Ξ^0

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

The parity has not actually been measured, but + is of course expected.

Ξ^0 MASS

The fit uses the Ξ^0, Ξ^-, and $\overline{\Xi}^+$ masses and the $\Xi^- - \Xi^0$ mass difference. It assumes that the Ξ^- and $\overline{\Xi}^+$ masses are the same.

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	COMMENT
1314.86±0.20 OUR FIT					
1314.82±0.06±0.20	3120	FANTI	00	NA48	p Be, 450 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •					
1315.2 ±0.92	49	WILQUET	72	HLBC	
1313.4 ±1.8	1	PALMER	68	HBC	

$m_{\Xi^-} - m_{\Xi^0}$

The fit uses the Ξ^0, Ξ^-, and $\overline{\Xi}^+$ masses and the $\Xi^- - \Xi^0$ mass difference. It assumes that the Ξ^- and $\overline{\Xi}^+$ masses are the same.

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	COMMENT
6.85±0.21 OUR FIT					
6.3 ±0.7 OUR AVERAGE					
6.9 ±2.2	29	LONDON	66	HBC	
6.1 ±0.9	88	PJERROU	65B	HBC	
6.8 ±1.6	23	JAUNEAU	63	FBC	
• • • We do not use the following data for averages, fits, limits, etc. • • •					
6.1 ±1.6	45	CARMONY	64B	HBC	See PJERROU 65B

Ξ^0 MEAN LIFE

VALUE (10^{-10} s)	EVTS	DOCUMENT ID		TECN	COMMENT
2.90±0.09 OUR AVERAGE					
2.83±0.16	6300	[1] ZECH	77	SPEC	Neutral hyperon beam
$2.88^{+0.21}_{-0.19}$	652	BALTAY	74	HBC	1.75 GeV/c $K^- p$
$2.90^{+0.32}_{-0.27}$	157	[2] MAYEUR	72	HLBC	2.1 GeV/c K^-
$3.07^{+0.22}_{-0.20}$	340	DAUBER	69	HBC	
3.0 ±0.5	80	PJERROU	65B	HBC	
$2.5^{+0.4}_{-0.3}$	101	HUBBARD	64	HBC	
$3.9^{+1.4}_{-0.8}$	24	JAUNEAU	63	FBC	
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$3.5^{+1.0}_{-0.8}$	45	CARMONY	64B	HBC	See PJERROU 65B

[1] The ZECH 77 result is $\tau_{\Xi^0} = \left[2.77-(\tau_{\Lambda}-2.69)\right] \times 10^{-10}$ s, in which we use $\tau_{\Lambda} = 2.63 \times 10^{-10}$ s.
[2] The MAYEUR 72 value is modified by the erratum.

Ξ^0 MAGNETIC MOMENT

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

VALUE (μ_N)	EVTS	DOCUMENT ID		TECN
−1.250±0.014 OUR AVERAGE				
−1.253±0.014	270k	COX	81	SPEC
−1.20 ±0.06	42k	BUNCE	79	SPEC

Ξ^0 DECAY MODES

	Mode		Fraction (Γ_i/Γ)	Confidence level
Γ_1	$\Lambda\pi^0$		(99.524±0.012) %	
Γ_2	$\Lambda\gamma$		(1.17 ±0.07) $\times 10^{-3}$	
Γ_3	$\Lambda e^+ e^-$		(7.6 ±0.6) $\times 10^{-6}$	
Γ_4	$\Sigma^0\gamma$		(3.33 ±0.10) $\times 10^{-3}$	
Γ_5	$\Sigma^+ e^- \overline{\nu}_e$		(2.52 ±0.08) $\times 10^{-4}$	
Γ_6	$\Sigma^+ \mu^- \overline{\nu}_\mu$		(2.33 ±0.35) $\times 10^{-6}$	
	$\Delta S = \Delta Q$ (SQ) violating modes or $\Delta S = 2$ forbidden ($S2$) modes			
Γ_7	$\Sigma^- e^+ \nu_e$	*SQ*	< 9 $\times 10^{-4}$	90%
Γ_8	$\Sigma^- \mu^+ \nu_\mu$	*SQ*	< 9 $\times 10^{-4}$	90%
Γ_9	$p\pi^-$	*S2*	< 8 $\times 10^{-6}$	90%
Γ_{10}	$p e^- \overline{\nu}_e$	*S2*	< 1.3 $\times 10^{-3}$	
Γ_{11}	$p \mu^- \overline{\nu}_\mu$	*S2*	< 1.3 $\times 10^{-3}$	

CONSTRAINED FIT INFORMATION

An overall fit to 5 branching ratios uses 11 measurements and one constraint to determine 5 parameters. The overall fit has a $\chi^2 =$ 7.5 for 7 degrees of freedom.

The following *off-diagonal* array elements are the correlation coefficients $\left\langle\delta x_i \delta x_j\right\rangle/(\delta x_i \cdot \delta x_j)$, 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.

x_2	−57			
x_4	−82	0		
x_5	−7	0	0	
x_6	0	0	0	1
	x_1	x_2	x_4	x_5

Ξ^0 BRANCHING RATIOS

$\Gamma(\Lambda\gamma)/\Gamma(\Lambda\pi^0)$ — Γ_2/Γ_1

VALUE (units 10^{-3})	EVTS	DOCUMENT ID		TECN	COMMENT
1.17±0.07 OUR FIT					
1.17±0.07 OUR AVERAGE					
1.17±0.05±0.06	672	[3] LAI	04A	NA48	p Be, 450 GeV
1.91±0.34±0.19	31	[4] FANTI	00	NA48	p Be, 450 GeV
1.06±0.12±0.11	116	JAMES	90	SPEC	FNAL hyperons

[3] LAI 04A used our 2002 value of 99.5% for the $\Xi^0 \rightarrow \Lambda\pi^0$ branching fraction to get $\Gamma(\Xi^0 \rightarrow \Lambda\gamma)/\Gamma_{total} = (1.16 \pm 0.05 \pm 0.06) \times 10^{-3}$. We adjust slightly to go back to what was directly measured.

[4] FANTI 00 used our 1998 value of 99.5% for the $\Xi^0 \rightarrow \Lambda\pi^0$ branching fraction to get $\Gamma(\Xi^0 \rightarrow \Lambda\gamma)/\Gamma_{total} = (1.90 \pm 0.34 \pm 0.19) \times 10^{-3}$. We adjust slightly to go back to what was directly measured.

$\Gamma(\Lambda e^+ e^-)/\Gamma_{total}$ — Γ_3/Γ

VALUE (units 10^{-6})	EVTS	DOCUMENT ID		TECN	COMMENT
7.6±0.4±0.5	397 ± 21	[5] BATLEY	07C	NA48	p Be, 400 GeV

[5] This BATLEY 07C result is consistent with internal bremsstrahlung.

$\Gamma(\Sigma^0\gamma)/\Gamma(\Lambda\pi^0)$ — Γ_4/Γ_1

VALUE (units 10^{-3})	EVTS	DOCUMENT ID		TECN	COMMENT
3.35±0.10 OUR FIT					
3.35±0.10 OUR AVERAGE					
3.34±0.05±0.09	4045	ALAVI-HARATI	01C	KTEV	p nucleus, 800 GeV
3.16±0.76±0.32	17	[6] FANTI	00	NA48	p Be, 450 GeV
3.56±0.42±0.10	85	TEIGE	89	SPEC	FNAL hyperons

[6] FANTI 00 used our 1998 value of 99.5% for the $\Xi^0 \rightarrow \Lambda\pi^0$ branching fraction to get $\Gamma(\Xi^0 \rightarrow \Sigma^0\gamma)/\Gamma_{total} = (3.14 \pm 0.76 \pm 0.32) \times 10^{-3}$. We adjust slightly to go back to what was directly measured.

$\Gamma(\Sigma^+ e^- \overline{\nu}_e)/\Gamma_{total}$ — Γ_5/Γ

VALUE (units 10^{-4})	EVTS	DOCUMENT ID		TECN	COMMENT
2.52±0.08 OUR FIT					
2.53±0.08 OUR AVERAGE					
2.51±0.03±0.09	6101	BATLEY	07	NA48	p Be, 400 GeV
2.55±0.14±0.10	419	[7] BATLEY	07	NA48	p Be, 400 GeV
2.71±0.22±0.31	176	AFFOLDER	99	KTEV	p nucleus, 800 GeV

[7] This BATLEY 07 result is for $\overline{\Xi}^0 \rightarrow \overline{\Sigma}^- e^+ \nu_e$ events.

$\Gamma(\Sigma^+ \mu^- \overline{\nu}_\mu)/\Gamma_{total}$ — Γ_6/Γ

VALUE (units 10^{-6})	EVTS	DOCUMENT ID		TECN	COMMENT
2.3 ±0.4 OUR FIT					
2.17±0.32±0.17	66	[8] BATLEY	13	NA48	p Be, 400 GeV

[8] BATLEY 13 used $\Xi^0 \rightarrow \Sigma^+ e^- \overline{\nu}_e$ decay as a normalization mode and its branching fraction value of $(2.51 \pm 0.03 \pm 0.09) \times 10^{-4}$ from BATLEY 07.

$\Gamma(\Sigma^+ \mu^- \overline{\nu}_\mu)/\Gamma(\Sigma^+ e^- \overline{\nu}_e)$ Γ_6/Γ_5

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.0092±0.0015 OUR FIT					
0.018 $^{+0.007}_{-0.005}$ **±0.002**	9	ABOUZAID	05	KTEV	*p* nucleus 800 GeV

$\Gamma(\Sigma^- e^+ \nu_e)/\Gamma(\Lambda\pi^0)$ Γ_7/Γ_1

Test of $\Delta S = \Delta Q$ rule.

VALUE (units 10^{-3})	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
<0.9	90	0	YEH	74	HBC	Effective denom.=2500
• • • We do not use the following data for averages, fits, limits, etc. • • •						
<1.5			DAUBER	69	HBC	
<6			HUBBARD	66	HBC	

$\Gamma(\Sigma^- \mu^+ \nu_\mu)/\Gamma(\Lambda\pi^0)$ Γ_8/Γ_1

Test of $\Delta S = \Delta Q$ rule.

VALUE (units 10^{-3})	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
<0.9	90	0	YEH	74	HBC	Effective denom.=2500
• • • We do not use the following data for averages, fits, limits, etc. • • •						
<1.5			DAUBER	69	HBC	
<6			HUBBARD	66	HBC	

$\Gamma(p\pi^-)/\Gamma(\Lambda\pi^0)$ Γ_9/Γ_1

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

VALUE (units 10^{-6})	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
< 8.2	90		WHITE	05	HYCP	*p* Cu, 800 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •						
< 36	90		GEWENIGER	75	SPEC	
<1800	90	0	YEH	74	HBC	Effective denom.=1300
< 900			DAUBER	69	HBC	
<5000			HUBBARD	66	HBC	

$\Gamma(p e^- \overline{\nu}_e)/\Gamma(\Lambda\pi^0)$ Γ_{10}/Γ_1

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

VALUE (units 10^{-3})	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
<1.3			DAUBER	69	HBC	
• • • We do not use the following data for averages, fits, limits, etc. • • •						
<3.4	90	0	YEH	74	HBC	Effective denom.=670
<6			HUBBARD	66	HBC	

$\Gamma(p \mu^- \overline{\nu}_\mu)/\Gamma(\Lambda\pi^0)$ Γ_{11}/Γ_1

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

VALUE (units 10^{-3})	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
<1.3			DAUBER	69	HBC	
• • • We do not use the following data for averages, fits, limits, etc. • • •						
<3.5	90	0	YEH	74	HBC	Effective denom.=664
<6			HUBBARD	66	HBC	

Ξ^0 DECAY PARAMETERS

See the "Note on Baryon Decay Parameters" in the neutron Listings.

$\alpha(\Xi^0)\,\alpha_-(\Lambda)$

This is a product of the $\Xi^0 \to \Lambda\pi^0$ and $\Lambda \to p\pi^-$ asymmetries.

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
−0.261±0.006 OUR AVERAGE					
−0.276±0.001±0.035	4M	BATLEY	10B	NA48	p Be, 400 GeV
−0.260±0.004±0.005	300k	HANDLER	82	SPEC	FNAL hyperons
• • • We do not use the following data for averages, fits, limits, etc. • • •					
−0.317±0.027	6075	BUNCE	78	SPEC	FNAL hyperons
−0.35 ±0.06	505	BALTAY	74	HBC	$K^- p$ 1.75 GeV/c
−0.28 ±0.06	739	DAUBER	69	HBC	$K^- p$ 1.7–2.6 GeV/c

α FOR $\Xi^0 \to \Lambda\pi^0$

The above average, $\alpha(\Xi^0)\alpha_-(\Lambda) = -0.261 \pm 0.006$, divided by our current average $\alpha_-(\Lambda) = 0.642 \pm 0.013$, gives the following value for $\alpha(\Xi^0)$.

VALUE	DOCUMENT ID
−0.406±0.013 OUR EVALUATION	

ϕ ANGLE FOR $\Xi^0 \to \Lambda\pi^0$ ($\tan\phi = \beta/\gamma$)

VALUE (°)	EVTS	DOCUMENT ID		TECN	COMMENT
21±12 OUR AVERAGE					
16±17	652	BALTAY	74	HBC	1.75 GeV/c $K^- p$
38±19	739	[9] DAUBER	69	HBC	
− 8±30	146	[10] BERGE	66	HBC	

[9] DAUBER 69 uses $\alpha_\Lambda = 0.647 \pm 0.020$.

[10] The errors have been multiplied by 1.2 due to approximations used for the Ξ polarization; see DAUBER 69 for a discussion.

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α FOR $\Xi^0 \to \Lambda\gamma$

See the note above on "Radiative Hyperon Decays."

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
−0.704±0.019±0.064	52k	[11] BATLEY	10B	NA48	p Be, 400 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •					
−0.78 ±0.18 ±0.06	672	LAI	04A	NA48	See BATLEY 10B
−0.43 ±0.44	87	[12] JAMES	90	SPEC	FNAL hyperons

[11] BATLEY 10B also measured the $\overline{\Xi}^0 \to \overline{\Lambda}\gamma$ asymmetry to be -0.798 ± 0.064 (no systematic error given) with 4769 events.

[12] The sign has been changed; see the erratum, JAMES 02.

α FOR $\Xi^0 \to \Lambda e^+ e^-$

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
−0.8±0.2	397 ± 21	[13] BATLEY	07C	NA48	p Be, 400 GeV

[13] This BATLEY 07C result is consistent with the asymmetry α for $\Xi^0 \to \Lambda\gamma$, as expected if the mechanism is internal bremsstrahlung.

α FOR $\Xi^0 \rightarrow \Sigma^0\gamma$

See the note above on "Radiative Hyperon Decays."

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
−0.69 ±0.06 OUR AVERAGE					
−0.729±0.030±0.076	15k	[14] BATLEY	10B	NA48	p Be, 400 GeV
−0.63 ±0.08 ±0.05	4045	ALAVI-HARATI	01C	KTEV	p nucleus, 800 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •					
+0.20 ±0.32 ±0.05	85	[15] TEIGE	89	SPEC	FNAL hyperons

[14] BATLEY 10B also measured the $\overline{\Xi}^0 \rightarrow \overline{\Sigma}^0\gamma$ asymmetry to be −0.786 ± 0.104 (no systematic error given) with 1404 events.

[15] This result has been withdrawn, due to an error. See the erratum, TEIGE 02.

$g_1(0)/f_1(0)$ FOR $\Xi^0 \rightarrow \Sigma^+ e^- \overline{\nu}_e$

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
1.22±0.05 OUR AVERAGE					
1.21±0.05		BATLEY	13	NA48	p Be, 400 GeV
$1.32^{+0.21}_{-0.17}\pm0.05$	487	[16] ALAVI-HARATI	01I	KTEV	p nucleus, 800 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •					
1.20±0.04±0.03	6520	[17] BATLEY	07	NA48	See BATLEY 13

[16] ALAVI-HARATI 01I assumes here that the second-class current is zero and that the weak-magnetism term takes its exact SU(3) value.

[17] This BATLEY 07 result uses our 2006 value of V_{us} from semileptonic kaon decays as input.

$g_2(0)/f_1(0))$ FOR $\Xi^0 \rightarrow \Sigma^+ e^- \overline{\nu}_e$

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
$\mathbf{-1.7^{+2.1}_{-2.0}\pm0.5}$	487	[18] ALAVI-HARATI	01I	KTEV	p nucleus, 800 GeV

[18] ALAVI-HARATI 01I thus assumes that $g_2 = 0$ in calculating g_1/f_1, above.

$f_2(0)/f_1(0)$ FOR $\Xi^0 \rightarrow \Sigma^+ e^- \overline{\nu}_e$

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
2.0±0.9 OUR AVERAGE					
2.0±1.3		BATLEY	13	NA48	p Be, 400 GeV
2.0±1.2±0.5	487	ALAVI-HARATI	01I	KTEV	p nucleus, 800 GeV

Ξ^0 REFERENCES

BATLEY	13	PL B720 105	J.R. Batley et al.	(CERN NA48/1 Collab.)
BATLEY	10B	PL B693 241	J.R. Batley et al.	(CERN NA48/1 Collab.)
BATLEY	07	PL B645 36	J.R. Batley et al.	(CERN NA48/1 Collab.)
BATLEY	07C	PL B650 1	J.R. Batley et al.	(CERN NA48 Collab.)
ABOUZAID	05	PRL 95 081801	E. Abouzaid et al.	(FNAL KTeV Collab.)
WHITE	05	PRL 94 101804	C.G. White et al.	(FNAL HyperCP Collab.)
LAI	04A	PL B584 251	A. Lai et al.	(CERN NA48 Collab.)
JAMES	02	PRL 89 169901 (errat)	C. James et al.	(MINN, MICH, WISC, RUTG)
TEIGE	02	PRL 89 169902 (errat)	S. Teige et al.	(RUTG, MICH, MINN)
ALAVI-HARATI	01C	PRL 86 3239	A. Alavi-Harati et al.	(FNAL KTeV Collab.)
ALAVI-HARATI	01I	PRL 87 132001	A. Alavi-Harati et al.	(FNAL KTeV Collab.)
FANTI	00	EPJ C12 69	V. Fanti et al.	(CERN NA48 Collab.)
AFFOLDER	99	PRL 82 3751	A. Affolder et al.	(FNAL KTeV Collab.)
JAMES	90	PRL 64 843	C. James et al.	(MINN, MICH, WISC, RUTG)
TEIGE	89	PRL 63 2717	S. Teige et al.	(RUTG, MICH, MINN)
HANDLER	82	PR D25 639	R. Handler et al.	(WISC, MICH, MINN+)
COX	81	PRL 46 877	P.T. Cox et al.	(MICH, WISC, RUTG, MINN+)

BUNCE	79	PL 86B 386	G.R.M. Bunce *et al.*	(BNL, MICH, RUTG+)
BUNCE	78	PR D18 633	G.R.M. Bunce *et al.*	(WISC, MICH, RUTG)
ZECH	77	NP B124 413	G. Zech *et al.*	(SIEG, CERN, DORT, HEIDH)
GEWENIGER	75	PL 57B 193	C. Geweniger *et al.*	(CERN, HEIDH)
BALTAY	74	PR D9 49	C. Baltay *et al.*	(COLU, BING) J
YEH	74	PR D10 3545	N. Yeh *et al.*	(BING, COLU)
MAYEUR	72	NP B47 333	C. Mayeur *et al.*	(BRUX, CERN, TUFTS, LOUC)
Also		NP B53 268 (erratum)	C. Mayeur	
WILQUET	72	PL 42B 372	G. Wilquet *et al.*	(BRUX, CERN, TUFTS+)
DAUBER	69	PR 179 1262	P.M. Dauber *et al.*	(LRL)
PALMER	68	PL 26B 323	R.B. Palmer *et al.*	(BNL, SYRA)
BERGE	66	PR 147 945	J.P. Berge *et al.*	(LRL)
HUBBARD	66	Thesis UCRL 11510	J.R. Hubbard	(LRL)
LONDON	66	PR 143 1034	G.W. London *et al.*	(BNL, SYRA)
PJERROU	65B	PRL 14 275	G.M. Pjerrou *et al.*	(UCLA)
Also		Thesis	G.M. Pjerrou	(UCLA)
CARMONY	64B	PRL 12 482	D.D. Carmony *et al.*	(UCLA)
HUBBARD	64	PR 135 B183	J.R. Hubbard *et al.*	(LRL)
JAUNEAU	63	PL 4 49	L. Jauneau *et al.*	(EPOL, CERN, LOUC+)
Also		Siena Conf. 1 1	L. Jauneau *et al.*	(EPOL, CERN, LOUC+)