# $\Omega^-$

$I(J^P) = 0(\frac{3}{2}^+)$ Status: ∗∗∗∗

The unambiguous discovery in both production and decay was by BARNES 64. The quantum numbers have not actually been measured, but follow from the assignment of the particle to the baryon decuplet. DEUTSCHMANN 78 and BAUBILLIER 78 rule out $J = 1/2$ and find consistency with $J = 3/2$.

We have omitted some results that have been superseded by later experiments. The omitted results may be found in our 1986 edition (Physics Letters **170B**) or in earlier editions.

## $\Omega^-$ MASS

The fit assumes the $\Omega^-$ and $\overline{\Omega}^+$ masses are the same.

| *VALUE* (MeV) | *EVTS* | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|---|
| **1672.45±0.29 OUR FIT** | | | | | |
| **1672.43±0.32 OUR AVERAGE** | | | | | |
| 1673 ±1 | 100 | HARTOUNI | 85 | SPEC | 80–280 GeV $K^0_L$ C |
| 1673.0 ±0.8 | 41 | BAUBILLIER | 78 | HBC | 8.25 GeV/$c$ $K^- p$ |
| 1671.7 ±0.6 | 27 | HEMINGWAY | 78 | HBC | 4.2 GeV/$c$ $K^- p$ |
| 1673.4 ±1.7 | 4 | [1] DIBIANCA | 75 | DBC | 4.9 GeV/$c$ $K^- d$ |
| 1673.3 ±1.0 | 3 | PALMER | 68 | HBC | $K^- p$ 4.6, 5 GeV/$c$ |
| 1671.8 ±0.8 | 3 | SCHULTZ | 68 | HBC | $K^- p$ 5.5 GeV/$c$ |
| 1674.2 ±1.6 | 5 | SCOTTER | 68 | HBC | $K^- p$ 6 GeV/$c$ |
| 1672.1 ±1.0 | 1 | [2] FRY | 55 | EMUL | |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | |
| 1671.43±0.78 | 13 | [3] DEUTSCH... | 73 | HBC | $K^- p$ 10 GeV/$c$ |
| 1671.9 ±1.2 | 6 | [3] SPETH | 69 | HBC | See DEUTSCHMANN 73 |
| 1673.0 ±8.0 | 1 | ABRAMS | 64 | HBC | $\rightarrow \Xi^- \pi^0$ |
| 1670.6 ±1.0 | 1 | [2] FRY | 55B | EMUL | |
| 1615 | 1 | [4] EISENBERG | 54 | EMUL | |

[1] DIBIANCA 75 gives a mass for each event. We quote the average.

[2] The FRY 55 and FRY 55B events were identified as $\Omega^-$ by ALVAREZ 73. The masses assume decay to $\Lambda K^-$ at rest. For FRY 55B, decay from an atomic orbit could Doppler shift the $K^-$ energy and the resulting $\Omega^-$ mass by several MeV. This shift is negligible for FRY 55 because the $\Omega$ decay is approximately perpendicular to its orbital velocity, as is known because the $\Lambda$ strikes the nucleus (L.Alvarez, private communication 1973). We have calculated the error assuming that the orbital n is 4 or larger.

[3] Excluded from the average; the $\Omega^-$ lifetimes measured by the experiments differ significantly from other measurements.

[4] The EISENBERG 54 mass was calculated for decay in flight. ALVAREZ 73 has shown that the $\Omega$ interacted with an Ag nucleus to give $K^- \Xi$ Ag.

## $\overline{\Omega}^+$ MASS

The fit assumes the $\Omega^-$ and $\overline{\Omega}^+$ masses are the same.

| *VALUE* (MeV) | *EVTS* | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|---|
| **1672.45±0.29 OUR FIT** | | | | | |
| **1672.5 ±0.7 OUR AVERAGE** | | | | | |
| 1672 ±1 | 72 | HARTOUNI | 85 | SPEC | 80–280 GeV $K^0_L$ C |
| 1673.1 ±1.0 | 1 | FIRESTONE | 71B | HBC | 12 GeV/$c$ $K^+ d$ |

## $(m_{\Omega^-} - m_{\overline{\Omega}^+}) \,/\, m_{\text{average}}$

A test of $CPT$ invariance. Calculated from the *average* $\Omega^-$ and $\overline{\Omega}^+$ masses, above.

| *VALUE* | *DOCUMENT ID* |
|---|---|
| **(0±5) x 10$^{-4}$ OUR EVALUATION** | |

## $\Omega^-$ MEAN LIFE

Measurements with an error $> 0.1 \times 10^{-10}$ s have been omitted.

| *VALUE* ($10^{-10}$ s) | *EVTS* | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|---|
| **0.822±0.012 OUR AVERAGE** | | | | | |
| 0.811±0.037 | 1096 | LUK | 88 | SPEC | $p$ Be 400 GeV |
| 0.823±0.013 | 12k | BOURQUIN | 84 | SPEC | SPS hyperon beam |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | |
| 0.822±0.028 | 2437 | BOURQUIN | 79B | SPEC | See BOURQUIN 84 |

## $\Omega^-$ MAGNETIC MOMENT

| *VALUE* ($\mu_N$) | *EVTS* | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|---|
| **−2.02 ±0.05 OUR AVERAGE** | | | | | |
| −2.024±0.056 | 235k | WALLACE | 95 | SPEC | $\Omega^-$ 300–550 GeV |
| −1.94 ±0.17 ±0.14 | 25k | DIEHL | 91 | SPEC | Spin-transfer production |

## $\Omega^-$ DECAY MODES

| | Mode | | Fraction ($\Gamma_i/\Gamma$) | Confidence level |
|---|---|---|---|---|
| $\Gamma_1$ | $\Lambda K^-$ | | $(67.8\pm0.7)$ % | |
| $\Gamma_2$ | $\Xi^0 \pi^-$ | | $(23.6\pm0.7)$ % | |
| $\Gamma_3$ | $\Xi^- \pi^0$ | | $(8.6\pm0.4)$ % | |
| $\Gamma_4$ | $\Xi^- \pi^+ \pi^-$ | | $(4.3^{+3.4}_{-1.3}) \times 10^{-4}$ | |
| $\Gamma_5$ | $\Xi(1530)^0 \pi^-$ | | $(6.4^{+5.1}_{-2.0}) \times 10^{-4}$ | |
| $\Gamma_6$ | $\Xi^0 e^- \overline{\nu}_e$ | | $(5.6\pm2.8) \times 10^{-3}$ | |
| $\Gamma_7$ | $\Xi^- \gamma$ | | $< 4.6 \times 10^{-4}$ | 90% |
| | **$\Delta S = 2$ forbidden ($S2$) modes** | | | |
| $\Gamma_8$ | $\Lambda \pi^-$ | *S2* | $< 1.9 \times 10^{-4}$ | 90% |

## $\Omega^-$ BRANCHING RATIOS

The BOURQUIN 84 values (which include results of BOURQUIN 79B, a separate experiment) are much more accurate than any other results, and so the other results have been omitted.

### $\Gamma(\Lambda K^-)/\Gamma_{\text{total}}$ — $\Gamma_1/\Gamma$

| *VALUE* | *EVTS* | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|---|
| **0.678±0.007** | 14k | BOURQUIN | 84 | SPEC | SPS hyperon beam |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | |
| 0.686±0.013 | 1920 | BOURQUIN | 79B | SPEC | See BOURQUIN 84 |

### $\Gamma(\Xi^0 \pi^-)/\Gamma_{\text{total}}$ — $\Gamma_2/\Gamma$

| *VALUE* | *EVTS* | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|---|
| **0.236±0.007** | 1947 | BOURQUIN | 84 | SPEC | SPS hyperon beam |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | |
| 0.234±0.013 | 317 | BOURQUIN | 79B | SPEC | See BOURQUIN 84 |

### $\Gamma(\Xi^- \pi^0)/\Gamma_{\text{total}}$ — $\Gamma_3/\Gamma$

| *VALUE* | *EVTS* | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|---|
| **0.086±0.004** | 759 | BOURQUIN | 84 | SPEC | SPS hyperon beam |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | |
| 0.080±0.008 | 145 | BOURQUIN | 79B | SPEC | See BOURQUIN 84 |

### $\Gamma(\Xi^- \pi^+ \pi^-)/\Gamma_{\text{total}}$ — $\Gamma_4/\Gamma$

| *VALUE* (units $10^{-4}$) | *EVTS* | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|---|
| $\mathbf{4.3^{+3.4}_{-1.3}}$ | 4 | BOURQUIN | 84 | SPEC | SPS hyperon beam |

*CITATION: L. Montanet et al., Physical Review D50, 1173 (1994) and 1995 off-year partial update for the 1996 edition (URL: http://pdg.lbl.gov/)

### $\Gamma(\Xi(1530)^0\pi^-)/\Gamma_{total}$ $\Gamma_5/\Gamma$

| VALUE (units $10^{-4}$) | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **$6.4^{+5.1}_{-2.0}$** | 4 | [5] BOURQUIN | 84 | SPEC | SPS hyperon beam |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | |
| $\sim$ 20 | 1 | BOURQUIN | 79B | SPEC | See BOURQUIN 84 |

[5] The same 4 events as in the previous mode, with the isospin factor to take into account $\Xi(1530)^0 \rightarrow \Xi^0\pi^0$ decays included.

### $\Gamma(\Xi^0 e^-\overline{\nu}_e)/\Gamma_{total}$ $\Gamma_6/\Gamma$

| VALUE (units $10^{-3}$) | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **5.6±2.8** | 14 | BOURQUIN | 84 | SPEC | SPS hyperon beam |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | |
| $\sim$ 10 | 3 | BOURQUIN | 79B | SPEC | See BOURQUIN 84 |

### $\Gamma(\Xi^-\gamma)/\Gamma_{total}$ $\Gamma_7/\Gamma$

| VALUE (units $10^{-4}$) | CL% | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|---|
| **< 4.6** | 90 | 0 | ALBUQUERQ... | 94 | E761 | $\Omega^-$ 375 GeV |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | | |
| <22 | 90 | 9 | BOURQUIN | 84 | SPEC | SPS hyperon beam |
| <31 | 90 | 0 | BOURQUIN | 79B | SPEC | See BOURQUIN 84 |

### $\Gamma(\Lambda\pi^-)/\Gamma_{total}$ $\Gamma_8/\Gamma$

$\Delta S$=2. Forbidden in first-order weak interaction.

| VALUE (units $10^{-4}$) | CL% | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|---|
| **< 1.9** | 90 | 0 | BOURQUIN | 84 | SPEC | SPS hyperon beam |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | | |
| <13 | 90 | 0 | BOURQUIN | 79B | SPEC | See BOURQUIN 84 |

## $\Omega^-$ DECAY PARAMETERS

### $\alpha$ FOR $\Omega^- \rightarrow \Lambda K^-$

Some early results have been omitted.

| VALUE | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **−0.026±0.026 OUR AVERAGE** | | | | | |
| −0.034±0.079 | 1743 | LUK | 88 | SPEC | $p$Be 400 GeV |
| −0.025±0.028 | 12k | BOURQUIN | 84 | SPEC | SPS hyperon beam |

### $\alpha$ FOR $\Omega^- \rightarrow \Xi^0\pi^-$

| VALUE | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **+0.09±0.14** | 1630 | BOURQUIN | 84 | SPEC | SPS hyperon beam |

### $\alpha$ FOR $\Omega^- \rightarrow \Xi^-\pi^0$

| VALUE | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **+0.05±0.21** | 614 | BOURQUIN | 84 | SPEC | SPS hyperon beam |

## $\Omega^-$ 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.


| | | | | |
|---|---|---|---|---|
| WALLACE | 95 | PRL 74 3732 | +Border+ | (MINN, ARIZ, MICH, FNAL) |
| ALBUQUERQ... | 94 | PR D50 R18 | Albuquerque, Bondar, Carrigan+ | (FNAL E761 Collab.) |
| DIEHL | 91 | PRL 67 804 | +Teige, Thompson, Zou+ | (RUTG, FNAL, MICH, MINN) |
| LUK | 88 | PR D38 19 | +Beretvas, Deck+ | (RUTG, WISC, MICH, MINN) |
| HARTOUNI | 85 | PRL 54 628 | +Atiya, Holmes, Knapp, Lee+ | (COLU, ILL, FNAL) |
| BOURQUIN | 84 | NP B241 1 | + | (BRIS, GEVA, HEIDP, LALO, RAL, STRB) |
| Also | 79 | PL 87B 297 | Bourquin+ | (BRIS, GEVA, HEIDP, ORSAY, RHEL, STRB) |
| BOURQUIN | 79B | PL 88B 192 | + | (BRIS, GEVA, HEIDP, LALO, RAL) |
| BAUBILLIER | 78 | PL 78B 342 | + | (BIRM, CERN, GLAS, MSU, CURIN, PARIN) J |
| DEUTSCH... | 78 | PL 73B 96 | Deutschmann+ | (AACH3, BERL, CERN, INNS, LOIC+) J |
| HEMINGWAY | 78 | NP B142 205 | +Armenteros+ | (CERN, ZEEM, NIJM, OXF) |
| DIBIANCA | 75 | NP B98 137 | +Endorf | (CMU) |
| ALVAREZ | 73 | PR D8 702 | | (LBL) |

| | | | | |
|---|---|---|---|---|
| DEUTSCH... | 73 | NP B61 102 | Deutschmann, Kaufmann, Besliv+ | (ABCLV Collab.) |
| FIRESTONE | 71B | PRL 26 410 | +Goldhaber, Lissauer, Sheldon, Trilling | (LRL) |
| SPETH | 69 | PL 29B 252 | + | (AACH, BERL, CERN, LOIC, VIEN) |
| PALMER | 68 | PL 26B 323 | +Radojicic, Rau, Richardson+ | (BNL, SYRA) |
| SCHULTZ | 68 | PR 168 1509 | + | (ILL, ANL, NWES, WISC) |
| SCOTTER | 68 | PL 26B 474 | + | (BIRM, GLAS, LOIC, MUNI, OXF) |
| ABRAMS | 64 | PRL 13 670 | +Burnstein, Glasser+ | (UMD, NRL) |
| BARNES | 64 | PRL 12 204 | +Connolly, Crennell, Culwick+ | (BNL) |
| FRY | 55 | PR 97 1189 | +Schneps, Swami | (WISC) |
| FRY | 55B | NC 2 346 | +Schneps, Swami | (WISC) |
| EISENBERG | 54 | PR 96 541 | | (CORN) |