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

A test of *CPT* invariance.

VALUE (units 10^{-12})	CL%	DOCUMENT ID		TECN	COMMENT
$-$ 0.5± 2.1		[5] VANDYCK	87	MRS	Penning trap
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$<$ 12	95	[6] VASSERMAN	87	CNTR	Assumes $m_{e^+} = m_{e^-}$
22 ±64		SCHWINBERG	81	MRS	Penning trap

[5] VANDYCK 87 measured $(g_-/g_+)-1$ and we converted it.

[6] VASSERMAN 87 measured $(g_+ - g_-)/(g-2)$. We multiplied by $(g-2)/g = 1.2 \times 10^{-3}$.

e ELECTRIC DIPOLE MOMENT

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

VALUE (10^{-26} $e$cm)	CL%	DOCUMENT ID		TECN	COMMENT
$-$ 0.27± 0.83		[7] ABDULLAH	90	MRS	^{205}Tl beams
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$-$ 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

[7] ABDULLAH 90 uses the relativistic enhancement of a valence electron's electric dipole moment in a high-Z atom.

e MEAN LIFE / BRANCHING FRACTION

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,** 1 June, Part II (1992), p. VI.10). We use the best "disappearance" limit for the Summary Tables. The best limit for the specific channel $e^- \to \nu\gamma$ is much better.

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

VALUE (yr)	CL%	DOCUMENT ID		TECN	COMMENT
>2.7 × 10^{23}	68	REUSSER	91	CNTR	Ge K-shell disappearance
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$>2.35 \times 10^{25}$	68	BALYSH	93	CNTR	$e^- \to \nu_e\gamma$, ^{76}Ge detector
$>1.5 \times 10^{25}$	68	AVIGNONE	86	CNTR	$e^- \to \nu\gamma$
$>1 \times 10^{39}$		[8] ORITO	85	ASTR	Astrophysical argument
$>3 \times 10^{23}$	68	BELLOTTI	83B	CNTR	$e^- \to \nu\gamma$
$>2 \times 10^{22}$	68	BELLOTTI	83B	CNTR	Ge K-shell disappearance
$>3.5 \times 10^{23}$	68	KOVALCHUK	79	CNTR	$e^- \to \nu\gamma$
$>2 \times 10^{22}$	68	[9] KOVALCHUK	79	CNTR	Disappearance
$>5.3 \times 10^{21}$		[9] STEINBERG	75	CNTR	Disappearance
$>2 \times 10^{21}$		[9,10] MOE	65	CNTR	Disappearance
$>4 \times 10^{22}$		MOE	65	CNTR	$e^- \to \nu\gamma$

[8] ORITO 85 assumes that electromagnetic forces extend out to large enough distances and that the age of our galaxy is 10^{10} years.

[9] These limits are for all modes in which decay particles escape from the detector without depositing energy.

[10] The MOE 65 limit is re-estimated by STEINBERG 75 to be 10^{20} years.

e REFERENCES

BALYSH	93	PL B298 278	+Beck, Belyaev, Bensch+	(KIAE, MPIH, SASSO)
HUGHES	92	PRL 69 578	+Deutch	(LANL, AARH)
MUELLER	92	PRL 69 3432	+Thoma	(DUKE)
PDG	92	PR D45, 1 June, Part II	Hikasa, Barnett, Stone+	(KEK, LBL, BOST+)
REUSSER	91	PL B255 143	+Treichel, Boehm, Broggini+	(NEUC, CIT, VILL)
ABDULLAH	90	PRL 65 2347	+Carlberg, Commins, Gould, Ross	(LBL, UCB)
CHO	89	PRL 63 2559	+Sangster, Hinds	(YALE)
MURTHY	89	PRL 63 965	+Krause, Li, Hunter	(AMHT)
COHEN	87	RMP 59 1121	+Taylor	(RISC, NBS)
LAMOREAUX	87	PRL 59 2275	+Jacobs, Heckel, Raab, Fortson	(WASH)
VANDYCK	87	PRL 59 26	Van Dyck, Schwinberg, Dehmelt	(WASH)
VASSERMAN	87	PL B198 302	+Vorobyov, Gluskin+	(NOVO)
Also	87B	PL B187 172	Vasserman, Vorobyov, Gluskin+	(NOVO)
AVIGNONE	86	PR D34 97	+Brodzinski, Hensley, Miley, Reeves+	(PNL, SCUC)
VANDYCK	86	PR D34 722	Van Dyck, Schwinberg, Dehmelt	(WASH)
ORITO	85	PRL 54 2457	+Yoshimura	(TOKY, KEK)
CHU	84	PRL 52 1689	+Mills, Hall	(BELL, NBS, COLO)
BELLOTTI	83B	PL 124B 435	+Corti, Fiorini, Liguori, Pullia+	(MILA)
KINOSHITA	81	PRL 47 1573	+Lindquist	(CORN)
SCHWINBERG	81	PRL 47 1679	+Van Dyck, Dehmelt	(WASH)
KOVALCHUK	79	JETPL 29 145	+Pomansky, Smolnikov	(INRM)
		Translated from ZETFP 29 163.		
SANDARS	75	PR A11 473	+Sternheimer	(OXF, BNL)
STEINBERG	75	PR D12 2582	+Kwiatkowski, Maenhaut+	(UMD)
COHEN	73	JPCRD 2 663	+Taylor	(RISC, NBS)
PLAYER	70	JPB 3 1620	+Sandars	(OXF)
WEISSKOPF	68	PRL 21 1645	+Carrico, Gould, Lipworth+	(BRAN)
MOE	65	PR 140B 992	+Reines	(CASE)

$\boxed{\mu}$

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

μ MASS

The mass is known more precisely in u (atomic mass units) than in MeV (see the footnote to COHEN 87). The conversion from u to MeV, 1 u = 931.49432 ± 0.00028 MeV, involves the relatively poorly known electronic charge.

Where m_μ/m_e was measured, we have used the 1986 CODATA value for $m_e = 0.51099906 \pm 0.00000015$ MeV.

VALUE (MeV)	DOCUMENT ID		TECN	CHG	COMMENT
105.658389±0.000034	[1] COHEN	87	RVUE		1986 CODATA value
• • • We do not use the following data for averages, fits, limits, etc. • • •					
105.65841 ±0.00033	[2] BELTRAMI	86	SPEC	$-$	Muonic atoms
105.658432±0.000064	[3] KLEMPT	82	CNTR	+	Incl. in MARIAM 82
105.658386±0.000044	[4] MARIAM	82	CNTR	+	
105.65856 ±0.00015	[5] CASPERSON	77	CNTR	+	
105.65836 ±0.00026	[6] CROWE	72	CNTR		
105.65865 ±0.00044	[7] CRANE	71	CNTR		

[1] The mass is known more precisely in u: $m = 0.113428913 \pm 0.000000017$ u. COHEN 87 makes use of the other entries below.

[2] BELTRAMI 86 gives $m_\mu/m_e = 206.76830(64)$.

[3] KLEMPT 82 gives $m_\mu/m_e = 206.76835(11)$.

[4] MARIAM 82 gives $m_\mu/m_e = 206.768259(62)$.

[5] CASPERSON 77 gives $m_\mu/m_e = 206.76859(29)$.

[6] CROWE 72 gives $m_\mu/m_e = 206.7682(5)$.

[7] CRANE 71 gives $m_\mu/m_e = 206.76878(85)$.

μ MEAN LIFE τ

Measurements with an error $> 0.001 \times 10^{-6}$ s have been omitted.

VALUE (10^{-6} s)	DOCUMENT ID		TECN	CHG
2.19703 ±0.00004 OUR AVERAGE				
2.197078±0.000073	BARDIN	84	CNTR	+
2.197025±0.000155	BARDIN	84	CNTR	$-$
2.19695 ±0.00006	GIOVANETTI	84	CNTR	+
2.19711 ±0.00008	BALANDIN	74	CNTR	+
2.1973 ±0.0003	DUCLOS	73	CNTR	+

$\tau_{\mu^+}/\tau_{\mu^-}$ MEAN LIFE RATIO

A test of *CPT* invariance.

VALUE	DOCUMENT ID		TECN	COMMENT
1.000024±0.000078	BARDIN	84	CNTR	
• • • We do not use the following data for averages, fits, limits, etc. • • •				
1.0008 ±0.0010	BAILEY	79	CNTR	Storage ring
1.000 ±0.001	MEYER	63	CNTR	Mean life μ^+ / μ^-

$(\tau_{\mu^+} - \tau_{\mu^-})$ / τ_{average}

A test of *CPT* invariance. Calculated from the mean-life ratio, above.

VALUE	DOCUMENT ID
(2±8) × 10^{-5} OUR EVALUATION	

μ MAGNETIC MOMENT ANOMALY

$\mu_\mu/(e\hbar/2m_\mu)-1 = (g_\mu-2)/2$

For reviews of theory and experiments, see HUGHES 85, KINOSHITA 84, COMBLEY 81, FARLEY 79, and CALMET 77.

VALUE (units 10^{-6})	DOCUMENT ID		TECN	CHG	COMMENT
1165.9230±0.0084	COHEN	87	RVUE		1986 CODATA value
• • • We do not use the following data for averages, fits, limits, etc. • • •					
1165.910 ±0.011	[8] BAILEY	79	CNTR	+	Storage ring
1165.937 ±0.012	[8] BAILEY	79	CNTR	$-$	Storage ring
1165.923 ±0.0085	[8] BAILEY	79	CNTR	±	Storage ring
1165.922 ±0.009	[8] BAILEY	77	CNTR	±	Storage ring
1166.16 ±0.31	BAILEY	68	CNTR	±	Storage rings
1162.0 ±5.0	CHARPAK	62	CNTR	+	

[8] BAILEY 79 is final result. Includes BAILEY 77 data. We use μ/p magnetic moment ratio = 3.1833452 and recalculate the BAILEY 79 values. Third BAILEY 79 result is first two combined.