Ω^-

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

The unambiguous discovery in both production and decay was by BARNES 64. The quantum numbers 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 $J = 3/2$. AUBERT,BE 06 finds from the decay angular distributions of $\Xi_c^0 \to \Omega^- K^+$ and $\Omega_c^0 \to \Omega^- K^+$ that $J = 3/2$; this depends on the spins of the Ξ_c^0 and Ω_c^0 being $J = 1/2$, their supposed values. ABLIKIM 21E determines the Ω^- spin to be $J = 3/2$ from the decay angular distributions of the complete decay chain $\psi(3686) \to \Omega^- \overline{\Omega}^+$, with subsequent decays $\Omega^- \to K^- \Lambda$ and $\overline{\Omega}^+ \to K^+ \overline{\Lambda}$.

We have omitted some results that have been superseded by later experiments.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

Ω^- MASS

The fit assumes the Ω^- and $\overline{\Omega}^+$ masses are the same, and averages them together.

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_L^0 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	$\to \Xi^- \pi^0$
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 Ω^- by ALVAREZ 73. The masses assume decay to ΛK^- at rest. For FRY 55B, decay from an atomic orbit could Doppler shift the K^- energy and the resulting Ω^- mass by several MeV. This shift is negligible for FRY 55 because the Ω decay is approximately perpendicular to its orbital velocity, as is known because the Λ 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 Ω^- 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 Ω interacted with an Ag nucleus to give $K^- \Xi$ Ag.

$\overline{\Omega}^+$ MASS

The fit assumes the Ω^- and $\overline{\Omega}^+$ masses are the same, and averages them together.

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 $K^+ d$

$(m_{\Omega^-} - m_{\overline{\Omega}^+}) / m_{\Omega^-}$

A test of CPT invariance.

VALUE (units 10^{-5})	DOCUMENT ID		TECN	COMMENT
−1.44±7.98	CHAN	98	E756	p Be, 800 GeV

Ω^- MEAN LIFE

Measurements with an error $> 0.1 \times 10^{-10}$ s have been omitted. The fit assumes the Ω^- and $\overline{\Omega}^+$ mean lives are the same, and averages them together.

VALUE (10^{-10} s)	EVTS	DOCUMENT ID		TECN	COMMENT
0.821±0.011 OUR FIT					
0.821±0.011 OUR AVERAGE					
0.817±0.013±0.018	6934	CHAN	98	E756	p Be, 800 GeV
0.811±0.037	1096	LUK	88	SPEC	pBe 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

$\overline{\Omega}^+$ MEAN LIFE

The fit assumes the Ω^- and $\overline{\Omega}^+$ mean lives are the same, and averages them together.

VALUE (10^{-10} s)	EVTS	DOCUMENT ID		TECN	COMMENT
0.821±0.011 OUR FIT					
0.823±0.031±0.022	1801	CHAN	98	E756	p Be, 800 GeV

$(\tau_{\Omega^-} - \tau_{\overline{\Omega}^+}) / \tau_{\Omega^-}$

A test of CPT invariance. Our calculation, from the averages in the preceding two data blocks.

VALUE	DOCUMENT ID
0.00±0.05 OUR ESTIMATE	

Ω^- MAGNETIC MOMENT

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

Ω^- DECAY MODES

	Mode		Fraction (Γ_i/Γ)	Scale factor/ Confidence level
Γ_1	ΛK^-		(67.7 ± 0.7) %	
Γ_2	$\Xi^0 \pi^-$		(24.3 ± 0.7) %	S=1.5
Γ_3	$\Xi^- \pi^0$		(8.55 ± 0.33) %	
Γ_4	$\Xi^- \pi^+ \pi^-$		$(3.7^{+0.7}_{-0.6}) \times 10^{-4}$	
Γ_5	$\Xi(1530)^0 \pi^-$		$< 7 \times 10^{-5}$	CL=90%
Γ_6	$\Xi^0 e^- \overline{\nu}_e$		$(5.6 \pm 2.8) \times 10^{-3}$	
Γ_7	$\Xi^- \gamma$		$< 4.6 \times 10^{-4}$	CL=90%

$\Delta S = 2$ forbidden ($S2$) modes

	Mode		Fraction (Γ_i/Γ)	Scale factor/ Confidence level
Γ_8	$\Lambda \pi^-$	$S2$	$< 2.9 \times 10^{-6}$	CL=90%
Γ_9	$\Sigma^0 \pi^-$		$< 5.4 \times 10^{-4}$	CL=90%
Γ_{10}	$n K^-$		$< 2.4 \times 10^{-4}$	CL=90%

Ω^- 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.

$\Gamma(\Lambda K^-)/\Gamma_{\text{total}}$ Γ_1/Γ

VALUE (%)	EVTS	DOCUMENT ID		TECN	COMMENT
67.7±0.7 OUR AVERAGE					
66.3±0.8±2.0	9.0k	ABLIKIM	23BJ	BES3	$e^+ e^- \to \psi(3686) \to \Omega \overline{\Omega}$
67.8±0.7	14k	BOURQUIN	84	SPEC	SPS hyperon beam
• • • We do not use the following data for averages, fits, limits, etc. • • •					
68.6±1.3	1920	BOURQUIN	79B	SPEC	See BOURQUIN 84

$\Gamma(\Xi^0 \pi^-)/\Gamma_{\text{total}}$ Γ_2/Γ

VALUE (%)	EVTS	DOCUMENT ID		TECN	COMMENT
24.3 ±0.7 OUR AVERAGE	Error includes scale factor of 1.5.				
25.03±0.44±0.53	5.4k	ABLIKIM	23BJ	BES3	$e^+ e^- \to \psi(3686) \to \Omega \overline{\Omega}$

23.6 $\pm$0.7	1947	BOURQUIN	84	SPEC	SPS hyperon beam
• • • We do not use the following data for averages, fits, limits, etc. • • •					
23.4 $\pm$1.3	317	BOURQUIN	79B	SPEC	See BOURQUIN 84

$\Gamma(\Xi^- \pi^0)/\Gamma_{\text{total}}$ Γ_3/Γ

VALUE (%)	EVTS	DOCUMENT ID		TECN	COMMENT
8.55$\pm$0.33 OUR AVERAGE					
8.43$\pm$0.52$\pm$0.28	794	ABLIKIM	23BJ	BES3	$e^+ e^- \rightarrow \psi(3686) \rightarrow \Omega\overline{\Omega}$
8.6 $\pm$0.4	759	BOURQUIN	84	SPEC	SPS hyperon beam
• • • We do not use the following data for averages, fits, limits, etc. • • •					
8.0 $\pm$0.8	145	BOURQUIN	79B	SPEC	See BOURQUIN 84

$\Gamma(\Xi^- \pi^+ \pi^-)/\Gamma_{\text{total}}$ Γ_4/Γ

VALUE (units 10^{-4})	EVTS	DOCUMENT ID		TECN	COMMENT
$3.74^{+0.67}_{-0.56}$	100	[5] KAMAEV	10	HYCP	p Cu, 800 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$4.3\ ^{+3.4}_{-1.3}$	4	BOURQUIN	84	SPEC	SPS hyperon beam

[5] This KAMAEV 10 value uses 76 $\Omega^- \rightarrow \Xi^- \pi^+ \pi^-$ and 24 $\overline{\Omega}^+ \rightarrow \overline{\Xi}^+ \pi^- \pi^+$ decays. The Ω^- and $\overline{\Omega}^+$ branching fractions measurements are statistically equal. The errors given combine statistical and systematic contributions. The *CP* branching-fraction asymmetry, $(\Omega^- - \overline{\Omega}^+)$/sum, is $+0.12 \pm 0.20$.

$\Gamma(\Xi(1530)^0 \pi^-)/\Gamma_{\text{total}}$ Γ_5/Γ

VALUE (units 10^{-4})	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
<0.7	90		KAMAEV	10	HYCP	p Cu, 800 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •						
$6.4^{+5.1}_{-2.0}$		4	[6] BOURQUIN	84	SPEC	SPS hyperon beam

[6] 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. BOURQUIN 84 adopted a theoretical assumption that $\Xi(1530)^0 \pi^-$ would dominate $\Xi^- \pi^+ \pi^-$ decay.

$\Gamma(\Xi^0 e^- \overline{\nu}_e)/\Gamma_{\text{total}}$ Γ_6/Γ

VALUE (units 10^{-3})	EVTS	DOCUMENT ID		TECN	COMMENT
5.6$\pm$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

$\Gamma(\Xi^- \gamma)/\Gamma_{\text{total}}$ Γ_7/Γ

VALUE (units 10^{-4})	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
< 4.6	90	0	ALBUQUERQ...	94	E761	Ω^- 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

$\Gamma(\Lambda\pi^-)/\Gamma_{total}$ Γ_8/Γ

ΔS=2. Forbidden in first-order weak interaction.

VALUE (units 10^{-6})	CL%	DOCUMENT ID		TECN	COMMENT
< 2.9	90	WHITE	05	HYCP	p Cu, 800 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •					
< 190	90	BOURQUIN	84	SPEC	SPS hyperon beam
<1300	90	BOURQUIN	79B	SPEC	See BOURQUIN 84

$\Gamma(\Sigma^0\pi^-)/\Gamma_{total}$ Γ_9/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<5.4\times10^{-4}$	90	ABLIKIM	24AI	BES3	$e^+e^- \to \psi(3686) \to \Omega\overline{\Omega}$

$\Gamma(nK^-)/\Gamma_{total}$ Γ_{10}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<2.4\times10^{-4}$	90	ABLIKIM	24AI	BES3	$e^+e^- \to \psi(3686) \to \Omega\overline{\Omega}$

Ω^- DECAY PARAMETERS

$\alpha(\Omega^-)\ \alpha_-(\Lambda)$ FOR $\Omega^- \to \Lambda K^-$

Some early results have been omitted.

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.0115±0.0015 OUR AVERAGE					
0.0133±0.0033±0.0052	960k	[7] CHEN	05	HYCP	p Cu, 800 GeV
0.0114±0.0012±0.0010	4.5M	[7] LU	05A	HYCP	p Cu, 800 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •					
−0.018 ±0.030	6953	CHAN	98	E756	p Be, 800 GeV
−0.022 ±0.051	1743	LUK	88	SPEC	p Be 400 GeV
−0.016 ±0.018	12k	BOURQUIN	84	SPEC	SPS hyperon beam

[7] The results of CHEN 05 and LU 05A are from different experimental runs.

α FOR $\Omega^- \to \Lambda K^-$

The above average, $\alpha(\Omega^-)\alpha_-(\Lambda) = 0.0115 \pm 0.0015$, divided by our current average $\alpha_-(\Lambda) = 0.749 \pm 0.008$ gives $\alpha(\Omega^-)$:

VALUE	DOCUMENT ID
0.0154±0.0020 OUR EVALUATION	

$\overline{\alpha}$ FOR $\overline{\Omega}^+ \to \overline{\Lambda} K^+$

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
−0.0181±0.0028±0.0026	1.89M	LU	06	HYCP	p Cu, 800 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •					
+0.017 ±0.077	1823	CHAN	98	E756	p Be, 800 GeV

$(\alpha+\overline{\alpha})/(\alpha-\overline{\alpha})$ in $\Omega^- \to \Lambda K^-$, $\overline{\Omega}^+ \to \overline{\Lambda} K^+$

Zero if CP is conserved.

VALUE	DOCUMENT ID		TECN	COMMENT
−0.016±0.092±0.089	[8] LU	06	HYCP	p Cu, 800 GeV

[8] This value uses the results of CHEN 05, LU 05A, and LU 06.

α FOR $\Omega^- \to \Xi^0\pi^-$

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

α FOR $\Omega^- \rightarrow \Xi^- \pi^0$

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

Ω^- REFERENCES

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

ABLIKIM	24AI	JHEP 2405 141	M. Ablikim *et al.*	(BESIII Collab.)
ABLIKIM	23BJ	PR D108 L091101	M. Ablikim *et al.*	(BESIII Collab.)
ABLIKIM	21E	PRL 126 092002	M. Ablikim *et al.*	(BESIII Collab.)
KAMAEV	10	PL B693 236	O. Kamaev *et al.*	(FNAL HyperCP Collab.)
AUBERT,BE	06	PRL 97 112001	B. Aubert *et al.*	(BABAR Collab.)
LU	06	PRL 96 242001	L.C. Lu *et al.*	(FNAL HyperCP Collab.)
CHEN	05	PR D71 051102	Y.C. Chen *et al.*	(FNAL HyperCP Collab.)
LU	05A	PL B617 11	L.C. Lu *et al.*	(FNAL HyperCP Collab.)
WHITE	05	PRL 94 101804	C.G. White *et al.*	(FNAL HyperCP Collab.)
CHAN	98	PR D58 072002	A.W. Chan *et al.*	(FNAL E756 Collab.)
WALLACE	95	PRL 74 3732	N.B. Wallace *et al.*	(MINN, ARIZ, MICH+)
ALBUQUERQ...	94	PR D50 18	I.F. Albuquerque *et al.*	(FNAL E761 Collab.)
DIEHL	91	PRL 67 804	H.T. Diehl *et al.*	(RUTG, FNAL, MICH+)
LUK	88	PR D38 19	K.B. Luk *et al.*	(RUTG, WISC, MICH, MINN)
HARTOUNI	85	PRL 54 628	E.P. Hartouni *et al.*	(COLU, ILL, FNAL)
BOURQUIN	84	NP B241 1	M.H. Bourquin *et al.*	(BRIS, GEVA, HEIDP+)
Also		PL 87B 297	M.H. Bourquin *et al.*	(BRIS, GEVA, HEIDP+)
BOURQUIN	79B	PL 88B 192	M.H. Bourquin *et al.*	(BRIS, GEVA, HEIDP+)
BAUBILLIER	78	PL 78B 342	M. Baubillier *et al.*	(BIRM, CERN, GLAS+) J
DEUTSCH...	78	PL 73B 96	M. Deutschmann *et al.*	(AACH3, BERL, CERN+) J
HEMINGWAY	78	NP B142 205	R.J. Hemingway *et al.*	(CERN, ZEEM, NIJM+)
DIBIANCA	75	NP B98 137	F.A. Dibianca, R.J. Endorf	(CMU)
ALVAREZ	73	PR D8 702	L.W. Alvarez	(LBL)
DEUTSCH...	73	NP B61 102	M. Deutschmann *et al.*	(ABCLV Collab.)
FIRESTONE	71B	PRL 26 410	I. Firestone *et al.*	(LRL)
SPETH	69	PL 29B 252	R. Speth *et al.*	(AACH, BERL, CERN, LOIC+)
PALMER	68	PL 26B 323	R.B. Palmer *et al.*	(BNL, SYRA)
SCHULTZ	68	PR 168 1509	P.F. Schultz *et al.*	(ILL, ANL, NWES+)
SCOTTER	68	PL 26B 474	D. Scotter *et al.*	(BIRM, GLAS, LOIC+)
ABRAMS	64	PRL 13 670	G.S. Abrams *et al.*	(UMD, NRL)
BARNES	64	PRL 12 204	V.E. Barnes *et al.*	(BNL)
FRY	55	PR 97 1189	W.F. Fry, J. Schneps, M.S. Swami	(WISC)
FRY	55B	NC 2 346	W.F. Fry, J. Schneps, M.S. Swami	(WISC)
EISENBERG	54	PR 96 541	Y. Eisenberg	(CORN)