

IX.A. CSEWG CONSTANTS

Recommendation of the CSEWG Constants Task Force

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In order to eliminate the use of different values for physical and mathematical constants as a source of discrepancy between calculations using different computer codes, CSEWG should take the following actions:

- (1) Formally designate as official CSEWG constants the values reported in “1986 CODATA Internationally recommended values of the Fundamental Physical Constants” on the Web site <http://physics.nist.gov/cuu/Constants/>. This is the “NIST Reference on Constants, Units, and Uncertainty, one of the technical activities of the Fundamental Constants Data Center of the NIST Physics Laboratory. The contents of this site have been prepared by Barry N. Taylor of the Data Center in close collaboration with Peter J. Mohr of the Physics Laboratory’s Atomic Physics Division.”
 - a. Relevant numbers from the CODATA list will be published in ENDF-102.
 - b. Evaluators and code developers should use the values published in ENDF-102, updating only when that document is updated.
- (2) Within the text of the next update of ENDF-102, remove numerical values for physical constants and replace by variable names; provide numerical values (and units) in a list in an appendix. This list should include (but is not limited to) the following:
 - a. m_n = mass of neutron in atomic mass units (u)
 [Remove values from pages 0.18 and D.4 of the Nov. 1995 version of ENDF-102].
 Recommended value from CODATA: $m_n = 1.008\,664\,904\,u$
 - b. Boltzmann’s constant k .
 Recommended value from CODATA: $k = 8.617\,385 \times 10^{-5} \text{ eV K}^{-1}$
 - c. $\sqrt{2m_n}/\hbar = \{\text{sqrt (2 mass of neutron) / Plank’s constant}\}$. [Remove value from p. D.3.]
 Recommended value based on information in CODATA:

$$\sqrt{2m_n}/\hbar = 0.002\,196\,807\,122\,623 / (10^{-12} \text{ cm } \sqrt{\text{eV}})$$
 - d. $2 \text{ (amu)} / \hbar^2$. [Remove value from Eq. (6.9).]
 Recommended value based on information in CODATA:

$$2 \text{ (amu)} / \hbar^2 = 4.784\,504\,258\,066 \times 10^{-6} / ([10^{-12} \text{ cm}]^2 \text{ eV}).$$
 - e. $(e^2 / \hbar)^2 \text{ amu}$. [Remove value from Eq. (6.10).]
 Recommended value based on CODATA:

$$(e^2 / \hbar)^2 \text{ amu} = 2.480\,167\,060\,319 \times 10^4 \text{ eV}.$$

- (3) Encourage code developers to locate any values for physical constants that may be currently buried deep within the coding, and replace by variables whose values are specified in one site only (e.g., in a block data statement). This ensures internal consistency, and expedites any necessary updates.
- (4) Encourage code developers to double-check that numerical constants (e.g., π or e) are represented to a degree of accuracy consistent with the precision of the computers on which the codes are to be run.
- (5) Encourage evaluators to use mass numbers, Q-values, etc., as specified on CODATA, for evaluations submitted for acceptance by ENDF. Values not found in CODATA should be obtained from G. Audi and A. H. Wapstra, *Nucl. Phys. A*, **595**, 409 (1995). The Web site for these values is maintained by the Atomic Mass Data Center, and located at <http://csnwww.in2p3.fr/massatom/masseval.html>.
- (6) Encourage evaluators to specify values for “hidden” physical constants within the header text of the ENDF file, to prevent future confusion in the event of changes in the accepted values.

Submitted by the CSEWG Constants Task Force, N. M. Larson, Chair

Table IXA.1. Exact values of constants as used in the current version of SAMMY

Description	Value ^a	Units
mass of neutron	1.008 664 915 60	amu
mass of proton	1.007 276 466 88	amu
mass of deuteron	2.013 553 212 70	amu
mass of alpha	4.001 506 179 149	amu
mass of hellion (³ He)	3.014 932 243 4	amu
mass of triton (3H) ^a	3.016 049 268	amu
Boltzmann's constant	$8.617\,343 \times 10^{-5}$	eV/K
$\hbar = \text{Planck's constant} / 2\pi$	$6.582\,119\,15 \times 10^{-16}$	eV s
atomic mass unit	$9.314\,940\,43 \times 10^8$	eV
speed of light	$2.997\,924\,58 \times 10^8$	m/s
$\alpha^{-1} = \text{inverse fine-structure constant}$	$1.370\,359\,991\,1 \times 10^2$	
amu	$1.660\,538\,86 \times 10^{-24}$	g (gram)
erg	$6.241\,509\,47 \times 10^{11}$	eV

^aAll values, except for the triton mass, are taken from the 2006 CODATA list. The triton mass was unavailable there and was instead taken from the ENDF-102 manual.