\[ I(J^P) = 1(\frac{1}{2}^+) \] Status: ******

We have omitted some results that have been superseded by later experiments.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

### $\Sigma^-$ MASS

The fit uses $\Sigma^+$, $\Sigma^0$, $\Sigma^-$, and $\Lambda$ mass and mass-difference measurements.

| VALUE (MeV) | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------------|------|-------------|------|---------|
| 1197.449 ± 0.030 OUR FIT | | | |
| 1197.45 ± 0.04 OUR AVERAGE | | | |
| 1197.417 ± 0.040 | GUREV | 93 | SPEC | $\Sigma^-$ C atom, crystal diff. |
| 1197.532 ± 0.057 | GALL | 88 | CNTR | $\Sigma^-$ Pb, $\Sigma^-$ W atoms |
| 1197.43 ± 0.08 | SCHMIDT | 65 | HBC | See note with $\Lambda$ mass |
| 1197.24 ± 0.15 | 1 DUGAN | 75 | CNTR | Exotic atoms |

1 GALL 88 concludes that the DUGAN 75 mass needs to be reevaluated.

### $m_{\Sigma^-} - m_{\Sigma^+}$

| VALUE (MeV) | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------------|------|-------------|------|---------|
| 8.08 ± 0.08 OUR FIT | | | |
| 8.09 ± 0.16 OUR AVERAGE | | | |
| 7.91 ± 0.23 | BOHM | 72 | EMUL | |
| 8.25 ± 0.25 | DOSCH | 65 | HBC | |
| 8.25 ± 0.40 | BARKAS | 63 | EMUL | |

### $m_{\Sigma^-} - m_{\Lambda}$

| VALUE (MeV) | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------------|------|-------------|------|---------|
| 81.766 ± 0.030 OUR FIT | | | |
| 81.69 ± 0.07 OUR AVERAGE | | | |
| 81.64 ± 0.09 | HEPP | 68 | HBC | |
| 81.80 ± 0.13 | SCHMIDT | 65 | HBC | See note with $\Lambda$ mass |
| 81.70 ± 0.19 | BURNSTEIN | 64 | HBC | |

### $\Sigma^-$ MEAN LIFE

Measurements with an error $\geq 0.2 \times 10^{-10}$ s have been omitted.

| VALUE ($\times 10^{-10}$ s) | EVTS | DOCUMENT ID | TECN | COMMENT |
|-----------------------------|------|-------------|------|---------|
| 1.479 ± 0.011 OUR AVERAGE | | | |
| 1.480 ± 0.014 | MARRAFFINO | 80 | HBC | $K^- p$ 0.42–0.5 GeV/c |
| 1.49 ± 0.03 | CONFORTO | 76 | HBC | $K^- p$ 1–1.4 GeV/c |
| 1.463 ± 0.039 | ROBERTSON | 72 | HBC | $K^- p$ 0.25 GeV/c |
| 1.42 ± 0.05 | BAKKER | 71 | DBC | $K^- N \rightarrow \Sigma^- \pi \pi$ |
| 1.41 ± 0.09 | TOVEE | 71 | EMUL | |

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### $\Sigma^-$ Mean Life ($10^{-10}$ s)

**$\Sigma^-$ Magnetic Moment**

See the "Note on Baryon Magnetic Moments" in the Λ Listings. Measurements with an error $\geq 0.3 \, \mu_N$ have been omitted.

| Value ($\mu_N$) | EVTS | DOCUMENT ID | TECN | COMMENT |
|-----------------|------|-------------|------|---------|
| $-1.160 \pm 0.025$ OUR AVERAGE | Error includes scale factor of 1.7. See the ideogram below. |
| $-1.105 \pm 0.029 \pm 0.010$ | HERTZOG 88 CNTR | Σ$^-$ Pb, Σ$^-$ W atoms |
| $-1.166 \pm 0.014 \pm 0.010$ | ZAPALAC 86 SPEC | $n^-$, $\nu$, $n^-$ decays |
| $-1.23 \pm 0.03 \pm 0.03$ | WAH 85 CNTR | $pCu \rightarrow \Sigma^- X$ |
| $-0.89 \pm 0.14$ | DECK 83 SPEC | $pBe \rightarrow \Sigma^- X$ |

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

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2 We have increased the CHANG 66 error of 0.018; see our 1970 edition, Reviews of Modern Physics 42 No. 1 (1970).
\[ \Sigma^- \] magnetic moment (\( \mu_N \))

\[ \Sigma^- \text{ DECAY MODES} \]

| Mode      | Fraction \( \Gamma_i / \Gamma \) |
|-----------|-----------------------------------|
| \( \Gamma_1 \) \( n \pi^- \) | (99.848 ± 0.005) % |
| \( \Gamma_2 \) \( n \pi^- \gamma \) | \([a] \ (4.6 \pm 0.6) \times 10^{-4}\) |
| \( \Gamma_3 \) \( n e^- \bar{\nu}_e \) | \( (1.017 \pm 0.034) \times 10^{-3}\) |
| \( \Gamma_4 \) \( n \mu^- \bar{\nu}_\mu \) | \( (4.5 \pm 0.4) \times 10^{-4}\) |
| \( \Gamma_5 \) \( \Lambda e^- \bar{\nu}_e \) | \( (5.73 \pm 0.27) \times 10^{-5}\) |

\[ [a] \text{ See the Particle Listings below for the pion momentum range used in this measurement.} \]
CONSTRANDED FIT INFORMATION

An overall fit to 3 branching ratios uses 16 measurements and one constraint to determine 4 parameters. The overall fit has a $\chi^2 = 8.7$ for 13 degrees of freedom.

The following off-diagonal array elements are the correlation coefficients $\langle \delta x_i \delta x_j \rangle / (\delta x_i, \delta x_j)$, in percent, from the fit to the branching fractions, $x_i \equiv \Gamma_i / \Gamma_{\text{total}}$. The fit constrains the $x_i$ whose labels appear in this array to sum to one.

\[
\begin{array}{c|ccc}
& x_3 & x_4 & x_5 \\
\hline
x_3 & -64 & & \\
x_4 & -77 & 0 & \\
x_5 & -5 & 0 & 0 \\
\end{array}
\]

$\Sigma^-$ BRANCHING RATIOS

$\Gamma(n\pi^-\gamma) / \Gamma(n\pi^-)$  $\Gamma_2 / \Gamma_1$

The $\pi^+$ momentum cuts differ, so we do not average the results but simply use the latest value for the Summary Table.

$\Gamma(n\pi^-\nu_e) / \Gamma(n\pi^-)$  $\Gamma_3 / \Gamma_1$

Measurements with an error $\geq 0.2 \times 10^{-3}$ have been omitted.

An additional negative systematic error is included for internal radiative corrections and latest form factors; see BOURQUIN 83C.
See the “Note on Baryon Decay Parameters” in the neutron Listings.
Older, outdated results have been omitted.

\( g_A/g_V \) FOR \( \Sigma^- \rightarrow ne^-\bar{\nu}_e \)

Measurements with fewer than 500 events have been omitted. Where necessary, signs have been changed to agree with our conventions, which are given in the “Note on Baryon Decay Parameters” in the neutron Listings. What is actually listed is \( |g_1/f_1| \) -
0.237 \frac{g_2}{f_1} \right| \cdot This reduces to \frac{g_A}{g_V} \equiv \frac{g_1(0)}{f_1(0)} on making the usual assumption that \( g_2 = 0 \). See also the note on HSUEH 88.

| VALUE    | EVTS | DOCUMENT ID | TECN | COMMENT |
|----------|------|-------------|------|---------|
| 0.340 ± 0.017 OUR AVERAGE | 6 | HSUEH 88 | SPEC | 250 GeV |
| +0.327 ± 0.007 ± 0.019 | 50k | BOURQUIN 83c | SPEC | SPS hyperon beam |
| +0.34 ± 0.05 | 4456 | TANENBAUM 74 | ASPK |

**TRIPLE CORRELATION COEFFICIENT D FOR \( \Sigma^- \rightarrow ne^-\nu_e \)**

The coefficient \( D \) of the term \( D \mathbf{P}(\mathbf{p}_e \times \mathbf{p}_\nu) \) in the \( \Sigma^- \rightarrow ne^-\nu_e \) decay angular distribution. A nonzero value would indicate a violation of time-reversal invariance.

| VALUE    | EVTS | DOCUMENT ID | TECN | COMMENT |
|----------|------|-------------|------|---------|
| 0.11 ± 0.10 OUR AVERAGE | 6 | HSUEH 88 | SPEC | 250 GeV |

**\( g_V/g_A \) FOR \( \Sigma^- \rightarrow \Lambda e^-\nu_e \)**

For the sign convention, see the “Note on Baryon Decay Parameters” in the neutron Listings. The value is predicted to be zero by conserved vector current theory. The values averaged assume CVC-SU(3) weak magnetism term.

| VALUE    | EVTS | DOCUMENT ID | TECN | COMMENT |
|----------|------|-------------|------|---------|
| 0.01 ± 0.10 OUR AVERAGE | 9 | BOURQUIN 82 | SPEC | SPS hyperon beam |
| +0.034 ± 0.080 | 1620 | THOMPSON 80 | ASPK | BNL hyperon beam |
| +0.29 ± 0.29 | 114 | TANENBAUM 75b | SPEC | BNL hyperon beam |
| +0.45 ± 0.20 | 186 | FRANZINI 72 | HBC |

6 The sign is, with our conventions, unambiguously positive. The value assumes, as usual, that \( g_2 = 0 \). If \( g_2 \) is included in the fit, than (with our sign convention) \( g_2 = -0.56 \pm 0.37 \), with a corresponding reduction of \( g_A/g_V \) to \( +0.20 \pm 0.08 \).

7 BOURQUIN 83c favors the positive sign by at least 2.6 standard deviations.

8 TANENBAUM 74 gives \( 0.435 \pm 0.035 \), assuming no \( q^2 \) dependence in \( g_A \) and \( g_V \). The listed result allows \( q^2 \) dependence, and is taken from HSUEH 88.

9 The sign has been changed to agree with our convention.

10 The FRANZINI 72 value includes the events of earlier papers.
We have omitted some papers that have been superseded by later experiments. See our earlier editions.

\[ g_V / g_A \text{ for } \Sigma^- \rightarrow \Lambda e^- \nu_e \]

\[ g_{WM} / g_A \text{ FOR } \Sigma^- \rightarrow \Lambda e^- \nu_e \]

The values quoted assume the CVC prediction \( g_V = 0 \).

| VALUE | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------|------|-------------|------|---------|
| 1.75 ± 3.5 | 114 | THOMPSON 80 ASPK | BNL hyperon beam |
| 3.5 ± 4.5 | 55 | TANENBAUM 75B SPEC | BNL hyperon beam |
| 2.4 ± 2.1 | 186 | FRANZINI 72 HBC | |

**Σ^- REFERENCES**

We have omitted some papers that have been superseded by later experiments. See our earlier editions.
| Name       | Year | Journal   | Additional Information |
|------------|------|-----------|------------------------|
| Tanenbaum  | 74   | PRL 33 175 | Hungerbuhler+ (Yale, FNAL, BNL) |
| Ebenhoh   | 73   | ZPHY 264 413 | Eisele, Filthuth, Hepp, Leitner, Thouw+ (HEIDT) |
| Sechizorn  | 73   | PR D8 12   | Snow (UMD) |
| Bohm      | 72   | NP B48 1   | (BERL, KIDR, BRUX, IASD, DUUC, LOUC+) |
| Franzini  | 72   | PR D6 2417 | (COLU, HEID, UMD, STON) |
| Robertson | 72   | Thesis UMI 78-00877 | (IIT) |
| Bakker    | 71   | LNC 1 37   | Hoogland, Kluiver, Massard+ (SABRE Collab.) |
| Cole      | 71   | PR D4 631  | Lee-Franzini, Loveless, Baltay+ (STON, COLU) |
| Also      | 69   | Thesis Nevis 175 | Norton (COLU) |
| Tovee     | 71   | NP B33 493 | (LOUC, KIDR, BERL, BRUX, DUUC, WARS) |
| Berley    | 70B  | PR D1 2015 | Yamin, Hertzbach, Kofler+ (BNL, MASA, YALE) |
| Bogert    | 70   | PR D2 6    | Lucas, Taft, Willis, Berley+ (BNL, MASA, YALE) |
| Eisele    | 70   | ZPHY 238 372 | Filthuth, Hepp, Presser, Zech (HEID) |
| PDG       | 70   | RMP 42 No. 1 | Barbara-Galtieri, Derenzo, Price+ (LRL, BRAN, CERN+) |
| Ang       | 69   | ZPHY 223 103 | Eisele, Engelmann, Filthuth+ (HEID) |
| Ang       | 69B  | ZPHY 228 151 | Ebenhoh, Eisele, Engelmann, Filthuth+ (HEID) |
| Baggett   | 69   | PRL 23 249 | Kehoe, Norton+ (UMD) |
| Baltay    | 69   | PRL 22 615 | Franzini, Newman, Norton+ (COLU, STON) |
| Bangerter | 69   | Thesis UCRL 19244 | Norton (LRL) |
| Bangerter | 69B  | PR 187 1821 | Alston-Garnjost, Galtieri, Gershwin+ (PRIN) |
| Barloutaud| 69   | NP B14 153 | DeBellefon, Granet+ (SACL, CERN, HEID) |
| Eisele    | 69   | ZPHY 221 1 | Engelmann, Filthuth, Fohlsch, Hepp+ (HEID) |
| Bierman   | 68   | PRL 20 1459 | Kounosu, Nauenberg+ (PRIN) |
| Hepp      | 68   | ZPHY 214 71 | Schleich (HEID) |
| Whiteside | 68   | NC 54A 537 | Gollub (BER) |
| Barash    | 67   | PRL 19 181 | Kehoe, Knop+ (UMD) |
| Chang     | 66   | PR 151 1081 | Kehoe, Zorn, Snow (UMD) |
| Bazin     | 65B  | PR 140B 1358 | Plano, Schmidt+ (PRIN, RUTG, COLU) |
| Dosch     | 65   | PL 14 239  | Engelmann, Filthuth, Hepp, Kluge+ (HEID) |
| Also      | 66   | PR 151 1081 | Chang (COLU) |
| Schmidt   | 65   | PR 140B 1328 | (COLU) |
| Burnstein | 64   | PRL 13 66 | Day, Hepp, Zorn, Snow (UMD) |
| Courant   | 64   | PR 136B 1791 | Filthuth+ (CERN, HEID, UMD, NRL, BNL) |
| Barkas    | 63   | PRL 11 26 | Dyer, Heckman (COLU) |
| Humphrey  | 62   | PR 127 1305 | Ross (LRL) |

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