NODE=S023

Ξ^0

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

NODE=S023

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

Ξ^0 MASS

NODE=S023M

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.

NODE=S023M

NODE=S023M

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	

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

NODE=S023D

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.

NODE=S023D

NODE=S023D

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

NODE=S023T

NODE=S023T

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 $\tau_{\Xi^0} = [2.77-(\tau_\Lambda-2.69)] \times 10^{-10}$ s, in which we use $\tau_\Lambda = 2.63 \times 10^{-10}$ s. NODE=S023T;LINKAGE=Z

[2] The MAYEUR 72 value is modified by the erratum. NODE=S023T;LINKAGE=M

Ξ^0 MAGNETIC MOMENT

NODE=S023MM

See the "Quark Model" review.

NODE=S023MM

NODE=S023MM

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

NODE=S023225;NODE=S023

	Mode		Fraction (Γ_i/Γ)	Scale factor/ Confidence level	
Γ_1	$\Lambda\pi^0$		(99.517 ± 0.012) %	S=1.1	DESIG=1
Γ_2	$\Lambda\gamma$		$(1.24\pm0.07)\times10^{-3}$	S=1.3	DESIG=9
Γ_3	Λe^+e^-		$(7.6\pm0.6)\times10^{-6}$		DESIG=12
Γ_4	$\Sigma^0\gamma$		$(3.33\pm0.10)\times10^{-3}$		DESIG=10
Γ_5	$\Sigma^+e^-\overline{\nu}_e$		$(2.52\pm0.08)\times10^{-4}$		DESIG=4
Γ_6	$\Sigma^+\mu^-\overline{\nu}_\mu$		$(2.3\pm0.4)\times10^{-6}$		DESIG=6

$\Delta S = \Delta Q$ (SQ) violating modes or $\Delta S = 2$ forbidden ($S2$) modes

NODE=S023;CLUMP=A

	Mode		Fraction (Γ_i/Γ)	Confidence level	
Γ_7	$\Sigma^-e^+\nu_e$	SQ	$<1.6\times10^{-4}$	CL=90%	DESIG=5
Γ_8	$\Sigma^-\mu^+\nu_\mu$	SQ	$<9\times10^{-4}$	CL=90%	DESIG=7
Γ_9	$p\pi^-$	$S2$	$<8\times10^{-6}$	CL=90%	DESIG=2
Γ_{10}	$pe^-\overline{\nu}_e$	$S2$	$<1.3\times10^{-3}$		DESIG=3
Γ_{11}	$p\mu^-\overline{\nu}_\mu$	$S2$	$<1.3\times10^{-3}$		DESIG=8
Γ_{12}	K^-e^+				DESIG=15
Γ_{13}	K^+e^-				DESIG=16

CONSTRAINED FIT INFORMATION

An overall fit to 6 branching ratios uses 12 measurements and one constraint to determine 5 parameters. The overall fit has a $\chi^2 =$ 10.2 for 8 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, $x_i \equiv \Gamma_i/\Gamma_{\rm total}$. 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	0
	x_1	x_2	x_4	x_5

Ξ^0 BRANCHING RATIOS

NODE=S023230

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

NODE=S023R8
NODE=S023R8

1.24±0.07 OUR FIT Error includes scale factor of 1.3. [(1.17 ± 0.07) × 10^{-3} OUR 2025 FIT] NEW

1.17±0.07 OUR AVERAGE

VALUE (units 10^{-3})	EVTS	DOCUMENT ID		TECN	COMMENT
1.17±0.05±0.06	672	[1] LAI	04A	NA48	p Be, 450 GeV
1.91±0.34±0.19	31	[2] FANTI	00	NA48	p Be, 450 GeV
1.06±0.12±0.11	116	JAMES	90	SPEC	FNAL hyperons

[1] LAI 04A used our 2002 value of 99.5% for the $\Xi^0 \to \Lambda\pi^0$ branching fraction to get $\Gamma(\Xi^0 \to \Lambda\gamma)/\Gamma_{\rm total} = (1.16 \pm 0.05 \pm 0.06)\times10^{-3}$. We adjust slightly to go back to what was directly measured. NODE=S023R8;LINKAGE=LA

[2] FANTI 00 used our 1998 value of 99.5% for the $\Xi^0 \to \Lambda\pi^0$ branching fraction to get $\Gamma(\Xi^0 \to \Lambda\gamma)/\Gamma_{\rm total} = (1.90 \pm 0.34 \pm 0.19)\times10^{-3}$. We adjust slightly to go back to what was directly measured. NODE=S023R8;LINKAGE=FT

$\Gamma(\Lambda\gamma)/\Gamma_{\rm total}$ — Γ_2/Γ

NODE=S023R03
NODE=S023R03

1.24 ±0.07 OUR FIT Error includes scale factor of 1.3.

VALUE (units 10^{-3})	EVTS	DOCUMENT ID		TECN	COMMENT
1.347±0.066±0.054	0.64k	[1] ABLIKIM	25AL	BES3	$J/\psi \to \Xi^0\overline{\Xi}^0$

[1] Based on 10B J/ψ events. NODE=S023R03;LINKAGE=B

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

NODE=S023R12
NODE=S023R12

VALUE (units 10^{-6})	EVTS	DOCUMENT ID		TECN	COMMENT
7.6±0.4±0.5	397 ± 21	[1] BATLEY	07C	NA48	p Be, 400 GeV

[1] This BATLEY 07C result is consistent with internal bremsstrahlung. NODE=S023R12;LINKAGE=BA

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

NODE=S023R9
NODE=S023R9

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	[1] FANTI	00	NA48	p Be, 450 GeV
3.56±0.42±0.10	85	TEIGE	89	SPEC	FNAL hyperons

[1] FANTI 00 used our 1998 value of 99.5% for the $\Xi^0 \to \Lambda\pi^0$ branching fraction to get $\Gamma(\Xi^0 \to \Sigma^0\gamma)/\Gamma_{\text{total}} = (3.14 \pm 0.76 \pm 0.32) \times 10^{-3}$. We adjust slightly to go back to what was directly measured. NODE=S023R9;LINKAGE=FT

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

NODE=S023R10
NODE=S023R10

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	[1] BATLEY	07	NA48	p Be, 400 GeV
2.71±0.22±0.31	176	AFFOLDER	99	KTEV	p nucleus, 800 GeV

OCCUR=2

[1] This BATLEY 07 result is for $\overline{\Xi}^0 \to \overline{\Sigma}^- e^+ \nu_e$ events. NODE=S023R10;LINKAGE=BT

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

NODE=S023R13
NODE=S023R13

VALUE (units 10^{-6})	EVTS	DOCUMENT ID		TECN	COMMENT
2.3 ±0.4 OUR FIT					
2.17±0.32±0.17	66	[1] BATLEY	13	NA48	p Be, 400 GeV

[1] BATLEY 13 used $\Xi^0 \to \Sigma^+ e^- \overline{\nu}_e$ 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. NODE=S023R13;LINKAGE=A

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

NODE=S023R11
NODE=S023R11

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

$\Gamma(\Sigma^- e^+ \nu_e)/\Gamma_{\text{total}}$ — Γ_7/Γ

NODE=S023R00
NODE=S023R00

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<1.6 \times 10^{-4}$	90	ABLIKIM	23B	BES3	$J/\psi \to \Xi^0 \overline{\Xi}^0$

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

NODE=S023R4

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

NODE=S023R4
NODE=S023R4

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

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

NODE=S023R6

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

NODE=S023R6
NODE=S023R6

VALUE (units 10^{-3})	CL%	DOCUMENT ID		TECN	COMMENT
<0.9	90	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

NODE=S023R1

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

NODE=S023R1
NODE=S023R1

VALUE (units 10^{-6})	CL%	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	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

NODE=S023R2

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

NODE=S023R2
NODE=S023R2

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

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

NODE=S023R7

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

NODE=S023R7
NODE=S023R7

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

$\Gamma(K^- e^+)/\Gamma_{total}$ Γ_{12}/Γ

NODE=S023R01
NODE=S023R01

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<3.6 \times 10^{-6}$	90	[1] ABLIKIM	23AP	BES3	$J/\psi \rightarrow \Xi^0 \overline{\Xi}^0$

[1] This decay mode violates baryon and lepton number conservation with Δ(B−L) = 0.

NODE=S023R01;LINKAGE=A

$\Gamma(K^+ e^-)/\Gamma_{total}$ Γ_{13}/Γ

NODE=S023R02
NODE=S023R02

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<1.9 \times 10^{-6}$	90	[1] ABLIKIM	23AP	BES3	$J/\psi \rightarrow \Xi^0 \overline{\Xi}^0$

[1] This decay mode violates baryon and lepton number conservation with $|\Delta$(B-L)$|$=2.

NODE=S023R02;LINKAGE=A

Ξ^0 DECAY PARAMETERS

NODE=S023235

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

NODE=S023235

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

NODE=S023AA

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

NODE=S023AA
NODE=S023AA

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
−0.277±0.008 OUR FIT	Error includes scale factor of 2.9.				
−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 $\Xi^0 \rightarrow \Lambda\pi^0$

NODE=S023A

The PDG 22 average $\alpha(\Xi^0)\alpha_-(\Lambda) = -0.261 \pm 0.006$ divided by the PDG 22 average $\alpha_-(\Lambda) = 0.748 \pm 0.007$ gives $\alpha(\Xi^0) = -0.349 \pm 0.009$.

NODE=S023A

NODE=S023A

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
−0.371 ±0.010 OUR FIT	Error includes scale factor of 3.0.				
−0.3750±0.0034±0.0016	327k	ABLIKIM	23AU	BES3	$J/\psi \rightarrow \Xi^0 \overline{\Xi}^0$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
−0.358 ±0.042 ±0.013	1.9k	ABLIKIM	23AD	BES3	$\psi(2S) \rightarrow \Xi^0 \overline{\Xi}^0$

α FOR $\overline{\Xi}^0 \rightarrow \overline{\Lambda}\pi^0$

NODE=S023A03
NODE=S023A03

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.3790±0.0034±0.0021	327k	ABLIKIM	23AU	BES3	$J/\psi \rightarrow \Xi^0 \overline{\Xi}^0$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.363 ±0.042 ±0.013	1.9k	ABLIKIM	23AD	BES3	$\psi(2S) \rightarrow \Xi^0 \overline{\Xi}^0$

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

NODE=S023F
NODE=S023F

VALUE (°)	EVTS	DOCUMENT ID		TECN	COMMENT
0.292± 0.550±0.103	327k	[1] ABLIKIM	23AU	BES3	$J/\psi \rightarrow \Xi^0 \overline{\Xi}^0$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
1.55 ± 6.70 ±0.63	1.9k	ABLIKIM	23AD	BES3	$\psi(2S) \rightarrow \Xi^0 \overline{\Xi}^0$
16 ±17	652	BALTAY	74	HBC	1.75 GeV/c $K^- p$
38 ±19	739	[2] DAUBER	69	HBC	
− 8 ±30	146	[3] BERGE	66	HBC	

[1] Converted from radians to degrees.
[2] DAUBER 69 uses $\alpha_\Lambda = 0.647 \pm 0.020$.
[3] The errors have been multiplied by 1.2 due to approximations used for the Ξ polarization; see DAUBER 69 for a discussion.

NODE=S023F;LINKAGE=B
NODE=S023F;LINKAGE=A
NODE=S023F;LINKAGE=D

ϕ ANGLE FOR $\overline{\Xi}^0 \rightarrow \overline{\Lambda}\pi^0$ ($\tan\phi = \beta/\gamma$)

NODE=S023A01
NODE=S023A01

VALUE (°)	EVTS	DOCUMENT ID	TECN	COMMENT
− 0.304±0.556±0.109	327k	ABLIKIM 23AU	BES3	$J/\psi \rightarrow \Xi^0\overline{\Xi}^0$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
−10.60 ±6.65 ±0.97	1.9k	ABLIKIM 23AD	BES3	$\psi(2S) \rightarrow \Xi^0\overline{\Xi}^0$

$\Delta\phi_{CP}(\Xi^0) = (\phi_{\Xi^0} + \phi_{\overline{\Xi}^0})/2$

NODE=S023A02
NODE=S023A02

VALUE (°)	EVTS	DOCUMENT ID	TECN	COMMENT
−0.006±0.395±0.052	327k	[1] ABLIKIM 23AU	BES3	$J/\psi \rightarrow \Xi^0\overline{\Xi}^0$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
−4.53 ±4.70 ±0.57	1.9k	[1] ABLIKIM 23AD	BES3	$\psi(2S) \rightarrow \Xi^0\overline{\Xi}^0$

[1] Converted from radians to degrees.

NODE=S023A02;LINKAGE=A

A_{CP} FOR $\Xi^0 \rightarrow \Lambda\pi^0$, $\overline{\Xi}^0 \rightarrow \overline{\Lambda}\pi^0$

NODE=S023A00

$A_{CP} = (\alpha + \overline{\alpha}) / (\alpha - \overline{\alpha})$

NODE=S023A00
NODE=S023A00

VALUE (units 10^{-3})	EVTS	DOCUMENT ID	TECN	COMMENT
−5.4± 6.5± 3.1	327k	[1] ABLIKIM 23AU	BES3	$J/\psi \rightarrow \Xi^0\overline{\Xi}^0$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
−7 ±82 ±25	1.9k	[1] ABLIKIM 23AD	BES3	$\psi(2S) \rightarrow \Xi^0\overline{\Xi}^0$

[1] Probing *CP* symmetry and weak phases with entangled double-strange baryons.

NODE=S023A00;LINKAGE=A

NODE=S023RHD

RADIATIVE HYPERON DECAYS

Revised July 2011 by J.D. Jackson (LBNL).

The weak radiative decays of spin-1/2 hyperons, $B_i \rightarrow B_f\gamma$, yield information about matrix elements (form factors) similar to that gained from weak hadronic decays. For a polarized spin-1/2 hyperon decaying radiatively via a $\Delta Q = 0$, $\Delta S = 1$ transition, the angular distribution of the direction $\hat{\mathbf{p}}$ of the final spin-1/2 baryon in the hyperon rest frame is

$$\frac{dN}{d\Omega} = \frac{N}{4\pi}\left(1 + \alpha_\gamma\, \mathbf{P}_i\cdot\hat{\mathbf{p}}\right) . \qquad (1)$$

Here $\mathbf{P}_i$ is the polarization of the decaying hyperon, and α_γ is the asymmetry parameter. In terms of the form factors $F_1(q^2)$, $F_2(q^2)$, and $G(q^2)$ of the effective hadronic weak electromagnetic vertex,

$$F_1(q^2)\gamma_\lambda + iF_2(q^2)\sigma_{\lambda\mu}q^\mu + G(q^2)\gamma_\lambda\gamma_5 \ ,$$

α_γ is

$$\alpha_\gamma = \frac{2\,\mathrm{Re}[G(0)F_M^*(0)]}{|G(0)|^2 + |F_M(0)|^2} \ , \qquad (2)$$

where $F_M = (m_i - m_f)[F_2 - F_1/(m_i + m_f)]$. If the decaying hyperon is unpolarized, the decay baryon has a longitudinal polarization given by $P_f = -\alpha_\gamma$ [1].

The angular distribution for the weak hadronic decay, $B_i \rightarrow B_f\pi$, has the same form as Eq. (1), but of course with a different asymmetry parameter, α_π. Now, however, if the decaying hyperon is unpolarized, the decay baryon has a longitudinal polarization given by $P_f = +\alpha_\pi$ [2,3]. The difference of sign is because the spins of the pion and photon are different.

$\Xi^0 \to \Lambda\gamma$ decay—The radiative decay $\Xi^0 \to \Lambda\gamma$ of an unpolarized Ξ^0 uses the hadronic decay $\Lambda \to p\pi^-$ as the analyzer. As noted above, the longitudinal polarization of the Λ will be $P_\Lambda = -\alpha_{\Xi\Lambda\gamma}$. Let α_- be the $\Lambda \to p\pi^-$ asymmetry parameter and $\theta_{\Lambda p}$ be the angle, as seen in the Λ rest frame, between the Λ line of flight and the proton momentum. Then the hadronic version of Eq. (1) applied to the $\Lambda \to p\pi^-$ decay gives

$$\frac{dN}{d\cos\theta_{\Lambda p}} = \frac{N}{2}\,(1 - \alpha_{\Xi\Lambda\gamma}\,\alpha_-\cos\theta_{\Lambda p}) \tag{3}$$

for the angular distribution of the proton in the Λ frame. Our current value, from the CERN NA48/1 experiment [4], is $\alpha_{\Xi\Lambda\gamma} = -0.704 \pm 0.019 \pm 0.064$.

$\Xi^0 \to \Sigma^0\gamma$ decay—The asymmetry parameter here, $\alpha_{\Xi\Sigma\gamma}$, is measured by following the decay chain $\Xi^0 \to \Sigma^0\gamma$, $\Sigma^0 \to \Lambda\gamma$, $\Lambda \to p\pi^-$. Again, for an unpolarized Ξ^0, the longitudinal polarization of the Σ^0 will be $P_\Sigma = -\alpha_{\Xi\Sigma\gamma}$. In the $\Sigma^0 \to \Lambda\gamma$ decay, a parity-conserving magnetic-dipole transition, the polarization of the Σ^0 is transferred to the Λ, as may be seen as follows. Let $\theta_{\Sigma\Lambda}$ be the angle seen in the Σ^0 rest frame between the Σ^0 line of flight and the Λ momentum. For Σ^0 helicity $+1/2$, the probability amplitudes for positive and negative spin states of the Σ^0 *along the Λ momentum* are $\cos(\theta_{\Sigma\Lambda}/2)$ and $\sin(\theta_{\Sigma\Lambda}/2)$. Then the amplitude for a negative helicity photon and a negative helicity Λ is $\cos(\theta_{\Sigma\Lambda}/2)$, while the amplitude for positive helicities for the photon and Λ is $\sin(\theta_{\Sigma\Lambda}/2)$. For Σ^0 helicity $-1/2$, the amplitudes are interchanged. If the Σ^0 has longitudinal polarization P_Σ, the probabilities for Λ helicities $\pm 1/2$ are therefore

$$p(\pm 1/2) = \frac{1}{2}(1 \mp P_\Sigma)\cos^2(\theta_{\Sigma\Lambda}/2) + \frac{1}{2}(1 \pm P_\Sigma)\sin^2(\theta_{\Sigma\Lambda}/2)\ , \tag{4}$$

and the longitudinal polarization of the Λ is

$$P_\Lambda = -P_\Sigma\cos\theta_{\Sigma\Lambda} = +\alpha_{\Xi\Sigma\gamma}\cos\theta_{\Sigma\Lambda}\ . \tag{5}$$

Using Eq. (1) for the $\Lambda \to p\pi^-$ decay again, we get for the joint angular distribution of the $\Sigma^0 \to \Lambda\gamma$, $\Lambda \to p\pi^-$ chain,

$$\frac{d^2N}{d\cos\theta_{\Sigma\Lambda}\,d\cos\theta_{\Lambda p}} = \frac{N}{4}\,(1 + \alpha_{\Xi\Sigma\gamma}\cos\theta_{\Sigma\Lambda}\,\alpha_-\cos\theta_{\Lambda p})\ . \tag{6}$$

Our current average for $\alpha_{\Xi\Sigma\gamma}$ is -0.69 ± 0.06 [4,5].

References

1. R.E. Behrends, Phys. Rev. **111**, 1691 (1958); see Eq. (7) or (8).
2. In ancient times, the signs of the asymmetry term in the angular distributions of radiative and hadronic decays of polarized hyperons were sometimes opposite. For roughly 50 years, however, the overwhelming convention has been to make them the same. The aim, not always achieved, is to remove ambiguities.
3. For the definition of α_π, see the note on "Baryon Decay Parameters" in the Neutron Listings.
4. J.R. Batley *et al.*, Phys. Lett. **B693**, 241 (2010).
5. A. Alavi-Harati *et al.*, Phys. Rev. Lett. **86**, 3239 (2001).

α FOR $\Xi^0 \to \Lambda\gamma$

NODE=S023LG

See the note above on "Radiative Hyperon Decays."

NODE=S023LG
NODE=S023LG
NEW

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
-0.72 ± 0.05 OUR AVERAGE					
[-0.70 ± 0.07 OUR 2025 AVERAGE]					
$-0.741 \pm 0.062 \pm 0.019$	0.64k	[1] ABLIKIM	25AL	BES3	$J/\psi \to \Xi^0 \overline{\Xi}^0$
$-0.704 \pm 0.019 \pm 0.064$	52k	[2] BATLEY	10B	NA48	p Be, 400 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$-0.78 \pm 0.18 \pm 0.06$	672	LAI	04A	NA48	See BATLEY 10B
-0.43 ± 0.44	87	[3] JAMES	90	SPEC	FNAL hyperons

[1] Based on 10B J/ψ events. NODE=S023LG;LINKAGE=C

[2] 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. NODE=S023LG;LINKAGE=BA

[3] The sign has been changed; see the erratum, JAMES 02. NODE=S023LG;LINKAGE=B

A_{CP} FOR $\Xi^0 \to \Lambda\gamma$, $\overline{\Xi}^0 \to \overline{\Lambda}\gamma$

NODE=S023A04

$A_{CP} = (\alpha + \overline{\alpha}) \,/\, (\alpha - \overline{\alpha})$

NODE=S023A04
NODE=S023A04

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
$-0.120 \pm 0.084 \pm 0.024$	0.64k	[1] ABLIKIM	25AL	BES3	$J/\psi \to \Xi^0 \overline{\Xi}^0$

[1] Probes *CP* symmetry and weak phases with entangled doubly-strange baryons. NODE=S023A04;LINKAGE=A

α FOR $\Xi^0 \to \Lambda e^+ e^-$

NODE=S023LEE
NODE=S023LEE

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
-0.8 ± 0.2	397 ± 21	[1] BATLEY	07C	NA48	p Be, 400 GeV

[1] This BATLEY 07C result is consistent with the asymmetry α for $\Xi^0 \to \Lambda\gamma$, as expected if the mechanism is internal bremsstrahlung. NODE=S023LEE;LINKAGE=BA

α FOR $\Xi^0 \to \Sigma^0\gamma$

NODE=S023AG

See the note above on "Radiative Hyperon Decays."

NODE=S023AG
NODE=S023AG

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
-0.69 ± 0.06 OUR AVERAGE					
$-0.729 \pm 0.030 \pm 0.076$	15k	[1] BATLEY	10B	NA48	p Be, 400 GeV
$-0.63 \pm 0.08 \pm 0.05$	4045	ALAVI-HARATI	01C	KTEV	p nucleus, 800 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$+0.20 \pm 0.32 \pm 0.05$	85	[2] TEIGE	89	SPEC	FNAL hyperons

[1] BATLEY 10B also measured the $\overline{\Xi}^0 \to \overline{\Sigma}^0\gamma$ asymmetry to be -0.786 ± 0.104 (no systematic error given) with 1404 events. NODE=S023AG;LINKAGE=BA

[2] This result has been withdrawn, due to an error. See the erratum, TEIGE 02. NODE=S023AG;LINKAGE=T1

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

NODE=S023AH

NODE=S023AH

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	[1] 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	[2] BATLEY	07	NA48	See BATLEY 13

[1] ALAVI-HARATI 01I assumes here that the second-class current is zero and that the weak-magnetism term takes its exact SU(3) value. NODE=S023AH;LINKAGE=A

[2] This BATLEY 07 result uses our 2006 value of V_{us} from semileptonic kaon decays as input. NODE=S023AH;LINKAGE=BT

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

NODE=S023AI

NODE=S023AI

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
$\mathbf{-1.7^{+2.1}_{-2.0}\pm0.5}$	487	[1] ALAVI-HARATI	01I	KTEV	p nucleus, 800 GeV

[1] ALAVI-HARATI 01I thus assumes that $g_2 = 0$ in calculating g_1/f_1, above. NODE=S023AI;LINKAGE=A

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

NODE=S023AJ

NODE=S023AJ

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

NODE=S023

ABLIKIM	25AL	SCIB 70 454	M. Ablikim *et al.*	(BESIII Collab.)	REFID=63284
ABLIKIM	23AD	PR D108 L011101	M. Ablikim *et al.*	(BESIII Collab.)	REFID=62090
ABLIKIM	23AP	PR D108 012006	M. Ablikim *et al.*	(BESIII Collab.)	REFID=62290
ABLIKIM	23AU	PR D108 L031106	M. Ablikim *et al.*	(BESIII Collab.)	REFID=62340
ABLIKIM	23B	PR D107 012002	M. Ablikim *et al.*	(BESIII Collab.)	REFID=62001
PDG	22	PTEP 2022 083C01	R.L. Workman *et al.*	(PDG Collab.)	REFID=61634
BATLEY	13	PL B720 105	J.R. Batley *et al.*	(CERN NA48/1 Collab.)	REFID=55067
BATLEY	10B	PL B693 241	J.R. Batley *et al.*	(CERN NA48/1 Collab.)	REFID=53428
BATLEY	07	PL B645 36	J.R. Batley *et al.*	(CERN NA48/1 Collab.)	REFID=51661
BATLEY	07C	PL B650 1	J.R. Batley *et al.*	(CERN NA48 Collab.)	REFID=51823
ABOUZAID	05	PRL 95 081801	E. Abouzaid *et al.*	(FNAL KTeV Collab.)	REFID=50699
WHITE	05	PRL 94 101804	C.G. White *et al.*	(FNAL HyperCP Collab.)	REFID=50583
LAI	04A	PL B584 251	A. Lai *et al.*	(CERN NA48 Collab.)	REFID=49823
JAMES	02	PRL 89 169901 (errat.)	C. James *et al.*	(MINN, MICH, WISC, RUTG)	REFID=48981
TEIGE	02	PRL 89 169902 (errat.)	S. Teige *et al.*	(RUTG, MICH, MINN)	REFID=48982
ALAVI-HARATI	01C	PRL 86 3239	A. Alavi-Harati *et al.*	(FNAL KTeV Collab.)	REFID=48118
ALAVI-HARATI	01I	PRL 87 132001	A. Alavi-Harati *et al.*	(FNAL KTeV Collab.)	REFID=48376
FANTI	00	EPJ C12 69	V. Fanti *et al.*	(CERN NA48 Collab.)	REFID=47370
AFFOLDER	99	PRL 82 3751	A. Affolder *et al.*	(FNAL KTeV Collab.)	REFID=47005
JAMES	90	PRL 64 843	C. James *et al.*	(MINN, MICH, WISC, RUTG)	REFID=41113
Also		PRL 89 169901 (errat.)	C. James *et al.*	(MINN, MICH, WISC, RUTG)	REFID=48981
TEIGE	89	PRL 63 2717	S. Teige *et al.*	(RUTG, MICH, MINN)	REFID=41027
HANDLER	82	PR D25 639	R. Handler *et al.*	(WISC, MICH, MINN+)	REFID=12026
COX	81	PRL 46 877	P.T. Cox *et al.*	(MICH, WISC, RUTG, MINN+)	REFID=11820
BUNCE	79	PL 86B 386	G.R.M. Bunce *et al.*	(BNL, MICH, RUTG+)	REFID=12024
BUNCE	78	PR D18 633	G.R.M. Bunce *et al.*	(WISC, MICH, RUTG)	REFID=12023
ZECH	77	NP B124 413	G. Zech *et al.*	(SIEG, CERN, DORT, HEIDH)	REFID=11817
GEWENIGER	75	PL 57B 193	C. Geweniger *et al.*	(CERN, HEIDH)	REFID=12021
BALTAY	74	PR D9 49	C. Baltay *et al.*	(COLU, BING) J	REFID=12019
YEH	74	PR D10 3545	N. Yeh *et al.*	(BING, COLU)	REFID=12020
MAYEUR	72	NP B47 333	C. Mayeur *et al.*	(BRUX, CERN, TUFTS, LOUC)	REFID=12016
Also		NP B53 268 (errat.)	C. Mayeur		REFID=12017
WILQUET	72	PL 42B 372	G. Wilquet *et al.*	(BRUX, CERN, TUFTS+)	REFID=12018
DAUBER	69	PR 179 1262	P.M. Dauber *et al.*	(LRL)	REFID=11783
PALMER	68	PL 26B 323	R.B. Palmer *et al.*	(BNL, SYRA)	REFID=12014
BERGE	66	PR 147 945	J.P. Berge *et al.*	(LRL)	REFID=12011
HUBBARD	66	Thesis UCRL 11510	J.R. Hubbard	(LRL)	REFID=12012
LONDON	66	PR 143 1034	G.W. London *et al.*	(BNL, SYRA)	REFID=11774
PJERROU	65B	PRL 14 275	G.M. Pjerrou *et al.*	(UCLA)	REFID=12009
Also		Thesis	G.M. Pjerrou	(UCLA)	REFID=12010
CARMONY	64B	PRL 12 482	D.D. Carmony *et al.*	(UCLA)	REFID=12007
HUBBARD	64	PR 135 B183	J.R. Hubbard *et al.*	(LRL)	REFID=11754
JAUNEAU	63	PL 4 49	L. Jauneau *et al.*	(EPOL, CERN, LOUC+)	REFID=12005
Also		Siena Conf. 1 1	L. Jauneau *et al.*	(EPOL, CERN, LOUC+)	REFID=12004