

# $\Xi$ BARYONS

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

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

 $\Xi^0$ 

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

$P$  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

$\Lambda\pi^0$        $\alpha = -0.406 \pm 0.013$   
 "       $\phi = (21 \pm 12)^\circ$   
 "       $\gamma = 0.85$  [a]  
 "       $\Delta = (218_{-19}^{+12})^\circ$  [a]  
 $\Lambda\gamma$        $\alpha = -0.70 \pm 0.07$   
 $\Lambda e^+ e^-$        $\alpha = -0.8 \pm 0.2$   
 $\Sigma^0 \gamma$        $\alpha = -0.69 \pm 0.06$   
 $\Sigma^+ e^- \bar{\nu}_e$        $g_1(0)/f_1(0) = 1.22 \pm 0.05$   
 $\Sigma^+ e^- \bar{\nu}_e$        $f_2(0)/f_1(0) = 2.0 \pm 0.9$

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

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

$\Sigma^- e^+ \nu_e$	SQ	$< 9$	$\times 10^{-4}$	90%	112
$\Sigma^- \mu^+ \nu_\mu$	SQ	$< 9$	$\times 10^{-4}$	90%	49
$p\pi^-$	S2	$< 8$	$\times 10^{-6}$	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

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

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

$c\tau = 4.91$  cm

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

Magnetic moment  $\mu = -0.6507 \pm 0.0025 \mu_N$

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

**Decay parameters**

$\Lambda\pi^- \quad \alpha = -0.458 \pm 0.012 \quad (S = 1.8)$

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

"  $\phi = (-2.1 \pm 0.8)^\circ$

"  $\gamma = 0.89$  [a]

"  $\Delta = (175.9 \pm 1.5)^\circ$  [a]

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

$\Xi^-$ DECAY MODES	Fraction ( $\Gamma_i/\Gamma$ )	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
$\Lambda\mu^- \bar{\nu}_\mu$	$(3.5 \begin{smallmatrix} +3.5 \\ -2.2 \end{smallmatrix}) \times 10^{-4}$		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
$\Xi^0 e^- \bar{\nu}_e$	$< 2.3 \times 10^{-3}$	90%	7

**$\Delta S = 2$  forbidden ( $S_2$ ) modes**

$n\pi^-$	$S_2$	$< 1.9 \times 10^{-5}$	90%	304
$ne^- \bar{\nu}_e$	$S_2$	$< 3.2 \times 10^{-3}$	90%	327
$n\mu^- \bar{\nu}_\mu$	$S_2$	$< 1.5 \%$	90%	314
$\rho\pi^- \pi^-$	$S_2$	$< 4 \times 10^{-4}$	90%	223
$\rho\pi^- e^- \bar{\nu}_e$	$S_2$	$< 4 \times 10^{-4}$	90%	305
$\rho\pi^- \mu^- \bar{\nu}_\mu$	$S_2$	$< 4 \times 10^{-4}$	90%	251
$\rho\mu^- \mu^-$	$L$	$< 4 \times 10^{-8}$	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 ( $\Gamma_i/\Gamma$ )	Confidence level	$p$ (MeV/c)
$\Xi \pi$	100 %		158
$\Xi \gamma$	<4 %	90%	202

**$\Xi(1690)$**

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

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

Full width  $\Gamma < 30$  MeV

$\Xi(1690)$ DECAY MODES	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (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 ( $\Gamma_i/\Gamma$ )	$p$ (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]

<b><math>\Xi(1950)</math> DECAY MODES</b>	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (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]

<b><math>\Xi(2030)</math> DECAY MODES</b>	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (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  $\gamma$  and  $\Delta$  are calculated from  $\alpha$  and  $\phi$  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  $\phi_{AV}$  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] The error given here is only an educated guess. It is larger than the error on the weighted average of the published values.