THE AUSTRALIAN NATIONAL UNIVERSITY

Rounding values and uncertainties in ENSDF

Tibor Kibèdi (ANU) and Filip Kondev (ANU)

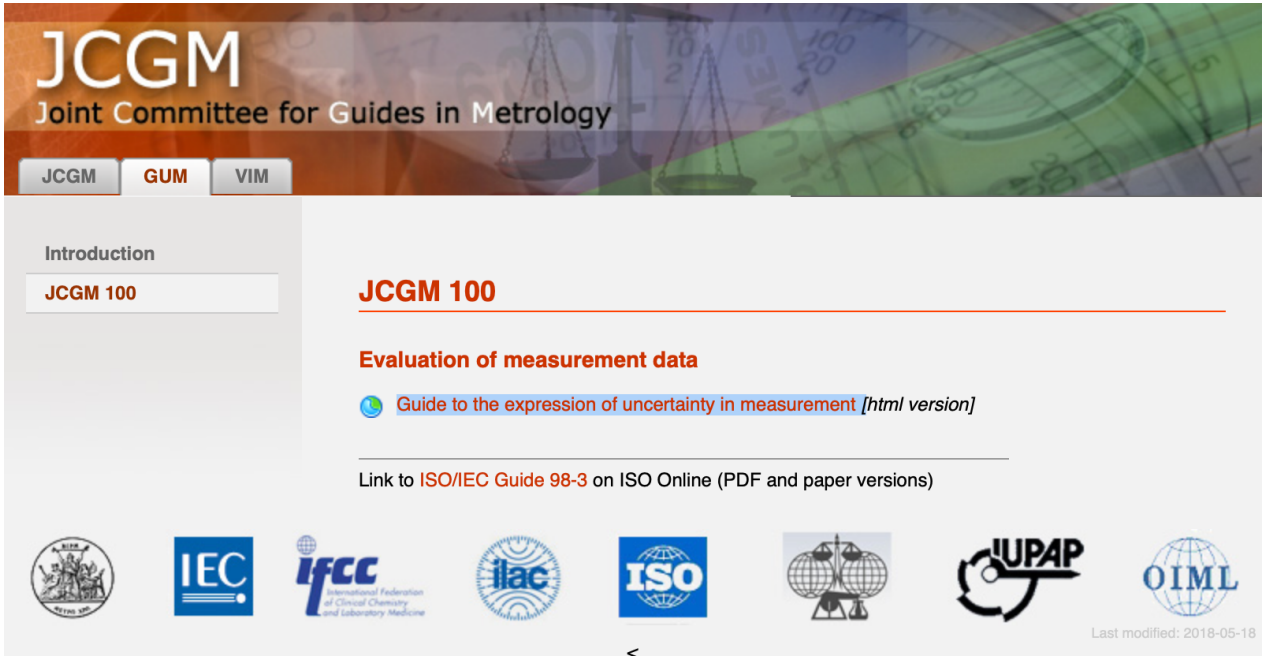
Expressing uncertainties

Rounding a number (Wikipedia)

- Replacing it with an other one, which is approximately equal to the original, but shorter or simpler easier to communicate
- To avoid misleadingly precise representation of a measured, estimated or a calculated number

GUM - Guide to the expression of Uncertainty in Measurement

Chapter 7



NDSh General Policies

ENSDF: <value> <uncertainty>;

- rounding based on 1 or 2 significant digits in the uncertainty

Uncertainties ("Errors") The uncertainty in any number is given one space after the number itself:

4.623 *3*	means 4.623 ±0.003
4.6 h *12*	means 4.6 ±1.2 h
5.4×10^3 *2*	means 5400 ±200
4.2 *+8–10*	means $4.2\ ^{+0.8}_{-1.0}$
–4.2 *+8–10*	means –(4.2 *+10–8*)=–4.2 $^{+0.8}_{-1.0}$

Symmetric uncertainties

11 DBR,DCC,DE,DHF,DIA,DIB,DIE,DIP,DNB

Includes DNR,DNP,DNT,DQP,DQ-,DS,DSP,DTI

These two character fields, represent uncertainty in the 'standard' form in the given quantity. The 'standard' numeric uncertainty denotes an uncertainty in the last significant figure(s), for example, NR=0.873, DNR=11 represent a normalization factor of 0.873 ± 0.011, similarly QP=2.3E6, DQP=10 stand for a Q-value of $(2.3 \pm 1.0) \times 10^6$ (see also General Policies given in Appendix H). The non-numeric uncertainty, e.g, $<, >, or \geq$, *etc.* is denoted by expressions LT, GT, and GE, *etc.* The allowed forms for these fields are summarized below:

1. Blank
2. An integer < 99, preferably < 25, (left or right justified)
3. One of the following expressions:
   LT, GT, LE, GE, AP, CA, SY
   for $<, >, \leq, \geq, \approx$, calculated, and from systematics, respectively.

FMTCHK
GTOL
GABS
LOGFT
RULER

CNVU2S(Y, DY, sX, lenX , sDX, lenDX)

Asymmetric uncertainties

12 DFT,DMR,DT,DNB,DQA

These fields allow for the specification of 'standard' asymmetric uncertainty. For example, T=4.2 S, DT=+8-10, represent a half-life=$4.2^{+0.8}_{-1}$ s, similarly MR=-3, DMR=+1-4 represent mixing ratio=-3^{+1}_{-4} meaning a range from -7 to -2. (Note: asymmetric uncertainties add algebraically.) When the +/− construction is missing from this field, the digits or the expressions given in this field represent either the numeric 'standard' symmetric or the non-numeric uncertainty as described in **V.11** above.

To summarize this field, there are two cases:

1. Symmetric uncertainty - the field consists of an integer number or an expression of the type described in **V.11** above.
2. Asymmetric uncertainty - the field is of the form $+x-y$, where x and y are integers.

FMTCHK
GTOL
GABS
LOGFT
RULER

CNVAU2S(Y, DYpos, DYneg, sX, lenX, sDXpos, sDXneg, lenDX)

Proposal for rounding numbers

Based on last 3 significant digits:

- [100:354] → round for 2 digits

  0.827±0.119 → 0.83(12)

- [355:949] → round for 1 digit

  0.827±0.367 → 0.8(4)

- [950:1000] → round round up to 1000 and keep two significant digits

  3.827±0.967 → 3.8(10)

PHYSICAL REVIEW D 98, 030001 (2018)

REVIEW OF PARTICLE PHYSICS*

Particle Data Group

5.3. ***Rounding*** : 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 ± 0.119 would appear as 0.83 ± 0.12, while 0.827 ± 0.367 would turn into 0.8 ± 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.

Finally, we should point out that in several instances, when a group of results come from a single fit to a set of data, we have chosen to keep two significant digits for all the results. This happens, for instance, for several properties of the W and Z bosons and the τ lepton.

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Symmetric uncertainty

Value	ENSDF	NEW rule
6.2228±0.0232	6.223(23)	6.223(23)
6.2228±0.0339	6.23(3)	6.223(34)
6.2228±0.0544	6.22(5)	6.22(5)
6.2228±0.0976	6.2(1)	6.2(1)

Asymmetric uncertainty

X (+DX_U -DX_L)

- Apply the rule for the smallest of |DX_U| and |DX_L| and round the other accordingly

  +6.229(+0.334 -1.452)

  +6.23(+33-145)

Proposal for rounding numbers

Way forward:

- ❑ Update NDSh general policies
- ❑ Update NSDFLIB: CNVU2S and CNVAU2S
  - CNVU2S already updated and used in new GABS
  - CNVAU2S not used (?)
- ❑ Re-compile FMTCHK, GTOL, GABS, LOGFT, RULER