



ATLAS NOTE

28th August 2014



A template for ATLAS papers

ATLAS Publication Committee

Abstract

This is a template ATLAS paper. It contains the structure, style files and hints on how to produce a paper for which a minimum amount of time is necessary to spend on typographic details. This template can be found on the web pages of the ATLAS Publication Committee. You can find the technical details about to use the template in a separate document.

This document was generated using version 00-97-00 of the ATLAS \LaTeX package.

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1 Front page

A couple of remarks about the paper front page:

- **Title:** it should be concise, clear and descriptive, and should include the word “ATLAS”.
- **Author list:** it will be provided by the Authorship Committee, and will be made available on their website. On the front page, you should name “The ATLAS Collaboration” as author.
- **Abstract:** it should also be clear, descriptive, and concise. It should ideally be one paragraph long, and certainly no more than half a page. It should stand on its own and, similarly, the main text of the paper should not depend on it. The abstract should state: what was the measurement; where was it done and with what dataset/luminosity; what method was used; what are the primary results and main conclusions. Citations in an abstract should be avoided. If only Monte Carlo data are used in the publication, this fact should be stated explicitly in the abstract.

2 Introduction

The introduction should be fairly brief, not more than one page. State the measurement being made, motivate its importance experimentally and theoretically. Include a summary of what is known to date about this measurement. Give a brief outline for the rest of the paper.

Your first action before embarking on writing a paper should be to read the ATLAS Publication Policy [1], available from the web pages of the Publication Committee. Chapter 3 of this document details the refereeing and approval procedures that you will need to follow; Chapter 4 gives information on the style.

At some point during the writing of an ATLAS paper, you should decide what journal it will be submitted to. Please keep in mind that each journal makes specific demands on length and style. Most journals use regular capitalisation for titles (i.e. capitalise the first word and all proper nouns, e.g. “The search for large extra dimensions”). The notable exception is Physical Review Letters, which capitalizes the first word and all other important words, e.g. “The Search for Large Extra Dimensions”.

The L^AT_EX file and Postscript versions of this template can be found on the web pages of the ATLAS Publication Committee. Example macros for figures can be found there as well. Comments and/or suggestions on improvements to this template are very welcome and should be given to the Publication Committee.

The `atlasphysics.sty` style file contains a set of particles, reactions, etc. that may be useful. For example, the missing- E_T symbol (E_T^{miss}) is defined there. A separate document [2] contains a list of the commands in `atlasphysics.sty`.

This paper template has been tested using L^AT_EX2e. You should get this version automatically. If you have problems check which L^AT_EX version you are running.

3 Theory

Give here a brief explanation of the theory relevant for this paper, with proper referencing. Use, for example, `\cite{Glashow:1961tr,Weinberg:1967tq,sm_salam}` to cite the Standard Model [3–5].

Define important quantities that will be used later. State how the measurement of interest is actually performed, and how parameters are extracted from the data. If quantities are extracted with a fit to the

data, describe the fit procedure. If the explanation needs to be a bit longer, a separate section may be appropriate.

4 Experimental setup

The Publication Committee provides a standard text giving examples for description of the ATLAS detector, and the appropriate references. This text is included in the paper template provided with this package. If necessary for your analysis, describe a subdetector in more detail.

The section on the experimental setup should also describe the dataset: when were the data taken, under what special circumstances (if any), and what was the integrated luminosity.

Examples of descriptions can be found below.

4.1 ATLAS detector

The ATLAS experiment [**atlas-detector**] at the LHC is a multi-purpose particle detector with a forward-backward symmetric cylindrical geometry and a near 4π coverage in solid angle¹. It consists of an inner tracking detector surrounded by a thin superconducting solenoid providing a 2 T axial magnetic field, electromagnetic and hadron calorimeters, and a muon spectrometer. The inner tracking detector covers the pseudorapidity range $|\eta| < 2.5$. It consists of silicon pixel, silicon micro-strip, and transition radiation tracking detectors. Lead/liquid-argon (LAr) sampling calorimeters provide electromagnetic (EM) energy measurements with high granularity. A hadron (iron/scintillator-tile) calorimeter covers the central pseudorapidity range ($|\eta| < 1.7$). The end-cap and forward regions are instrumented with LAr calorimeters for both EM and hadronic energy measurements up to $|\eta| = 4.9$. The muon spectrometer surrounds the calorimeters and is based on three large air-core toroid superconducting magnets with eight coils each. Its bending power is in the range from 2.0 to 7.5 T m. It includes a system of precision tracking chambers and fast detectors for triggering. A three-level trigger system is used to select events. The first-level trigger is implemented in hardware and uses a subset of the detector information to reduce the accepted rate to at most 75 kHz. This is followed by two software-based trigger levels that together reduce the accepted event rate to 400 Hz on average depending on the data-taking conditions during 2012.

4.2 ATLAS coordinate system footnote

5 Monte Carlo

Any Monte Carlo programs used must be clearly stated with full version number. A brief description of the program is useful but not necessary unless a less well known program is used. Any corrections or special parameter settings must be clearly explained. The statistics should be given if the amount used results in a non-negligible uncertainty.

¹ATLAS uses a right-handed coordinate system with its origin at the nominal interaction point (IP) in the centre of the detector and the z -axis along the beam pipe. The x -axis points from the IP to the centre of the LHC ring, and the y -axis points upwards. Cylindrical coordinates (r, ϕ) are used in the transverse plane, ϕ being the azimuthal angle around the beam pipe. The pseudorapidity is defined in terms of the polar angle θ as $\eta = -\ln \tan(\theta/2)$. Angular distance is measured in units of $\Delta R \equiv \sqrt{\Delta\eta^2 + \Delta\phi^2}$.

6 Event selection

List the trigger and offline selection criteria, give the obtained statistics.

7 Data characteristics

Discuss here the characteristics of the data, in terms of primary quantities and backgrounds.

8 Systematic uncertainties

Give a detailed list of systematic uncertainties, the method by which they were obtained, and a justification of the resulting values. Use “systematic uncertainty” instead of “systematic errors”. The latter sounds as if you have made a mistake systematically.

9 Results

State the results without interpretations.

10 Discussion

Put the results into the context of the theory or a model. If the results lead to exclusion plots, make sure that it is clear which region on the plot is excluded.

11 Summary and conclusion

Reiterate the main points of the paper and the primary results and conclusions.

Note that many readers look mostly at the title, abstract and conclusion. The conclusion should be interesting enough to make them want to read the whole paper. It is not good style to just repeat the abstract.

If your paper is short and only has one result quoted at the end of the paper, then you should consider whether conclusions are necessary.

Try not to end your conclusions with a sentence such as “All the results in this paper are in good agreement with the Standard Model, the current world average and recent measurements by other experiments”. This might lead a referee (internal or external) to wonder why it is worth publishing this paper!

Note that all figures and tables should be output before the start of the “Summary and conclusion”.

Acknowledgements

A standard template for the acknowledgements is available on the web pages of the Publication Committee. See reference [1] for the URL.

The acknowledgements should be in an unnumbered section.

References

- [1] *ATLAS Publication Policy*.
URL: <http://atlas.web.cern.ch/Atlas/GROUPS/GENERAL/SCINOTES/scinotes.html>.
- [2] *Symbols defined in atlasphysics.sty*.
URL: <https://twiki.cern.ch/twiki/pub/AtlasProtected/PubComTemplates/atlas-physics.pdf>.
- [3] S. L. Glashow. “Partial Symmetries of Weak Interactions”.
In: *Nucl. Phys.* 22 (1961), pp. 579–588. DOI: [10.1016/0029-5582\(61\)90469-2](https://doi.org/10.1016/0029-5582(61)90469-2).
- [4] S. Weinberg. “A Model of Leptons”. In: *Phys. Rev. Lett.* 19 (1967), pp. 1264–1266.
DOI: [10.1103/PhysRevLett.19.1264](https://doi.org/10.1103/PhysRevLett.19.1264).
- [5] A. Salam. in *Elementary Particle Theory*. Stockholm: Almqvist and Wiksell, 1968, p. 367.
- [6] *ATLAS Style Guide*. URL: <https://cds.cern.ch/record/1110290>.
- [7] *Users guide to the ATLAS L^AT_EX templates*. URL: <http://twiki.cern.ch/twiki/pub/AtlasProtected/PubComTemplates/atlas-latex.pdf>.
- [8] *ATLAS BibT_EX Guide*.
URL: <https://twiki.cern.ch/twiki/pub/AtlasProtected/PubComTemplates/atlas-bibtex.pdf>.
- [9] *ATLAS Rounding Guidelines*.
URL: <https://twiki.cern.ch/twiki/bin/view/AtlasProtected/PubComTemplates>.
- [10] *ATLAS Glossary*.
URL: <https://twiki.cern.ch/twiki/bin/view/Atlas/AtlasGlossary>.

Appendices

In general, you use the appendices to include all the technical details of your work that are relevant for the ATLAS Collaboration only (e.g. dataset details, software release used). In an ATLAS paper auxiliary plots and tables that are supposed to be made public should be collected in an appendix.

Use the following commands to start the Appendices section:

```
\newpage
\appendix
\part*{Appendices}
\addcontentsline{toc}{part}{Appendices}
```

In this document the appendices contain some general remarks on the style to use in ATLAS papers and some technical aspects on how to implement the style. More details on how to use the ATLAS L^AT_EX templates to help you follow these recommendations can be found in other documents:

- ATLAS style guide [6].
- ATLAS L^AT_EX guide [7];
- ATLAS B_IB_TE_X guide [8];
- ATLAS physics symbols [2].
- Rounding in ATLAS [9];

A General Style

We recommend the use of British English. However, whatever you decide to choose, be consistent throughout the paper. For much more detailed information on writing, spelling and typographic style, etc. please see the ATLAS Style Guide [6]. The ATLAS Glossary [10] contains a list of ATLAS detector acronyms.

A.1 Emphasis

Use italics for emphasis sparingly: too many italicised words defeat their purpose. When you do italicise a word, really italicise it: do not use math mode! Note the difference between *per se* (`\emph{per se}`) and *per se* (`$per se$`). Abbreviations like i.e., e.g., etc., and et al. should *not* be italicised! For program names we recommend to use small capitals: `\textsc{Pythia}` produces PYTHIA.

B Tables

All tables appearing in the paper must be mentioned in the text. The tables should appear in the same order as mentioned in the text. Do not abbreviate the word “Table”. Capitalise the first word of any row or column heading. Label all rows/columns, including units if appropriate. Units are given in brackets, e.g. “Energy [GeV]”. Horizontal and vertical lines should be kept to a minimum and only used as necessary to make the table entries clear. The table caption appears below the table. Any

symbols/variables used in the table must be defined in the caption. Always use labels to refer to tables and figures. Note that the label must be included in the body of the caption.

If table entries include uncertainties, the entries should be aligned on the “ \pm ” sign. Numbers look best when aligned on the decimal point. Otherwise, column entries should be left-aligned. Table 1 shows the use of \pm as the intercolumn character for alignment. An alternative, as shown in Table 2, is to use `\phantom` to put in extra space equal to the width of a number if you have different numbers of decimal places in the table. The note on rounding [9] contains more examples on how to format tables.

The `booktabs` package provides the macros `\toprule`, `\midrule`, `\bottomrule` which are to be preferred over `\hline`, as, among other things, they introduce some extra spacing around the lines, which is useful.

Category	μ	e
$b \rightarrow \ell$	$65.2 \pm 0.4 \%$	79.3%
$b \rightarrow c \rightarrow \ell$	$7.8 \pm 0.3 \%$	5.4%
Total	$73.0 \pm 0.2 \%$	9.1%

Table 1: Monte Carlo estimates of the fraction of each process in the single lepton data sample. This table uses “S” format from `siunitx` and “ \pm ” as the intercolumn separator.

Category	μ	e
$b \rightarrow \ell$	$65.2 \pm 0.4 \%$	79.3%
$b \rightarrow c \rightarrow \ell$	$7.8 \pm 0.3 \%$	5.4%
Total	$73.0 \pm 0.2 \%$	9.1%

Table 2: Monte Carlo estimates of the fraction of each process in the single lepton data sample. This table uses `\phantom`.

C Figures

The Publication Committee has a root macro to create figures in ATLAS style, it can be found on the Publication Committee web pages. Use this style consistently throughout the paper. An example figure can be seen in Figure 1.

Figures should be always made available in both `eps` (or `pdf`) and `png` format. Additionally, a `pdf` version of the plots can be useful in case `pdfLaTeX` is used to produce a publication.

All figures appearing in the paper must be mentioned in the text. The figures should appear in the same order as mentioned in the text. At the beginning of a sentence, use the full word “Figure”. Within a sentence, the abbreviation “Fig.” may be used. If a figure appears in two or more parts, refer to it as “Fig. 1(a)” and “Fig. 1(b)”. Both “(a)” and “(b)” should appear in the text, in the figure, and in the caption. The word “ATLAS” (or “ATLAS Preliminary”, if appropriate) should appear prominently somewhere in the figure. This becomes important when the figure is copied and shown out of context. If appropriate, it is useful to include information about the luminosity corresponding to a figure.

All axes must be labeled, including units (i.e. “Energy [GeV]”). The vertical axis units should specify the bin width, unless arbitrarily normalized. A legend box explaining all plotting symbols must appear somewhere in the figure.

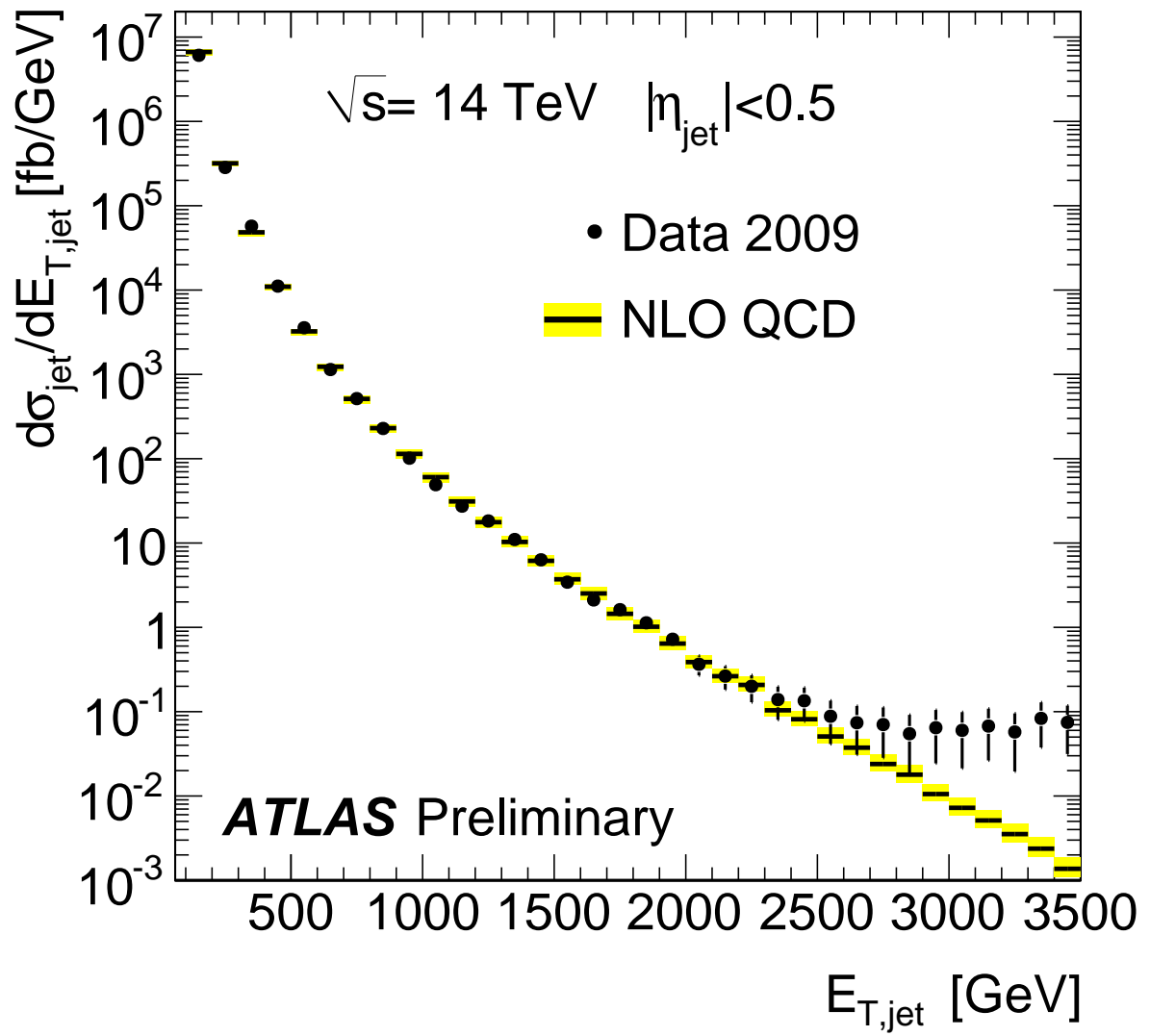


Figure 1: An example ATLAS figure.

The caption should be placed below the figure. All lines, all plotting symbols, and all variables used in the figure must be defined in the caption. Do not refer to any characteristic that is not distinguishable in black-and-white. If relevant, the normalization method of the plot should be specified.

A figure with subfigures can be made as shown in the example of Figure 2.

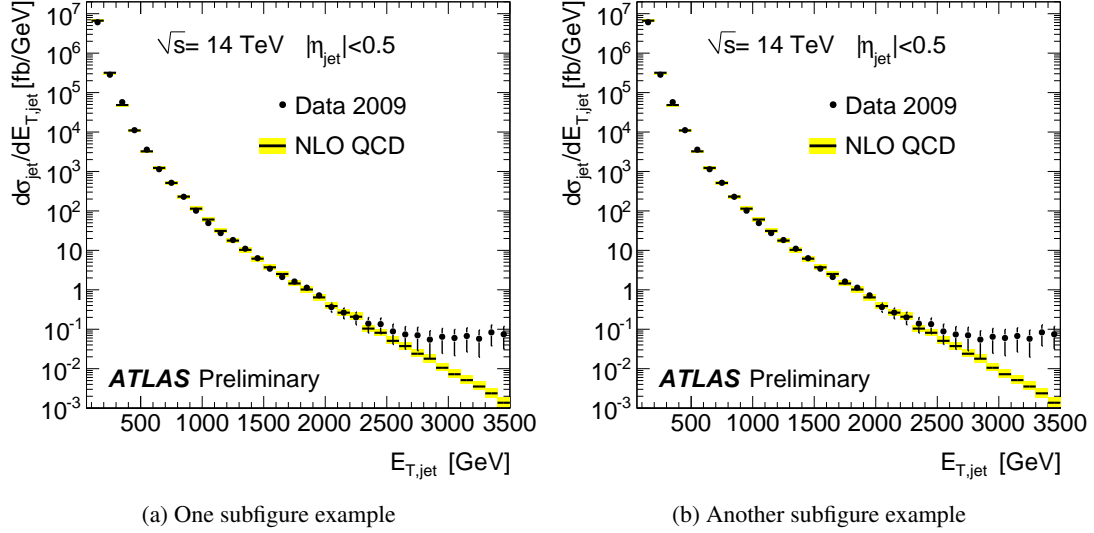


Figure 2: Subfigure example (2a) and (2b).

D References

Only cite permanent, publicly available, or ATLAS approved references. Private references, not available to the general public, should be avoided. Caution should be used when referring to ATLAS notes. Only reference approved notes. Do not reference COM or INT notes, as these are not available outside ATLAS.

Whenever possible, cite the article’s journal rather than its preprint number. If possible, the arXiv number should be given in addition. Always double check references when copying them from another source.

Referencing styles are journal-dependent. See the ATLAS Publication Policy document for more information.

Use BibTeX for the references. Although it often appears harder to use at the beginning, it means that the number of typos should be reduced significantly and the format of the references will be correct, without you having to worry about formatting it. In addition the order of the references is automatically correct.

One or more files with the extension .bib (in this example: atlas-paper.bib) should contain all the references. The files may also contain references that you do not use, so they may act like a library of references. The typical compilation cycle when using BibTeX looks like the following:

```
(pdf)latex instructions
bibtex instructions
(pdf)latex instructions
```

(pdf)latex instructions

B_BT_EX will create a file with the extension .bbl, which will contain the actual references used, and L^AT_EX will then take care to include them in your paper. Note that only after the third run of L^AT_EX will all references be correct. Unless you change a reference you do not have to do the bibtex step again.

Two B_BT_EX style files (bibtex/bst/atlasBibStyleWoTitle.bst and bibtex/bst/atlasBibStyleWoTitle. are provided with the ATLAS L^AT_EX package. You can use one of them in your text source file as follows:

```
\bibliographystyle{bibtex/bst/atlasBibStyleWoTitle}
\bibliography{atlas-paper}
```

Note that biblatex is a more modern replacement for B_BT_EX that has a number of advantages. If you want to use this package, you should include commands like:

```
\usepackage[backend=biber,
style=numeric-comp,sorting=none,block=ragged,firstinits=true]{biblatex}
\addbibresource{atlas-paper.bib}
```

in the preamble of our document. Then include the command:

```
\printbibliography
```

where the bibliography should get printed. Use the command biber instead of bibtex to process the .bib files.

For further information on B_BT_EX and on the standard ATLAS style for referencing, see the “ATLAS B_BT_EX Guide” [8].

E Remarks on units and symbols

It is highly recommended to use a units package to format your units properly. The package siunitx works very well and is the package of choice. Alternatives include units and hepunits, which is based on SIunits.

If you use a units package, it automatically set SI units in roman-type font and leaves a small space between the value and the units (e.g. 12 mm). In addition, it makes sure they end up always together on the same line. `\SI{12}{\mm}`. Natural units, where $c = \hbar = 1$, should be used for all ATLAS publications. Masses are therefore in GeV, not GeV/c.

Use math mode for all symbols (e.g. use c (`c`) rather than simply c). Momentum should be in lower case p (`p`). Transverse momentum is a lower case p with an upper case roman T subscript: `\pT` produces p_T . Energy is an upper case E (`E`), `\ET` produces E_T . Use `\mathscr` mode for luminosity \mathcal{L} or aplanarity \mathcal{A} , including the package `mathrsfs.sty`.

Trigonometric functions should be in roman type. Natural logarithm should be \ln and log base 10 is \log . When in math mode, use `\ln`, `\sin`, etc. We recommend to specify the base of the logarithm: `\log_{10}`.

If your note makes use of cones, for example cone-jets, explain that these cones are constructed in η - ϕ space, and define η .

Add the word *events* as the unit when quoting the number of events: “The resulting background is 4.0 ± 1.3 events.”. The number of expected events should be written as N_{pred} rather than N_{exp} , since the latter could also mean experimental.

For particle names and symbols, ATLAS uses the standards of the Particle Data Book. Intermediate vector bosons should be called *W boson(s)* and *Z boson(s)*, not just *W's* or *Ws*. The Z boson should not have a superscript of 0. W without the word boson attached may be used in *W pair production*, and similar phrases. Other particle names should be spelled out when used in a sentence: muon(s), electron(s), tau lepton(s). *Top quark* should be used instead of *top* in most places: say “top quark mass” instead of “top mass”. Top quark and bottom quark may be shortened to *t* quark and *b* quark. The neutrino symbol ν should not have any subscripts, unless necessary for understanding. For the J/ψ use the command `\Jpsi` from `atlasphysics.sty`: it will produce a lower case ψ .

When in doubt, use the PDG style.

F The `atlasdoc` class

This paper has been typeset using the `atlasdoc.cls` class. This class implements the ATLAS template and can be used for papers, preprints, notes. The class is available from the web pages of the Publication Committee and from SVN. It also contains these guidelines and related files.

Details on how to use the templates can be found in a separate document `atlas-latex.pdf` [7].

The style file `atlasphysics.sty` defines a lot of useful macros for particles and more. See the separate document `atlas-physics.pdf` [2] for details.