

Ξ BARYONS

($S = -2, I = 1/2$)

$\Xi^0 = uss, \Xi^- = dss$

Ξ^0

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

P is not yet measured; + is the quark model prediction.

Mass $m = 1314.86 \pm 0.20$ MeV
 $m_{\Xi^-} - m_{\Xi^0} = 6.85 \pm 0.21$ MeV
 Mean life $\tau = (2.90 \pm 0.09) \times 10^{-10}$ s
 $c\tau = 8.71$ cm
 Magnetic moment $\mu = -1.250 \pm 0.014 \mu_N$

Decay parameters

$\Lambda\pi^0 \quad \alpha = -0.349 \pm 0.009$
 α FOR $\Xi^0 \rightarrow \bar{\Lambda}\pi^0 = 0.379 \pm 0.004$
 " $\phi = (0.3 \pm 0.6)^\circ$
 ϕ ANGLE FOR $\Xi^0 \rightarrow \bar{\Lambda}\pi^0$ with $\tan\phi = \beta/\gamma = -0.3 \pm 0.6$ degrees
 $\Delta\phi_{CP}(\Xi^0) = (\phi_{\Xi^0} + \phi_{\bar{\Xi}^0})/2 = 0.0 \pm 0.4$ degrees
 A_{CP} FOR $\Xi^0 \rightarrow \bar{\Lambda}\pi^0, \bar{\Xi}^0 \rightarrow \bar{\Lambda}\pi^0 = (-5 \pm 7) \times 10^{-3}$
 " $\gamma = 0.85$ [a]
 " $\Delta = (218_{-19}^{+12})^\circ$ [a]
 $\Lambda\gamma \quad \alpha = -0.70 \pm 0.07$
 $\Lambda e^+ e^- \quad \alpha = -0.8 \pm 0.2$
 $\Sigma^0\gamma \quad \alpha = -0.69 \pm 0.06$
 $\Sigma^+ e^- \bar{\nu}_e \quad g_1(0)/f_1(0) = 1.22 \pm 0.05$
 $\Sigma^+ e^- \bar{\nu}_e \quad f_2(0)/f_1(0) = 2.0 \pm 0.9$

Ξ^0 DECAY MODES	Fraction (Γ_i/Γ)	Confidence level	P (MeV/c)
$\Lambda\pi^0$	(99.524±0.012) %		135
$\Lambda\gamma$	(1.17 ±0.07) × 10 ⁻³		184
$\Lambda e^+ e^-$	(7.6 ±0.6) × 10 ⁻⁶		184
$\Sigma^0\gamma$	(3.33 ±0.10) × 10 ⁻³		117
$\Sigma^+ e^- \bar{\nu}_e$	(2.52 ±0.08) × 10 ⁻⁴		120
$\Sigma^+ \mu^- \bar{\nu}_\mu$	(2.33 ±0.35) × 10 ⁻⁶		64

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

$\Sigma^- e^+ \nu_e$	SQ	< 1.6	× 10 ⁻⁴	90%	112
$\Sigma^- \mu^+ \nu_\mu$	SQ	< 9	× 10 ⁻⁴	90%	49
$\rho\pi^-$	S2	< 8	× 10 ⁻⁶	90%	299

$p e^- \bar{\nu}_e$	S2	< 1.3	$\times 10^{-3}$	323
$p \mu^- \bar{\nu}_\mu$	S2	< 1.3	$\times 10^{-3}$	309



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

P is not yet measured; + is the quark model prediction.

Mass $m = 1321.71 \pm 0.07$ MeV

$$(m_{\Xi^-} - m_{\Xi^+}) / m_{\Xi^-} = (-3 \pm 9) \times 10^{-5}$$

$$\text{Mean life } \tau = (1.639 \pm 0.015) \times 10^{-10} \text{ s}$$

$$c\tau = 4.91 \text{ cm}$$

$$(\tau_{\Xi^-} - \tau_{\Xi^+}) / \tau_{\Xi^-} = -0.01 \pm 0.07$$

$$\text{Magnetic moment } \mu = -0.6507 \pm 0.0025 \mu_N$$

$$(\mu_{\Xi^-} + \mu_{\Xi^+}) / |\mu_{\Xi^-}| = +0.01 \pm 0.05$$

Decay parameters

$$\Lambda \pi^- \quad \alpha = -0.390 \pm 0.007 \quad (S = 2.0)$$

$$\alpha(\Xi^+) \text{ for } \Xi^+ \rightarrow \bar{\Lambda} \pi^+ = 0.371 \pm 0.007$$

$$(\alpha + \bar{\alpha}) / (\alpha - \bar{\alpha}) \text{ for } \Xi^- \rightarrow \Lambda \pi^-, \Xi^+ \rightarrow \bar{\Lambda} \pi^+ = (6 \pm 14) \times 10^{-3}$$

$$[\alpha(\Xi^-)\alpha_-(\Lambda) - \alpha(\Xi^+)\alpha_+(\bar{\Lambda})] / [\text{sum}] = (0 \pm 7) \times 10^{-4}$$

$$\phi = (-1.2 \pm 1.0)^\circ \quad (S = 1.4)$$

$$\phi \text{ ANGLE FOR } \Xi^+ \rightarrow \bar{\Lambda} \pi^+ \quad (\tan \phi = \beta/\gamma) = (-1.2 \pm 1.2)^\circ$$

$$\Delta \Phi_{CP} = (\Phi_- + \Phi_+)/2 = (-0.3 \pm 0.8)^\circ$$

$$\gamma = 0.89 \text{ [a]}$$

$$\Delta = (175.9 \pm 1.5)^\circ \text{ [a]}$$

$$\Lambda e^- \bar{\nu}_e \quad g_A/g_V = -0.25 \pm 0.05 \text{ [b]}$$

Ξ^- DECAY MODES	Fraction (Γ_i/Γ)	Confidence level	p (MeV/c)
$\Lambda \pi^-$	$(99.887 \pm 0.035) \%$		140
$\Sigma^- \gamma$	$(1.27 \pm 0.23) \times 10^{-4}$		118
$\Lambda e^- \bar{\nu}_e$	$(5.63 \pm 0.31) \times 10^{-4}$		190
$\Lambda \mu^- \bar{\nu}_\mu$	$(3.5 \text{ }^{+3.5}_{-2.2}) \times 10^{-4}$		163
$\Sigma^0 e^- \bar{\nu}_e$	$(8.7 \pm 1.7) \times 10^{-5}$		123
$\Sigma^0 \mu^- \bar{\nu}_\mu$	< 8	$\times 10^{-4}$	90% 70
$\Xi^0 e^- \bar{\nu}_e$	< 2.59	$\times 10^{-4}$	90% 7

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

$n \pi^-$	S2	< 1.9	$\times 10^{-5}$	90%	304
$n e^- \bar{\nu}_e$	S2	< 3.2	$\times 10^{-3}$	90%	327
$n \mu^- \bar{\nu}_\mu$	S2	< 1.5	%	90%	314
$p \pi^- \pi^-$	S2	< 4	$\times 10^{-4}$	90%	223

$p\pi^-e^-\bar{\nu}_e$	S2	< 4	$\times 10^{-4}$	90%	305
$p\pi^-\mu^-\bar{\nu}_\mu$	S2	< 4	$\times 10^{-4}$	90%	251
$p\mu^-\mu^-$	L	< 4	$\times 10^{-8}$	90%	272

$\Xi(1530) 3/2^+$

$$I(J^P) = \frac{1}{2}(\frac{3}{2}^+)$$

$\Xi(1530)^0$ mass $m = 1531.80 \pm 0.32$ MeV ($S = 1.3$)

$\Xi(1530)^-$ mass $m = 1535.0 \pm 0.6$ MeV

$\Xi(1530)^0$ full width $\Gamma = 9.1 \pm 0.5$ MeV

$\Xi(1530)^-$ full width $\Gamma = 9.9^{+1.7}_{-1.9}$ MeV

$\Xi(1530)$ DECAY MODES	Fraction (Γ_i/Γ)	Confidence level	p (MeV/c)
$\Xi\pi$	100 %		158
$\Xi\gamma$	<3.7 %	90%	202

$\Xi(1690)$

$$I(J^P) = \frac{1}{2}(?^?)$$

Mass $m = 1690 \pm 10$ MeV [c]

Full width $\Gamma = 20 \pm 15$ MeV

$\Xi(1690)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\Lambda\bar{K}$	seen	240
$\Sigma\bar{K}$	seen	70
$\Xi\pi$	seen	311
$\Xi^-\pi^+\pi^-$	possibly seen	213

$\Xi(1820) 3/2^-$

$$I(J^P) = \frac{1}{2}(\frac{3}{2}^-)$$

Mass $m = 1823 \pm 5$ MeV [c]

Full width $\Gamma = 24^{+15}_{-10}$ MeV [c]

$\Xi(1820)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\Lambda\bar{K}$	large	402
$\Sigma\bar{K}$	small	324
$\Xi\pi$	small	421
$\Xi(1530)\pi$	small	237

$\Xi(1950)$

$$I(J^P) = \frac{1}{2}(??)$$

Mass $m = 1950 \pm 15$ MeV [c]
 Full width $\Gamma = 60 \pm 20$ MeV [c]

$\Xi(1950)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\Lambda \bar{K}$	seen	522
$\Sigma \bar{K}$	possibly seen	460
$\Xi \pi$	seen	519

$\Xi(2030)$

$$I(J^P) = \frac{1}{2}(\geq \frac{5}{2}?)$$

Mass $m = 2025 \pm 5$ MeV [c]
 Full width $\Gamma = 20^{+15}_{-5}$ MeV [c]

$\Xi(2030)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\Lambda \bar{K}$	$\sim 20\%$	585
$\Sigma \bar{K}$	$\sim 80\%$	529
$\Xi \pi$	small	574
$\Xi(1530)\pi$	small	416
$\Lambda \bar{K} \pi$	small	499
$\Sigma \bar{K} \pi$	small	428

NOTES

[a] The decay parameters γ and Δ are calculated from α and ϕ using

$$\gamma = \sqrt{1-\alpha^2} \cos\phi, \quad \tan\Delta = -\frac{1}{\alpha} \sqrt{1-\alpha^2} \sin\phi.$$

See the “Note on Baryon Decay Parameters” in the neutron Particle Listings.

[b] The parameters g_A , g_V , and g_{WM} for semileptonic modes are defined by $\bar{B}_f[\gamma_\lambda(g_V + g_A\gamma_5) + i(g_{WM}/m_{B_i}) \sigma_{\lambda\nu} q^\nu]B_i$, and ϕ_{AV} is defined by $g_A/g_V = |g_A/g_V|e^{i\phi_{AV}}$. See the “Note on Baryon Decay Parameters” in the neutron Particle Listings.

[c] Our estimate. See the Particle Listings for details.