## $n \to p e^- \nu$ 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 and asymmetry parameter $A$, comparisons with other methods of obtaining these constants, and implications for particle and astrophysics, see DUBBERS 91 and WOOLCOCK 91. For tests of the $V-A$ theory of neutron decay, see EROZOLIMSKII 91B.

### $g_A$ / $g_V$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| **−1.2573±0.0028 OUR AVERAGE** | | | | |
| −1.2544±0.0036 | EROZOLIM... | 91 | CNTR | $e$ mom-$n$ spin corr. |
| −1.262 ±0.005 | BOPP | 86 | SPEC | $e$ mom-$n$ spin corr. |
| −1.261 ±0.012 | [12] EROZOLIM... | 79 | CNTR | $e$ mom-$n$ spin corr. |
| −1.259 ±0.017 | [12] STRATOWA | 78 | CNTR | proton recoil spectrum |
| −1.258 ±0.015 | [13] KROHN | 75 | CNTR | $e$ mom-$n$ spin corr. |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| −1.226 ±0.042 | MOSTOVOY | 83 | RVUE | |
| −1.263 ±0.015 | EROZOLIM... | 77 | CNTR | See EROZOLIMSKII 79 |
| −1.250 ±0.036 | [12] DOBROZE... | 75 | CNTR | See STRATOWA 78 |
| −1.263 ±0.016 | [14] KROPF | 74 | RVUE | $n$ decay alone |
| −1.250 ±0.009 | [14] KROPF | 74 | RVUE | $n$ decay + nuclear ft |

[12] These experiments measure the absolute value of $g_A/g_V$ only.
[13] KROHN 75 includes events of CHRISTENSEN 70.
[14] KROPF 74 reviews all data through 1972.

### $\beta$ 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.

| VALUE | DOCUMENT ID | | TECN |
|---|---|---|---|
| **−0.1127±0.0011 OUR AVERAGE** | | | |
| −0.1116±0.0014 | EROZOLIM... | 91 | CNTR |
| −0.1146±0.0019 | BOPP | 86 | SPEC |
| −0.114 ±0.005 | [15] EROZOLIM... | 79 | CNTR |
| −0.113 ±0.006 | [15] KROHN | 75 | CNTR |

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

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

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

| VALUE | DOCUMENT ID | | TECN |
|---|---|---|---|
| **0.997±0.028 OUR AVERAGE** | | | |
| 0.995±0.034 | CHRISTENSEN | 70 | CNTR |
| 1.00 ±0.05 | EROZOLIM... | 70C | CNTR |

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

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| **−0.102 ±0.005 OUR AVERAGE** | | | | |
| −0.1017±0.0051 | STRATOWA | 78 | CNTR | Proton recoil spectrum |
| −0.091 ±0.039 | GRIGOREV | 68 | SPEC | Proton recoil spectrum |

### $\phi_{AV}$, PHASE OF $g_A$ RELATIVE TO $g_V$

Time reversal invariance requires this to be 0 or 180°.

| VALUE (°) | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| **180.07±0.18 OUR EVALUATION** | Using the average value for quantity $D$ given in the next data block and $\lambda \equiv g_A/g_V$ in $\sin\phi_{AV} = D(1+3\lambda^2)/2\lambda$. | | | |
| **180.09±0.18 OUR AVERAGE** | | | | |
| 179.71±0.39 | EROZOLIM... | 78 | CNTR | Polarized neutrons |
| 180.35±0.43 | EROZOLIM... | 74 | CNTR | Polarized neutrons |
| 180.14±0.22 | STEINBERG | 74 | CNTR | Polarized neutrons |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 181.1 ±1.3 | [16] KROPF | 74 | RVUE | $n$ decay |

[16] 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 $\beta$ decay. Should be zero if $T$ invariance is not violated.

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| **$(-0.5 \pm 1.4) \times 10^{-3}$ OUR AVERAGE** | | | | |
| + 0.0022±0.0030 | EROZOLIM... | 78 | CNTR | Polarized neutrons |
| − 0.0027±0.0050 | [17] EROZOLIM... | 74 | CNTR | Polarized neutrons |
| − 0.0011±0.0017 | STEINBERG | 74 | CNTR | Polarized neutrons |

[17] 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. The omitted papers may be found in our 1986 edition (Physics Letters **170B**) or in earlier editions.


| | | | | |
|---|---|---|---|---|
| MAMPE | 93 | JETPL 57 82 | +Bondarenko, Morozov+ | (KIAE) |
| | | Translated from ZETFP 57 77. | | |
| NATARAJAN | 93 | PRL 71 1998 | +Boyce, DiFilippo, Pritchard | (MIT) |
| PENDLEBURY | 93 | ARNPS 43 687 | | (ILLG) |
| ALTAREV | 92 | PL B276 242 | +Borisov, Borovikova, Ivanov+ | (PNPI) |
| NESVIZHEV... | 92 | JETP 75 405 | Nesvizhevskii, Serebrov, Tal'daev+ | (PNPI, JINR) |
| | | Translated from ZETF 102 740. | | |
| SCHRECK... | 92 | JPG 18 1 | Schreckenbach, Mampe | (ILLG) |
| ALBERICO | 91 | NP A523 488 | +de Pace, Pignone | (TORI) |
| DUBBERS | 91 | NP A527 239c | | (ILLG) |
| Also | 90 | EPL 11 195 | Dubbers, Mampe, Doehner | (ILLG, HEID) |
| EROZOLIM... | 91 | PL B263 33 | Erozolimskii, Kuznetsov, Stepanenko, Kuida+ | (PNPI, KIAE) |
| Also | 90 | SJNP 52 999 | Erozolimskii, Kuznetsov, Stepanenko, Kuida+ | (PNPI, KIAE) |
| | | Translated from YAF 52 1583. | | |
| EROZOLIM... | 91B | SJNP 53 260 | Erozolimskii, Mostovoi | (KIAE) |
| | | Translated from YAF 53 418. | | |
| SCHMIEDM... | 91 | PRL 66 1015 | Schmiedmayer, Riehs, Harvey, Hill | (TUW, ORNL) |
| WOOLCOCK | 91 | MPL A6 2579 | | (CANB) |
| ALFIMENKOV | 90 | JETPL 52 373 | +Varlamov, Vasil'ev, Gudkov+ | (PNPI, JINR) |
| | | Translated from ZETFP 52 984. | | |
| BALDO-... | 90 | PL B236 95 | Baldo-Ceolin, Benetti, Bitter+ | (PADO, PAVI, HEIDP, ILLG) |
| BERGER | 90 | PL B240 237 | +Froehlich, Moench, Nisius+ | (FREJUS Collab.) |
| BRESSI | 90 | NC 103A 731 | +Calligarich, Cambiaghi+ | (PAVI, ROMA, MILA) |
| BYRNE | 90 | PRL 65 289 | +Dawber, Spain, Williams+ | (SUSS, NBS, SCOT, CBNM) |
| FREEDMAN | 90 | CNPP 19 209 | | (ANL) |
| GREEN | 90 | JPG 16 L75 | +Thompson | (RAL) |
| RAMSEY | 90 | ARNPS 40 1 | | (HARV) |
| ROSE | 90 | PL B234 460 | +Zurmuehl, Rullhusen, Ludwig+ | (GOET, MPCM, MANZ) |
| ROSE | 90B | NP A514 621 | +Zurmuehl, Rullhusen, Ludwig+ | (GOET, MPCM) |
| SMITH | 90 | PL B234 191 | +Crampin+ | (SUSS, RAL, HARV, WASH, ILLG, MUNT) |
| BRESSI | 89 | ZPHY C43 175 | +Calligarich, Cambiaghi+ | (INFN, MILA, PAVI, ROMA) |
| DOVER | 89 | NIM A284 13 | +Gal, Richard | (BNL, HEBR, ISNG) |
| EROZOLIM... | 89 | NIM A284 89 | Erozolimskii | (PNPI) |
| KOSSAKOW... | 89 | NP A503 473 | Kossakowski, Grivot+ | (LAPP, SAVO, ISNG, ILLG) |
| MAMPE | 89 | PRL 63 593 | +Ageron, Bates, Pendlebury, Steyerl | (ILLG, RISL, SUSS, URI) |
| MOHAPATRA | 89 | NIM A284 1 | | (UMD) |
| PAUL | 89 | ZPHY C45 25 | +Anton, Paul, Paul, Mampe | (BONN, WUPP, MPIH, ILLG) |
| SCHMIEDM... | 89 | NIM A284 137 | Schmiedmayer, Rauch, Riehs | (WIEN) |
| BAUMANN | 88 | PR D37 3107 | +Gaehler, Kalus, Mampe | (BAYR, MUNI, ILLG) |
| KOESTER | 88 | ZPHY A329 229 | +Waschkowski, Meier | (MUNI, MUNT) |
| LAST | 88 | PRL 60 995 | +Arnold, Doehner, Dubbers+ | (HEIDP, ILLG, ANL) |
| SCHMIEDM... | 88 | PRL 61 1065 | Schmiedmayer, Rauch, Riehs | (TUW) |
| Also | 88B | PRL 61 2509 erratum | Schmiedmayer, Rauch, Riehs | (TUW) |
| SPIVAK | 88 | JETP 67 1735 | | (KIAE) |
| | | Translated from ZETF 94 1. | | |
| COHEN | 87 | RMP 59 1121 | +Taylor | (RISC, NBS) |
| ALTAREV | 86 | JETPL 44 460 | +Borisov, Borovikova, Brandin, Egorov+ | (PNPI) |
| | | Translated from ZETFP 44 360. | | |
| BOPP | 86 | PRL 56 919 | +Dubbers, Hornig, Klemt, Last+ | (HEIDP, ANL, ILLG) |
| Also | 88 | ZPHY C37 179 | Klemt, Bopp, Hornig, Last+ | (HEIDP, ANL, ILLG) |
| CRESTI | 86 | PL B177 206 | +Pasquali, Peruzzo, Pinori, Sartori | (PADO) |
| Also | 88 | PL B200 587 erratum | Cresti, Pasquali, Peruzzo, Pinori, Sartori | (PADO) |
| GREENE | 86 | PRL 56 819 | +Kessler, Deslattes, Boerner | (NBS, ILLG) |
| KOSVINTSEV | 86 | JETPL 44 571 | +Morozov, Terekhov | (KIAE) |
| | | Translated from ZETFP 44 444. | | |
| TAKITA | 86 | PR D34 902 | +Arisaka, Kajita, Kifune+ | (KEK, TOKY+) |
| DOVER | 85 | PR C31 1423 | +Gal, Richard | (BNL) |
| FIDECARO | 85 | PL 156B 122 | +Lanceri+ | (CERN, ILLG, PADO, RAL, SUSS) |
| PARK | 85B | NP B252 261 | +Blewitt, Cortez, Foster+ | (IMB Collab.) |
| BATTISTONI | 84 | PL 133B 454 | +Bellotti, Bologna, Campana+ | (NUSEX Collab.) |
| JONES | 84 | PRL 52 720 | +Bionta, Blewitt, Bratton+ | (IMB Collab.) |
| PENDLEBURY | 84 | PL 136B 327 | +Smith, Golub, Byrne+ | (SUSS, HARV, RAL, ILLG) |
| CHERRY | 83 | PRL 50 1354 | +Lande, Lee, Steinberg, Cleveland | (PENN, BNL) |
| DOVER | 83 | PR D27 1090 | +Gal, Richards | (BNL) |
| KABIR | 83 | PRL 51 231 | | (HARV) |
| MOSTOVOY | 83 | JETPL 37 196 | | (KIAE) |
| | | Translated from ZETFP 37 162. | | |
| ROY | 83 | PR D28 1770 | +Vaidya, Ephraim, Datar, Bhatki+ | (TATA) |
| VAIDYA | 83 | PR D27 486 | +Roy, Ephraim, Datar, Bhattacherjee | (TATA) |
| GAEHLER | 82 | PR D25 2887 | +Kalus, Mampe | (BAYR, ILLG) |
| GREENE | 82 | Metrologia 18 93 | + | (YALE, HARV, ILLG, SUSS, ORNL, CENG) |
| ALTAREV | 81 | PL 102B 13 | +Borisov, Borovikova, Brandin, Egorov+ | (PNPI) |
| BARABANOV | 80 | JETPL 32 359 | +Veretenkin, Gavrin+ | (PNPI) |
| | | Translated from ZETFP 32 384. | | |
| BYRNE | 80 | PL 92B 274 | +Morse, Smith, Shaikh, Green, Greene | (SUSS, RL) |
| KOSVINTSEV | 80 | JETPL 31 236 | +Kushnir, Morozov, Terekhov | (JINR) |
| | | Translated from ZETFP 31 257. | | |
| MOHAPATRA | 80 | PRL 44 1316 | +Marshak | (CUNY, VPI) |
| ALTAREV | 79 | JETPL 29 730 | +Borisov, Brandin, Egorov, Ezhov, Ivanov+ | (PNPI) |
| | | Translated from ZETFP 29 794. | | |
| EROZOLIM... | 79 | SJNP 30 356 | Erozolimskii, Frank, Mostovoy+ | (KIAE) |
| | | Translated from YAF 30 692. | | |
| NORMAN | 79 | PRL 43 1226 | +Seamster | (WASH) |
| BONDAREN... | 78 | JETPL 28 303 | Bondarenko, Kurguzov, Prokofev+ | (KIAE) |
| | | Translated from ZETFP 28 328. | | |
| Also | 82 | Smolenice Conf. | Bondarenko | (KIAE) |
| EROZOLIM... | 78 | SJNP 28 48 | Erozolimskii, Mostovoy, Fedunin, Frank+ | (KIAE) |
| | | Translated from YAF 28 98. | | |
| STRATOWA | 78 | PR D18 3970 | +Dobrozemsky, Weinzierl | (SEIB) |
| EROZOLIM... | 77 | JETPL 23 663 | Erozolimskii, Frank, Mostovoy+ | (KIAE) |
| | | Translated from ZETFP 23 720. | | |
| STEINBERG | 76 | PR D13 2469 | +Liaud, Vignon, Hughes | (YALE, ISNG) |
| DOBROZE... | 75 | PR D11 510 | Dobrozemsky, Kerschbaum, Moraw, Paul+ | (SEIB) |
| KROHN | 75 | PL 55B 175 | +Ringo | (ANL) |
| EROZOLIM... | 74 | JETPL 20 345 | Erozolimskii, Mostovoy, Fedunin, Frank+ | |
| | | Translated from ZETFP 20 745. | | |
| KROPF | 74 | ZPHY 267 129 | +Paul | (LINZ) |
| Also | 70 | NP A154 160 | Paul | (VIEN) |
| STEINBERG | 74 | PRL 33 41 | +Liaud, Vignon, Hughes | (YALE, ISNG) |
| COHEN | 73 | JPCRD 2 663 | +Taylor | (RISC, NBS) |
| CHRISTENSEN | 72 | PR D5 1628 | +Nielson, Bahnsen, Brown+ | (RISO) |
| CHRISTENSEN | 70 | PR C1 1693 | +Krohn, Ringo | (ANL) |
| EROZOLIM... | 70C | PL 33B 351 | Erozolimskii, Bondarenko, Mostovoy, Obinyakov+ | (KIAE) |
| GRIGOREV | 68 | SJNP 6 239 | Grigor'ev, Grishin, Vladimirsky, Nikolaevskii+ | (ITEP) |
| | | Translated from YAF 6 329. | | |