

# Λ BARYONS

## (S = -1, I = 0)

$$\Lambda^0 = uds$$



$$I(J^P) = 0(\frac{1}{2}^+)$$

Mass  $m = 1115.683 \pm 0.006$  MeV

$$(m_\Lambda - m_{\bar{\Lambda}}) / m_\Lambda = (-0.1 \pm 1.1) \times 10^{-5} \quad (S = 1.6)$$

$$\text{Mean life } \tau = (2.632 \pm 0.020) \times 10^{-10} \text{ s} \quad (S = 1.6)$$

$$(\tau_\Lambda - \tau_{\bar{\Lambda}}) / \tau_\Lambda = -0.001 \pm 0.009$$

$$c\tau = 7.89 \text{ cm}$$

$$\text{Magnetic moment } \mu = -0.613 \pm 0.004 \mu_N$$

$$\text{Electric dipole moment } d < 1.5 \times 10^{-16} \text{ ecm, CL} = 95\%$$

### Decay parameters

$$p\pi^- \quad \alpha_- = 0.642 \pm 0.013$$

$$\bar{p}\pi^+ \quad \alpha_+ = -0.71 \pm 0.08$$

$$p\pi^- \quad \phi_- = (-6.5 \pm 3.5)^\circ$$

$$" \quad \gamma_- = 0.76 [a]$$

$$" \quad \Delta_- = (8 \pm 4)^\circ [a]$$

$$n\pi^0 \quad \alpha_0 = 0.65 \pm 0.04$$

$$pe^- \bar{\nu}_e \quad g_A/g_V = -0.718 \pm 0.015 [b]$$

Λ DECAY MODES	Fraction ( $\Gamma_i/\Gamma$ )	Confidence level	$\rho$ (MeV/c)
$p\pi^-$	(63.9 ± 0.5) %		101
$n\pi^0$	(35.8 ± 0.5) %		104
$n\gamma$	(1.75 ± 0.15) × 10 <sup>-3</sup>		162
$p\pi^- \gamma$	[c] (8.4 ± 1.4) × 10 <sup>-4</sup>		101
$pe^- \bar{\nu}_e$	(8.32 ± 0.14) × 10 <sup>-4</sup>		163
$p\mu^- \bar{\nu}_\mu$	(1.57 ± 0.35) × 10 <sup>-4</sup>		131

### Lepton (L) and/or Baryon (B) number violating decay modes

$\pi^+ e^-$	L,B	< 6	× 10 <sup>-7</sup>	90%	549
$\pi^+ \mu^-$	L,B	< 6	× 10 <sup>-7</sup>	90%	544
$\pi^- e^+$	L,B	< 4	× 10 <sup>-7</sup>	90%	549
$\pi^- \mu^+$	L,B	< 6	× 10 <sup>-7</sup>	90%	544
$K^+ e^-$	L,B	< 2	× 10 <sup>-6</sup>	90%	449

$K^+ \mu^-$	$L, B$	$< 3$	$\times 10^{-6}$	90%	441
$K^- e^+$	$L, B$	$< 2$	$\times 10^{-6}$	90%	449
$K^- \mu^+$	$L, B$	$< 3$	$\times 10^{-6}$	90%	441
$K_S^0 \nu$	$L, B$	$< 2$	$\times 10^{-5}$	90%	447
$\bar{p} \pi^+$	$B$	$< 9$	$\times 10^{-7}$	90%	101

**$\Lambda(1405) 1/2^-$**

$I(J^P) = 0(\frac{1}{2}^-)$

Mass  $m = 1405.1^{+1.3}_{-1.0}$  MeV  
 Full width  $\Gamma = 50.5 \pm 2.0$  MeV  
 Below  $\bar{K}N$  threshold

<b><math>\Lambda(1405)</math> DECAY MODES</b>	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$\Sigma \pi$	100 %	155

**$\Lambda(1520) 3/2^-$**

$I(J^P) = 0(\frac{3}{2}^-)$

Mass  $m = 1519.5 \pm 1.0$  MeV [d]  
 Full width  $\Gamma = 15.6 \pm 1.0$  MeV [d]

<b><math>\Lambda(1520)</math> DECAY MODES</b>	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$N \bar{K}$	(45 $\pm 1$ ) %	243
$\Sigma \pi$	(42 $\pm 1$ ) %	268
$\Lambda \pi \pi$	(10 $\pm 1$ ) %	259
$\Sigma \pi \pi$	( 0.9 $\pm 0.1$ ) %	169
$\Lambda \gamma$	( 0.85 $\pm 0.15$ ) %	350

**$\Lambda(1600) 1/2^+$**

$I(J^P) = 0(\frac{1}{2}^+)$

Mass  $m = 1560$  to  $1700$  ( $\approx 1600$ ) MeV  
 Full width  $\Gamma = 50$  to  $250$  ( $\approx 150$ ) MeV

<b><math>\Lambda(1600)</math> DECAY MODES</b>	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$N \bar{K}$	15–30 %	343
$\Sigma \pi$	10–60 %	338

**$\Lambda(1670) 1/2^-$** 

$$I(J^P) = 0(\frac{1}{2}^-)$$

Mass  $m = 1660$  to  $1680$  ( $\approx 1670$ ) MeVFull width  $\Gamma = 25$  to  $50$  ( $\approx 35$ ) MeV

<b><math>\Lambda(1670)</math> DECAY MODES</b>	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$N\bar{K}$	20–30 %	414
$\Sigma\pi$	25–55 %	394
$\Lambda\eta$	10–25 %	69
$N\bar{K}^*(892)$ , $S=3/2$ , $D$ -wave	$(5\pm 4)$ %	†

 **$\Lambda(1690) 3/2^-$** 

$$I(J^P) = 0(\frac{3}{2}^-)$$

Mass  $m = 1685$  to  $1695$  ( $\approx 1690$ ) MeVFull width  $\Gamma = 50$  to  $70$  ( $\approx 60$ ) MeV

<b><math>\Lambda(1690)</math> DECAY MODES</b>	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$N\bar{K}$	20–30 %	433
$\Sigma\pi$	20–40 %	410
$\Lambda\pi\pi$	$\sim 25$ %	419
$\Sigma\pi\pi$	$\sim 20$ %	358

 **$\Lambda(1800) 1/2^-$** 

$$I(J^P) = 0(\frac{1}{2}^-)$$

Mass  $m = 1720$  to  $1850$  ( $\approx 1800$ ) MeVFull width  $\Gamma = 200$  to  $400$  ( $\approx 300$ ) MeV

<b><math>\Lambda(1800)</math> DECAY MODES</b>	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$N\bar{K}$	25–40 %	528
$\Sigma\pi$	seen	494
$\Sigma(1385)\pi$	seen	349
$\Lambda\eta$	$(6\pm 5)$ %	326
$N\bar{K}^*(892)$	seen	†

**$\Lambda(1810) 1/2^+$** 

$$I(J^P) = 0(\frac{1}{2}^+)$$

Mass  $m = 1750$  to  $1850$  ( $\approx 1810$ ) MeVFull width  $\Gamma = 50$  to  $250$  ( $\approx 150$ ) MeV

<b><math>\Lambda(1810)</math> DECAY MODES</b>	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$N\bar{K}$	20–50 %	537
$\Sigma\pi$	10–40 %	501
$\Sigma(1385)\pi$	seen	357
$N\bar{K}^*(892)$	30–60 %	†

 **$\Lambda(1820) 5/2^+$** 

$$I(J^P) = 0(\frac{5}{2}^+)$$

Mass  $m = 1815$  to  $1825$  ( $\approx 1820$ ) MeVFull width  $\Gamma = 70$  to  $90$  ( $\approx 80$ ) MeV

<b><math>\Lambda(1820)</math> DECAY MODES</b>	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$N\bar{K}$	55–65 %	545
$\Sigma\pi$	8–14 %	509
$\Sigma(1385)\pi$	5–10 %	366
$N\bar{K}^*(892)$ , $S=3/2$ , $P$ -wave	( $3.0 \pm 1.0$ ) %	†

 **$\Lambda(1830) 5/2^-$** 

$$I(J^P) = 0(\frac{5}{2}^-)$$

Mass  $m = 1810$  to  $1830$  ( $\approx 1830$ ) MeVFull width  $\Gamma = 60$  to  $110$  ( $\approx 95$ ) MeV

<b><math>\Lambda(1830)</math> DECAY MODES</b>	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$N\bar{K}$	3–10 %	553
$\Sigma\pi$	35–75 %	516
$\Sigma(1385)\pi$	>15 %	374
$\Sigma(1385)\pi$ , $D$ -wave	( $52 \pm 6$ ) %	374

**$\Lambda(1890) 3/2^+$** 

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

Mass  $m = 1850$  to  $1910$  ( $\approx 1890$ ) MeVFull width  $\Gamma = 60$  to  $200$  ( $\approx 100$ ) MeV

<b><math>\Lambda(1890)</math> DECAY MODES</b>	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$N\bar{K}$	20–35 %	599
$\Sigma\pi$	3–10 %	560
$\Sigma(1385)\pi$	seen	423
$N\bar{K}^*(892)$	seen	236

 **$\Lambda(2100) 7/2^-$** 

$$I(J^P) = 0(\frac{7}{2}^-)$$

Mass  $m = 2090$  to  $2110$  ( $\approx 2100$ ) MeVFull width  $\Gamma = 100$  to  $250$  ( $\approx 200$ ) MeV

<b><math>\Lambda(2100)</math> DECAY MODES</b>	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$N\bar{K}$	25–35 %	751
$\Sigma\pi$	$\sim 5$ %	705
$\Lambda\eta$	$< 3$ %	617
$\Xi K$	$< 3$ %	491
$\Lambda\omega$	$< 8$ %	443
$N\bar{K}^*(892)$	10–20 %	515

 **$\Lambda(2110) 5/2^+$** 

$$I(J^P) = 0(\frac{5}{2}^+)$$

Mass  $m = 2090$  to  $2140$  ( $\approx 2110$ ) MeVFull width  $\Gamma = 150$  to  $250$  ( $\approx 200$ ) MeV

<b><math>\Lambda(2110)</math> DECAY MODES</b>	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$N\bar{K}$	5–25 %	757
$\Sigma\pi$	10–40 %	711
$\Lambda\omega$	seen	455
$\Sigma(1385)\pi$	seen	591
$N\bar{K}^*(892)$	10–60 %	525

**$\Lambda(2350) 9/2^+$** 

$$I(J^P) = 0(\frac{9}{2}^+)$$

Mass  $m = 2340$  to  $2370$  ( $\approx 2350$ ) MeVFull width  $\Gamma = 100$  to  $250$  ( $\approx 150$ ) MeV

<b><math>\Lambda(2350)</math> DECAY MODES</b>	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$N\bar{K}$	$\sim 12\%$	915
$\Sigma\pi$	$\sim 10\%$	867

## 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] See the Listings for the pion momentum range used in this measurement.

[d] The error given here is only an educated guess. It is larger than the error on the weighted average of the published values.