be labelled, including units. Units should be given in square brackets, e.g. 'Energy [GeV]'. Axis labels should be big, clear, and meaningful as well as begin with a capital letter. Axis numbers should be in a clear, standard font. On histograms, the vertical axis units should specify the bin width, unless arbitrarily normalized or the bins are variable sizes.
- If different plotting symbols are used, a legend box explaining them must appear somewhere in the figure. If possible, the symbols should be listed in the order that they appear in the figure.
- The automatic statistics and fit results box from ROOT should be omitted unless its inclusion is relevant to the discussion. However, in that case it is better to include the relevant information, properly formatted, within the figure. Make sure you truncate the number of significant figures in the parameters appropriately.
- Pick solid, prominent plotting symbols to represent ATLAS data when comparing to other data, and use bold lines when superimposing curves.
- For certain types of figures, e.g. scatter plots, it is useful to have tick marks appearing on all four sides of a figure. Include these wherever possible.

3.3.4 General RULES and RECOMMENDATIONS for figure captions

Note that most of what follows is done automatically by the **LATEX** \caption command.

- The figure caption should be below the figure. The caption begins with the words 'Figure *n*:', where *n* is the figure number (but check the journal's conventions for punctuation, etc.). At the end of the caption a full stop (period) is usually used.
- Normal type is recommended for the caption. It can be set off from the main text by using, for example, a smaller font size. Formatting rules—bold or plain type,

justification, etc.—can depend on the journal, so check their instructions. A reasonable default is 'Figure *n*:' in bold and the rest of the caption in normal text.

- For multi-part figures, the convention 'this figure shows (a) first thing, (b) second thing, …' is preferred over 'this figure shows first thing (a), second thing (b), …'.
- All variables and plotting symbols used in the figure must be defined in the caption. Define all lines used in the figure (solid, dashed, dot-dashed, dotted, etc.)
- If relevant, the normalization method of the plot should be specified.

3.4 Tables

3.4.1 General RULES and RECOMMENDATIONS for tables

- All tables appearing in a paper must be mentioned in the text. The tables should appear in the same order as referred to in the text, and should be placed reasonably close to where they are first mentioned.
- There is no abbreviation for the word 'Table'.
- Capitalize the first word of any row or column heading.
- All rows/columns must be labelled, including units if appropriate. Units are given in brackets, e.g. 'Energy [GeV]'.
- Horizontal and vertical lines should be used as necessary to make the table entries clear. If there are several tables use a consistent style.
- If table entries are text they should usually be left-aligned.
- If numerical table entries include uncertainties, the entries should be aligned on the ± sign. If they include decimal points, the entries should be aligned on the decimal points. Otherwise, numerical column entries should usually be right-aligned.
- A good place for tables is at the tops of pages, except when a main heading would normally be there. (In **LATEX** ensure this with \begin{table}[t].) This also avoids having isolated text trapped above a big table at the top of a page.

3.4.2 General RULES and RECOMMENDATIONS for table captions

Note that most of what follows is done automatically by the **LATEX** \caption command.

- Many journals require that the table caption should appear ***above*** the table, so this is the recommended option unless you are certain that any journal you might submit to will accept it below the table. The caption begins with the words 'Table *n*:', where *n* is the table number (but check the journal's conventions for punctuation, etc.). At the end of the caption a full stop (period) is usually used.
- Normal type is recommended for the caption. It can be set off from the main text by using, for example, a smaller font size. Formatting rules—bold or plain type, justification, etc.—can depend on the journal, so check their instructions. A reasonable default is 'Table *n*:' in bold and the rest of the caption in normal text.
- All variables or symbols used in the table must be defined in the caption.

3.5 Acknowledgements

A standard acknowledgement paragraph is provided by the Publications Committee [3]. The contributions of the laboratory, the machine group, and the funding agencies are covered in that paragraph. Any additional acknowledgements beyond the standard paragraph can only be made with the approval of the Publications Committee chairperson. The names of ATLAS authors should not appear in the acknowledgements of an ATLAS physics publication. For physics papers, the naming of other specific individuals is not encouraged unless this individual is a non-collaboration member who contributed directly to the success of the publication (e.g. a theorist). Note, however, that simply discussing a theorist's model is usually not enough. For detector papers, the rules are more flexible as the entire ATLAS author list may not always be used. However, the naming of specific individuals should only appear at the end of the acknowledgements.

3.6 References and footnotes

Although the style of referencing is journal dependent, papers are to be prepared with the **standard ATLAS preprint format** [3] and should follow the recommendations below.

There are two main types of referencing. Harvard-style refers to author and year, and lists references alphabetically by author at the end of the document. Vancouver-style numbers the references in the order they occur in the text. In particle physics, papers (but not necessarily books or long review articles) almost always use Vancouver-style numbered references.

RECOMMENDATION: Use numbered (i.e. Vancouver-style) references.

If you are managing lists of more than a few references there are some very useful tools available. The standard one for **LATEX** is **BibTEX** [5]—it is integrated into the ATLAS template [3] and is highly recommended because it does most of the work for you. The bibliography files provided in the atlaslatex package should be used as much as possible to guarantee proper formatting of the references.

RECOMMENDATION: With **LATEX** you should use **BibTEX** for references.

3.6.1 General RULES and RECOMMENDATIONS for references

This section is based on ATLAS and journal rules, and experience with journal referees.

- Cite only permanent, publicly available, or ATLAS-***approved*** references, such as journals, books, TDRs, preprints or CONF notes, although the latter are disfavoured.
- Do ***not*** refer to ATLAS COM, INT or other internal notes since they are not available outside ATLAS.
- If at all possible, quote only proper publications rather than ATLAS notes. If you have to quote notes, give a web address to 'permanent' storage such as arXiv or CDS.
- Only cite theses if the material is not available elsewhere, but beware of making unapproved material public. Give a web address if the item has not been published.
- Do ***not*** cite private references, such as private communications.
- Wherever possible, cite an article's journal reference rather than its preprint number. The arXiv number should be given as well, in the format arXiv:1234.56789 [hep-ph],

or arXiv:hep-ph/1234567 for older references. For example, [1] Phys. Lett. B123 (2013)123 [arXiv:1234.56789 [hep-ph]]. Do not include version numbers.

- Wherever possible, web addresses alone should be avoided, or used in addition to other information as they are not permanent. The use of DOIs (Digital Object Identifiers) [6] promises to improve the situation.
- Always double-check references when copying them from another source.

3.6.2 Journal and book references

To ensure uniformity across the collaboration, particularly for documents that will not be published in a journal, a recommended reference style is given below. It is very helpful to include the title. A list of standard abbreviations for journal names is given in the CERN style pages [7]. Note that if you search for articles using the **INSPIRE database** (formerly Spires) [8] it also provides a citation in **LaTeX** format.

RECOMMENDATION: A good standard format for a journal reference is 'J. Doe et al., *New phenomena observed in the XYZ detector*, Phys. Lett. **999** (2012) 1234', or 'XYZ Collaboration, J. Doe et al., *New phenomena observed in the XYZ detector*, Phys. Lett. **999** (2012) 1234'.

RECOMMENDATION: For references to ATLAS and CMS papers there is a **special agreement** to omit the name of the first author and simply write 'ATLAS Collaboration' or 'CMS Collaboration', e.g. 'ATLAS Collaboration, *New phenomena observed in the ATLAS detector*, Phys. Lett. **999** (2012) 1234'.

Some journals ask for the first author (and only the first author) to be cited surname first, e.g. 'Doe, J.'. And since 'et al.' is not originally English it is sometimes written in italics, but this is not necessary (see Section 4.3.9).

If there are up to three or four authors you should list all names, e.g. 'J. Bloggs, J. Doe, and S. Smith'. For more authors, use 'J. Bloggs et al.' Non-breaking spaces (see Section 4.3.4) between initials and surname keep them together on the same line. For a well-known collaboration it is useful to add its name, e.g. 'ATLAS Collaboration', since that information is not usually obvious from the name of the first author.

Although not always required by journals, it is very helpful to readers to include the titles of papers in references. Italicize the title to make it stand out, as above.

When citing multiple papers in one reference, separate the entries with a semicolon, e.g. 'XYZ Collaboration, J. Doe et al., *New phenomena observed in the XYZ detector*, Phys. Lett. **999** (2012) 1234; PQR Collaboration, J. Bloggs et al., *Are new phenomena observed in PQR?*, Nucl. Phys. A **111** (2012) 217.' Avoid using the word 'ibid' for multiple references to the same journal. If several papers are cited in one section of the text, you can use the style [1, 3–6, 8] rather than [1,3,4,5,6,8].

For references to books, give the author(s), title (in italics), publisher, and year, e.g. G.F. Knoll, *Radiation detection and measurements*, John Wiley and Sons, 2000. It is also useful to add the international reference number (ISBN). If the book is a collection of articles or conference proceedings, give the title of the article as well as that of the book.

At the beginning of a sentence use the full word 'Reference'. Within a sentence, the abbreviation 'Ref.' may be used. It is better to say 'details are found in Ref. [1]' than 'details are found in [1]'. A non-breaking space (see Section 4.3.4) between 'Ref.' and the

number keeps them together on the same line. If you wish to direct the reader to the references of another paper, the usage should be something like: 'see Ref. [1] and references therein.' However, if you are simply indicating a reference for a point being made you can just give the reference number, e.g. 'we assume a mass of 172 GeV [3]'.

3.6.3 Footnotes

The use of footnotes should be minimized, and some journals do not allow them at all. They should be brief and should not contain information that is vital to the understanding of the body of the text. References within a footnote are allowed, and should appear in the reference section in the order they are read in the paper.

Footnote markers in the text should not be placed between a word or number and an immediately following comma, period/full-stop, colon or semicolon, but should follow the punctuation mark. For example, 'we assume a mass of 172 GeV.[3]'

3.7 Some advice for editing and correcting papers

It is very difficult to judge your own writing objectively, especially at the time you are doing it. There are a number of things that you can do to produce a better paper. *Do not rely on the ATLAS editorial process to turn a sloppy draft into a well-written report or paper—it is far more efficient to write it as well as possible initially.*

- Try to write short, simple phrases and sentences rather than long, complex ones. There is a strong tendency nowadays to use complicated 'management-speak' much too often. A useful list of examples of unnecessary verbiage can be found on the CERN web pages on style [7].
- Re-read what you have written, but wait until some time has passed—certainly not the same day.
- Get colleagues to read the paper. If it is long, ask people to concentrate on specific parts according to their expertise rather than just asking them to read the whole thing. (But do not lose sight of the full picture.)
- Remember that the reader is not an expert in your analysis. In order to ensure that it is comprehensible to non-experts, it is very useful to get someone *not* familiar with the topic to read the paper.
- If you are not writing in your native language, ask someone whose native language it is to read the paper. Try to find a person who is careful about writing—many people are not, even in their own language.

Some points that are more ATLAS-specific:

- Write a detailed outline of the paper and discuss it with the EdBoard. It is much easier to rearrange the order of presentation at this point than later on. Particular attention should be paid to the description of the event selection and the determination of the background; sometimes a given process is background in one part of the paper and signal in another part.
- Be careful not to copy and paste too much from CONF notes. This often leads to disjointed text if several notes are used as input to a single paper.
- ATLAS internal notes are not available to the reader, so include all the relevant arguments in the paper.

4 Layout, styles, and typography

This section begins with the overall layout of a paper and the organization of sections and subsections. This is followed by an introduction to the concept of styles. Then some of the basics of typography are described, including a section on typing special characters. We also discuss the use of units, equations, lists, and italics.

4.1 Document layout

4.1.1 Overall layout

If done well, the layout of a paper and its general attractiveness can make reading it as easy and pleasant as possible. However, if done badly it can irritate readers and put them off. Clear, easy-to-follow headings, a legible font, and enough (but not too much) white space all play a role. Figures and tables are very important; there is some general advice on laying out figures and tables in Sections 3.3 and 3.4, respectively.

RECOMMENDATION: Use of **ATLAS standard preprint formatting** [3] will guarantee proper layout for the paper.

A particular problem to beware of concerns page size. American journals use 'US letter' paper size, while the rest of the world uses the slightly longer and narrower A4. If the top and bottom margins look too wide and the side margins look too narrow the page size may be set to US letter when it should be A4. For US journals the situation is reversed if A4 is selected instead of US letter.

RECOMMENDATION: The default paper size should be set to A4 unless the document is destined for the USA.

4.1.2 Organization into sections and subsections

Good organization of a paper can make it easier to read and understand. Before starting to write the main text, think about the outline of the paper in terms of the sections needed and how they fit together into a consistent hierarchy. This can always be changed later as the paper develops, but it is helpful to see at the beginning what material is needed. Some people find it useful to use a dedicated outlining program; others just work from a rough outline or a list of section headings.

Do not go too far with the division into sections—two or three levels of sections and subsections should usually be enough. If you get to four you should question whether that is really necessary (unless the document is very long and complex). Try to be consistent in the sort of detail needed for each level. If there are very big differences in the lengths of sections at the same level, make sure there is a good reason and that it is not due to inconsistent organization. If most of the sections are very short, especially at the finest level of detail, consider whether some of the information could be combined. On the other hand, if sections are very long you should be asking whether they would be better broken up into shorter sections.

When referring to a section in the text, write out the word in full and capitalized, e.g. 'This is discussed in Section 4.3'. Do not use 'Sect.'.

4.1.3 Styles

For the uninitiated, the concept of styles is important to learn. The idea is that all text of the same type (section headings, body text, lists, symbols, superscripts and subscripts, etc.) should have a uniform appearance. This includes the choice of font, its size, whether it is bold or italic, and the line spacing. Paragraph layout is also defined, including left and right justification, indentation of the first line, white space above and below, and making sure headings do not appear on their own at the bottom of a page with the text on the next page. Defining the styles for an entire document in one place makes it is very easy to change the appearance of the document if you are not happy with it. For example, one simple command can change the size and font of all the subsection headings.

LATEX enforces the use of styles even for those who are not fully aware of the concept. One of the rewards for doing this is never having to go painfully through the entire document, changing all the occurrences of a particular feature one at a time in order to get the desired appearance.

4.2 Typography: general points

4.2.1 Paragraphs and page breaks

Text is divided into paragraphs. There are two ways to indicate where they start and end: by having white space between them, or by indenting the first line of each paragraph. **LATEX** handles this automatically, without the need for extra blank paragraphs.

If you are indenting the first line, the paragraph style will define how much to indent—*never* do it by typing a series of spaces. It is common for the first paragraph under a section or subsection heading not to have its first line indented (even if others are) as this looks better. Again, **LATEX** can do this automatically.

Within a paragraph, the character size and line spacing can also be exactly specified. The traditional printer's unit that is still used is points (pt), defined as 1/72 inch (0.356 mm). Common default text sizes are 11 pt or 12 pt.

Do not put double spaces between sentences—it is an outdated practice from the days of typewriters. In any case, **LATEX** will ignore spurious extra spaces.

To line up information vertically, without using a full-blown table, the correct method to use is tabs. *Never* be tempted to use multiple spaces, because that will not work with proportionally spaced fonts (such as Times New Roman or Arial). Tabs allow you to reliably align the left edge of text, the right edge, the centre, or for numbers the decimal points. In **LATEX**, tabbing is similar to making tables.

An option to think about concerns so-called widows and orphans, where one line of a paragraph is stranded on its own at the bottom or top of a page. This is often considered to be bad design, and you can choose to turn on 'widow and orphan control' in the **LATEX** paragraph style definitions.

4.2.2 Fonts

There are thousands of fonts, or typefaces, available, and you probably have quite a few on your computer. However, for document portability it is a good idea to use only the very widely used ones so that other people (including journal editors and typesetters) can read them without problems, and printers can work without having to be sent any less-common

fonts. There also used to be problems between Macintosh fonts and basically similar Windows fonts, but nowadays Macintoshes also have Windows fonts available.

Some distinctions are useful for characterizing fonts. Text fonts are generally divided into serif, which have extra little decorative bits on the ends of the letters, and sans serif, which have plainer letters. Although there are no strict rules, the main body text of a document (and other small text) is usually considered to be easier to read if a serif font such as Times New Roman or Times is used, while sans serif fonts such as Arial or Helvetica are often used for headings (and signs). This document is an example. These text fonts are proportionally spaced, i.e. the space allocated for a letter depends on its width. Numbers, however, are uniformly spaced, so that columns of numbers can be lined up.

Monospaced fonts (sometimes called 'typewriter fonts' by people old enough to have used typewriters) use the same width for all characters, and so line up exactly. This is useful for numbers, and is often used for plain text. A typical monospaced font is Courier.

Special fonts are used for mathematical symbols and Greek letters, a standard choice being Symbol. **LATEX** handles this automatically.

RECOMMENDATION: In **LATEX**, use Times 11-point or 12-point for body text and Helvetica for sans serif text, e.g. headings.

4.3 Typography: specific aspects

Many of the points below, especially particle symbols and related items, are implemented for **LATEX** users as an extensive list of macros in the file **atlasphysics.sty** [3].

RECOMMENDATION: Use the macros file **atlasphysics.sty** for particle symbols, variables, etc. This will ensure correctness and consistency, as well as saving you some work.

4.3.1 Numbers

A common confusion is whether to write out numbers in words or to use digits. The general rule is that small numbers should be written out (e.g. 'three quarks') while larger ones are not (e.g. '64 sectors in azimuth'). A common choice for making the distinction is to write out numbers of ten or less, though other choices such as eight are common. If you have a mixture do not mix digits and words—the normal choice is to use digits for all the numbers.

Numbers together with units (e.g. '3 mm'), decimal points (e.g. 'the ratio is 3.5'), or percentages *always* use digits.

If the value before a decimal point is zero then write it (e.g. '0.5' not '.5'), since otherwise the decimal point is easy to miss. For larger numbers, write e.g. '4000' without a divider, but for more digits write, e.g., '40 000' or '40,000'. Using spaces rather than commas avoids ambiguities due to some countries using commas instead of decimal points.

As always, whatever choices you make should be applied consistently.

RECOMMENDATION: Write out integers from one to ten. Use digits for decimals, percentages, and when there are units. Use spaces for numbers with five or more digits unless the journal insists on commas. Numbers at the beginning of a sentence should always be written out. Do not mix digits and words—use digits.

4.3.2 Variables and symbols

RECOMMENDATION: Variables should always be written in italics, to make them easier to distinguish from the main text.

For example, use '*x*' rather than 'x'. In **LATEX** math mode this happens automatically. However, remember the following in order to prevent some very common errors:

- Isolated variables in the *main* text must be in italics—use math mode in **LATEX**.
- Unit names and abbreviations should *never* be in italics. In **LATEX** math mode people often do not get this right; use \mathrm or take the units outside of math mode.
- Standard functions, such as sine and cosine, should *not* be in italic. Using the **LATEX** macros for them (e.g. \sin) ensures that.
- Derivatives should not have the 'd's' in italic, e.g. d*y*/d*x*. Note that this is British usage; American usage is to have italic 'd's' (e.g. *dy*/*dx*).

Use special symbols rather than trying to substitute ordinary characters. Examples are:

- The 'times' symbol—$\times$ in **LATEX**, e.g. 0.1 × 0.2; do not use the letter 'x'.
- The degree symbol—$^\circ$ in **LATEX**, e.g. 11 °C; do not use a superscript 'o'. But note that kelvin does *not* take a degree sign, and that journals disagree about whether to put a space between the value and the degree symbol.
- The plus-or-minus symbol—$\pm$ in **LATEX**, e.g. ±2 mm; do not use '+/-'.

A very common mistake concerns minus signs. These are *not* the same as hyphens, but should be as long as a plus sign. (Compare $x - y + z$ with $x - y + z$, –5.2 with -5.2, and 10^{-34} with 10^{-34}.) Again, **LATEX** math mode does it correctly, but documents and PowerPoint slides abound with anaemic-looking hyphens instead of minus signs. To fix this outside of math mode use an *en-dash* rather than a hyphen; see Section 4.3.4.

RECOMMENDATION: Do not start a sentence with a symbol—it is not good style.

There are a number of cases where there is no clear rule regarding symbols in italics, and different publishers have their own conventions. Consult the journal's style recommendations, and if you make your own choices then apply them consistently:

- Constants of nature (*e, c, h,* etc.) are usually in italics.
- Numbers such as e, π, and i are usually not in italics, because they are not variables.
- Greek-letter variables are sometimes in italics, sometimes not.
- Symbols for elementary particles are very controversial. However, almost all particle physics journals use italics, so not doing this can create extra work and problems.

RECOMMENDATION: The ATLAS convention is to use italics for particle symbols.

RECOMMENDATION: Where macros are defined (e.g. in **atlasphysics.sty**) they should be used, even if simple. If you typeset them yourself you risk violating ATLAS conventions.

4.3.3 Subscripts and superscripts

Subscripts and superscripts should be in italics if they are variables or characters that take values, and in normal text if they simply represent words or labels. For example, e^x has an italic exponent but E_{jet} does not have an italic subscript. There is some transatlantic

disagreement over the latter example—the American argument is that the subscript is part of the main symbol and therefore should be italic as well. This issue arises very frequently in ATLAS regarding transverse momentum p_{T} (which of course is a shorter way of writing $p_{\mathrm{transverse}}$), transverse energy E_{T}, and missing transverse energy $E_{\mathrm{T}}^{\mathrm{miss}}$ (which some would write as E_{T}^{miss} or E_{T}^{miss}).

RECOMMENDATION: If subscripts and superscripts are not variables then do not use italics. Specific examples are p_{T}, E_{T} and $E_{\mathrm{T}}^{\mathrm{miss}}$.

4.3.4 Special characters

In this section we mention some special characters: why they are used, and how to produce them in **LATEX**.

En-dashes and em-dashes
The usage of hyphens, and the longer versions known as en-dashes (the width of an 'N') and em-dashes (the width of an 'M') is discussed in Sections 5.4.1, 5.4.2, and 5.4.3, respectively. Note that en-dashes, *not* hyphens, should be used for minus signs. To produce en-dashes and em-dashes in **LATEX** just type two consecutive hyphens (--) for an en-dash and three hyphens (---) for an em-dash.

Line-breaks
Sometimes you would like to force text on to a new line, but without starting a new paragraph. In **LATEX** use the command \linebreak.

Non-breaking spaces
It is often desirable to use a non-breaking space to force text including a space to stay together on the same line. A very common example is a number and its associated units; others include 'Figure', 'Table', or 'Section' with their associated number, and also first initials and surnames. For a non-breaking space in **LATEX** just type the character '~'.

Non-breaking hyphens
Hyphens do not normally force the following text to stay on the same line. Sometimes it is better if it does, so a non-breaking hyphen is used. In **LATEX** the command is '\mbox{-}'.

Quotation marks
Quotation marks in formatted text should be the proper 'curly' kind, which look like this: '…' or "…". Apostrophes should also be 'curly', e.g. 'don't'. In **LATEX** you use the convention `…' or ``…'' for single or double quotation marks, respectively; apostrophes are handled automatically. For usage of these characters, see Section 5.5.4. But *note* that the symbols for prime (', in **LATEX** $'$ or $\prime$) and double prime (", in **LATEX** $''$), which are also used for minutes and seconds (and also feet and inches, if you need to use them), must *not* be 'curly'.

Thick and thin spaces
Spaces of more or less than standard width are especially useful for making mathematical expressions easier to read and understand. **LATEX** provides thin (\,), medium (\:), and thick (\;) spaces in math mode.

4.3.5 Units

All units should be SI unless there is a very good reason not to do so. There is a list of units and their internationally agreed symbols, with non-SI units flagged, in Appendix A. The multiplicative prefixes such as nano or Mega are also listed; in general only steps of

10^3 should be used. It is good practice to use prefixes or scientific notation so that the numbers are not very big or small.

Prefixes for multipliers smaller than one are lower-case, while multipliers larger than one are capitalized—with the important exception of 'k' in order to avoid confusion between kilo and kelvin.

In a scientific paper avoid using SI-deprecated units or prefixes that are common in everyday life, such as centimetres or decilitres.

The names of units, even when they are the name of a person, are *not* capitalized, with the exception of degrees Celsius. However, unit symbols are often capitalized. ('T' is for 'tesla', but 'Tesla' is the man not the unit.)

Units should always be in roman type, *not* italic. This is a common error when **LATEX** math mode is used. Two ways for doing it correctly are: \$x=25~\$mm, or \$10^{34}~\mathrm{cm^{-2}s^{-1}}\$.

RECOMMENDATION: Use SI units and their preferred (powers of 10^3) prefixes.

RECOMMENDATION: There should be a non-breaking space between the value and the symbol for the unit, to ensure that they stay together on the same line. (For how to do this see Section 4.3.4.)

RECOMMENDATION: The choice in ATLAS is to use natural units, where $c = h/2\pi = 1$. This means mass is in GeV rather than GeV/c^2, and momentum is in GeV rather than GeV/c. Note that if you do use GeV/c^2 or similar, the c should be in italics (Section 4.3.2).

4.3.6 Equations

Equations should only be inserted in-line if they are very short and simple. To preserve the line spacing, any fractions should be horizontal, using /, rather than vertical. All other equations should be on a separate line and centred.

If there are several lines of equations, the method of aligning them depends to some extent on the context. Sometimes it is clearer if the equal signs are vertically aligned (e.g. in a derivation); if not then the equations might be better left-aligned.

Only number an equation if it is actually referred to in the text. The number should be in parentheses at the right-hand margin. The reference to it should be of the form 'Eq. (3)' unless the journal specifies otherwise; some prefer just '(3)' unless it is at the beginning of sentence when they want a full word, e.g. 'Equation (3)'. To avoid numbering an equation in **LATEX**, use \begin{equation*} ... \end{equation*}.

Punctuation of equations causes much argument. In-line equations should be punctuated just like any other part of a sentence, i.e. full stops (periods), semicolons, commas, etc. Journals usually ask for equations on their own to be punctuated as well. However, some people feel that having a full stop, semicolon or comma at the end of an equation looks odd and do not do this.

RECOMMENDATION: Use punctuation for equations on their own.

In **LATEX**, always use math mode for writing equations. Standard functions such as sine should use macros (e.g. \sin) so that they are correctly set in roman (not italic) text.

4.3.7 Lists

There are two general types of displayed lists: enumerated, in which items are designated by numbers or letters and ordered in a specific way; and bullet-style lists, where items are set off by a standard symbol (or sometimes no symbol at all). It is usual to distinguish lists from the main text by the use of different margins, text size, font, or line spacing.

If each item contains enough text to make full sentences, then treat each one as a paragraph in its own right and end it with a full stop (period). This is how most of the lists in this document have been written; see for example Section 4.3.2.

If the items are short, such that taken together they could form a sentence with commas or semicolons as separators, then end each item in that way and put a full stop (period) at the end of the last item. Some people feel that this looks fussy, and so do not put any punctuation at all at the end of each item. For example, in the following list some people would remove the colon, the commas at the end of the first two items, the 'and', and the full stop at the end, but others would write it as shown.

Detector calibration will be effective only if it is:
- closely monitored,
- comprehensive, and
- done regularly.

Whether to start each item with a capital letter may depend partly on the length of the items, and is a matter of taste.

RECOMMENDATION: Capitalize and punctuate lists as if they were normal sentences.

Note that this is for papers. Bulleted lists in oral presentations do not need to be so formal.

4.3.8 Use of italics and bold type

- Italics and bold type can be used for emphasis, but this must be done sparingly. For example, 'I don't care *how* you do it; just *do* it.' The use of underlined text or capital letters for emphasis is generally discouraged, and may also cause confusion with web links.
- Bold type is often used for the titles and headings in a document.
- Italics can be used instead of quotation marks for the titles of books, magazines and journals, articles and papers. For example, 'The paper was published in *Physical Review Letters* recently'. If you are writing a paper for a journal it is best to follow their own style rules concerning this.
- When new words or phrases are introduced they are sometimes set off by using italics or quotation marks. The use of italics is preferred. For example, 'This procedure is called a *pedestal run*.' Do not use a different font family to do this. A useful suggestion is to use italics at the place where a new word that would otherwise be in normal type is defined, and to use quotation marks when the word must always be set off to avoid confusion with normal use of the word, for example 'medium' electrons.
- Italics are used for variables, and often for constants of nature and particle symbols (see Section 4.3.2, and the note on superscripts and subscripts in Section 4.3.3).

4.3.9 Words from other languages

Italics are used to set off words or phrases from another language, e.g. 'We used the following *ansatz* …'. However, 'foreign' terms that become standard usage lose their italic status. This is a very grey area, since people disagree about which terms have become standard English. Candidates include 'ad hoc', 'ad nauseam', 'au fait', 'bremsstrahlung', 'en route', 'et al.', 'in situ', 'versus', and 'vice versa'.

Another problem is whether to retain accents and other diacritical marks when words have become 'naturalized' into English. Words like 'cafe' and 'role' are now usually written without diacritical marks, but it is much less clear what to do about less frequently used words such as 'pâté', etc.

RECOMMENDATION: Words and abbreviations which are commonly used in everyday English should not be in italics, and need not retain accents and other diacritical marks.

5 English usage

This section discusses some of the issues that arise when writing papers in English. Most of these are relevant even for people whose first language is English. Some of the items discussed are more esoteric than others, and they are not (necessarily) meant to be read in sequential order.

This is not intended to be a complete guide to all the subtleties of English grammar and usage. That would be too long, and require a more expert author. If you want to know more, there are many books and articles about writing English in general and scientific documents in particular. Some books used and recommended by professionals are given in Ref. [9]. Many journals provide their own style guides; Reviews of Modern Physics has an interesting one that concentrates on good writing and has a useful section for non-native English speakers [10]. However, writing English is a very complex area in which there are often no fixed rules, and even when there are rules they often evolve with time.

Possibly the most obvious issue, especially at an international laboratory like CERN, is American versus British English. (Not to mention variants used in other English-speaking countries.) Although the use of grammar is similar, everyone who has learned even a little English soon discovers that there are obvious differences in spelling. There are more of these than many people notice, and to make things really confusing there are cases (especially in British English) where more than one spelling of a word is acceptable. A choice is necessary, and whichever you choose it must be done consistently.

RECOMMENDATION: British English is recommended by the ATLAS Publications Committee for European journals and ATLAS notes. American English is acceptable for American journals. Note that this does not resolve all spelling issues—see Section 5.2.3.

Fortunately, the many differences between the words and phrases used in American, British, and other forms of English in everyday life (far more than many people realize) are not usually relevant for scientific and technical writing. Even well-known examples, such as ‘earth’ or ‘ground’ for the zero-volt reference, have tended to disappear in the international community (we all use ‘ground’ at CERN), so we can pass over these issues. In addition the traditional British ‘billion’, 10^{12}, has been replaced by the American version, 10^{9}.

Some areas cause problems even for native English speakers. Capitalization can start a lot of arguments, often due to a fuzzy distinction between proper names and ordinary ones. Hyphenation has few strict rules, and as new words are invented and become common usage they often lose their hyphens. For example, do you write ‘End Cap’, ‘End-Cap’, ‘Endcap’, ‘end cap’, ‘end-cap’, or ‘endcap’? The **ATLAS Glossary** [4] provides recommendations on this and many others.

5.1 General considerations

5.1.1 Tense

It is difficult to use a fixed tense when writing a paper. The use of tense must be consistent within a sentence. The present tense should usually be used for statements whose validity remains as true when they are written as when they are read, e.g. ‘The data agree with the theoretical predictions’. The past tense should be used for statements whose validity is dated, e.g. ‘The data were recorded in 2008’.

In a paper the choice of tenses is to some extent a matter of taste. However, the introduction, where the current physics landscape is surveyed, will tend to be written in the present tense. For the rest of the paper, the tense used should distinguish between what is properly in the past and what is still true. Most ATLAS papers follow the convention that the data-taking and the Monte Carlo production are in the past, while the analysis, results, and conclusions are in the present. This also tends to engage the reader more.

Do not use tenses such as the past perfect (e.g. 'had been') or present perfect (e.g. 'has been' or 'have been') when the simple past (e.g. 'was' or 'is') is appropriate. For example, 'This efficiency was found to be 0.85' rather than 'This efficiency has been found to be 0.85'. This is more direct and immediate.

Do not write phrases like 'this will be discussed in Section 5.2'—it is discussed there now, so just say 'this is discussed in Section 5.2'.

5.1.2 Voices: passive, active and personal

Scientific literature has traditionally used the passive voice (e.g. 'A review of this problem was given by Bloggs') because it can sound more objective. On the other hand, the active voice (e.g. 'Bloggs reviewed this problem') is often more natural, shorter and more direct—it can be used where there is a significant gain in clarity.

However, active writing often uses personal pronouns, e.g. 'we'. This is very often considered unscientific, immodest and not sufficiently detached. It is a controversial point, as some publishers now encourage personal references in order to make the writing more engaging and human. Used sparingly, this can be useful in describing work by a small group. But for the huge ATLAS collaboration it is almost always inappropriate.

RECOMMENDATION: Avoid the use of personal pronouns.

5.1.3 Sentence structure

Avoid long, complicated sentences. If a sentence becomes really long you will often find that it can be broken up into two or more sentences without losing any meaning. Long introductory elements in a sentence are not good style. Sentences are often more effective if the point you are trying to emphasize is given at the end of the sentence.

5.1.4 Jargon

Try to avoid using ATLAS-specific and LHC-specific jargon, i.e. expressions used mainly within the collaboration or at CERN, and be sure to define all of the terms you do use.

5.1.5 Acronyms

A **glossary** of ATLAS acronyms and other terminology is provided separately in Ref. [4]. Although useful for brevity, do not use too many acronyms. Check whether you are really saving much space, and not just using them once or twice. Readers will have trouble remembering them all, especially since many are similar. Always define acronyms where they are first used, and re-define them at their first use in main sections—not everyone will remember them, or they may not be reading the paper in sequential order.

When using initials as an abbreviation, do not use spaces or dots, e.g. UN, BBC, LHC. (American usage tends to put dots after each letter, e.g. 'U.S.A.'.) Some people recommend using all capital letters when the acronym is pronounced as letters (e.g. EU),

and small letters when it is said like a word (e.g. Nasa). But some acronyms are pronounced both ways, so this seems artificial and likely to confuse.

RECOMMENDATION: Use all capital letters for acronyms (as we do with 'ATLAS').

The pronunciation of acronyms also affects whether to use 'a' or 'an' in front of them. Use 'a' if it is pronounced as if it starts with a consonant sound (e.g. 'a ROD') and 'an' if it sounds as if it starts with a vowel sound (e.g. 'an AOD' or 'an SFI'); remember that some acronyms are pronounced as letters and others like a word. (Also see Section 5.6.5.)

5.1.6 Slang, trendy expressions and obscure words

Remember that a large fraction of readers will not be native English speakers, and even those who are may not be familiar with slang from elsewhere. Trendy expressions often go out of date very quickly. Avoid obscure words and slang if at all possible. In general, try to keep things simple and clear.

5.2 Spelling

This section is mainly concerned with British and American spelling. For unambiguous cases it is best to consult a good dictionary, though a spell-checker (set to the correct form of English!) often does a fairly good job. In general, British spelling is preferred for many journals, especially European ones, but American spelling is mandatory for American ones. However, if you are much more at home with American spelling many journals will also accept that. As ever, it is important to be *consistent* within the paper.

RECOMMENDATION: British spelling is recommended for European journals and ATLAS notes. American English is acceptable for American journals. Note that this does not resolve all spelling issues—see especially Section 5.2.3.

There is a good and useful article on British and American spelling differences in Wikipedia [11]. It goes into more detail and has more examples than is possible here. Although some of the differences in spelling are obvious to anyone who has much experience with English, there are also many subtle points. And as usual in English, rules sometimes seem to be made in order to be broken.

The following discussion is broken down into three sections: differences that are *always* observed (Section 5.2.1), cases of British usage which seem to break the rules and are therefore tricky (Section 5.2.2), and some examples where British spelling offers a choice (sometimes leading to heated arguments) (Section 5.2.3).

In the following examples, the convention ***(British spelling)/(American spelling)*** is used in order to save space.

5.2.1 Universal RULES

- ***-our/-or*:** colour/color, favour/favor, flavour/flavor, honour/honor, humour/humor, labour/labor, neighbour/neighbor, tumour/tumor, rigour/rigor, vigour/vigor.
- ***-ence/-ense*:** defence/defense, offence/offense, pretence/pretense.
- ***-re/-er*:** centre/center, fibre/fiber, litre/liter, meagre/meager, theatre/theater.
- ***-ogue/-og*:** analogue/analog, catalogue/catalog (but note that 'analog' is often used at CERN).

- ***-ise/-ize*:** Although there are many words with endings *-ize* in American spelling that can be either *-ise* or *-ize* in British spelling (see Section 5.2.3), there are also some words that *always* have *-ise* endings in both. Some examples are: advertise, advise, arise, comprise, compromise, despise, devise, disguise, enterprise, exercise, expertise, improvise, premise, revise, supervise, surprise, and televise.
- ***-yse/-yze*:** analyse/analyze, catalyse/catalyze, paralyse/paralyze.
- ***-oul-/-ol-*:** mould/mold, smoulder/smolder.
- ***-c-/-k-*:** mollusc/mollusk, sceptic/skeptic, sceptical/skeptical.
- ***-s-/-ss-*:** focusing/focussing, focused/focussed.
- ***-l/-ll*:** distil/distill, fulfil/fulfill, skilful/skillful, appal/appall, *but* ...
- ***-ll-/-l-*:** cancelling/canceling, levelling/leveling, modelling/modeling, travelling/traveling, tunnelling/tunneling.
- ***-ge/-g*:** acknowledgement/acknowledgment.
- ***-ae-/-e-* and *-oe-/-e-*:** amoeba/ameba, anaemic/anemic, anaesthetic/anesthetic, archaeology/archeology, haemoglobin/hemoglobin.
- ***-eable/-able*:** likeable/likable, liveable/livable, saleable/salable, scaleable/scalable; sizeable/sizable, unshakeable/unshakable, upgradeable/upgradable.
- **Chemical elements:** aluminium/aluminum, caesium/cesium, sulphur/sulfur.
- **Miscellaneous:** aeroplane/airplane, ageing/aging, plough/plow, tyre/tire.

5.2.2 RULES that can be unsuspected traps in British spelling

The following have special rules in *British* (but *not* in American) spelling:

- practise/practice when used as a verb, but 'practice' when used as a noun, e.g. 'to practise writing C++' *vs.* 'it is a common practice in C++'.
- licence/license when used as a noun, but 'license' when used as a verb e.g. 'I must license the software' *vs.* 'I have a licence for the software'.
- metre/meter for the unit, but 'meter' for a measuring instrument.
- programme/program for the plan of an event, but 'program' for computer code.
- disc/disk, but 'disk' on a computer. But note that CD is *always* Compact Disc, the registered trademark.
- instalment/installment, but 'install'.
- judgement/judgment, but 'judgment' in legal usage.
- speciality/specialty, but 'specialty' for a branch of medicine.
- dependant/dependent when used as a noun, but 'dependent' when used as an adjective.
- grey/gray, but 'gray' for the radiation unit (named after L.H. Gray).
- rigour/rigor, but 'rigorous'.
- vigour/vigor, but 'vigorous'.
- vapour/vapor, but 'vaporize' (or vaporise).

- The past tense and past participle forms ‘burned’, ‘learned’ and ‘spelled’ are correct in both British and American, but in British you can also use ‘burnt’, ‘learnt’ and ‘spelt’. However, ‘earn’ always becomes ‘earned’, and ‘deal’ always becomes ‘dealt’.

5.2.3 RULES with some choice allowed

A very common confusion in British spelling concerns the many words ending in *-ise* or *-ize*, e.g. ‘digitise’ or ‘digitize’. Other examples include ‘emphasise’ or ‘emphasize’, ‘organise’ or ‘organize’, ‘polarise’ or ‘polarize’, ‘realise’ or ‘realize’, and ‘recognise’ or ‘recognize’. The choice extends to other forms, e.g. ‘digitising’ or ‘digitizing’ and ‘digitisation’ or ‘digitization’. American spelling *always* uses ‘z’. In everyday British writing the ‘s’ versions dominate. However, some British academic publishers (for example the Institute of Physics and Oxford University Press) recommend the ‘z’ forms, but do not insist on them. (This is based on historical arguments, not American usage.) The ‘z’ versions are often used at CERN, and seem to be a good, safe compromise. There are many affected words, so whichever choice you make you must put in some effort to be consistent. Note also that there are many words where *-ise* is the standard spelling in both British and American; see Section 5.2.1.

RECOMMENDATION: When using British spelling, choose *-ize* rather than *-ise* for words where both are acceptable. This applies to other forms as well, e.g. *-izing* and *-ized*.

Another choice concerns co-operate or cooperate, co-ordinate or coordinate, and related forms. In American spelling the hyphen is not used; in British spelling the hyphen is common but not using it is also acceptable, especially for the mathematical meaning of ‘coordinate’.

The unit ‘ton’ (sometimes written ‘tonne’ when metric) can confuse when the US or the UK are involved—see the entry in Appendix A. (This concerns the size of the unit more than the spelling!)

The case of ‘parameterise’ or ‘parameterize’ and ‘parametrise’ or ‘parametrize’ (and similarly for other forms) presents two issues: *-is-* or *-iz-*, and *-ter-* or *-tr-*. Some references state that *-ter-* is incorrect, but others give it as the better choice. It seems acceptable to choose the more obvious *-ter-*.

RECOMMENDATION: Use the spelling ‘parameterize’, and similarly for other forms.

5.3 Capitalization RULES and RECOMMENDATIONS

Capital letters are used to punctuate sentences, to distinguish proper nouns from other words, and in headings and titles. Capitalization is an area in which the rules are not completely rigid and tastes have evolved, with less use of capitalization now than in the past. We start with the agreed rules and then reach the less defined areas.

- The first letter of a sentence is capitalized. A complete sentence starting after a colon begins with a capital letter in American usage, but not in British (recommended).
- Proper names are capitalized, and this is useful to distinguish between a normal word and a name, e.g. ‘the city of London’ *vs.* ‘the City’ (the financial district of London). Capitalize the names of institutions, organizations, societies and groups, e.g. ‘the Pergamon Museum’ or ‘the Institute of Physics’. Note that ‘the’ is not capitalized.

- Geographical locations and the names of buildings are capitalized, e.g. ‘Times Square’, ‘the Pacific Ocean’, ‘the Empire State Building’.
- Names derived from people, such as ‘Breit–Wigner’, ‘Gaussian’ or ‘Cabibbo angle’, are capitalized. But ‘fermion’, ‘boson’, and the names of most units are *not*. (However, units named for people usually have a capitalized *symbol*. See Appendix A.) Titles of office or rank are capitalized, e.g. ‘President Obama’ or ‘Professor Higgins’.
- The names of days of the week, months, festivals, and holidays are capitalized, e.g. ‘Tuesday, 5th November’, or ‘Easter’. So are historical periods, e.g. ‘the Renaissance’. But seasons are not, e.g. ‘summer’.
- When written as words, do *not* capitalize the names of particles (e.g. neutrino), chemical elements (e.g. hydrogen), or chemical compounds (e.g. carbon dioxide).
- People often over-use capitalization. Do *not* capitalize words for emphasis—use italics or bold type if necessary, but be sparing. Try to avoid writing specific terms, such as ‘global warming’, with capitals as if they were proper nouns.
- Rules are less consistent for the titles of documents. As mentioned in Section 3.1.1, some journals capitalize all the main words in the title, but others use ‘regular’ capitalization—just the first word and proper nouns.

RECOMMENDATION: Only capitalize the first word and proper nouns of the title if you have the choice. (That way it will be clear which words are proper nouns.)

- Capitalization of section and subsection headings again depends on the publisher. Sometimes the more important headings have all the main words capitalized and less important headings do not.

RECOMMENDATION: Only capitalize the first word and proper nouns of section and subsection headings unless the publisher requires otherwise.

- The names of Monte Carlo simulation programs are often written in capital letters or with the \smallcaps **LATEX** font, but you should follow the choice of the author(s).
- More controversial are the names of parts of the experiment, particular software, etc. Many people consider specific components of ATLAS as being proper nouns, e.g. ‘Liquid Argon Calorimeters’ or ‘Run Control System’, but others do not agree and would write these as ‘liquid argon calorimeters’ or ‘run control system’.

RECOMMENDATION: Capitalize the proper names of specific items, but do this with restraint. Suggested ways to write many ATLAS-specific items are given in the **ATLAS Glossary** [4].

- **RECOMMENDATION:** Always write ‘ATLAS’, never ‘Atlas’.

5.4 Hyphenation and dashes

5.4.1 Hyphenation

Hyphens are used in a number of ways. ‘Soft’ hyphens are used at the ends of lines to indicate that the last word is split and continues on the following line. This is mainly done when text is in narrow columns, to avoid having very wide, wasteful spaces. When the lines of text are the full width of the page there is little need for soft hyphens. Breaking up the words in a way that allows the reader to understand the text quickly and without

ambiguity, while at the same time keeping the text layout efficient and attractive, is a specialist art for copy-editors and printers, and will not be discussed here.

'Hard' hyphens join words or parts of words (e.g. 'second-rate', 'anti-nuclear'), and are sometimes essential to make the meaning clear. However, it is important to understand that in many cases there are no fixed rules. Much of the time there are other ways to write the same thing, or a hyphen is only used to make things easier to understand. Here we discuss the main situations that cause problems.

Compound words

There are no rigid rules for compound words. Like the example given earlier ('end cap', 'end-cap' or 'endcap'), there are many cases where all three forms could be considered acceptable. In addition, the use of hyphens in compound words changes with time, especially as exotic technical jargon or new concepts become well known and evolve into single words, e.g. 'photo-multiplier' becoming 'photomultiplier'.

RECOMMENDATION: Try to minimize the number of hyphens by using them only where necessary (but note that the best solution will not always be clear).

This means considering both the 'open' form (e.g. the noun 'set up') and the 'fused' single-word form ('setup') as well as the hyphenated version ('set-up'). (The *verb* is always 'set up'.) There is a tendency (not universal) for American English to use single words and British English to use two words. Sometimes the hyphenated version is preferred to avoid awkward letter combinations, e.g. 'take-off', 'part-time'. Below are some examples of open, hyphenated, and fused compound words.

- **Open:** bubble chamber, charged current, drift chamber, Monte Carlo, neutral current, Standard Model.
- **Hyphenated:** cross-section (this is controversial: hyphenation is preferred, but if unhyphenated is chosen do it consistently and hyphenate when used as a compound adjective), cross-check, cut-off, four-momentum, space-like, time-like, wave-function. (The last three are sometimes written as fused words.)
- **Fused:** ultraviolet, electrodynamics, hypercharge, infrared, isospin, photomultiplier, photoproduction, pseudorapidity, renormalization, semiconductor, superconductor, subdivision, superposition.

Note the occasional use of 'hanging' hyphens when two or more similar words are used, e.g. 'both second- and third-order differentials'. This is fine but do not do it too often.

Prefixes and suffixes

There are a number of prefixes and suffixes that are joined to words with hyphens, and in many cases the words pass into standard usage and lose the hyphen (but sometimes not everyone will agree).

- **Prefixes:** anti-*anything*, but antiquark and antimatter; dilepton, diboson, dijets (not everyone agrees); multi-*anything*, non-*anything*, quasi-*anything*; n-type, p-type; re-entry, re-analyse, but renormalization.
- **Suffixes:** anything-*like*, anything-*less*, but wireless.

Groups of modifiers

A very important use of hyphens is when a string of adjectives and nouns modifies a noun. In some cases, using a hyphen simply makes it easier to grasp the meaning quickly by

grouping related words. Examples of this are: ‘up-to-date data’, ‘a wide-ranging review’, ‘a high-energy differential cross-section’ or ‘a next-to-leading-order calculation’.

But in many cases the hyphen is *essential* to make the meaning clear, and not having the hyphen, or putting it somewhere else, actually *changes* the meaning. Consider the following examples:

- ‘Disease-causing poor nutrition’ *vs.* ‘disease causing poor nutrition’, i.e. does poor nutrition cause the disease, or does the disease cause poor nutrition?
- ‘Two year-old computers’ *vs.* ‘two-year-old computers, i.e. are there two computers each one year old, or some computers that are two years old?.
- ‘Man eating lion seen’ *vs.* ‘man-eating lion seen’, i.e. was there a man eating a lion, or a lion that likes to eat people?
- ‘Cycling-friendly chief executive’ *vs.* ‘cycling friendly chief executive’, i.e. is the chief executive sympathetic to cyclists, or is he a friendly person on a bicycle?

However, do not use more hyphens than are necessary to make the meaning clear. So ‘Standard Model result’ is clear without using any hyphens, and ‘Standard Model cross-section’ only has a hyphen because ‘cross-section’ is (preferably) hyphenated anyway.

One case where a string of modifiers does *not* take a hyphen is when the modifier is an adverb, most notably ending in ***-ly***. That is because it is clear what the adverb is modifying. For example, ‘badly written paper’ or ‘newly discovered particle’.

5.4.2 En-dashes

En-dashes (sometimes called ‘en-rules’) are a bit longer than a hyphen, nominally the width of the letter ‘N’. See Section 4.3.4 for how to produce them. They have a number of uses:

- As a minus sign (do *not* use a hyphen, it is not long enough).
- To indicate a range of values, e.g. ‘27–31’, or ‘Monday–Wednesday’.
- To join two words with some relationship, but not part of a string of adjectives, e.g. ‘electron–positron annihilation’, ‘*p*–*p* scattering’, ‘permian–carboniferous boundary’, or ‘staff–student relations’.
- To join the names of joint creators or authors, e.g. ‘Fermi–Dirac statistics’, since a hyphen might be taken to indicate the hyphenated name of one person.
- To show the hierarchy when multiple hyphens would be confusing, e.g. ‘high-priority–high-pressure tasks’.

En-dashes are normally used with no spaces between the words or characters and the en-dash (but see the last comment below on em-dashes).

5.4.3 Em-dashes

Em-dashes (sometimes called ‘em-rules’) are considerably longer than a hyphen, nominally the width of the letter ‘M’. See Section 4.3.4 for how to produce them. They are used in two ways:

- Like parentheses but indicating more emphasis, e.g. ‘The repair took—we knew it would—far longer than planned’.

- To introduce a phrase at the end of a sentence, instead of using a colon, mainly as an afterthought or an aside, e.g. 'That publisher accepts material from most people—basically, anyone with money'.

Traditionally, em-dashes are put between words with no spaces. However, many publishers now put spaces around the dash but use an en-dash instead of an em-dash – like this. Whichever you choose, do it consistently.

5.5 Punctuation

5.5.1 Commas

Commas, like hyphens, are an area where usage is often a question of taste rather than rigid rules. In addition to clarifying the meaning of a sentence, they are also useful in breaking up long sentences to make them easier to understand quickly.

RECOMMENDATION: Try to minimize the use of commas to what is needed to ensure there is no ambiguity in the meaning, and to make sentences easier to understand.

Commas are used to set off 'non-restrictive', 'non-defining', or parenthetical clauses that add information not strictly essential to the sentence, e.g. 'The valley's people, who are Catholic, speak French.' On the other hand, essential information ('restrictive' or 'defining' clauses) should not have commas, e.g. 'The people who are on shift are really worried about this.' (Try putting commas around 'who are on shift' to see how it changes the meaning.)

Do not use a comma to join two main clauses of a sentence linked by an adverb such as 'therefore' or 'nevertheless', so 'He was tired, nevertheless he went on shift as usual.' is incorrect. Instead use either a semicolon ('He was tired; nevertheless he went on shift as usual.'), or use a conjunction such as 'and', 'but', or 'so' ('He was tired, but he went on shift as usual.').

Adverbs such as 'however', 'therefore' and 'already' should usually be followed by a comma when at the beginning of a sentence, and enclosed in commas when in the middle, e.g. 'However, the other method of analysis …' and 'There was, however, one important difference'. An exception to this is when qualifying an adjective or adverb, for example 'However much work you do …'.

A controversial point is the use of commas before 'and' and 'or' at the end of a list of items. This is called an 'Oxford' and even a 'Harvard' comma, though many other publishers also use it. Examples are 'mad, bad, and dangerous to know' and 'Birmingham, Heidelberg, Mainz, or Stockholm universities'. Omitting the final comma in these examples is also correct, and would not change the meaning. However, there are cases where the comma is definitely needed to make the meaning clear. Compare 'She took photographs of her parents, the president, and the vice president' with 'She took photographs of her parents, the president and the vice president'. It is not clear whether the second sentence is saying that the president and vice president are her parents or not.

5.5.2 Semicolons and colons

The semicolon is a separator that is stronger than a comma but does not end a sentence.

- Use a semicolon to divide clauses that could stand as sentences in their own right, but are better left in the same sentence because one explains or complements the other,

e.g. ‘Some of the students were brilliant; others were less so.’ or ‘The cooling pipes go through the gap in the detector; the signal cables follow the same route.’

- In a sentence already subdivided by commas, a semicolon indicates a stronger division, e.g. ‘They pointed out that they had used the equipment required; had taken every reasonable precaution, including some not mentioned in the manual; and that the program had been written by qualified programmers, all very experienced.’
- In a list where some elements already contain commas, use semicolons to clarify the relationships, e.g. ‘This work was supported by BMBF, Germany; The Swedish Research Council, Sweden; and the Science and Technology Facilities Council, United Kingdom.’

The colon points forward, with the same function as words like ‘namely’, ‘that is’, ‘as’, ‘for example’, ‘because’ or ‘therefore’.

- The material following a colon does not have to be able to stand alone as a sentence, e.g. ‘It is available in two colours: white or black.’
- The colon can be used to introduce a list, e.g. ‘We need the following: a computer, some diagnostic software, an oscilloscope, and a logic analyser.’
- Do not use a colon followed by other linking words to introduce a list or statement, e.g. ‘She outlined the lives of three physicists, namely, Planck, Heisenberg, and Dirac.’ However, you can use a colon if it is *after* the link word, e.g. ‘She gave an example: the Dirac equation.’
- Both a colon and an em-dash can be used to introduce a phrase at the end of a sentence, but the em-dash is less formal and often implies an afterthought or an aside.
- Do not put a space before a colon.

5.5.3 Apostrophes

The apostrophe has two main uses. The first, usually together with an ‘s’, indicates possession, e.g. *Maxwell’s distribution*. The second use indicates that letters have been omitted in a word, e.g. *don’t* for *do not*, or *I’ve* for *I have*. A guideline for formal writing is to try to minimize the use of such contractions. (In this section, examples are in italics rather than quotation marks to make the use of apostrophes more obvious.)

- The possessive for words ending in ‘s’ can be confusing. Add an ‘s’ after the apostrophe if the result is easy to pronounce, but not if it is awkward (e.g. *Jones’s data* but *Archimedes’ Principle*). This is an area where people disagree, so use your judgement.
- The possessive for plurals ending in ‘s’ can be confusing. A general recommendation is to use the apostrophe but omit the extra ‘s’. As an indication of the subtleties, compare the singular and plural usage in the following four phrases: *my sister’s friend’s studies; my sisters’ friends’ studies; my sisters’ friend’s studies; my sister’s friends’ studies*.
- A special case concerns periods of time, e.g. *two days’ time*, *six weeks’ holiday*.
- People understandably get very confused about *its* and *it’s*. *Its* without an apostrophe is the possessive. *It’s* with an apostrophe is short for *it is*; this looks like a possessive but is not. However, it has unfortunately become increasingly common for popular

publications to be sloppy about this, and *it's* is being used more and more often as a possessive.

- Do not use apostrophes to indicate plural acronyms, e.g. *RODs* not *ROD's*. (Not everyone agrees with this—apostrophes used to be normal usage.)
- Apostrophes can be used to indicate plurals of single letters and Greek letters, especially when not using an apostrophe would be unclear or ambiguous.
- Never use the incorrect 'greengrocer's apostrophe' for plurals. This gets its name from shops which incorrectly label items with words like *lettuce's*, or *video's*. The apostrophe is not needed for plural words. It should only be used when there is a need for clarity, e.g. *dot the i's and cross the t's*, or *subtract all the* x *'s from all the* y *'s*.

5.5.4 Quotation marks

Single ('…') and double ("…") quotation marks, often called 'inverted commas' in British English, are another area where American usage is well defined but British usage presents a choice. See Section 4.3.4 for how to type proper 'curly' quotation marks. (In this section, examples are in italics rather than quotation marks to make the use of quotation marks more obvious.)

Traditional British practice is to enclose quoted matter in single quotation marks, and to use double quotation marks for a quotation within a quotation. This is completely reversed in American writing, and now also in much British writing (notably newspapers and magazines). For example, *'Have you any idea', she said, 'what "red mercury" is?'* would be traditional British, while *"Have you any idea", she said, "what 'red mercury' is?"* would be American, or nowadays much British, usage. Unless the journal requires the older British usage, double quotation marks are recommended.

Quotation marks are also used for the first occurrence of an unfamiliar or newly-invented word or phrase, or one used in a technical sense, e.g. *the birth, or 'calving' of an iceberg*, or *This scheme is called 'bunch-crossing multiplexing'*.

Finally, quotation marks can be used to distance the writer from a point of view, a claim, or an expression, e.g. *the organization of 'voluntary' night shifts*.

5.6 Miscellaneous items

5.6.1 Plurals

Here we are concerned with two different aspects of plurals: whether some things are singular or plural, and how to form the plurals of some words.

RECOMMENDATION: Data should be considered as plural (with the rarely used singular 'datum'), e.g. 'the data were analysed'.

Sometimes people refer to data as singular, e.g. 'the data was analysed'. This is not strictly wrong, and if you do it be sure to be consistent, but it is not the favoured usage.

RECOMMENDATION: A collaboration, organization or company should usually be treated as singular, e.g. 'ATLAS has decided to …', not plural, e.g. 'ATLAS have decided to …'.

Again, not everyone agrees but the singular is far more widely used.

Although many English words simply add an ‘s’ for the plural, there are numerous others that do other things. Some add *-es*, e.g. ‘wishes’, ‘patches’, or ‘tomatoes’. And some plurals do not have an ‘s’ at all, e.g. ‘children’ or ‘sheep’.

The possessive form of plural nouns, and how apostrophes are used, is discussed in Section 5.5.3. The generally accepted way to form plural acronyms is to add an ‘s’, but without any apostrophe, e.g. ‘RODs’. Never use the ‘greengrocer’s apostrophe’ (again see Section 5.5.3).

Plurals of non-English words are in a state of change. Do you say ‘formulas’ or ‘formulae’, ‘stadiums’ or ‘stadia’, ‘bureaus’ or ‘bureaux’, ‘referendums’ or ‘referenda’?

RECOMMENDATION: Use English forms of the plural (the first in each example) instead of the non-English one when they exist. Note, however, that ‘alumni’ and ‘nuclei’ remain standard usage.

To make matters more confusing there is ‘index’. Referring to many books we might talk of ‘indexes’, but for a mathematical expression use ‘indices’ for the plural. A similar word is ‘vertex’, for which the plural is ‘vertices’.

A very common mistake, made nowadays by many native English speakers, is to use the plural ‘criteria’ instead of the singular ‘criterion’ if there is only one. Similarly, the singular of ‘media’ is ‘medium’, and the singular of ‘phenomena’ is ‘phenomenon’. It is *wrong* to say ‘a criteria’, ‘this storage media’ or ‘that phenomena’.

5.6.2 Which vs. that

This is a common confusion. For a ‘restrictive’ clause, i.e. one that defines something or restricts the scope, ‘that’ can be used. In British English, but *not* American, ‘which’ can also be used. So for example, ‘all tracks that were not identified as coming from conversions were combined with tracks of positive charge’ since you are restricting the tracks to those not coming from conversions. On the other hand, for a ‘non-restrictive’ clause that simply adds information, ‘which’ can be used but *never* ‘that’. For example, ‘cell clusters were also formed, which were then used to aid in electron identification’ gives additional information without defining a subset.

5.6.3 Split infinitives

A split infinitive occurs when you put an adverb in the middle of an infinitive, rather than before or after it. One of the best known examples comes from *Star Trek*: ‘To boldly go where no man has gone before.’ Many people believe that split infinitives are wrong or are bad style, but they are not. They tend to be used more in American than British English. My personal approach is to try to avoid using them if it is easy and the result sounds good, simply in order to avoid unnecessary arguments. But in some cases avoiding a split infinitive sounds awkward, or less strong. How would you re-write ‘we expect our recorded data to more than double by next year’? In such cases use the split infinitive.

5.6.4 Homophones

These are many pairs of words that sound the same but are spelled differently, and have *different* meanings. Even native English speakers get these wrong very often. Here are some common ones:

- affect *vs.* effect: to produce an effect on something or someone *vs.* the result of an action. For example, 'Exhortations in the style guide had no effect (*noun*) on the number of mistakes; the level of mistakes was not affected (*verb*) by exhortations in the style guide; we hope to effect (*verb*) a change in this.' *(Guardian Style Guide)*
- complement *vs.* compliment: to make complete *vs.* praise.
- discreet *vs.* discrete: tactful or circumspect *vs.* separate.
- principal *vs.* principle: first in rank or importance *vs.* fundamental truth, rule or standard of conduct.
- stationary *vs.* stationery: not moving or changing *vs.* writing materials.
- there *vs.* their: a place or position *vs.* belonging to them.

5.6.5 A vs. an

The two forms of indefinite article, 'a' and 'an', are meant to make things sound good. The basic rule is to use 'a' before words starting with a consonant and 'an' before vowels.

A big exception is for words beginning with 'h', which is often silent. So we write 'a hadron' but 'an hour'. However, a few words are sometimes pronounced with a silent 'h' but sometimes not, e.g. 'herb' (silent 'h' in American but not in British)—in these cases 'a' or 'an' becomes a matter of taste. (In the past we were taught to write things like 'an hotel', but that is no longer fashionable; it now depends on pronunciation.)

There are some words beginning with a vowel that is pronounced like a consonant, so use 'a' (e.g. 'a unit'). And there are cases where a consonant sounds as if it begins with a vowel, such as 'an *x*-dependence'.

5.6.6 Some common abbreviations

There are a number of 'standard' abbreviations that you can assume readers will understand. However, do not overdo it, especially since many readers will not be native English speakers, and if you have any doubts then spell them out.

You can assume familiarity with widely known abbreviations such as 'UN', 'US', 'UK', and CERN, as well as 'AD' and 'BC' to specify the era. Other abbreviations should be defined on their first appearance.

Some Latin-based abbreviations are often used to make English a bit more compact. There is no need to write these in italics. They include:

- etc. (*et cetera*) = and other things
- et al. (*et alii*) = and others (some publishers do put this in italics)
- i.e. (*id est*) = that is
- e.g. (*exempli gratia*) = for example
- N.B. (*nota bene*) = note well
- cf. (*confer*) = compare

Rarer forms that now tend to be discouraged are 'viz' (*videlicet*) meaning 'namely', and 'ibid.' (*ibidem*) meaning 'in the same place' and used for references.

If a sentence ends on an abbreviation (e.g. 'etc.') use only one full stop (period), *not* two.

5.6.7 Miscellaneous ATLAS and physics-related items

- Beware of being over-precise in writing numbers with errors. It is usually nonsense to quote three significant figures on errors, and even two is often too many. Very few results are known to 1% precision, let alone better.
- A document on ATLAS recommendations and advice for rounding of numbers is available via the PubCom home page [1].
- When writing symbols in **LATEX**, use the latest version of the official style file **atlasphysics.sty** [3] from PubCom rather than trying to define the symbol yourself.
- If the symbol is to be followed by a space, use a trailing '\ ' (e.g. '\pt\ ') to ensure this. Note that there is a space after the '\'. The '\ ' is not needed if there is something other than a space, such as a punctuation, after the symbol.
- Use Greek letters for particle symbols—do not spell out Greek letter names, e.g. π or μ not 'pi' or 'mu'. However, 'pion' or 'muon' are acceptable.
- The complications of notating different τ decay modes are spelled out in a separate note [12].
- Note the difference between particles (the underlying physical objects) and the measured quantities such as tracks or clusters.
- CERN policy is to refer to the mechanism for electroweak symmetry breaking as the 'Englert–Brout–Higgs' or 'EBH' mechanism. However, the boson is simply the 'Higgs boson' (and not just 'the Higgs').
- If you have to use phrases like 'Higgs boson mass' a lot you might use the full form the first time, but then just 'Higgs mass'.
- Higgs boson production processes should be written as 'gluon–gluon fusion' not 'gluon fusion', and 'vector-boson fusion (VBF)' not 'weak-boson fusion'.
- The Z boson should be written without the zero (i.e. Z rather than Z^0).
- 'B-physics' (not 'b-physics'), but 'b-tagging', 'b-quarks', 'b-jets'.
- Always use a cursive ℓ (\ell in **LATEX**) for a generic lepton (usually e or μ).
- Use m rather than M for masses, e.g. m_W, m_H, m_t.
- Write 'Standard Model' capitalized. Do not abbreviate it in the abstract. If it occurs often, write it out the first time you use it and define the abbreviation: 'Standard Model (SM)'. Likewise, 'MSSM' is acceptable but define it on first use.
- In physics 'Monte Carlo' is an adjective, so it should *always* be followed by a noun (e.g. 'Monte Carlo simulation'). Using 'Monte Carlo' on its own as a noun (e.g. 'corrections obtained from Monte Carlo') could imply the city of that name.
- 'Confidence level' can be abbreviated to 'CL' (but define it on first use); note that it is 'level' not 'limit'. Writing it as 'C.L.' is discouraged.
- Use ΔR rather than R for $\sqrt{(\Delta\eta)^2 + (\Delta\phi)^2}$.
- Avoid such ATLAS-specific jargon as 'truth particle' (and 'truth' in general), 'AOD', 'CSC', 'ESD', 'containers', etc.

5.6.8 Common mistakes by non-native English speakers

Languages have many subtle points, so it is not surprising that even people who have learned a language well and speak it very fluently will still make small mistakes in writing it. The actual mistakes of course depend on the person's native language, but there are some constructions that come up commonly at CERN that are perhaps worth pointing out.

- 'Since five years' should be something like 'for five years' or 'five years ago', depending on the exact situation.
- 'Allows to measure' should be something like 'allows measurement of'.
- 'I will shortly describe' should often be 'I will briefly describe', since 'shortly' means 'after a short time' not 'for a short time'.
- 'Until Friday' or 'till Friday' should often be replaced with 'by Friday'.
- 'We did a control of' should be 'we did a test of' or 'we did an examination of', since 'control' does not have that meaning in English.
- 'Built' is often used incorrectly instead of 'build'. 'Built' is the past of the verb 'to build', and the present tense is 'build'. The computer jargon term is 'nightly build'. Similarly for 'sent' and 'send'.
- 'How xx looks like' should either be 'how xx looks' or 'what xx looks like'
- 'For what concerns xx' should be 'concerning xx', 'as regards xx', or 'as far as xx is concerned'.
- 'As it is the case' should be 'as is the case'—do not use 'it' in this way.
- 'This shows how bad the tracks were aligned'—should say 'badly'; similarly for 'seriously', 'precisely', etc.

There is a useful CERN page [7] on avoiding 'franglais', useful not only for native French speakers but also for many others (including some native English speakers!) who have been at CERN for a long time.

5.6.9 Other points of English

- Use 'alternatively' rather than 'alternately', unless you mean something that alternates.
- Do not use 'essentially' (fundamentally or basically) to mean 'effectively' or 'approximately'.
- Do not confuse 'imply' (strongly suggests) with 'infer' (deduce from facts and reasoning).
- To make certain of or to guarantee something, British usage is 'ensure' and American is either 'insure' or 'ensure'. (But if it concerns insurance it is always 'insure'.)
- If something has been lost you 'lose' it, you do not 'loose' it. 'Loose' means 'not tight'. (This mistake is very common in British writing.)
- The past of 'to lead' is 'led', not 'lead' (unlike 'read', the past of 'to read').
- Use 'allows', not 'allows for', if you mean something is permitted or enabled. For example, 'doing this allows changes due to ageing to be estimated'. 'Allows for' means you have considered something that is possible but not certain, for example 'the error quoted allows for possible changes due to ageing'.

- ‘Presently’ means ‘soon’, and in US usage can also mean ‘now’. ‘Momentarily’ means ‘for a moment’, and in US usage can also mean ‘at any moment’. If you want to be certain that your meaning is clear, it might be best to avoid using either of these.

There is a useful list containing more terms which are commonly misused on the CERN web pages on style [7].

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[4] ATLAS Glossary: https://twiki.cern.ch/twiki/bin/view/Atlas/AtlasGlossary

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[12] *Standardized notation for tau leptons at ATLAS*:
https://twiki.cern.ch/twiki/pub/AtlasProtected/EditorialBoardGuidelines/tau-notation.pdf

[13] **LaTeX** spell-checkers: for Mac OS, for example: http://Excalibur.sourceforge.net; for Windows, for example: http://www.microspell.com/

[14] MathType: http://www.dessci.com/en/products/mathtype/

[15] EndNote: http://www.endnote.com

Appendix A: SI and other units

Note: Multiplicative prefixes are listed separately at the end.

Unit	Symbol	Definition, comment
ampere	A	SI unit of electric current
ångstrom	Å	Unit of length (***not SI***); 0.1 nm
atomic mass unit	U	1/12 of mass of carbon-12 nuclide
bar	bar	Unit of atmospheric pressure ***(not SI)***; 10^5 Pa
barn	b	Cross-section, 10^{-28} m^2
baud	Bd	One signalling element per second
becquerel	Bq	SI unit of radioactivity; 1 disintegration/second
bit	b	Binary digit
byte	B	8 bits
calorie	cal	Unit of energy ***(not SI)***; 4.184 J
centimetre	cm	10^{-2} metre; *deprecated*
coulomb	C	SI unit of electric charge, A·s
curie	Ci	Unit of radioactivity (***not SI***); 3.7×10^{10} Bq
decibel	dB	Logarithmic ratio
degree	°	Angle
degree C	°C	Degree Celsius
dyne	dyn	Unit of force ***(not SI)***, gm·cm/s^2; 10^{-5} N
electron volt	eV	Energy of charge *e* accelerated through 1 V
erg	erg	Unit of energy (***not SI***), dyn·cm, 10^{-7} J
farad	F	SI unit of capacitance, C/V
gauss	G	Unit of magnetic flux density (***not SI***); 10^{-4} T
gram	g	10^{-3} kg
gray	Gy	SI unit of absorbed radiation dose, J/kg
henry	H	SI unit of inductance, V·s/A
hertz	Hz	Frequency; one cycle per second
joule	J	SI unit of energy, N·m
kelvin	K	SI unit of temperature; *symbol is upper-case*
kilogram	kg	SI unit of mass
litre	L	10^{-3} m^3
lumen	lm	SI unit of luminous flux
metre	m	SI unit of length
micron	μm	10^{-6} m; *name is deprecated—use* micrometre
mole	mol	SI unit of substance; Avogadro's number of elementary entities (atoms, molecules, ions, etc.)
newton	N	SI unit of force, kg·m/s^2

ohm	Ω	SI unit of electrical resistance, V/A
pascal	Pa	SI unit of pressure, N/m^2
rad	rd	Unit of absorbed radiation dose (***not SI***); 0.01 Gy
radian	rad	SI unit of angle
rem	rem	Unit of radiation dose equivalent (***not SI***); 0.01 Sv
roentgen	R	Unit of radiation exposure (***not SI***)
second	s	SI unit of time
siemens	S	SI unit of conductance, 1/Ω
sievert	Sv	SI unit of radiation dose equivalent
steradian	sr	SI unit of solid angle
tesla	T	SI unit of magnetic flux density, Wb/m^2
ton	ton	1000 kg; *also 907 kg (US) or 1016 kg (UK)* ***(not SI)***
tonne	t	1000 kg
torr	Torr	Unit of pressure ***(not SI)***; 1 mm Hg; 133.322 Pa
volt	V	SI unit of voltage
watt	W	SI unit of power, J/s
weber	Wb	SI unit of magnetic flux, V·s

Multiplicative prefixes

yocto	y	10^{-24}
zepto	z	10^{-21}
atto	a	10^{-18}
femto	f	10^{-15}
pico	p	10^{-12}
nano	n	10^{-9}
micro	μ	10^{-6}
milli	m	10^{-3}
centi	c	10^{-2}; *deprecated*
deci	d	10^{-1}; *deprecated*
deka	da	10^{1}; *deprecated*
hecto	h	10^{2}; *deprecated*
kilo	k	10^{3}; *note that symbol is lower-case*
mega	M	10^{6}
giga	G	10^{9}
tera	T	10^{12}
peta	P	10^{15}
exa	E	10^{18}
zetta	Z	10^{21}
yotta	Y	10^{24}

Appendix B: Software tools

B.1 Introduction

In this appendix we describe the two main software tools that are used for document preparation: **LaTeX** and **Microsoft Word**. Neither is perfect, and we will mention their relative pros and cons. Specific advice on using **LaTeX** is given throughout the main text. Below, in Section B.3.2, we also give some specific advice on how to use **Word**.

In the past ATLAS encouraged the use of Adobe FrameMaker, which worked under Windows, Mac and Unix. Although less user-friendly than **Word**, FrameMaker was more robust at handling very large, complex documents. Unfortunately, FrameMaker is no longer available for either Mac or Linux. More recently, open-source 'office' packages have become available for all three major platforms; these offer relatively good—but not 100%—compatibility with the corresponding Microsoft products, and much of the **Word**-related advice in this document is applicable. There are also other word processors that can read and save files in **Word** formats, such as Apple's Pages. However, compatibility does not always include fine details needed in complex documents, so if you are going to use a **Word** template supplied by a journal it is still safest to use **Word**.

The use of styles is built in to **LaTeX** in a deep way. It is also fully implemented in **Word**, even though it can be evaded. Styles make it easy to format a document in a consistent way, and to make global changes quickly and easily. Combined with using **LaTeX** or **Word** templates, either from the journal or ATLAS, it should be relatively easy to produce attractive documents and papers that will not cause problems with journals. However, it is also essential to read the journal's guidelines and adhere to them.

Which tool to use is for some people almost a 'religious' issue. There are people who think it is impossible to write a 'proper' physics paper in **Word**, and others who think **LaTeX** is hopelessly out of date. However, people do write papers using both, and publishers use both to produce attractive and complex journals and books. But neither will give good results if you do not take some time to learn how to use them beyond the most basic level. A more balanced view recognizes the strengths and weaknesses of both **LaTeX** and **Word**, as discussed in more detail below. Here is a quick summary.

- **LaTeX** is better for complex equations, cross-platform compatibility, and general stability. It is also better at enforcing standard styles. It is not good for complex graphics layout, nor for collaborative editing. The non-WYSIWYG ('what you see is what you get') versions often used in particle physics make fixing problems and using many of its features more difficult. However, files of pre-defined macros are available and are very helpful. **LaTeX** is used for ATLAS physics papers.
- **Word** is good for complex graphics layouts, is WYSIWYG, and has useful tools for collaborative editing. Its styles work but are perhaps too easy to modify or avoid using, and its equation editor is best for relatively simple things. It can become unstable when handling big, complex documents, and there are still occasional, annoying incompatibilities between the Windows and Mac OS versions.

Whatever your choice, distribute the final result as a PDF file. PDFs can be read using free software on all operating systems, they produce good quality printing, they do not require the reader to have particular fonts installed, and they support internal and external hyperlinks.

B.2 LaTeX

LaTeX exists in numerous versions, many free, for Linux, Mac OS, and Windows. There are some expensive WYSIWYG implementations, but in particle physics many people edit their code with a text editor and then process it to produce the final (usually PDF) document. It helps to use a text editor which colours the code by context and which provides a glossary of commands and macros, but not everyone does this. **LaTeX** files are plain text—hence they are compact and cross-platform, with few problems.

LaTeX tends to be very stable and reproducible. Styles are built in to the general way of working in an easy way, and can be defined in separate files. This is good for enforcing consistent formats even when used by non-experts. Automatic numbering of sections, figures, references, etc. works well and is built in.

The traditional default **LaTeX** font, Computer Modern, is out of date (it is bitmapped, which causes problems with some screen viewers) and ugly (at least to my eyes), but it is not difficult to use standard fonts such as Times or Times New Roman.

Figures are normally stored in a separate folder; the standard format remains EPS (encapsulated postscript) even though the use of postscript files has generally gone out of favour despite their excellent scaling qualities.

These limitations are largely removed by the use of newer implementations such as **pdfLaTeX**. This converts the input file directly to PDF format without use of a DVI file. There is better provision for modern fonts, and graphics can be in PNG, JPEG or PDF formats. Although **pdfLaTeX** cannot handle EPS directly there are ways around this.

LaTeX is very powerful for generating even highly complex equations, but this requires good knowledge of how to use the commands effectively. If you don't use a WYSIWYG **LaTeX** package it can, however, be tedious to get things completely right.

Files providing macros make generation of complex symbols and expressions easy and consistent. In ATLAS, a wide range of macros covering particle symbols, some reactions, and many variables is provided in the file **atlasphysics.sty** [3].

Quite a bit of expertise is needed to master the layout of figures, and at times it is hard to predict where they will end up. Tables likewise have to be laid out in a way that often requires tedious debugging.

LaTeX spell-checkers for both Macs and Windows exist [13], but they have to be able to parse the commands and are not widely used. As a result, **LaTeX** documents tend to have more spelling and typographical errors than you might expect, adding to the editing task.

Finally, it is useful to be able to track changes in a document, and to allow groups of people to make comments that point to the relevant text and identify the person making the comment. **LaTeX** does not provide such facilities.

B.3 Microsoft Word

B.3.1 General comments

Word is part of the Microsoft Office suite. Although the full price is high, it is much lower for site licences, educational and home use. **Word** is fully WYSIWYG. It is available for Windows and Mac, but not Linux. Recent versions introduced a new file format, .docx, based on XML and replacing the venerable .doc format, and there are

features that do not work if .docx files are opened in old versions of **Word** using a converter. The current versions of Word can also save files in .doc format to make life easier for those who have not upgraded.

There are some small, long-standing, but irritating incompatibilities between **Word** files produced in Windows and Mac OS; these are largely avoidable if care is taken, e.g. by using standard fonts. A version for Macs, Office 2008, lacked Visual Basic for Applications (VBA)—this meant that **Word** (and Excel and PowerPoint) files using VBA macros did not work. As a result, many Mac users continued to use the previous version (Office 2004), or installed Windows and Office 2010 on their Macs. However, VBA was restored in Office 2011 and Office 2016, and in general improved Mac/Windows compatibility is claimed.

Word has powerful style features, but you have to know which styles to use, and not override them with your own changes. Even in a well-designed template users can simply ignore styles, redefine them, or change the format of styled text. In a way, **Word's** ease of use can be a disadvantage because it is actually too easy for users not familiar with good practice to ignore the extensive facilities provided for producing good documents.

A wide range of graphics formats are accepted, and once inserted there are powerful (but sometimes awkward to use) tools for laying figures out with a choice of options for text wrapping. However, the original graphics file format is unfortunately lost.

Beware of simply copying figures between various types of Microsoft Office documents, as resolution is sometimes badly degraded. If you paste figures into **Word**, use 'Paste Special …' and choose the appropriate option in order to avoid problems.

There are good, flexible, WYSIWYG table-making features.

The ***equation editor*** provided with **Word** is now a dedicated one. The editor works starting with versions Office 2007 (Windows) and Office 2011 (Mac). Older versions of Office can view the new equation format but not edit it. Previously it was based on a reduced version of the WYSIWYG standalone program **MathType** [14]. The full version of MathType, is more powerful, even easier to use, works with a wide variety of software, and can read and produce **LaTeX** if necessary. MathType can still be used with current versions of **Word**, but has to be purchased separately. Another complication is that for symbols, recent **Word** versions use the Cambria Math font instead of the long-running Symbol font.

For managing references in **Word**, a popular extra-cost add-on is **EndNote** [15].

Some people find it useful to use **Word's** outline view for planning documents.

Word has good spell-checking, with customizable dictionaries and a wide choice of languages, including different forms of English. Obviously, no spell checker can find mistakes or typographical errors that result in valid words, or mistakes in acronyms. Most people find **Word's** attempts at checking grammar less successful, and turn it off.

There are extensive tools for tracking changes in documents, and also for collaborative editing so that colleagues can comment on a document and propose changes. These comments are embedded in the file and identify each person. They can be very useful.

Despite being a 'mature' product, **Word** can become unstable when handling large, complex documents. This is especially true if there are a lot of embedded graphics, or

automatic section, figure and reference numbering is being used—it is sometimes necessary to turn these automatic features off.

B.3.2 Specific advice on using Word

Document layout
It is very helpful in diagnosing problems to select the option that shows non-printing characters, such as spaces, tabs, line and paragraph feeds, etc. on the screen.

Many **Word** users don't seem to know about ***page breaks***. Sometimes the next section or subsection should start on a new page, either because it is a major division in the document, or because the material preceding it takes up nearly all of a page and starting a new section near the bottom looks awkward. *Never* do this just by typing 'return' until you get to a new page, because any subsequent changes upstream can easily change the layout so that the page break moves elsewhere and you are left with a big blank space in the middle of a page. Insert a page break to guarantee that you go to a new page no matter what else happens. For important headings, you can define the style so that a page break happens automatically and the headings are always at the top of a page.

You can avoid section headings being stranded at the bottom of a page with the following text on the next page by selecting 'keep with next' in the style definition of the heading. A related point concerns so-called widows and orphans, where one line of a paragraph is stranded on its own at the bottom or top of a page. This is often considered to be bad design, and there are options for 'widow and orphan control' in the paragraph style definitions.

If you are using white space between paragraphs to show where they begin, it may seem quick and easy just to type an extra 'return' at the end of each paragraph to insert a blank paragraph. However, it is not necessary for this white space to be a full line in height—you can specify exactly how much white space appears between paragraphs. This is done automatically as an integral part of each paragraph by setting the 'spacing before' and 'spacing after' (in points) in the paragraph style definition.

If you are indenting the first lines of paragraphs to show where they begin, the paragraph style and the ruler can define how much to indent automatically—*never* do it by typing a series of spaces. It is common for the first paragraph under a section or subsection heading not to have its first line indented (even if others are) as this looks better. **Word** can do it by defining a separate 'first paragraph' style and setting up the heading style to select the 'first paragraph' style as the one following a heading. The normal 'body text' style then follows the 'first paragraph' style.

Within a paragraph, the character size and line spacing can also be exactly specified. Many people just opt for 'single line' spacing, but it is better to define the vertical height of each line and **Word** allows that. It is easier to read long lines if there is a bit more space between the lines, especially if they extend all the way across the page. Set the line spacing to be, say, 13 pt or 14 pt for 11-point text, or 14 pt or 15 pt for 12-point text. Choose the line spacing option 'exactly' rather than 'at least'—this ensures that the line spacing does not open up and look messy if you use superscripts or subscripts, or insert simple objects such as elements from the equation editor. As an example, this document uses 12 pt text with exactly 15 pt line spacing, and 6 pt of white space after each paragraph.

A useful variety of types of tabs (left, right, centred, decimal point) for a given paragraph or paragraph style can be set up in the ruler. You do not have to use the default options.

Typography and special symbols
Special fonts are used for mathematical symbols and Greek letters, the standard choices being Symbol, or Cambria Math in recent versions of **Word**. Using the small selection of Greek letters and special symbols included as part of normal text fonts such as Times New Roman is more likely to produce problems on other computers. A safe procedure is to use **Word's** 'Insert Symbol …' command.

In addition, 'dingbat' fonts such as Wingdings provide other special symbols, including some that may be useful as bullet points. If you send the Word file rather than a PDF to other people there can be problems if they do not have the correct font installed.

Do not put double spaces between sentences—it is an out of date practice from the days of typewriters.

In Table B.1 we describe keyboard shortcuts for producing some special symbols, on both Windows and Mac systems. You can also get most of them using the command 'Insert Symbol ...' and 'Special Characters'. For more information about their use see Section 4.3.4.

The **Word** Equation Editor makes minus signs correctly, but **Word** documents and PowerPoint slides abound with anaemic-looking hyphens instead of minus signs. To fix this use an **en-dash** rather than a hyphen

Table B.1: How to produce some special characters in **Word**.

Character	Word – Windows	Word – Mac OS
En-dash (–) and minus sign	Ctrl + Num. keypad minus	Alt + Hyphen
Em-dash (—)	Alt + Ctrl + Num. keypad minus	Alt + Shift + Hyphen
New line	Shift + Return	Shift + Return
Non-breaking space	Ctrl + Shift + Spacebar	Alt + Spacebar
Non-breaking hyphen	Ctrl + Underscore	Cmnd + Shift + Hyphen
Curly left single quote (‘)	Ctrl + ` then `	Alt +]
Curly right single quote (’)	Ctrl + ' then '	Alt + Shift +]
Curly left double quote (“)	Ctrl + ` then "	Alt + [
Curly right double quote (”)	Ctrl + ' then "	Alt + Shift + [

A Word challenge: *If styles are used consistently and correctly, there should be no need ever to have two consecutive spaces or two consecutive paragraph marks (i.e. return) characters. That is true of this document, and is a good test for others!*