



# ATLAS Paper

8th November 2017



## General guidelines for ATLAS papers

ATLAS Publication Committee

This document gives general guidelines on how an ATLAS paper should be structured and what authors should pay attention to. It is part of the ATLAS  $\LaTeX$  package which can be downloaded from Publication Committee TWiki pages. The technical details about how to use the ATLAS  $\LaTeX$  style files are included in a separate document.

This document was generated using version 05-00-00 of the ATLAS  $\LaTeX$  package. The  $\TeX$  Live version is set to 2016. It uses the option `atlasstyle`, which implies that the standard ATLAS preprint style is used.

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# 1 Front page

Before we get to the meat of the document, a few remarks about the paper front page.

## 1.1 Title

The title should be concise, clear and descriptive, and should include the word ‘ATLAS’.

## 1.2 Author list

The author list will be provided by the Authorship Committee and Physics Office. It will be created by the Physics Office at the time of the first draft announcement by PubCom, and added to the CDS record for the paper as a separate document from the paper itself. Requests for exceptional authorship or for removal of names should be made to the Spokesperson and Authorship Committee while the first draft is circulating. The author list will be archived when the second draft announcement is made by Publication Committee, and again added to the CDS record as a separate document from the paper. The front page of the paper should name ‘The ATLAS Collaboration’ as the author.

## 1.3 Abstract

The abstract should also be clear, descriptive and concise. It should consist of a single paragraph, occupying no more than half a page. It should stand on its own and the main text of the paper should not depend on it. The abstract should state what was measured; where the measurement was made and with what dataset / luminosity; what method was used; what are the primary results and main conclusions. Citations, footnotes, references etc. should be avoided in the abstract. If only Monte Carlo data are used in the publication, this fact should be stated explicitly in the abstract.

### Example of a Search Analysis Abstract

A search for the Standard Model Higgs boson in the two photon decay channel is reported, using  $1.08 \text{ fb}^{-1}$  of proton–proton collision data at a centre-of-mass energy of 7 TeV recorded by the ATLAS detector. No significant excess is observed in the investigated mass range of 110 to 150 GeV. Upper limits on the cross-section times branching ratio of between 2.0 and 5.8 times the Standard Model prediction are derived for this mass range.

(From ‘Search for the Standard Model Higgs boson in the two photon decay channel with the ATLAS detector at the LHC’)

## Example of a Standard Model Measurement Analysis Abstract

This Letter presents a measurement of the  $WW$  production cross section in  $\sqrt{s} = 7$  TeV  $pp$  collisions by the ATLAS experiment, using  $34 \text{ pb}^{-1}$  of integrated luminosity produced by the Large Hadron Collider at CERN. Selecting events with two isolated leptons, each either an electron or a muon, 8 candidate events are observed with an expected background of  $1.7 \pm 0.6$  events. The measured cross section is  $(41^{+20}_{-16}(\text{stat.}) \pm 5(\text{syst.}) \pm 1(\text{lumi.})) \text{ pb}$ , which is consistent with the standard model prediction of  $(44 \pm 3) \text{ pb}$  calculated at next-to-leading order in QCD. In fact, the ATLAS convention is to write this as  $44 \pm 3 \text{ pb}$ , i.e. without the enclosing parentheses.

(From ‘Measurement of the  $WW$  cross section in  $\sqrt{s} = 7$  TeV  $pp$  collisions with ATLAS’)

## 2 Introduction

This should be fairly brief. State the measurement being made, motivate its importance experimentally and theoretically. It is considered bad form to point out being the first to publish something as a motivation. Include a summary of what has already been published on this subject, as well as the most appropriate theory references. For a longer paper, give a brief outline of the paper, especially if the structure is unusual. Even for a long paper, the introduction should generally not exceed one page.

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 capitalises the first word and all other important words, e.g. ‘The Search for Large Extra Dimensions’.

This document can be found on the web pages of the ATLAS Publication Committee and in the `atlaslatex` package. The Publication Committee provides standard texts giving examples for the description of the ATLAS detector, and the appropriate references, as well as other text snippets that may be useful to avoid too much use of ATLAS jargon. The ATLAS detector description is included in Appendix A. Text snippets can be found on the web pages [2]. Comments and/or suggestions on improvements 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 ( $E_T^{\text{miss}}$ ) is defined there. A separate document [3] contains a list of the commands in `atlasphysics.sty`.

## 3 Theory

Sometimes combined with the introduction in shorter papers. This should be a brief overview of the theory relevant for this paper, with proper referencing. This is a good place to define important quantities which

will be used later. State how the measurement of interest is actually performed, and how the parameters are extracted from the data. If quantities are extracted with a fit to the data, describe the fit procedure; if a limit is set, state what kind of limit-setting technique is used. If these explanations need to be a bit longer, separate sections may be appropriate.

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 [4–6].

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

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 in Appendix A.

## 5 Monte Carlo

All Monte Carlo generators and calculators used must be clearly named with the full version number and reference. A brief description may be useful if it is a less well known generator. It is usually necessary to say to what order it calculates (LO, NLO, NNLO...) and to specify any corrections, tunings or special parameter settings. The PDF sets used should be listed, also with the full version numbers and references. Statistics should be given if the number of simulated events gives rise to a non-negligible uncertainty.

## 6 Event selection

List the trigger and offline selection criteria, and number of events passing.

## 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 error”. The latter sounds as if you have made a mistake systematically.

## 9 Results

State the results without interpretations here.

## 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. Please also make sure that statistical interpretations and limit setting are done following the current ATLAS Statistics Tools and Guidelines

## 11 Summary and conclusion

Please make sure that there is a conclusion! The concluding statements should reflect what is in the abstract. 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 just to 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’. This can be achieved using the macro `\FloatBarrier` that is part of the `placeins` package.

## 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.

# Appendices

In a paper, an appendix is used for technical details that would otherwise disturb the flow of the paper. Such an appendix should be printed before the Bibliography. In an ATLAS paper, auxiliary plots and tables that are supposed to be made public should be collected in an appendix that has the title ‘Auxiliary material’. This appendix should be printed after the Bibliography.

In an ATLAS note, 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).

Use the following commands to start the Appendices section:

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

In this document the appendices contain some general remarks on the style to use in ATLAS papers. More technical details on how to use the ATLAS  $\LaTeX$  templates to help you follow these recommendations can be found in other documents:

- ATLAS style guide [7].
- Users guide to the ATLAS  $\LaTeX$  package [8];
- Guide to references and  $\BibTeX$  in ATLAS documents [9];
- ATLAS physics symbols [3];
- Guide to formatting tables for ATLAS documents [10];
- Rounding – ATLAS Recommendations [11];
- Report of the ATLAS figures task force [12].

ATLAS papers should use the `atlasstyle` option with the class `atlasdoc`. The default fonts for ATLAS documents are `newtxtext` and `newtxmath`. These are more modern variants of the package `txfonts` that has been used in ATLAS documents in the past. However, arXiv currently uses an older version of  $\TeX$  Live (2011) that does not include the `newtx` fonts. Hence, in ATLAS papers, please add the option `txfonts` to `atlasdoc`.

## 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 [7]. The ATLAS Glossary [13] contains a list of ATLAS detector acronyms.

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 should be aligned on the decimal point. Otherwise, column entries should be left-aligned.

More details on the style to be followed can be found in Section 3.4 of the ‘ATLAS Style Guide’ [7]. Example tables and hints on how to obtain the desired format can be found in a separate document [10]. The note on rounding [11] contains more examples on how to format tables.

## C Figures

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 labelled, 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.

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 normalisation method of the plot should be specified.

More details on the style to be followed can be found in Section 3.3 of the ‘ATLAS Style Guide’ [7]. The Publication Committee has a root macro to create figures in ATLAS style, it can be found on the Publication Committee web pages [14]. Use this style consistently throughout the paper.



## 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. This is not a problem if the ATLAS preprint style is used, as the journals will adapt the document to their style.

For further information on `BIBTEX` and on the standard ATLAS style for referencing, see the ‘ATLAS `BIBTEX` Guide’ [9]. More details on what to pay attention to can be found in Section 3.6 of the ‘ATLAS Style Guide’ [7].

## 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 an upright font and leaves a small space between the value and the units (e.g. 12 mm). In addition, it makes sure the value and unit end up 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  $p$ . Transverse momentum is a lower case  $p$  with an upper case roman T subscript: `\pT` produces  $p_T$ . Energy is an upper case  $E$ , `\ET` produces  $E_T$ . Use `\mathcal` mode for luminosity  $\mathcal{L}$  or aplanarity  $\mathcal{A}$ .

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  $\eta$ - $\phi$  space, and define  $\eta$ .

Add the word *events* as the unit when quoting the number of events: ‘The resulting background is  $4.0 \pm 1.3$  events.’. The number of expected events should be written as  $N_{\text{pred}}$  rather than  $N_{\text{exp}}$ , 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  $\nu$

should not have any subscripts, unless necessary for understanding. For the  $J/\psi$  use the command `\Jpsi` from `atlasphysics.sty`: it will produce a lower case  $\psi$ .

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` [8].

The style file `atlaspackage.sty` loads packages that are usually used in documents. Several options exist to turn on or off the loading of various packages.

The style file `atlasphysics.sty` defines a lot of useful macros for particles and more. See the separate document `atlas_physics.pdf` [3] for details.

## References

- [1] *ATLAS Publication Policy*,  
URL: <https://twiki.cern.ch/twiki/bin/view/AtlasProtected/PubComHomePage>.
- [2] *Common pieces of text for papers*,  
URL: <https://twiki.cern.ch/twiki/bin/view/AtlasProtected/PubComCommonText>.
- [3] I. Brock, *Symbols defined in atlasphysics.sty*, URL: [https://twiki.cern.ch/twiki/pub/AtlasProtected/PubComLaTeX/atlas\\_physics.pdf](https://twiki.cern.ch/twiki/pub/AtlasProtected/PubComLaTeX/atlas_physics.pdf).
- [4] S. L. Glashow, *Partial Symmetries of Weak Interactions*, *Nucl. Phys.* **22** (1961) 579.
- [5] S. Weinberg, *A Model of Leptons*, *Phys. Rev. Lett.* **19** (1967) 1264.
- [6] A. Salam, ‘Weak and Electromagnetic Interactions’, *Elementary Particle Theory*, ed. by N. Svartholm, Almqvist and Wiksell, 1968 367.
- [7] E. Eisenhandler, *ATLAS Style Guide*, URL: <https://cds.cern.ch/record/1110290>.
- [8] I. Brock, *Users guide to the ATLAS L<sup>A</sup>T<sub>E</sub>X package*, URL: [https://twiki.cern.ch/twiki/pub/AtlasProtected/PubComLaTeX/atlas\\_latex.pdf](https://twiki.cern.ch/twiki/pub/AtlasProtected/PubComLaTeX/atlas_latex.pdf).
- [9] I. Brock, *Guide to references and BibT<sub>E</sub>X in ATLAS documents*, URL: [https://twiki.cern.ch/twiki/pub/AtlasProtected/PubComLaTeX/atlas\\_bibtex.pdf](https://twiki.cern.ch/twiki/pub/AtlasProtected/PubComLaTeX/atlas_bibtex.pdf).
- [10] I. Brock, *Guide to formatting tables for ATLAS documents*, URL: [https://twiki.cern.ch/twiki/pub/AtlasProtected/PubComLaTeX/atlas\\_tables.pdf](https://twiki.cern.ch/twiki/pub/AtlasProtected/PubComLaTeX/atlas_tables.pdf).
- [11] H. Abramowicz et al., *Rounding – ATLAS Recommendations*,  
URL: <https://cds.cern.ch/record/1668799>.
- [12] H. Abramowicz et al., *Report of the ATLAS figures task force*,  
URL: <https://cds.cern.ch/record/1707807>.

- [13] *ATLAS Glossary*, URL: <https://twiki.cern.ch/twiki/bin/view/Atlas/AtlasGlossary>.
- [14] *Style guide for ATLAS plots*,  
URL: <https://twiki.cern.ch/twiki/bin/view/AtlasProtected/PubComPlotStyle>.
- [15] ATLAS Collaboration, *The ATLAS Experiment at the CERN Large Hadron Collider*,  
*JINST* **3** (2008) S08003.
- [16] ATLAS Collaboration, *Performance of the ATLAS Trigger System in 2010*,  
*Eur. Phys. J. C* **72** (2012) 1849, arXiv: [1110.1530 \[hep-ex\]](#).

# Auxiliary material

## A ATLAS detector descriptions

These descriptions can be found in the file `templates/atlas-detector.tex`.

### A.1 Run 1 ATLAS detector example for a Letter

The ATLAS experiment [15] at the LHC is a multi-purpose particle detector with a forward-backward symmetric cylindrical geometry and a near  $4\pi$  coverage in solid angle.<sup>1</sup> 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 (steel/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 toroidal superconducting magnets with eight coils each. The field integral of the toroids ranges between 2.0 and 6.0 T m across most of the detector. The muon spectrometer 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.

### A.2 Run 1 ATLAS detector example for a paper making use of the whole detector

The ATLAS detector [15] at the LHC covers nearly the entire solid angle around the collision point. It consists of an inner tracking detector surrounded by a thin superconducting solenoid, electromagnetic and hadronic calorimeters, and a muon spectrometer incorporating three large superconducting toroidal magnets. The inner-detector system (ID) is immersed in a 2 T axial magnetic field and provides charged particle tracking in the range  $|\eta| < 2.5$ .

The high-granularity silicon pixel detector covers the vertex region and typically provides three measurements per track, the first hit being normally in the innermost layer. It is followed by the silicon microstrip tracker which usually provides four two-dimensional measurement points per track. These silicon detectors are complemented by the transition radiation tracker, which enables radially extended track reconstruction up to  $|\eta| = 2.0$ . The transition radiation tracker also provides electron identification

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<sup>1</sup> ATLAS 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  $(r, \phi)$  are used in the transverse plane,  $\phi$  being the azimuthal angle around the  $z$ -axis. The pseudorapidity is defined in terms of the polar angle  $\theta$  as  $\eta = -\ln \tan(\theta/2)$ . Angular distance is measured in units of  $\Delta R \equiv \sqrt{(\Delta\eta)^2 + (\Delta\phi)^2}$ .

information based on the fraction of hits (typically 30 in total) above a higher energy deposit threshold corresponding to transition radiation.

The calorimeter system covers the pseudorapidity range  $|\eta| < 4.9$ . Within the region  $|\eta| < 3.2$ , electromagnetic calorimetry is provided by barrel and endcap high-granularity lead/liquid-argon (LAr) electromagnetic calorimeters, with an additional thin LAr presampler covering  $|\eta| < 1.8$ , to correct for energy loss in material upstream of the calorimeters. Hadronic calorimetry is provided by the steel/scintillating-tile calorimeter, segmented into three barrel structures within  $|\eta| < 1.7$ , and two copper/LAr hadronic endcap calorimeters. The solid angle coverage is completed with forward copper/LAr and tungsten/LAr calorimeter modules optimised for electromagnetic and hadronic measurements respectively.

The muon spectrometer (MS) comprises separate trigger and high-precision tracking chambers measuring the deflection of muons in a magnetic field generated by superconducting air-core toroids. The field integral of the toroids ranges between 2.0 and 6.0 T m across most of the detector. A set of precision chambers covers the region  $|\eta| < 2.7$  with three layers of monitored drift tubes, complemented by cathode strip chambers in the forward region, where the background is highest. The muon trigger system covers the range  $|\eta| < 2.4$  with resistive plate chambers in the barrel, and thin gap chambers in the endcap regions. A three-level trigger system is used to select interesting events [16]. The Level-1 trigger is implemented in hardware and uses a subset of detector information to reduce the event rate to a design value of at most 75 kHz. This is followed by two software-based trigger levels which together reduce the event rate to about 200 Hz.