# ATLAS NOTE

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# Rounding – ATLAS Recommendations

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**Abstract**

Several conventions for rounding numbers exist and one can almost always find reasons why one or the other is to be preferred. In order to minimise the discussion of which convention should be used in ATLAS publications, this note summarises the recommendations for ATLAS papers. A tool to help with rounding in practice is discussed and some example tables are given.

# 1 Executive summary

Even though this document is not very long, it is useful to collect the recommendations into an executive summary. The PDG rounding rules are given in Section 3. The other rounding convention that is recommended is referred to here as 'two-digit-uncertainty' rounding. In this case the uncertainty is always rounded to two significant digits. The recommendations are:

- apply common sense in the application of the guidelines;
- the central value should have a precision that matches the uncertainty;
- for final results quoted in the text of a document, PDG rounding rules are preferred. In specific cases, two-digit-uncertainty rounding can be applied;
- in general two-digit-uncertainty rounding should be used in tables;
- for PDG rounding, if statistical and systematic uncertainties are of similar size and on either side of the boundary for quoting one or two significant digits, round to two significant digits on the uncertainty;
- for measurements dominated by either statistical or systematic uncertainties, use the larger uncertainty to determine the precision with which the result should be given, e.g. $\sigma = 160 \pm 1\,(\text{stat.})^{+21}_{-17}\,(\text{syst.})\,\text{pb}$ (see Sec.3.2);
- in tables of event number yields, the total number of events should be evaluated using the full precision available on the numbers, with all numbers subsequently rounded.

# 2 Introduction

Rounding is a perennial problem and something that can lead to endless discussions. ATLAS PubCom has therefore decided to provide a set of recommendations that are accepted within the collaboration. There are at least three different situations where one has to consider how rounding should be done:

- giving results in the text of a paper;
- tables of event yields, systematic uncertainties, measurements;
- combining results within or between experiments.

For the purpose of this note, it is assumed that a detailed breakdown of the numbers needed for a combination, is made available outside of a paper, so that one does not have to worry about the third case here.

In Sections 3.1 and 3.2, the recommendations are discussed and some examples are given. Tables are discussed in Section 3.3. A tool for semi-automatically rounding numbers, the LaTeX siunitx package is given in Appendix A. Some example tables are shown in Appendix B. These are intended to illustrate how typical tables that appear in publications and notes should be formatted.

Both the LaTeX source file and the final PDF document are made available, so that authors can use the LaTeX code in their own document. The explicit recommendations are given in boldface.

## 3 ATLAS recommendations on rounding

### 3.1 PDG rounding

The Particle Data Group [1] has a clear description of how they round numbers:

> While the results shown in the Particle Listings are usually exactly those published by the experiments, the numbers that appear in the Summary Tables (means, averages and limits) are subject to a set of rounding rules. The basic rule states that if the three highest order digits of the error lie between 100 and 354, we round to two significant digits. If they lie between 355 and 949, we round to one significant digit. Finally, if they lie between 950 and 999, we round up to 1000 and keep two significant digits. In all cases, the central value is given with a precision that matches that of the error. So, for example, the result (coming from an average) $0.827 \pm 0.119$ would appear as $0.83 \pm 0.12$, while $0.827 \pm 0.367$ would turn into $0.8 \pm 0.4$. Rounding is not performed if a result in a Summary Table comes from a single measurement, without any averaging. In that case, the number of digits published in the original paper is kept, unless we feel it inappropriate. Note that, even for a single measurement, when we combine statistical and systematic errors in quadrature, rounding rules apply to the result of the combination. It should be noted also that most of the limits in the Summary Tables come from a single source (the best limit) and, therefore, are not subject to rounding.

**For final results quoted in the text of a document, PDG rounding rules as given above are preferred. In specific cases, two-digit-uncertainty can be applied instead.**

As will be discussed below, one thing that is missing from this recommendation is how to deal with uncertainties that are broken down into statistical and systematic uncertainties, where one uncertainty is on one side of the boundary, e.g. 0.34, and the other is on the other side, e.g. 0.36.

Note that there may well be cases where it is sensible to part with these guidelines and quote numbers with slightly more or less precision. This is most commonly the case in tables. Common sense should be used and it is always important to consider how well the numbers (and especially the uncertainties) are actually known. One case where PDG rounding makes more sense than two-digit-uncertainty is a result like $1.01 \pm 0.98$, where $1.0 \pm 1.0$ is to be preferred.

### 3.2 Examples

In this section some simple, and some not so simple, examples are given:

- the measured cross-section

  $$\sigma = 2.63 \pm 0.14\,(\text{stat.}) \pm 0.18\,(\text{syst.})\,\text{pb}\,;$$

  is straightforward and remains unchanged,

- while the measurement made with a less precise method yields

  $$\sigma = 2.7 \pm 0.5\,(\text{stat.}) \pm 0.4\,(\text{syst.})\,\text{pb}\,;$$

- in a third result the two uncertainties straddle the lower rounding boundary and the result should be written

  $$\sigma = 2.63 \pm 0.32\,(\text{stat.}) \pm 0.44\,(\text{syst.})\,\text{pb}.$$

Here, one can argue whether one or two significant digits should be given. **In such cases, it is recommended to give two significant digits on the uncertainty.**

- a fourth result has uncertainties that straddle the upper rounding boundary: it has a statistical uncertainty of 0.56 and a systematic uncertainty of 0.96. PDG rounding rules then require that the result be quoted as
$$\sigma = 2.6 \pm 0.6\,(\text{stat.}) \pm 1.0\,(\text{syst.})\,\text{pb}\,.$$

In a more extreme case of the third result, a cross-section is measured to be $160.2 \pm 0.9\,(\text{stat.})^{+20.6}_{-17.1}\,(\text{syst.})\,\text{pb}$. The relative sizes of statistical and systematic uncertainties given here are typical for jet cross-sections. The PDG rounding rules applied to the systematic uncertainty lead to $^{+21}_{-17}$, and the statistical uncertainty is rounded to 1, not left as 0.9, to be consistent. **Hence the cross-section should be quoted as $160 \pm 1$ (stat.)$^{+21}_{-17}$ (syst.)** pb.

Tables 1 and 2 show further examples of PDG rounding. In these tables the same central value is given, but the uncertainty varies.

| Raw | PDG scheme |
|---|---|
| $0.9441 \pm 0.119$ | $0.94 \pm 0.12$ |
| $0.9441 \pm 0.367$ | $0.9 \pm 0.4$ |
| $0.9441 \pm 0.967$ | $0.9 \pm 1.0$ |
| $0.9441 \pm 0.0632$ | $0.94 \pm 0.06$ |
| $0.9441 \pm 1.0632$ | $0.9 \pm 1.1$ |
| $0.9441 \pm 9.0632$ | $1 \pm 9$ |
| $0.9441 \pm 9.6632$ | $1 \pm 10$ |

Table 1: PDG rounding for real numbers.

| Raw | PDG scheme |
|---|---|
| $191819 \pm 17$ | $191\,819 \pm 17$ |
| $191819 \pm 17891$ | $192\,000 \pm 18\,000$ |
| $191819 \pm 37891$ | $190\,000 \pm 40\,000$ |
| $191819 \pm 97891$ | $190\,000 \pm 100\,000$ |

Table 2: PDG rounding examples for integers. The fourth line (PDG scheme) is an interpretation of the PDG rules.

In general, it is a good idea to avoid too many zeroes in the quoted numbers. Hence it is better to write $(190 \pm 100) \times 10^3$ than $190\,000 \pm 100\,000$, or for numbers with units write $(190 \pm 100)$ nb rather than $(190\,000 \pm 100\,000)$ pb. The ATLAS convention is in fact to write cross-sections without parentheses, e.g. $190 \pm 100$ nb. In tables, instead of writing $(190 \pm 100) \times 10^3$, $190 \pm 100$ could be used with 'Events / $10^3$' in the header.

## 3.3 Rounding in tables

Results presented in tables require special consideration.

Tables of event yields often contain numbers that vary by many orders of magnitude. In addition, while some uncertainties are just Poissonian, the uncertainty on the multijet background is typically 50 %. The size of the uncertainty determined from Monte Carlo events depends on the number of events that have been generated. Table 3 is a typical (real) example, where the raw numbers are shown (no rounding). Table 4 shows the result of applying the PDG rules, while two-digit-uncertainty rounding has been used in Table 5. In both cases, the central values have been rounded to be consistent with the uncertainties. Comparing the tables side-by-side, either version is acceptable.

How should the total number of events be evaluated? One can either round all the numbers and then add them, or use the full precision available and then round both the individual numbers and the

| | Selected events | | |
|---|---|---|---|
| $WW, WZ, ZZ$ | 943.045 | ± | 94.3045 |
| QCD multijets | 2 838.39 | ± | 1 419.19 |
| $Wc\bar{c}, Wb\bar{b}, Wc$ | 31 178.0 | ± | 13 094.8 |
| $W$ + jets | 10 584.5 | ± | 4 445.49 |
| Single top $Wt$ | 1 699.75 | ± | 152.977 |
| $Z$ + jets | 2 378.42 | ± | 998.934 |
| Single top $s$ | 297.591 | ± | 12.4988 |
| Single top $t$ | 3 936.98 | ± | 165.353 |
| $t\bar{t}$ | 9 386.28 | ± | 901.083 |
| Expected | 63 243 | ± | 13 968.5 |
| Data | 73062 | | |

Table 3: Example event yields spread over several orders of magnitude: Raw, unrounded, values. See Tables 4 and 5 for rounding options.

| | Selected events |
|---|---|
| $WW, WZ, ZZ$ | 940 ± 90 |
| QCD multijets | 2 800 ± 1 400 |
| $Wc\bar{c}, Wb\bar{b}, Wc$ | 31 000 ± 13 000 |
| $W$ + jets | 11 000 ± 4 000 |
| Single top $Wt$ | 1 700 ± 150 |
| $Z$ + jets | 2 400 ± 1 000 |
| Single top $s$ | 298 ± 12 |
| Single top $t$ | 3 940 ± 170 |
| $t\bar{t}$ | 9 400 ± 900 |
| Expected | 63 000 ± 14 000 |
| Data | 73 062 |

Table 4: Example event yields spread over several orders of magnitude and rounded according to PDG rules. (Acceptable)

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

Table 5: Example event yields spread over several orders of magnitude and rounded to 2 significant digits on the error. (Recommended)

total. Given that this is what a computer program does if it computes the total, **the recommendation is to evaluate the total number of events using the full precision available, and to subsequently round all numbers. In this case the sum will always be consistent within the rounding uncertainty, although it may not correspond exactly to the sum of the rounded numbers.**

A problem taken from a recent ATLAS paper, which a referee spotted is shown in Table 6. This illustrates a common mistake in applying (PDG) rounding rules. The table shows an extract from a table in the paper for the $Z \to \mu\mu$ channel and the column with at least 6 jets. The mistake occurred in column 3, where the rounded numbers imply that 80 + 17 + 2 = 90! The error here is that the PDG rule was applied in the first line to the central value instead of the uncertainty: (75.1 → 1 digit → 80) instead of (16.9 → 2 digits → 75 ± 17). Note that the $Z \to (\tau\tau)$, diboson and multijet rows have been rounded to only one digit, in violation of the PDG rules, as the uncertainties on these numbers are 50 % to 100 %.

| | Original values | Rounded Paper | Rounded Correctly |
|---|---|---|---|
| $Z \to (\mu\mu)$ | 75.1 ± 16.9 | 80 | 75 |
| $W \to \mu\nu$ | 0.0 ± 0.0 | < 0.5 | 0 |
| $Z \to (\tau\tau)$ | 0.09 ± 0.09 | 0.1 | 0.1 |
| Diboson | 0.41 ± 0.21 | 0.4 | 0.4 |
| $t\bar{t}$, single top | 17.2 ± 5.0 | 17 | 17 |
| Multi-jet | 2.09 ± 2.18 | 2 | 2 |
| Total expected | 94.92 ± 17.76 | 90 | 95 |
| Data (4.6 fb$^{-1}$) | 122 ± 11 | 122 | 122 |

Table 6: Event yields in the 6-jet bin in $Z$ + jets events.

A second very common use of tables is for a list of systematic uncertainties. Table 7 shows a typical example. As the numbers of interest are themselves relative uncertainties, PDG rounding is not applicable. Table 7a rounds to 2 significant digits. Table 7c shows the unrounded numbers for reference. **It is argued though that Table 7b is the optimal solution.** All numbers are rounded to one decimal place, except the large uncertainties such as 'Jet/$E_{\mathrm{T}}^{\mathrm{miss}}$'. With this solution, minor fractional uncertainties are often rounded to fewer significant digits than the major ones.

## A siunitx – a tool for rounding

While rounding can be done by hand, such a procedure is error prone, especially when dealing with many numbers, and it has to be redone every time the numbers change. The siunitx package [2] can do the rounding automatically and provides a number of hooks to steer precisely how this is done. It would of course be great to have an option `round-mode=pdg`, but this is not yet available.[1]

Note that the syntax used here assumes siunitx version 2. This is integrated into TEX Live 2011 and later. In order to use this version of LATEX on `lxplus`, the appropriate directory must be added to the beginning of the UNIX path:

[1]It is not so straightforward to come up with a syntax that is universally useful. `\num{4.634(43)}` is OK. For more complicated cases one could consider something like `\sigma = \numPDG[0.4374]{6.4348}{1}`, where the optional argument gives the relevant (total) error for the rounding and the last argument gives the number of digits for the rounding.

| Source | $\Delta\sigma/\sigma$ [%] |
|---|---|
| Data statistics | $-3.0\ /+3.1$ |
| Luminosity | $-4.3\ /+4.7$ |
| MC statistics | $-0.70/+0.71$ |
| Leptons | $-2.5\ /+2.6$ |
| Jet/$E_{\mathrm{T}}^{\mathrm{miss}}$ | $-9.8\ /+11$ |
| $b$-tagging | $-0.17/+0.42$ |
| $Z$ + jets | $-0.18/+0.40$ |
| Combined | $-11\ /+12$ |

(a) This version keeps two significant digits.

| Source | $\Delta\sigma/\sigma$ [%] |
|---|---|
| Data statistics | $-3.0/+3.1$ |
| Luminosity | $-4.3/+4.7$ |
| MC statistics | $-0.7/+0.7$ |
| Leptons | $-2.5/+2.6$ |
| Jet/$E_{\mathrm{T}}^{\mathrm{miss}}$ | $-10\ /+11$ |
| $b$-tagging | $-0.2/+0.4$ |
| $Z$ + jets | $-0.2/+0.4$ |
| Combined | $-11\ /+12$ |

(b) This version uses a fixed number (one) of decimal places, except for the 'Jet/$E_{\mathrm{T}}^{\mathrm{miss}}$' uncertainty and the combined uncertainty. (Recommended)

| Source | $\Delta\sigma/\sigma$ [%] |
|---|---|
| Data statistics | -3.04 / +3.06 |
| Luminosity | -4.3123 / +4.7234 |
| MC statistics | -0.704 / +0.713 |
| Leptons | -2.487 / +2.586 |
| Jet/$E_{\mathrm{T}}^{\mathrm{miss}}$ | -9.8264 / +10.7932 |
| $b$-tagging | -0.171 / +0.423 |
| $Z$ + jets | -0.183 / +0.396 |
| Combined | -11.452 / +12.478 |

(c) Version with unrounded numbers for reference

Table 7: Breakdown of the systematic uncertainties on the cross-section measurement.

```
export PATH=/afs/cern.ch/sw/XML/texlive/latest/bin/x86_64-linux:$PATH
```

Replace `x86_64-linux` by `i386-linux` for 32-bit machines.

The \num macro can be used to round numbers (see the tex file). For numbers with an associated unit, the macro \SI should be used instead. In the LaTeX code of this note, a few macros are defined that make the syntax of using \siunitx a bit shorter:

**\numR** output a number with a given precision using the current default rounding mode;

**\numRF** output a number with a fixed number of significant digits;

**\numRP** output a number with a fixed number of decimal places;

**\numpmerr** output an asymmetric uncertainty with a given number of significant digits or decimal places, depending on the setting of the option round-mode;

**\numpmRF** output an asymmetric uncertainty with a given number of significant digits;

**\numpmRP** output an asymmetric uncertainty with a given number of decimal places.

Some example tables are given in the following section. These have been chosen to show typical (difficult) formatting problems. Note that all numbers given in tables in this document have more digits in the LaTeX file than are shown in the tables. Hence when different rounding options are used only the options change and not the numbers themselves.

It takes a while to learn what the different options in \siunitx mean and their consequences. These examples should cover most problems and at least give ideas as to what is possible. For more detail see the extensive documentation that comes with the package.

Tables such as the ones shown in Table 8 are very nice, as all numbers except the one that requires an extra digit are written without any special formatting! This makes it very easy to create such tables with a program and then simply copy the numbers into a latex file.

Table 2 gives examples with integers. Note that the macro \num, and the related macro \SI which is used to typeset numbers with units, do other nice things like putting a small space every factor of $10^3$, e.g. the total number of events after the selection is 373 844, while the number predicted by the background Monte Carlo is $267\,000 \pm 24\,000$.

## B Example tables

It requires some effort to get the tables in your document formatted correctly. In general, integer numbers should be right-aligned and decimal numbers should be aligned on the decimal point.

If the siunitx package is used, one way to format things is to use the ‘S’ format column to get the correct alignment and also do the rounding. This produces tables whose formatting is typically 90 % correct, which is probably OK for internal notes. This option is most suitable for numbers in tables that are of similar size. For final publication, standards are somewhat higher and probably more has to be done by hand. Hence, when it comes to producing a perfect table, \num commands will probably also have to be used.

The LaTeX code for the examples given below can be found in Appendix C.

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 8 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 C). 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` in 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.

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

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

Table 8: 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 C).

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 $E_{\mathrm{T}}$ or $x$. Tables 9 and 10 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 values will again have to be adjusted by hand. In Table 9b 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 10 is probably the most challenging to format correctly, as the bin boundaries also vary by several orders of magnitude. Table 10a 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 10b, 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.

| $E_T$ | $d\sigma/dE_T$ [pb GeV$^{-1}$] | | | |
|---|---|---|---|---|
| 4 : 8 | 3 630 | ± | 110 | $^{+200}_{-180}$ |
| 8 : 11 | 719 | ± | 22 | $^{+43}_{-40}$ |
| 11 : 14 | 215 | ± | 9.7 | $^{+21}_{-20}$ |
| 14 : 17 | 85.8 | ± | 6.0 | $^{+10}_{-9.0}$ |
| 17 : 20 | 35.4 | ± | 3.9 | $^{+5.5}_{-5.4}$ |
| 20 : 25 | 14.1 | ± | 2.7 | $^{+3.5}_{-3.2}$ |
| 25 : 35 | 2.38 | ± | 0.97 | $^{+0.85}_{-0.86}$ |

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

| $E_T$ [GeV] | $d\sigma/dE_T$ [pb GeV$^{-1}$] | | | |
|---|---|---|---|---|
| 4 : 8 | 3 630 | ± | 110 | $^{+200}_{-180}$ |
| 8 : 11 | 719 | ± | 22 | $^{+43}_{-40}$ |
| 11 : 14 | 210 | ± | 10 | $^{+21}_{-20}$ |
| 14 : 17 | 86 | ± | 6 | $^{+10}_{-9}$ |
| 17 : 20 | 35.4 | ± | 3.9 | $^{+5.5}_{-5.4}$ |
| 20 : 25 | 14.1 | ± | 2.7 | $^{+3.5}_{-3.2}$ |
| 25 : 35 | 2.4 | ± | 1.0 | $^{+0.8}_{-0.9}$ |

(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 9: Cross-section vs. $E_T$.

# C LaTeX code for tables

This appendix gives the LaTeX code including the raw data used for Tables 8, 9 and 10. These files for Tables 9 and 10 can also be found on `http://to-be-defined`.

## C.1 Table 8

```
\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} &
```

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

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

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

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

Table 10: Cross-section vs. $x$.

```
$^{\numRP{+0.162}{2}}_{\numRP{-0.162}{2}}$ \\
{\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 & $^{\num{+0.283}}_{\num{-0.233}}$ \\
+0.1 & +0.5 & 3.160 & 0.211 & $^{\num{+0.232}}_{\num{-0.172}}$ \\
+0.5 & +1.4 & 2.881 & 0.154 & $^{\num{+0.201}}_{\num{-0.301}}$ \\
\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}
```

### C.2 Table 9

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\
\sisetup{round-mode=figures, round-precision=2,
  retain-explicit-plus=true, 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}{$\dif\sigma / \dif\ET$}\\
  \multicolumn{2}{c}{\mbox{}} & \multicolumn{3}{c}{[\si{\pico\barn\per\GeV}]}\\
  \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\
\sisetup{round-mode=places, round-precision=2,
  retain-explicit-plus=true, 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 }{-8.99952 }{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}{-0.855525}{1}  \\
  \bottomrule
\end{tabular}
```

## C.3 Table 10

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
\sisetup{round-mode=figures, round-precision=2,
  retain-explicit-plus=true, group-digits = integer, group-minimum-digits=4,
  scientific-notation=fixed, fixed-exponent=0}
\begin{tabular}{%
    S[table-format=1.5, table-number-alignment=right,
    round-mode=figures, round-precision=1]@{$\,:\,$}
    S[table-format=1.5, table-number-alignment=left,
    round-mode=figures, round-precision=1]
    S[table-format=8.0, table-number-alignment=right,
    round-mode=figures, round-precision=3]@{$\,\pm\,$}
    S[table-format=6.0, table-number-alignment=right,
    round-mode=figures, round-precision=2]@{$\,$}r}
  \toprule
  \multicolumn{2}{c}{$x$} &
  \multicolumn{3}{c}{$\dif\sigma / \dif x$}\\
  \multicolumn{2}{c}{\mbox{}} & \multicolumn{3}{c}{[\si{\pico\barn}]}\\
  \midrule
0.00008 & 0.00020 & 1.08474e+07 & 867945  & \numpmerr{+761437 }{-647690 }{2}  \\
0.00020 & 0.00060 & 1.08385e+07 & 388976  & \numpmerr{+567443 }{-441257 }{2}  \\
0.00060 & 0.00160 & 4.974e+06   & 135404  & \numpmerr{+256385 }{-233376 }{2}  \\
```

```
0.00160 & 0.00500 & 1.21664e+06 & 31162.1 & \numpmerr{+68948.1}{-62459.6}{2} \\
0.00500 & 0.01000 & 256870      & 12232.7 & \numpmerr{+18363.7}{-16463.7}{2} \\
0.01000 & 0.10000 & 10652.6     &  791.21 & \numpmerr{+913.118}{-815.675}{2} \\
  \bottomrule
\end{tabular}
```

```
%Charm differential cross sections d sigma / dY in bins of xda
\sisetup{round-mode=figures, round-precision=2,
  retain-explicit-plus=true, group-digits = integer, group-minimum-digits=4,
  scientific-notation=fixed, fixed-exponent=0}
\begin{tabular}{%
    S[table-format=1.5, table-number-alignment=right,
    round-mode=figures, round-precision=1]@{$\,:\,$}
    S[table-format=1.5, table-number-alignment=left,
    round-mode=figures, round-precision=1]
    S[table-format=5.1, table-alignment=right,
    round-mode=figures, round-precision=4]@{$\,\pm\,$}
    S[table-format=3.1, table-alignment=right,
    round-mode=figures, round-precision=2]@{$\,$}r}
  \toprule
  \multicolumn{2}{c}{$x$} &
  \multicolumn{3}{c}{$\dif\sigma / \dif x$}\\
  \multicolumn{2}{c}{\mbox{}} & \multicolumn{3}{c}{[\si{\nano\barn}]}\\
  \midrule
0.00008 & 0.00020                 & {\numRF{1.08474e+04}{2}\phdo}  & {\numRF{867945e-3}{1}\phdo}  & \numpmerr{+761437 e-3}{-647690 e-3}{1} \\
0.00020 & 0.00060                 & {\numRF{1.08385e+04}{3}\phdo}  & {\numRF{388976e-3}{1}\phdo}  & \numpmerr{+567443 e-3}{-441257 e-3}{1} \\
0.00060 & {\numRF{0.0016}{2}\pho} & {\numRF{4.974e+03}{3}\phdo}    & 135404e-3                    & \numpmerr{+256385 e-3}{-233376 e-3}{2} \\
{\numRF{0.0016}{2}\pho} & 0.00500 & {\numRF{1.21664e+03}{4}\phdo}  & 31162.1e-3                   & \numpmerr{+68948.1e-3}{-62459.6e-3}{2} \\
0.00500 & 0.01000                 & {\numRF{256870e-03}{3}\phdo}   & 12232.7e-3                   & \numpmerr{+18363.7e-3}{-16463.7e-3}{2} \\
0.01000 & 0.10000                 & {\numRF{10652.6e-03}{3}}       & {\numRF{791.21e-3}{1}}       & \numpmerr{+913.118e-3}{-815.675e-3}{1} \\
  \bottomrule
\end{tabular}
```

# References


[1] J. Beringer et al. (Particle Data Group), *Review of Particle Physics*, *Phys. Rev.* D86 (July 2012) 010001.

[2] http://ctan.org/pkg/siunitx.