n

$I(J^P) = \frac{1}{2}(\frac{1}{2}^+)$ Status: ∗∗∗∗

We have omitted some results that have been superseded by later experiments. See our earlier editions.

n MASS (atomic mass units u)

The mass is known much more precisely in u (atomic mass units) than in MeV. The conversion from u to MeV, 1 u = 931.494013±0.000037 MeV/c^2 (MOHR 99, the 1998 CODATA value), involves the relatively poorly known electronic charge.

VALUE (u)	*DOCUMENT ID*		*TECN*	*COMMENT*
1.00866491578±0.00000000055	MOHR	99	RVUE	1998 CODATA value
• • • We do not use the following data for averages, fits, limits, etc. • • •				
1.008665904 ±0.000000014	COHEN	87	RVUE	1986 CODATA value

n MASS (MeV)

The mass is known much more precisely in u (atomic mass units) than in MeV; see the previous data block. The conversion from u to MeV, 1 u = 931.494013±0.000037 MeV/c^2 (MOHR 99, the 1998 CODATA value), involves the relatively poorly known electronic charge.

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
939.565330±0.000038	MOHR	99	RVUE	1998 CODATA value
• • • We do not use the following data for averages, fits, limits, etc. • • •				
939.565331±0.000037	[1] KESSLER	99	SPEC	$np \to d\gamma$
939.56565 ±0.00028	[2,3] DIFILIPPO	94	TRAP	Penning trap
939.56563 ±0.00028	COHEN	87	RVUE	1986 CODATA value
939.56564 ±0.00028	[3,4] GREENE	86	SPEC	$np \to d\gamma$
939.5731 ±0.0027	[3] COHEN	73	RVUE	1973 CODATA value

[1] We use the 1998 CODATA u-to-MeV conversion factor (see the heading above) to get this mass in MeV from the much more precisely measured KESSLER 99 value of 1.00866491637 ± 0.00000000082 u.

[2] The mass is known much more precisely in u: m = 1.0086649235 ± 0.0000000023 u. We use the 1986 CODATA conversion factor to get the mass in MeV.

[3] These determinations are not independent of the $m_n - m_p$ measurements below.

[4] The mass is known much more precisely in u: m = 1.008664919 ± 0.000000014 u.

$\overline{n}$ MASS

VALUE (MeV)	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
939.485±0.051	59	[5] CRESTI	86	HBC	$\overline{p}p \to \overline{n}n$

[5] This is a corrected result (see the erratum). The error is statistical. The maximum systematic error is 0.029 MeV.

$(m_n - m_{\overline{n}})/\ m_n$

A test of *CPT* invariance. Calculated from the n and $\overline{n}$ masses, above.

VALUE	*DOCUMENT ID*
$(9\pm5)\times10^{-5}$ OUR EVALUATION	

$m_n - m_p$

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
1.2933318±0.0000005	[6] MOHR	99	RVUE	1998 CODATA value
• • • We do not use the following data for averages, fits, limits, etc. • • •				
1.293318 ±0.000009	[7] COHEN	87	RVUE	1986 CODATA value
1.2933328±0.0000072	GREENE	86	SPEC	$np \rightarrow d\gamma$
1.293429 ±0.000036	COHEN	73	RVUE	1973 CODATA value

[6] Calculated by us from the MOHR 99 ratio $m_n/m_p = 1.00137841887 \pm 0.00000000058$. In u, $m_n - m_p = (1.3884489 \pm 0.0000006) \times 10^{-3}$ u.

[7] Calculated by us from the COHEN 87 ratio $m_n/m_p = 1.001378404 \pm 0.000000009$. In u, $m_n - m_p = 0.001388434 \pm 0.000000009$ u.

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n MEAN LIFE

We now compile only direct measurements of the lifetime, not those inferred from decay correlation measurements. For the average, we only use measurements with an error less than 10 s.

Limits on lifetimes for *bound* neutrons are given in the section "*p* PARTIAL MEAN LIVES."

For an early review, see EROZOLIMSKII 89 and papers that follow it in an issue of NIM devoted to the "Proceedings of the International Workshop on Fundamental Physics with Slow Neutrons" (Grenoble 1989). For later reviews and/or commentary, see FREEDMAN 90, SCHRECKENBACH 92, and PENDLEBURY 93.

VALUE (s)	*DOCUMENT ID*		*TECN*	*COMMENT*
885.7± 0.8 OUR AVERAGE				
885.4± 0.9± 0.4	ARZUMANOV	00	CNTR	UCN double bottle
889.2± 3.0± 3.8	BYRNE	96	CNTR	Penning trap
882.6± 2.7	[8] MAMPE	93	CNTR	Gravitational trap
888.4± 3.1± 1.1	NESVIZHEV...	92	CNTR	Gravitational trap
887.6± 3.0	MAMPE	89	CNTR	Gravitational trap
891 ± 9	SPIVAK	88	CNTR	Beam
• • • We do not use the following data for averages, fits, limits, etc. • • •				
888.4± 2.9	ALFIMENKOV	90	CNTR	See NESVIZHEVSKII 92
893.6± 3.8± 3.7	BYRNE	90	CNTR	See BYRNE 96
878 ±27 ±14	KOSSAKOW...	89	TPC	Pulsed beam
877 ±10	PAUL	89	CNTR	Storage ring
876 ±10 ±19	LAST	88	SPEC	Pulsed beam

903 ±13	KOSVINTSEV 86	CNTR	Gravitational trap
937 ±18	[9] BYRNE 80	CNTR	
875 ±95	KOSVINTSEV 80	CNTR	
881 ± 8	BONDAREN... 78	CNTR	See SPIVAK 88
918 ±14	CHRISTENSEN72	CNTR	

[8] IGNATOVICH 95 calls into question some of the corrections and averaging procedures used by MAMPE 93. The response, BONDARENKO 96, denies the validity of the criticisms.

[9] This measurement has been withdrawn (J. Byrne, private communication, 1990).

n MAGNETIC MOMENT

See the "Note on Baryon Magnetic Moments" in the Λ Listings.

VALUE (μ_N)	*DOCUMENT ID*	*TECN*	*COMMENT*
−1.91304272±0.00000045	MOHR 99	RVUE	1998 CODATA value
• • • We do not use the following data for averages, fits, limits, etc. • • •			
−1.91304275±0.00000045	COHEN 87	RVUE	1986 CODATA value
−1.91304277±0.00000048	[10] GREENE 82	MRS	

[10] GREENE 82 measures the moment to be $(1.04187564 \pm 0.00000026) \times 10^{-3}$ Bohr magnetons. The value above is obtained by multiplying this by $m_p/m_e = 1836.152701 \pm 0.000037$ (the 1986 CODATA value from COHEN 87).

n ELECTRIC DIPOLE MOMENT

A nonzero value is forbidden by both *T* invariance and *P* invariance. A number of early results have been omitted. See RAMSEY 90 and GOLUB 94 for reviews.

VALUE (10^{-25} *e*cm)	*CL%*	*DOCUMENT ID*	*TECN*	*COMMENT*
< 0.63	90	[11] HARRIS 99	MRS	$d = (-0.1 \pm 0.36) \times 10^{-25}$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
< 0.97	90	ALTAREV 96	MRS	$(+0.26 \pm 0.40 \pm 0.16) \times 10^{-25}$
< 1.1	95	ALTAREV 92	MRS	See ALTAREV 96
< 1.2	95	SMITH 90	MRS	See HARRIS 99
< 2.6	95	ALTAREV 86	MRS	$d = (-1.4 \pm 0.6) \times 10^{-25}$
0.3 ±4.8		PENDLEBURY 84	MRS	Ultracold neutrons
< 6	90	ALTAREV 81	MRS	$d = (2.1 \pm 2.4) \times 10^{-25}$
<16	90	ALTAREV 79	MRS	$d = (4.0 \pm 7.5) \times 10^{-25}$

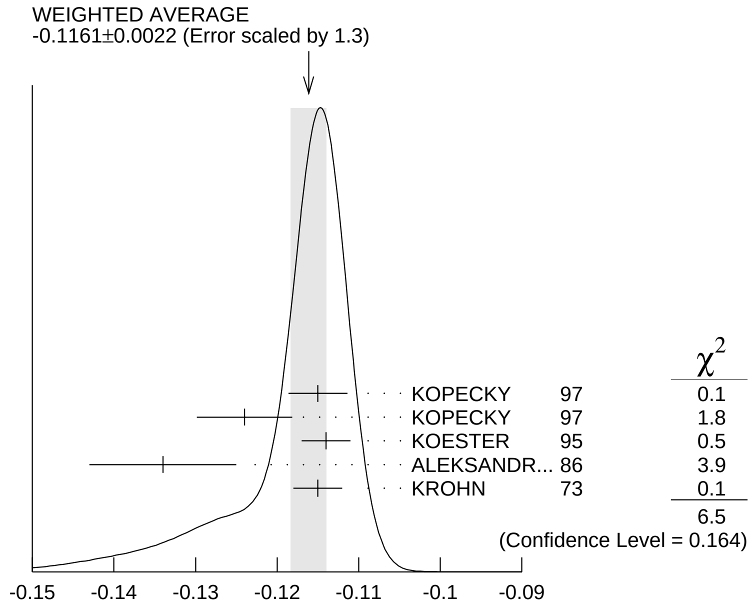
[11] This HARRIS 99 result includes the result of SMITH 90. However, the averaging of the results of these two experiments has been criticized by LAMOREAUX 00.

n MEAN-SQUARE CHARGE RADIUS

The mean-square charge radius of the neutron, $\langle r_n^2 \rangle$, is related to the neutron-electron scattering length b_{ne} by $\langle r_n^2 \rangle = 3(m_e a_0/m_n) b_{ne}$, where m_e and m_n are the masses of the electron and neutron, and a_0 is the Bohr radius. Numerically, $\langle r_n^2 \rangle = 86.34\, b_{ne}$, if we use a_0 for a nucleus with infinite mass.

VALUE (fm^2)		*DOCUMENT ID*	*COMMENT*
−0.1161±0.0022 OUR AVERAGE		Error includes scale factor of 1.3. See the ideogram below.	
−0.115 ±0.002 ±0.003		KOPECKY 97	*ne* scattering (Pb)
−0.124 ±0.003 ±0.005		KOPECKY 97	*ne* scattering (Bi)
−0.114 ±0.003		KOESTER 95	*ne* scattering (Pb, Bi)
−0.134 ±0.009		ALEKSANDR... 86	*ne* scattering (Bi)
−0.115 ±0.003	[12]	KROHN 73	*ne* scattering (Ne, Ar, Kr, Xe)
• • • We do not use the following data for averages, fits, limits, etc. • • •			
−0.113 ±0.003 ±0.004		KOPECKY 95	*ne* scattering (Pb)
−0.114 ±0.003		KOESTER 86	*ne* scattering (Pb, Bi)
−0.118 ±0.002		KOESTER 76	*ne* scattering (Pb)
−0.120 ±0.002		KOESTER 76	*ne* scattering (Bi)
−0.116 ±0.003		KROHN 66	*ne* scattering (Ne, Ar, Kr, Xe)

[12] This value is as corrected by KOESTER 76.



n mean-square charge radius

n ELECTRIC POLARIZABILITY α_n

Following is the electric polarizability α_n defined in terms of the induced electric dipole moment by $\mathbf{D} = 4\pi\epsilon_0\alpha_n\mathbf{E}$. For a review, see SCHMIEDMAYER 89.

VALUE (10^{-4} fm^3)	*DOCUMENT ID*		*TECN*	*COMMENT*
11.0± 1.6 OUR NEW AVERAGE				Error includes scale factor of 1.1. [$(9.8^{+1.9}_{-2.3}) \times 10^{-4}$ fm^3 OUR 2002 AVERAGE Scale factor = 1.1]
$12.5 \pm 1.8^{+1.6}_{-1.3}$	[13] KOSSERT	02	CNTR	$\gamma d \rightarrow \gamma p n$
0.0 ± 5.0	[14] KOESTER	95	CNTR	*n* Pb, *n* Bi transmission
$12.0 \pm 1.5 \pm 2.0$	SCHMIEDM...	91	CNTR	*n* Pb transmission
$10.7^{+3.3}_{-10.7}$	ROSE	90B	CNTR	$\gamma d \rightarrow \gamma n p$
8 ± 10	KOESTER	88	CNTR	*n* Pb, *n* Bi transmission
12 ± 10	SCHMIEDM...	88	CNTR	*n* Pb, *n* C transmission
• • • We do not use the following data for averages, fits, limits, etc. • • •				
13.6	[15] KOLB	00	CNTR	$\gamma d \rightarrow \gamma n p$
$11.7^{+4.3}_{-11.7}$	ROSE	90	CNTR	See ROSE 90B

[13] KOSSERT 02 gets $\alpha_n - \beta_n = (9.8 \pm 3.6^{+2.1}_{-1.1} \pm 2.2) \times 10^{-4}$ fm^3, and uses $\alpha_n + \beta_n = (15.2 \pm 0.5) \times 10^{-4}$ fm^3 from OLMOSDELEON 01. Thus the errors on α_n and β_n are anti-correlated.

[14] KOESTER 95 uses natural Pb and the isotopes 208, 207, and 206. See this paper for a discussion of methods used by various groups to extract α_n from data.

[15] KOLB 00 obtains this value with a lower limit of 7.6×10^{-4} fm^3 but no upper limit from this experiment alone. Combined with results of ROSE 90, the 1-σ range is (7.6–14.0) $\times 10^{-4}$ fm^3.

n MAGNETIC POLARIZABILITY β_n

VALUE (10^{-4} fm^3)	*DOCUMENT ID*		*TECN*	*COMMENT*
$\mathbf{2.7 \pm 1.8^{+1.3}_{-1.6}}$	[16] KOSSERT	02	CNTR	$\gamma d \rightarrow \gamma p n$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
1.6	[17] KOLB	00	CNTR	$\gamma d \rightarrow \gamma n p$

[16] KOSSERT 02 gets $\alpha_n - \beta_n = (9.8 \pm 3.6^{+2.1}_{-1.1} \pm 2.2) \times 10^{-4}$ fm^3, and uses $\alpha_n + \beta_n = (15.2 \pm 0.5) \times 10^{-4}$ fm^3 from OLMOSDELEON 01. Thus the errors on α_n and β_n are anti-correlated.

[17] KOLB 00 obtains this value with an upper limit of 7.6×10^{-4} fm^3 but no lower limit from this experiment alone. Combined with results of ROSE 90, the 1-σ range is (1.2–7.6) $\times 10^{-4}$ fm^3.

n CHARGE

See also "$|q_p + q_e|/e$" in the proton Listings.

VALUE (10^{-21} *e*)	*DOCUMENT ID*		*TECN*	*COMMENT*
− 0.4± 1.1	[18] BAUMANN	88		Cold *n* deflection
• • • We do not use the following data for averages, fits, limits, etc. • • •				
−15 ±22	[19] GAEHLER	82	CNTR	Cold *n* deflection

[18] The BAUMANN 88 error ±1.1 gives the 68% CL limits about the the value −0.4.

[19] The GAEHLER 82 error ±22 gives the 90% CL limits about the the value −15.

LIMIT ON $n\overline{n}$ OSCILLATIONS

Mean Time for $n\overline{n}$ Transition in Vacuum

A test of ΔB=2 baryon number nonconservation. MOHAPATRA 80 and MOHAPATRA 89 discuss the theoretical motivations for looking for $n\overline{n}$ oscillations. DOVER 83 and DOVER 85 give phenomenological analyses. The best limits come from looking for the decay of neutrons bound in nuclei. However, these analyses require model-dependent corrections for nuclear effects. See KABIR 83, DOVER 89, ALBERICO 91, and GAL 00 for discussions. Direct searches for $n \rightarrow \overline{n}$ transitions using reactor neutrons are cleaner but give somewhat poorer limits. We include limits for both free and bound neutrons in the Summary Table.

VALUE (s)	*CL%*	*DOCUMENT ID*		*TECN*	*COMMENT*
$\mathbf{>1.3 \times 10^{8}}$	90	CHUNG	02B	SOU2	*n* bound in iron
$\mathbf{>8.6 \times 10^{7}}$	90	BALDO-...	94	CNTR	Reactor (free) neutrons
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$>1 \times 10^{7}$	90	BALDO-...	90	CNTR	See BALDO-CEOLIN 94
$>1.2 \times 10^{8}$	90	BERGER	90	FREJ	*n* bound in iron
$>4.9 \times 10^{5}$	90	BRESSI	90	CNTR	Reactor neutrons
$>4.7 \times 10^{5}$	90	BRESSI	89	CNTR	See BRESSI 90
$>1.2 \times 10^{8}$	90	TAKITA	86	CNTR	*n* bound in oxygen
$>1 \times 10^{6}$	90	FIDECARO	85	CNTR	Reactor neutrons
$>8.8 \times 10^{7}$	90	PARK	85B	CNTR	
$>3 \times 10^{7}$		BATTISTONI	84	NUSX	
$> 2.7 \times 10^{7}$–1.1×10^{8}		JONES	84	CNTR	
$>2 \times 10^{7}$		CHERRY	83	CNTR	

n DECAY MODES

	Mode		Fraction (Γ_i/Γ)	Confidence level
Γ_1	$p e^- \overline{\nu}_e$		100 %	
Γ_2	hydrogen-atom$\overline{\nu}_e$			

Charge conservation (*Q*) violating mode

Γ_3	$p \nu_e \overline{\nu}_e$	*Q*	$< 8 \times 10^{-27}$	68%

n BRANCHING RATIOS

$\Gamma(\text{hydrogen-atom}\,\overline{\nu}_e)/\Gamma_{\text{total}}$ Γ_2/Γ

VALUE	*CL%*	*DOCUMENT ID*	*TECN*
• • • We do not use the following data for averages, fits, limits, etc. • • •			
$<3 \times 10^{-2}$	95	[20] GREEN 90	RVUE

[20] GREEN 90 infers that $\tau(\text{hydrogen-atom}\,\overline{\nu}_e) > 3 \times 10^4$ s by comparing neutron lifetime measurements made in storage experiments with those made in β-decay experiments. However, the result depends sensitively on the lifetime measurements, and does not of course take into account more recent measurements of same.

$\Gamma(p\nu_e\overline{\nu}_e)/\Gamma_{\text{total}}$ Γ_3/Γ

Forbidden by charge conservation.

VALUE	*CL%*	*DOCUMENT ID*	*TECN*	*COMMENT*
$<8 \times 10^{-27}$	68	[21] NORMAN 96	RVUE	^{71}Ga → ^{71}Ge neutrals
• • • We do not use the following data for averages, fits, limits, etc. • • •				
$<9.7 \times 10^{-18}$	90	ROY 83	CNTR	^{113}Cd → ^{113m}In neut.
$<7.9 \times 10^{-21}$		VAIDYA 83	CNTR	^{87}Rb → ^{87m}Sr neut.
$<9 \times 10^{-24}$	90	BARABANOV 80	CNTR	^{71}Ga → ^{71}GeX
$<3 \times 10^{-19}$		NORMAN 79	CNTR	^{87}Rb → ^{87m}Sr neut.

[21] NORMAN 96 gets this limit by attributing SAGE and GALLEX counting rates to the charge-nonconserving transition ^{71}Ga → ^{71}Ge+neutrals rather than to solar-neutrino reactions.

A REVIEW GOES HERE – Check our WWW List of Reviews

$n \rightarrow pe^-\overline{\nu}_e$ DECAY PARAMETERS

See the above "Note on Baryon Decay Parameters." For discussions of recent results, see the references cited at the beginning of the section on the neutron mean life. For discussions of the values of the weak coupling constants g_A and g_V obtained using the neutron lifetime and asymmetry parameter A, comparisons with other methods of obtaining these constants, and implications for particle physics and for astrophysics, see DUBBERS 91 and WOOLCOCK 91. For tests of the $V-A$ theory of neutron decay, see EROZOLIMSKII 91B and MOSTOVOI 96.

$\lambda \equiv g_A\ /\ g_V$

VALUE	*DOCUMENT ID*	*TECN*	*COMMENT*
−1.2695±0.0029 OUR NEW AVERAGE Error includes scale factor of 2.0. See the ideogram below. [−1.2670 ± 0.0030 OUR 2002 AVERAGE Scale factor = 1.6]			
-1.2739 ± 0.0019	[22] ABELE 02	SPEC	Cold *n*, polarized
$-1.2686 \pm 0.0046 \pm 0.007$	[23] MOSTOVOI 01	CNTR	*A* and *B* × polarizations
-1.266 ± 0.004	LIAUD 97	TPC	Cold *n*, polarized, *A*
-1.2594 ± 0.0038	[24] YEROZLIM... 97	CNTR	Cold *n*, polarized, *A*
-1.262 ± 0.005	BOPP 86	SPEC	Cold *n*, polarized, *A*

• • • We do not use the following data for averages, fits, limits, etc. • • •

-1.274 ± 0.003	ABELE	97D	SPEC	Cold n, polarized, A
-1.266 ± 0.004	SCHRECK...	95	TPC	See LIAUD 97
-1.2544 ± 0.0036	EROZOLIM...	91	CNTR	See YEROZOLIMSKY 97
-1.226 ± 0.042	MOSTOVOY	83	RVUE	
-1.261 ± 0.012	EROZOLIM...	79	CNTR	Cold n, polarized, A
-1.259 ± 0.017	[25] STRATOWA	78	CNTR	p recoil spectrum, a
-1.263 ± 0.015	EROZOLIM...	77	CNTR	See EROZOLIMSKII 79
-1.250 ± 0.036	[25] DOBROZE...	75	CNTR	See STRATOWA 78
-1.258 ± 0.015	[26] KROHN	75	CNTR	Cold n, polarized, A
-1.263 ± 0.016	[27] KROPF	74	RVUE	n decay alone
-1.250 ± 0.009	[27] KROPF	74	RVUE	n decay + nuclear ft

[22] This is the combined result of ABELE 02 and ABELE 97D.

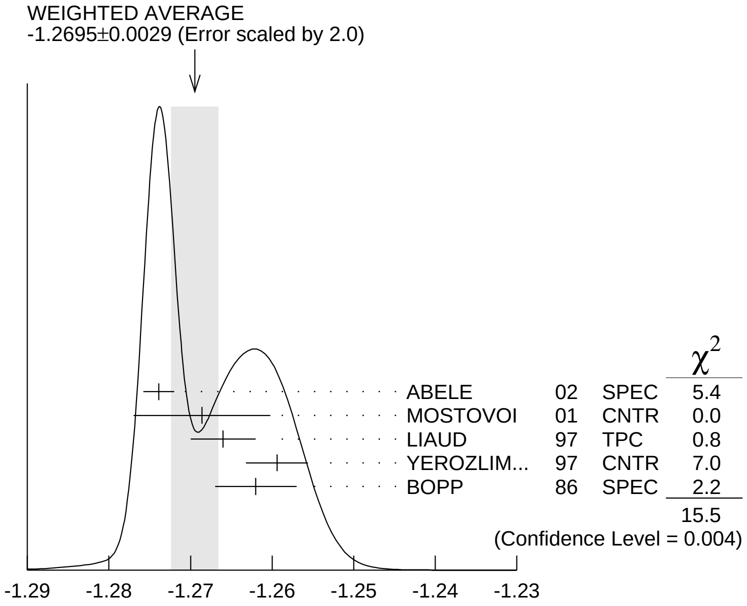
[23] MOSTOVOI 01 measures the two P-odd correlations A and B, or rather SA and SB, where S is the n polarization, in free neutron decay.

[24] YEROZOLIMSKY 97 makes a correction to the EROZOLIMSKII 91 value.

[25] These experiments measure the absolute value of g_A/g_V only.

[26] KROHN 75 includes events of CHRISTENSEN 70.

[27] KROPF 74 reviews all data through 1972.



$\lambda \equiv g_A \,/\, g_V$

β ASYMMETRY PARAMETER *A*

This is the neutron-spin electron-momentum correlation coefficient. Unless otherwise noted, the values are corrected for radiative effects and weak magnetism.

−0.1173±0.0013 OUR NEW AVERAGE Error includes scale factor of 2.3. See the ideogram below. [−0.1162 ± 0.0013 OUR 2002 AVERAGE Scale factor = 1.8]

VALUE	*DOCUMENT ID*		*TECN*	*COMMENT*
−0.1189±0.0007	[28] ABELE	02	SPEC	Cold *n*, polarized
−0.1160±0.0009±0.0012	LIAUD	97	TPC	Cold *n*, polarized
−0.1135±0.0014	[29] YEROZLIM...	97	CNTR	Cold *n*, polarized
−0.1146±0.0019	BOPP	86	SPEC	Cold *n*, polarized

• • • We do not use the following data for averages, fits, limits, etc. • • •

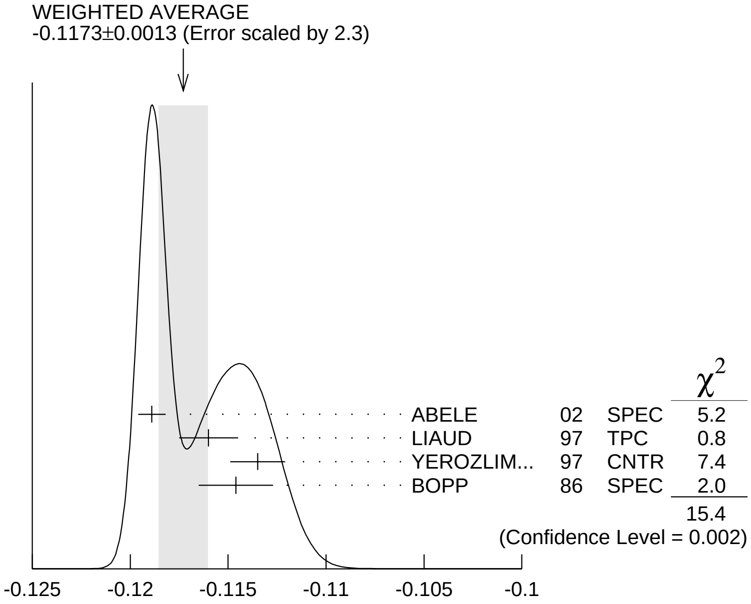
−0.1168±0.0017	[30] MOSTOVOI	01	CNTR	Inferred
−0.1189±0.0012	ABELE	97D	SPEC	Cold *n*, polarized
−0.1160±0.0009±0.0011	SCHRECK...	95	TPC	See LIAUD 97
−0.1116±0.0014	EROZOLIM...	91	CNTR	See YEROZOLIMSKY 97
−0.114 ±0.005	[31] EROZOLIM...	79	CNTR	Cold *n*, polarized
−0.113 ±0.006	[31] KROHN	75	CNTR	Cold *n*, polarized

[28] This is the combined result of ABELE 02 and ABELE 97D.

[29] YEROZOLIMSKY 97 makes a correction to the EROZOLIMSKII 91 value.

[30] MOSTOVOI 01 calculates this from its measurement of $\lambda = g_A/g_V$ above.

[31] These results are not corrected for radiative effects and weak magnetism, but the corrections are small compared to the errors.



β asymmetry parameter *A*

$\overline{\nu}_e$ ASYMMETRY PARAMETER B

This is the neutron-spin antineutrino-momentum correlation coefficient.

VALUE	*DOCUMENT ID*		*TECN*	*COMMENT*
0.983 ±0.004 OUR AVERAGE				
0.9801±0.0046	SEREBROV	98	CNTR	Cold *n*, polarized
0.9894±0.0083	KUZNETSOV	95	CNTR	Cold *n*, polarized
0.995 ±0.034	CHRISTENSEN	70	CNTR	Cold *n*, polarized
1.00 ±0.05	EROZOLIM...	70C	CNTR	Cold *n*, polarized
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.9876±0.0004	[32] MOSTOVOI	01	CNTR	Inferred

[32] MOSTOVOI 01 calculates this from its measurement of $\lambda = g_A/g_V$ above.

e-$\overline{\nu}_e$ ANGULAR CORRELATION COEFFICIENT a

VALUE	*DOCUMENT ID*		*TECN*	*COMMENT*
−0.103 ±0.004 OUR NEW AVERAGE [−0.102 ± 0.005 OUR 2002 AVERAGE]				
−0.1054±0.0055	BYRNE	02	SPEC	Proton recoil spectrum
−0.1017±0.0051	STRATOWA	78	CNTR	Proton recoil spectrum
−0.091 ±0.039	GRIGOREV	68	SPEC	Proton recoil spectrum
• • • We do not use the following data for averages, fits, limits, etc. • • •				
−0.1045±0.0014	[33] MOSTOVOI	01	CNTR	Inferred

[33] MOSTOVOI 01 calculates this from its measurement of $\lambda = g_A/g_V$ above.

ϕ_{AV}, PHASE OF g_A RELATIVE TO g_V

Time reversal invariance requires this to be 0 or 180°. This is related to D given in the next data block and $\lambda \equiv g_A/g_V$ by $\sin(\phi_{AV}) = D(1+3\lambda^2)/2\lambda$.

VALUE (°)	*DOCUMENT ID*		*TECN*	*COMMENT*
180.08±0.10 OUR AVERAGE				
180.08±0.13	LISING	00	CNTR	Polarized >93%
179.71±0.39	EROZOLIM...	78	CNTR	Cold *n*, polarized
180.35±0.43	EROZOLIM...	74	CNTR	Cold *n*, polarized
180.14±0.22	STEINBERG	74	CNTR	Cold *n*, polarized
• • • We do not use the following data for averages, fits, limits, etc. • • •				
181.1 ±1.3	[34] KROPF	74	RVUE	*n* decay

[34] KROPF 74 reviews all data through 1972.

TRIPLE CORRELATION COEFFICIENT D

These are measurements of the component of n spin perpendicular to the decay plane in β decay. Should be zero if T invariance is not violated.

VALUE	*DOCUMENT ID*		*TECN*	*COMMENT*
$(-0.6 \pm 1.0) \times 10^{-3}$ OUR AVERAGE				
− 0.0006±0.0012±0.0005	LISING	00	CNTR	Polarized >93%
+ 0.0022±0.0030	EROZOLIM...	78	CNTR	Cold *n*, polarized
− 0.0027±0.0050	[35] EROZOLIM...	74	CNTR	Cold *n*, polarized
− 0.0011±0.0017	STEINBERG	74	CNTR	Cold *n*, polarized

[35] EROZOLIMSKII 78 says asymmetric proton losses and nonuniform beam polarization may give a systematic error up to 0.003, thus increasing the EROZOLIMSKII 74 error to 0.005. STEINBERG 74 and STEINBERG 76 estimate these systematic errors to be insignificant in their experiment.

n REFERENCES

We have omitted some papers that have been superseded by later experiments. See our earlier editions.

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