



# ATLAS Note

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## Guide to formatting tables for ATLAS documents

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This document illustrates the preferred style for tables in ATLAS documents. It illustrates what the tables should look like and also provides guidelines on how to achieve this look.

This document was generated using version 03-00-01 of the ATLAS  $\text{\LaTeX}$  package. The  $\text{\TeX}$  Live version is set to 2016. It uses the option `atlasstyle`, which implies that the standard ATLAS preprint style is used.

## 1 General guidelines

Tables should only contain as many lines as are needed for clarity. Table 1 shows a good example that has been taken from ‘Rounding – ATLAS Recommendations’ [1].

Channel	Selected events	
$WW, WZ, ZZ$	$943 \pm$	94
QCD multijets	$2\,800 \pm$	1\,400
$Wc\bar{c}, Wb\bar{b}, Wc$	$31\,000 \pm$	13\,000
$W + \text{jets}$	$10\,600 \pm$	4\,400
Single top $Wt$	$1\,700 \pm$	150
$Z + \text{jets}$	$2\,400 \pm$	1\,000
Single top $s$	$298 \pm$	12
Single top $t$	$3\,940 \pm$	170
$t\bar{t}$	$9\,390 \pm$	900
Expected	$63\,000 \pm 14\,000$	
Data	73\,062	

Table 1: Example event yields spread over several orders of magnitude.

An example of a wider and somewhat more complicated table is shown in Table 2.

Coupling	LEP		HERA	
$\mathcal{B}(t \rightarrow q\gamma)$	$2.4 \times 10^{-2}$		$6.4 \times 10^{-3}$	$(t\gamma)$
$\mathcal{B}(t \rightarrow qZ)$	$7.8 \times 10^{-2}$		$49 \times 10^{-2}$	$(tZ)$
$\mathcal{B}(t \rightarrow qg)$	$17 \times 10^{-2}$		$13 \times 10^{-2}$	
Coupling	Tevatron		LHC	
$\mathcal{B}(t \rightarrow q\gamma)$	$3.2 \times 10^{-2}$		—	
$\mathcal{B}(t \rightarrow qZ)$	$3.2 \times 10^{-2}$		$7.0 \times 10^{-4}$	
$\mathcal{B}(t \rightarrow qg)$	$2.0 \times 10^{-4}$	$(tug), (2 \rightarrow 2)$	—	
	$3.9 \times 10^{-3}$	$(tcg), (2 \rightarrow 2)$	—	
	$3.9 \times 10^{-4}$	$(tug), (2 \rightarrow 1)$	$5.7 \times 10^{-5}$	$(tug), (2 \rightarrow 1)$
	$5.7 \times 10^{-3}$	$(tcg), (2 \rightarrow 1)$	$2.7 \times 10^{-4}$	$(tcg), (2 \rightarrow 1)$

Table 2: Present experimental limits at 95 % confidence level on the branching fractions of the FCNC top quark decay channels established by experiments of the LEP, HERA, Tevatron and LHC accelerators.

A typical table containing Monte Carlo samples is given in Table 3.

Table 4 shows the use of  $\pm$  as the intercolumn character for alignment. An alternative, as shown in Table 5, 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 `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.

	$\sigma$ [pb]	Generator	$N_{MC}$	$k$ -factor	Dataset ID
$Wt$ all decays	22	POWHEG + PYTHIA	1 000 000	1.09	110 140
$t$ -channel (lepton+jets) top	18	POWHEG + PYTHIA	5 000 000	1.05	110 090
$s$ -channel (lepton+jets) antitop	1.8	POWHEG + PYTHIA	5 000 000	1.06	110 091
$t\bar{t}$ no fully hadronic	114	POWHEG + PYTHIA	100 000 000	1.12	117 050

Table 3: Top quark event MC samples used for this analysis. The cross-section column includes  $k$ -factors and branching ratios.

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

Table 4: 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	$\mu$	$e$
$b \rightarrow \ell$	$65.2 \pm 0.4 \%$	79.3 %
$b \rightarrow c \rightarrow \ell$	$7.8 \pm 0.3 \%$	5.4 %
Total	$73.0 \pm 0.2 \%$	9.1 %

Table 5: Monte Carlo estimates of the fraction of each process in the single lepton data sample. This table uses `\phantom`.

## 2 L<sup>A</sup>T<sub>E</sub>X packages for table

The L<sup>A</sup>T<sub>E</sub>X package `booktabs` gives a number of guidelines on how tables should be formatted. These are followed to a large extent in this document. The following packages related to tables are included by default when you load the package `atlaspackage`:

**booktabs** useful tools for formatting tables;

**siunitx** tools for rounding and also for helping to format and align numbers in tables;

Further packages related to the formatting of tables are:

**xtab** the most modern package for tables that spread over more than one page;

**longtable** an alternative package for long tables;

**supertabular** yet another alternative package for long tables;

**dcolumn** can be used as an alternative to `siunitx` to align numbers in tables.

`xtab` is included if you load `atlaspackage` with the option `full`. You may also need to rotate a big table. The `rotating` package can be used for this.

In order to shorten commands when doing rounding in tables, it is useful to define a few extra macros. Typical definitions can be found in the file `atlas_tables-defs.sty`.

### 3 Tables and rounding

Further examples of tables can be found in the note discussing the ATLAS recommendation on rounding [1]. A selection of those tables are also reproduced here. The  $\text{\LaTeX}$  code for the examples given below can be found in Appendix A.

The tables shown earlier in this document were also created with `siunitx`. A few more examples of how to steer the formatting are given here. Table 6 compares two different approaches to how this can be done in `siunitx`, even for asymmetric errors. Note that although these tables look almost identical, the syntax used to create them is different (see Appendix A). While the form may appear to be a bit clumsy at first, it is easy enough to get a program to write out the lines. In the left-hand table `\numRP` is used in column 3, while the full syntax of `\num` is shown in column 4 for illustration purposes only. The syntax to change the precision of a single number is shown in the first line of the left-hand part of the table. This is seen to be rather trivial, but the alignment on the decimal point is now no longer perfect. While this is probably OK for internal notes etc., papers (should) have more stringent requirements. Another way of achieving the same thing and avoiding the use of `round-mode` and `round-precision` is shown in the code for the right-hand table. Note the use of options for the `S` format and the use of `\num` enclosed in braces to format the row that requires a different precision.

$\eta_{\text{jet}}$	$d\sigma^b/d\eta^b$ [pb]	$\eta_{\text{jet}}$	$d\sigma^b/d\eta^b$ [pb]
$-1.60 : -1.10$	$0.574 \pm 0.094^{+0.035}_{-0.031}$	$-1.60 : -1.10$	$0.574 \pm 0.094^{+0.035}_{-0.031}$
$-1.10 : -0.80$	$1.21 \pm 0.21^{+0.16}_{-0.16}$	$-1.10 : -0.80$	$1.21 \pm 0.21^{+0.16}_{-0.16}$
$-0.80 : -0.50$	$2.14 \pm 0.22^{+0.22}_{-0.12}$	$-0.80 : -0.50$	$2.14 \pm 0.22^{+0.22}_{-0.12}$
$-0.50 : -0.20$	$2.33 \pm 0.21^{+0.28}_{-0.21}$	$-0.50 : -0.20$	$2.33 \pm 0.21^{+0.28}_{-0.21}$
$-0.20 : +0.10$	$2.64 \pm 0.22^{+0.28}_{-0.23}$	$-0.20 : +0.10$	$2.64 \pm 0.22^{+0.28}_{-0.23}$
$+0.10 : +0.50$	$3.16 \pm 0.21^{+0.23}_{-0.17}$	$+0.10 : +0.50$	$3.16 \pm 0.21^{+0.23}_{-0.17}$
$+0.50 : +1.40$	$2.88 \pm 0.15^{+0.20}_{-0.30}$	$+0.50 : +1.40$	$2.88 \pm 0.15^{+0.20}_{-0.30}$

Table 6: A selection of cross-section measurements. Note that for numbers with asymmetric errors, the option `\sisetup{retain-explicit-plus}` is used to stop `siunitx` from dropping the plus signs on the positive errors. (although these tables look almost identical, the syntax used to create them is different - see Appendix A).

Cross-sections vs.  $\eta$  are usually not so difficult to format, as the magnitudes of the numbers do not change much from one bin to the next. The situation is different for cross-sections as a function of  $E_T$  or  $x$ . Tables 7 and 8 show examples of such tables.

`round-mode=figures` is in general best for cross-sections and their errors. A precision of 2 digits for the uncertainties is a good starting point, but will then have to be reduced to 1 digit in some cases. For the cross-section values, more digits (typically 3) probably have to be specified and the precision of some

$E_T$	$d\sigma/dE_T$				$E_T$	$d\sigma/dE_T$			
	[pb GeV <sup>-1</sup> ]				[GeV]	[pb GeV <sup>-1</sup> ]			
4 : 8	3 630	± 110	<sup>+200</sup> <sub>-180</sub>		4 : 8	3 630	± 110	<sup>+200</sup> <sub>-180</sub>	
8 : 11	719	± 22	<sup>+43</sup> <sub>-40</sub>		8 : 11	719	± 22	<sup>0</sup> <sub>0</sub>	
11 : 14	215	± 9.7	<sup>+21</sup> <sub>-20</sub>		11 : 14	210	± 10	<sup>0</sup> <sub>0</sub>	
14 : 17	85.8	± 6.0	<sup>+10</sup> <sub>-9.0</sub>		14 : 17	86	± 6	<sup>0</sup> <sub>0</sub>	
17 : 20	35.4	± 3.9	<sup>+5.5</sup> <sub>-5.4</sub>		17 : 20	35.4	± 3.9	<sup>+6</sup> <sub>-5</sub>	
20 : 25	14.1	± 2.7	<sup>+3.5</sup> <sub>-3.2</sub>		20 : 25	14.1	± 2.7	<sup>+3</sup> <sub>-3</sub>	
25 : 35	2.38	± 0.97	<sup>+0.85</sup> <sub>-0.86</sub>		25 : 35	2.4	± 1.0	<sup>+0.8</sup> <sub>-0.9</sub>	

(a) No special formatting and `round-mode=figures`. This is the starting point for more refined formatting.

(b) Numbers adjusted according to the recommendations. `round-mode=places` is used for asymmetric errors (except the first row). Some judicious use of `\phantom` is applied to get improved, but not yet perfect, alignment.

Table 7: Cross-section vs.  $E_T$ .

values will again have to be adjusted by hand. In Table 7(b) some of the rounding is adjusted by hand so that the numbers conform to the rules. For the asymmetric errors, `round-mode=places` is used and the precision of each asymmetric uncertainty is then set by hand. This works well if the cross-sections should all be shown with decimal points, but does not work if used to round a number such as 182. Hence the first row uses `round-mode=figures`. Even with the tools offered by `\siunitx` getting things exactly right is non-trivial.

Table 8 is probably the most challenging to format correctly, as the bin boundaries also vary by several orders of magnitude. Table 8(a) gives the numbers with the option `scientific-notation=fixed` to illustrate the problem of what the table would look like if the cross-sections are output in pb. In Table 8(b), the exponential format of numbers is used to rescale the cross-section from pb to nb. `\phantom` had to be used in more places than we really like in order to get the final alignment correct. Investigations are ongoing to see if this can be improved.

## History

**2014-11-25: Ian Brock** First version of the document released.

## References

- [1] H. Abramowicz et al., *Rounding – ATLAS Recommendations*,  
URL: <https://cds.cern.ch/record/1668799>.

$x$	$d\sigma/dx$
	[pb]
0.00008 : 0.0002	$10\,800\,000 \pm 870\,000$ <sup>+760 000</sup> <sub>-650 000</sub>
0.0002 : 0.0006	$10\,800\,000 \pm 390\,000$ <sup>+570 000</sup> <sub>-440 000</sub>
0.0006 : 0.002	$4\,970\,000 \pm 140\,000$ <sup>+260 000</sup> <sub>-230 000</sub>
0.002 : 0.005	$1\,220\,000 \pm 31\,000$ <sup>+69 000</sup> <sub>-62 000</sub>
0.005 : 0.01	$257\,000 \pm 12\,000$ <sup>+18 000</sup> <sub>-16 000</sub>
0.01 : 0.1	$10\,700 \pm 790$ <sup>+910</sup> <sub>-820</sub>

(a) No special formatting or rounding. Option `scientific-notation=fixed` used.

$x$	$d\sigma/dx$
	[nb]
0.00008 : 0.0002	$11\,000 \pm 900$ <sup>+800</sup> <sub>-600</sub>
0.0002 : 0.0006	$10\,800 \pm 400$ <sup>+600</sup> <sub>-400</sub>
0.0006 : 0.0016	$4\,970 \pm 140$ <sup>+260</sup> <sub>-230</sub>
0.0016 : 0.005	$1\,217 \pm 31$ <sup>+69</sup> <sub>-62</sub>
0.005 : 0.01	$257 \pm 12$ <sup>+18</sup> <sub>-16</sub>
0.01 : 0.1	$10.7 \pm 0.8$ <sup>+0.9</sup> <sub>-0.8</sub>

(b) Several fixes including rescaled cross-section. Quite a lot of `\phantom` commands are applied to get alignment correct.

Table 8: Cross-section vs.  $x$ .

## A L<sup>A</sup>T<sub>E</sub>X code for tables

This appendix gives the L<sup>A</sup>T<sub>E</sub>X code including the raw data used for Tables 6, 7 and 8. These files for Tables 7 and 8 can also be found in the `doc/atlas_tables` directory of the `atlaslatex` package. The options given here correspond to those that are need for T<sub>E</sub>X Live 2012 and later. See the code for the appropriate options for earlier versions.

### A.1 Table 6

```
\begin{table}[htbp]
\centering
\renewcommand{\arraystretch}{1.4}
\sisetup{retain-explicit-plus}
```

```

\sisetup{round-mode = places}
\begin{tabular}{%
S@{\,,:\\,}S
r@{\,}@\{$\pm$\}@{\,}l@{\,}l
}
\toprule
\multicolumn{2}{c}{\etajet} & \multicolumn{3}{c}{\diffetab} \\
\multicolumn{2}{c}{} & \multicolumn{3}{c}{[\si{pico\barn}]} \\
\midrule
{\num{-1.6}} & -1.1 & {\numRP{0.574}{3}} & {\num[round-precision=3]{0.094}} &
$^{\numRP{+0.035}{3}}_{\numRP{-0.031}{3}}$ \\
{\num{-1.1}} & -0.8 & {\numRP{1.213}{2}} & {\num[round-precision=2]{0.211}} &
$^{\numRP{+0.162}{2}}_{\numRP{-0.162}{2}}$ \\
{\num{-0.8}} & -0.5 & {\numRP{2.141}{2}} & {\num[round-precision=2]{0.219}} &
$^{\numRP{+0.223}{2}}_{\numRP{-0.123}{2}}$ \\
{\num{-0.5}} & -0.2 & {\numRP{2.326}{2}} & {\num[round-precision=2]{0.210}} &
$^{\numRP{+0.284}{2}}_{\numRP{-0.214}{2}}$ \\
{\num{-0.2}} & +0.1 & {\numRP{2.641}{2}} & {\num[round-precision=2]{0.220}} &
$^{\numRP{+0.283}{2}}_{\numRP{-0.233}{2}}$ \\
{\num{+0.1}} & +0.5 & {\numRP{3.160}{2}} & {\num[round-precision=2]{0.211}} &
$^{\numRP{+0.232}{2}}_{\numRP{-0.172}{2}}$ \\
{\num{+0.5}} & +1.4 & {\numRP{2.881}{2}} & {\num[round-precision=2]{0.154}} &
$^{\numRP{+0.201}{2}}_{\numRP{-0.301}{2}}$ \\
\bottomrule
\end{tabular}
%
\quad
%
\sisetup{round-mode = places, round-precision = 2}
\begin{tabular}{%
S[table-format=3.2, table-number-alignment = right]@{\,,:\\,}S
S[round-mode = places, round-precision = 2,
table-format = 1.3, table-number-alignment = right]
@{\,}@\pm\,$
S[round-mode = places, round-precision = 2,
table-format = 1.3, table-number-alignment = left]
@{\,}l
}
\toprule
\multicolumn{2}{c}{\etajet} & \multicolumn{3}{c}{\diffetab} \\
\multicolumn{2}{c}{} & \multicolumn{3}{c}{[\si{pico\barn}]} \\
\midrule
-1.6 & -1.1 & {\numRP{0.574}{3}} & {\numRP{0.094}{3}} &
$^{\numRP{+0.035}{3}}_{\numRP{-0.031}{3}}$ \\
-1.1 & -0.8 & 1.213 & 0.211 & $^{\num{+0.162}}_{\num{-0.162}}$ \\
-0.8 & -0.5 & 2.141 & 0.219 & $^{\num{+0.223}}_{\num{-0.123}}$ \\
-0.5 & -0.2 & 2.326 & 0.210 & $^{\num{+0.284}}_{\num{-0.214}}$

```

```

-0.2 & +0.1 & 2.641 & 0.220 &  $^{\{\text{num}\{+0.283\}}_{\{\text{num}\{-0.233\}}}$  $ \\
+0.1 & +0.5 & 3.160 & 0.211 &  $^{\{\text{num}\{+0.232\}}_{\{\text{num}\{-0.172\}}}$  $ \\
+0.5 & +1.4 & 2.881 & 0.154 &  $^{\{\text{num}\{+0.201\}}_{\{\text{num}\{-0.301\}}}$  $ \\
\bottomrule
\end{tabular}
%
\caption{A selection of cross-section measurements! Note the
use of \Macro{sisetup} to keep the plus signs on the positive
errors.}
\label{tab:rounding:xsect}
\end{table}

```

## A.2 Table 7

The files are: cross\_sections\_charm-ET1.tex and cross\_sections\_charm-ET2.tex:

```

%Charm differential cross sections d sigma / dY in bins of Et
\typeout{ATTeXLiveVersion is [\ATTeXLiveVersion]}
\ifthenelse{\ATTeXLiveVersion < 2012}{%
  \sisetup{round-mode=figures, round-precision=2,
    group-integer-digits=true, group-four-digits=true}
}{%
  \sisetup{round-mode=figures, round-precision=2,
    group-digits=integer, group-minimum-digits=4}
}
\begin{tabular}{%
  S[table-format=2.0, table-number-alignment=right,
    round-mode=places, round-precision=0]@{\$,.\,$}
  S[table-format=2.0, table-number-alignment=left,
    round-mode=places, round-precision=0]
  S[table-format=4.2, table-number-alignment=right,
    round-mode=figures, round-precision=3]@{\$, \pm\,$}
  S[table-format=3.2, table-number-alignment=right,
    round-mode=figures, round-precision=2]@{\$, \$}l}
\toprule
\multicolumn{2}{c}{\ET} &
\multicolumn{3}{c}{\mathit{d}\sigma / \mathit{d}Y} \\
\multicolumn{2}{c}{\mbox{}} & \multicolumn{3}{c}{\mathit{d}\sigma / \mathit{d}Y} \\
\midrule
4.2 & 8.0 & 3634.06 & 114.491 & \numpmerr{+201.404}{-181.511}{2} \\
8.0 & 11.0 & 719.458 & 21.9334 & \numpmerr{+43.3087}{-39.7824}{2} \\
11.0 & 14.0 & 214.572 & 9.71991 & \numpmerr{+20.5413}{-19.6464}{2} \\
14.0 & 17.0 & 85.7584 & 6.03401 & \numpmerr{+10.0875}{-8.99952}{2} \\
17.0 & 20.0 & 35.4095 & 3.91591 & \numpmerr{+5.5349}{-5.41347}{2} \\
20.0 & 25.0 & 14.1253 & 2.72552 & \numpmerr{+3.46528}{-3.22476}{2} \\
25.0 & 35.0 & 2.37786 & 0.968562 & \numpmerr{+0.849647}{-0.855525}{2} \\
\bottomrule
\end{tabular}

%Charm differential cross sections d sigma / dY in bins of Et\
\typeout{ATTeXLiveVersion is [\ATTeXLiveVersion]}
\ifthenelse{\ATTeXLiveVersion < 2012}{%
  \sisetup{round-mode=figures, round-precision=2,
    group-integer-digits=true, group-four-digits=true}
}{%
  \sisetup{round-mode=figures, round-precision=2,
    group-digits=integer, group-minimum-digits=4}
}

```



```

\begin{tabular}{%
  S[table-format=2.0, table-number-alignment=right,
  round-mode=places, round-precision=0]@{${},.:,$}
  S[table-format=2.0, table-number-alignment=left,
  round-mode=places, round-precision=0]
  S[table-format=4.1, table-alignment=right,
  round-mode=figures, round-precision=3]@{${},\pm\,, $}
  S[table-format=3.1, table-alignment=right,
  round-mode=figures, round-precision=2]@{${}, $}r}
\toprule
\multicolumn{2}{c}{\ET} &
\multicolumn{3}{c}{\dif\sigma / \dif\ET$}\\
\multicolumn{2}{c}{[\si{GeV}]} & \multicolumn{3}{c}{[\si{pico\barn\per\GeV}]}\\
\midrule
4.2 & 8.0 & 3634.06 & & 114.491 & & \numpmRF{+201.404}{-181.511}{2} \\
8.0 & 11.0 & 719.458 & & 21.9334 & & \numpmerr{+43.3087}{-39.7824}{0} \\
11.0 & 14.0 & {\numRF{214.572}{2}\phdo} & & {\numRF{9.71991}{1}\phdo} & & \numpmerr{+20.5413}{-19.6464}{0} \\
14.0 & 17.0 & {\numRF{85.7584}{2}\phdo} & & {\numRF{6.03401}{1}\phdo} & & \numpmerr{+10.0875}{-8.9952}{0} \\
17.0 & 20.0 & {\numRF{35.4095}{3}} & & {\numRF{3.91591}{2}} & & \numpmerr{+5.5349}{-5.41347}{1} \\
20.0 & 25.0 & 14.1253 & & 2.72552 & & \numpmerr{+3.46528}{-3.22476}{1} \\
25.0 & 35.0 & {\numRF{2.37786}{2}} & & {\numRF{0.968562}{1}} & & \numpmerr{+0.849647}{-0.85525}{1} \\
\bottomrule
\end{tabular}

```

The files are: `cross_sections_charm-x1.tex` and `cross_sections_charm-x2.tex`:

```
%Charm differential cross sections d sigma / dY in bins of xda
\typeout{ATeXLiveVersion is [\ATeXLiveVersion]}
```

