NODE=S003

e $J = \frac{1}{2}$

NODE=S003203

e MASS (atomic mass units u)

NODE=S003203

The primary determination of an electron's mass comes from measuring the ratio of the mass to that of a nucleus, so that the result is obtained in u (atomic mass units). The conversion factor to MeV is more uncertain than the mass of the electron in u; indeed, the recent improvements in the mass determination are not evident when the result is given in MeV. In this datablock we give the result in u, and in the following datablock in MeV.

NODE=S003AMU

VALUE (10^{-6} u)	*DOCUMENT ID*		*TECN*	*COMMENT*
548.57990943±0.00000023	MOHR	08	RVUE	2006 CODATA value
• • • We do not use the following data for averages, fits, limits, etc. • • •				
548.57990945±0.00000024	MOHR	05	RVUE	2002 CODATA value
548.5799092 ±0.0000004	[1] BEIER	02	CNTR	Penning trap
548.5799110 ±0.0000012	MOHR	99	RVUE	1998 CODATA value
548.5799111 ±0.0000012	[2] FARNHAM	95	CNTR	Penning trap
548.579903 ±0.000013	COHEN	87	RVUE	1986 CODATA value

[1] BEIER 02 compares Larmor frequency of the electron bound in a $^{12}C^{5+}$ ion with the cyclotron frequency of a single trapped $^{12}C^{5+}$ ion. NODE=S003AMU;LINKAGE=EI

[2] FARNHAM 95 compares cyclotron frequency of trapped electrons with that of a single trapped $^{12}C^{6+}$ ion. NODE=S003AMU;LINKAGE=FA

NODE=S003205

e MASS

NODE=S003205

2006 CODATA (MOHR 08) gives the conversion factor from u (atomic mass units, see the above datablock) to MeV as 931.494 028 (23). Earlier values use the then-current conversion factor. The conversion error dominates the uncertainty of the masses given below.

NODE=S003M

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
0.510998910±0.000000013	MOHR	08	RVUE	2006 CODATA value
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.510998918±0.000000044	MOHR	05	RVUE	2002 CODATA value
0.510998901±0.000000020	[3,4] BEIER	02	CNTR	Penning trap
0.510998902±0.000000021	MOHR	99	RVUE	1998 CODATA value
0.510998903±0.000000020	[3,5] FARNHAM	95	CNTR	Penning trap
0.510998895±0.000000024	[3] COHEN	87	RVUE	1986 CODATA value
0.5110034 ±0.0000014	COHEN	73	RVUE	1973 CODATA value

[3] Converted to MeV using the 1998 CODATA value of the conversion constant, 931.494013 ± 0.000037 MeV/u. NODE=S003M;LINKAGE=A1

[4] BEIER 02 compares Larmor frequency of the electron bound in a $^{12}C^{5+}$ ion with the cyclotron frequency of a single trapped $^{12}C^{5+}$ ion. NODE=S003M;LINKAGE=IE

[5] FARNHAM 95 compares cyclotron frequency of trapped electrons with that of a single trapped $^{12}C^{6+}$ ion. NODE=S003M;LINKAGE=AF

NODE=S003207

$(m_{e^+} - m_{e^-})\ /\ m_{\text{average}}$

NODE=S003207

A test of *CPT* invariance.

NODE=S003DM

VALUE	*CL%*	*DOCUMENT ID*		*TECN*	*COMMENT*
$<8 \times 10^{-9}$	90	[6] FEE	93	CNTR	Positronium spectroscopy
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$<4 \times 10^{-8}$	90	CHU	84	CNTR	Positronium spectroscopy

[6] FEE 93 value is obtained under the assumption that the positronium Rydberg constant is exactly half the hydrogen one. NODE=S003DM;LINKAGE=B

$|q_{e^+} + q_{e^-}|/e$

NODE=S003208

A test of *CPT* invariance. See also similar tests involving the proton.

NODE=S003208

NODE=S003DQ

VALUE	*DOCUMENT ID*		*TECN*	*COMMENT*
<4 × 10^{-8}	[7] HUGHES	92	RVUE	
• • • We do not use the following data for averages, fits, limits, etc. • • •				
$<2 \times 10^{-18}$	[8] SCHAEFER	95	THEO	Vacuum polarization
$<1 \times 10^{-18}$	[9] MUELLER	92	THEO	Vacuum polarization

[7] HUGHES 92 uses recent measurements of Rydberg-energy and cyclotron-frequency ratios. NODE=S003DQ;LINKAGE=A

[8] SCHAEFER 95 removes model dependency of MUELLER 92. NODE=S003DQ;LINKAGE=S

[9] MUELLER 92 argues that an inequality of the charge magnitudes would, through higher-order vacuum polarization, contribute to the net charge of atoms. NODE=S003DQ;LINKAGE=B

e MAGNETIC MOMENT ANOMALY

NODE=S003215

$\mu_e/\mu_B - 1 = (g-2)/2$

NODE=S003MM

The CODATA value assumes the $g/2$ values for e^+ and e^- are equal, as required by *CPT*.

NODE=S003MM

NODE=S003MM

VALUE (units 10^{-6})	*DOCUMENT ID*		*TECN*	*CHG*	*COMMENT*
1159.65218111±0.00000074	MOHR	08	RVUE		2006 CODATA value
• • • We do not use the following data for averages, fits, limits, etc. • • •					
1159.65218085±0.00000076	ODOM	06	MRS	−	single electron
1159.6521859 ±0.0000038	MOHR	05	RVUE		2002 CODATA value
1159.6521869 ±0.0000041	MOHR	99	RVUE		1998 CODATA value
1159.652193 ±0.000010	COHEN	87	RVUE		1986 CODATA value
1159.6521884 ±0.0000043	VANDYCK	87	MRS	−	Single electron
1159.6521879 ±0.0000043	VANDYCK	87	MRS	+	Single positron

OCCUR=2

$(g_{e^+} - g_{e^-})\ /\ g_{\text{average}}$

NODE=S003217

A test of *CPT* invariance.

NODE=S003217

NODE=S003MMR

VALUE (units 10^{-12})	*CL%*	*DOCUMENT ID*		*TECN*	*COMMENT*
− 0.5± 2.1		[10] VANDYCK	87	MRS	Penning trap
• • • We do not use the following data for averages, fits, limits, etc. • • •					
< 12	95	[11] VASSERMAN	87	CNTR	Assumes $m_{e^+} = m_{e^-}$
22 ±64		SCHWINBERG	81	MRS	Penning trap

[10] VANDYCK 87 measured $(g_-/g_+)-1$ and we converted it. NODE=S003MMR;LINKAGE=A

[11] VASSERMAN 87 measured $(g_+ - g_-)/(g-2)$. We multiplied by $(g-2)/g = 1.2 \times 10^{-3}$. NODE=S003MMR;LINKAGE=V

e ELECTRIC DIPOLE MOMENT (d)

NODE=S003220

A nonzero value is forbidden by both *T* invariance and *P* invariance.

NODE=S003220

NODE=S003EDM

VALUE (10^{-26} *e*cm)	*CL%*	*DOCUMENT ID*		*TECN*	*COMMENT*
0.069± 0.074		REGAN	02	MRS	^{205}Tl beams
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.18 ± 0.12 ±0.10		[12] COMMINS	94	MRS	^{205}Tl beams
− 0.27 ± 0.83		[12] ABDULLAH	90	MRS	^{205}Tl beams
− 14 ± 24		CHO	89	NMR	Tl F molecules
− 1.5 ± 5.5 ±1.5		MURTHY	89		Cesium, no *B* field
− 50 ±110		LAMOREAUX	87	NMR	^{199}Hg
190 ±340	90	SANDARS	75	MRS	Thallium
70 ±220	90	PLAYER	70	MRS	Xenon
< 300	90	WEISSKOPF	68	MRS	Cesium

[12] ABDULLAH 90, COMMINS 94, and REGAN 02 use the relativistic enhancement of a valence electron's electric dipole moment in a high-Z atom. NODE=S003EDM;LINKAGE=A

e^- MEAN LIFE / BRANCHING FRACTION

NODE=S003210

A test of charge conservation. See the "Note on Testing Charge Conservation and the Pauli Exclusion Principle" following this section in our 1992 edition (Physical Review **D45** S1 (1992), p. VI.10).

NODE=S003210

Most of these experiments are one of three kinds: Attempts to observe (a) the 255.5 keV gamma ray produced in $e^- \rightarrow \nu_e \gamma$, (b) the (K) shell x ray produced when an electron decays without additional energy deposit, e.g., $e^- \rightarrow \nu_e \overline{\nu}_e \nu_e$ ("disappearance" experiments), and (c) nuclear de-excitation gamma rays after the electron disappears from an atomic shell and the nucleus is left in an excited state. The last can include both weak boson and photon mediating processes. We use the best $e^- \rightarrow \nu_e \gamma$ limit for the Summary Tables.

Note that we use the mean life rather than the half life, which is often reported.

$e \rightarrow \nu_e \gamma$ and astrophysical limits

NODE=S003T
NODE=S003T

VALUE (yr)	*CL%*	*DOCUMENT ID*		*TECN*	*COMMENT*
$>4.6 \times 10^{26}$	90	BACK	02	BORX	$e^- \rightarrow \nu\gamma$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$>1.22 \times 10^{26}$	68	[13] KLAPDOR-K...	07	CNTR	$e^- \rightarrow \nu\gamma$
$>3.4 \times 10^{26}$	68	BELLI	00B	DAMA	$e^- \rightarrow \nu\gamma$, liquid Xe
$>3.7 \times 10^{25}$	68	AHARONOV	95B	CNTR	$e^- \rightarrow \nu\gamma$
$>2.35 \times 10^{25}$	68	BALYSH	93	CNTR	$e^- \rightarrow \nu\gamma$, ^{76}Ge detector
$>1.5 \times 10^{25}$	68	AVIGNONE	86	CNTR	$e^- \rightarrow \nu\gamma$
$>1 \times 10^{39}$		[14] ORITO	85	ASTR	Astrophysical argument
$>3 \times 10^{23}$	68	BELLOTTI	83B	CNTR	$e^- \rightarrow \nu\gamma$

OCCUR=2

[13] The authors of A. Derbin et al, arXiv:0704.2047v1 argue that this limit is overestimated by at least a factor of 5. NODE=S003T;LINKAGE=KL

[14] ORITO 85 assumes that electromagnetic forces extend out to large enough distances and that the age of our galaxy is 10^{10} years. NODE=S003T;LINKAGE=O

Disappearance and nuclear-de-excitation experiments

NODE=S003TD
NODE=S003TD

VALUE (yr)	*CL%*	*DOCUMENT ID*		*TECN*	*COMMENT*
$>6.4 \times 10^{24}$	68	[15] BELLI	99B	DAMA	De-excitation of ^{129}Xe
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$>4.2 \times 10^{24}$	68	BELLI	99	DAMA	Iodine L-shell disappearance
$>2.4 \times 10^{23}$	90	[16] BELLI	99D	DAMA	De-excitation of ^{127}I (in NaI)
$>4.3 \times 10^{23}$	68	AHARONOV	95B	CNTR	Ge K-shell disappearance
$>2.7 \times 10^{23}$	68	REUSSER	91	CNTR	Ge K-shell disappearance
$>2 \times 10^{22}$	68	BELLOTTI	83B	CNTR	Ge K-shell disappearance

OCCUR=2

[15] BELLI 99B limit on charge nonconserving e^- capture involving excitation of the 236.1 keV nuclear state of ^{129}Xe; the 90% CL limit is 3.7×10^{24} yr. Less stringent limits for other states are also given. NODE=S003TD;LINKAGE=A

[16] BELLI 99D limit on charge nonconserving e^- capture involving excitation of the 57.6 keV nuclear state of ^{127}I. Less stringent limits for the other states and for the state of ^{23}Na are also given. NODE=S003TD;LINKAGE=TD

LIMITS ON LEPTON-FLAVOR VIOLATION IN PRODUCTION

NODE=S003230

Forbidden by lepton family number conservation.

NODE=S003230

This section was added for the 2008 edition of this *Review* and is not complete. For a list of further measurements see references in the papers listed below.

$\sigma(e^+e^- \rightarrow e^\pm\tau^\mp) / \sigma(e^+e^- \rightarrow \mu^+\mu^-)$

NODE=S003RET
NODE=S003RET

VALUE	*CL%*	*DOCUMENT ID*		*TECN*	*COMMENT*
$<8.9 \times 10^{-6}$	95	AUBERT	07P	BABR	e^+e^- at $E_{cm} = 10.58$ GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$<1.8 \times 10^{-3}$	95	GOMEZ-CAD...	91	MRK2	e^+e^- at $E_{cm} = 29$ GeV

$\sigma(e^+e^- \rightarrow \mu^\pm\tau^\mp) / \sigma(e^+e^- \rightarrow \mu^+\mu^-)$

NODE=S003RMT
NODE=S003RMT

VALUE	*CL%*	*DOCUMENT ID*		*TECN*	*COMMENT*
$<4.0 \times 10^{-6}$	95	AUBERT	07P	BABR	e^+e^- at $E_{cm} = 10.58$ GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$<6.1 \times 10^{-3}$	95	GOMEZ-CAD...	91	MRK2	e^+e^- at $E_{cm} = 29$ GeV

e REFERENCES

NODE=S003

MOHR	08	arXiv:0801.0028[atom-ph]	P.J. Mohr, B.N. Taylor, D.B. Newell	(NIST)	REFID=52197
to appear in RMP and JPCRD					
AUBERT	07P	PR D75 031103R	B. Aubert *et al.*	(BABAR Collab.)	REFID=51687
KLAPDOR-K...	07	PL B644 109	H.V. Klapdor-Kleingrothaus, I.V. Krivosheina, I.V. Titkova		REFID=51596
ODOM	06	PRL 97 030801	B. Odom *et al.*	(HARV)	REFID=51358
MOHR	05	RMP 77 1	P.J. Mohr, B.N. Taylor	(NIST)	REFID=49695
BACK	02	PL B525 29	H.O. Back *et al.*	(BOREXINO/SASSO Collab.)	REFID=48528
BEIER	02	PRL 88 011603	T. Beier *et al.*		REFID=48516
REGAN	02	PRL 88 071805	B.C. Regan *et al.*		REFID=48608
BELLI	00B	PR D61 117301	P. Belli *et al.*	(DAMA Collab.)	REFID=47628
BELLI	99	PL B460 236	P. Belli *et al.*	(DAMA Collab.)	REFID=47060
BELLI	99B	PL B465 315	P. Belli *et al.*	(DAMA Collab.)	REFID=47246
BELLI	99D	PR C60 065501	P. Belli *et al.*	(DAMA Collab.)	REFID=47560
MOHR	99	JPCRD 28 1713	P.J. Mohr, B.N. Taylor	(NIST)	REFID=47256
Also		RMP 72 351	P.J. Mohr, B.N. Taylor	(NIST)	REFID=47373
AHARONOV	95B	PR D52 3785	Y. Aharonov *et al.*	(SCUC, PNL, ZARA+)	REFID=44454
Also		PL B353 168	Y. Aharonov *et al.*	(SCUC, PNL, ZARA+)	REFID=44387
FARNHAM	95	PRL 75 3598	D.L. Farnham, R.S. van Dyck, P.B. Schwinberg	(WASH)	REFID=44548
SCHAEFER	95	PR A51 838	A. Schaefer, J. Reinhardt	(FRAN)	REFID=45975
COMMINS	94	PR A50 2960	E.D. Commins *et al.*		REFID=45949
BALYSH	93	PL B298 278	A. Balysh *et al.*	(KIAE, MPIH, SASSO)	REFID=43285
FEE	93	PR A48 192	M.S. Fee *et al.*		REFID=46777
HUGHES	92	PRL 69 578	R.J. Hughes, B.I. Deutch	(LANL, AARH)	REFID=42139
MUELLER	92	PRL 69 3432	B. Muller, M.H. Thoma	(DUKE)	REFID=43158
PDG	92	PR D45 S1	K. Hikasa *et al.*	(KEK, LBL, BOST+)	REFID=41900
GOMEZ-CAD...	91	PRL 66 1007	J.J. Gomez-Cadenas *et al.*	(SLAC MARK-2 Collab.)	REFID=41469
REUSSER	91	PL B255 143	D. Reusser *et al.*	(NEUC, CIT, PSI)	REFID=41453
ABDULLAH	90	PRL 65 2347	K. Abdullah *et al.*	(LBL, UCB)	REFID=41395
CHO	89	PRL 63 2559	D. Cho, K. Sangster, E.A. Hinds	(YALE)	REFID=41081
MURTHY	89	PRL 63 965	S.A. Murthy *et al.*	(AMHT)	REFID=41047
COHEN	87	RMP 59 1121	E.R. Cohen, B.N. Taylor	(RISC, NBS)	REFID=11616
LAMOREAUX	87	PRL 59 2275	S.K. Lamoreaux *et al.*	(WASH)	REFID=41048
VANDYCK	87	PRL 59 26	R.S. van Dyck, P.B. Schwinberg, H.G. Dehmelt	(WASH)	REFID=40305
VASSERMAN	87	PL B198 302	I.B. Vasserman *et al.*	(NOVO)	REFID=40311
Also		PL B187 172	I.B. Vasserman *et al.*	(NOVO)	REFID=40312
AVIGNONE	86	PR D34 97	F.T. Avignone *et al.*	(PNL, SCUC)	REFID=10111
ORITO	85	PRL 54 2457	S. Orito, M. Yoshimura	(TOKY, KEK)	REFID=40529
CHU	84	PRL 52 1689	S. Chu, A.P. Mills, J.L. Hall	(BELL, NBS, COLO)	REFID=40549
BELLOTTI	83B	PL 124B 435	E. Bellotti *et al.*	(MILA)	REFID=10109
SCHWINBERG	81	PRL 47 1679	P.B. Schwinberg, R.S. van Dyck, H.G. Dehmelt	(WASH)	REFID=10108
SANDARS	75	PR A11 473	P.G.H. Sandars, D.M. Sternheimer	(OXF, BNL)	REFID=10100
COHEN	73	JPCRD 2 664	E.R. Cohen, B.N. Taylor	(RISC, NBS)	REFID=10098
PLAYER	70	JPB 3 1620	M.A. Player, P.G.H. Sandars	(OXF)	REFID=10092
WEISSKOPF	68	PRL 21 1645	M.C. Weisskopf *et al.*	(BRAN)	REFID=10090