

Λ BARYONS

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

$$\Lambda^0 = uds$$

Λ

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

$$\text{Mass } m = 1115.683 \pm 0.006 \text{ MeV}$$

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

$$\text{Mean life } \tau = (2.617 \pm 0.010) \times 10^{-10} \text{ s} \quad (S = 1.5)$$

$$(\tau_\Lambda - \tau_{\bar{\Lambda}}) / \tau_\Lambda = (0.9 \pm 3.2) \times 10^{-3}$$

$$c\tau = 7.845 \text{ cm}$$

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

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

Decay parameters

$$p\pi^- \quad \alpha_- = 0.749 \pm 0.008 \quad (S = 2.4)$$

$$\bar{p}\pi^+ \quad \alpha_+ = -0.758 \pm 0.005 \quad (S = 1.2)$$

$$\bar{n}\pi^0 \quad \bar{\alpha}_0 = -0.675 \pm 0.011 \quad (S = 1.2)$$

$$n\pi^0 \quad \alpha_0 = 0.670 \pm 0.012$$

$$n\gamma \quad \alpha_\gamma = -0.16 \pm 0.11$$

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

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

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

$$\bar{\alpha}_0 / \alpha_+ \text{ in } \bar{\Lambda} \rightarrow \bar{n}\pi^0, \bar{\Lambda} \rightarrow \bar{p}\pi^+ = 0.876_{-0.020}^{+0.022} \quad (S = 1.4)$$

$$(\alpha_0 + \bar{\alpha}_0) / (\alpha_0 - \bar{\alpha}_0) \text{ in } \Lambda \rightarrow n\pi^0, \bar{\Lambda} \rightarrow \bar{n}\pi^0 = (0.1_{-1.1}^{+1.0}) \times 10^{-2}$$

$$R = |G_E/G_M| \text{ in } \Lambda \rightarrow p\pi^-, \bar{\Lambda} \rightarrow \bar{p}\pi^+ = 0.96 \pm 0.14$$

$$\Delta\Phi = \Phi_E - \Phi_M \text{ in } \Lambda \rightarrow p\pi^-, \bar{\Lambda} \rightarrow \bar{p}\pi^+ = 37 \pm 13 \text{ degrees}$$

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

Λ DECAY MODES	Fraction (Γ_i/Γ)	Confidence level	p (MeV/c)
$p\pi^-$	(64.1 $\pm$ 0.5) %		101
$n\pi^0$	(35.9 $\pm$ 0.5) %		104
$n\gamma$	(8.3 $\pm$ 0.7) $\times 10^{-4}$		162
$p\pi^-\gamma$	[c] (8.5 $\pm$ 1.4) $\times 10^{-4}$		101
$pe^-\bar{\nu}_e$	(8.34 $\pm$ 0.14) $\times 10^{-4}$		163
$p\mu^-\bar{\nu}_\mu$	(1.51 $\pm$ 0.19) $\times 10^{-4}$		131

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

π^+e^-	L,B	< 6	$\times 10^{-7}$	90%	549
$\pi^+\mu^-$	L,B	< 6	$\times 10^{-7}$	90%	544
π^-e^+	L,B	< 4	$\times 10^{-7}$	90%	549
$\pi^-\mu^+$	L,B	< 6	$\times 10^{-7}$	90%	544
K^+e^-	L,B	< 2	$\times 10^{-6}$	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
invisible		< 7.4	$\times 10^{-5}$	90%	—

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

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

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

$\Lambda(1405)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\Sigma\pi$	100 %	155

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

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

Mass $m = 1518$ to 1520 (≈ 1519) MeV ^[d]
Full width $\Gamma = 15$ to 17 (≈ 16) MeV ^[d]

$\Lambda(1520)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\overline{K}$	(45 $\pm$ 1) %	242
$\Sigma\pi$	(42 $\pm$ 1) %	268
$\Lambda\pi\pi$	(10 $\pm$ 1) %	259
$\Sigma\pi\pi$	(0.9 $\pm$ 0.1) %	168
$\Lambda\gamma$	(0.85 $\pm$ 0.15) %	350

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

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

Mass $m = 1570$ to 1630 (≈ 1600) MeV
Full width $\Gamma = 150$ to 250 (≈ 200) MeV

$\Lambda(1600)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\overline{K}$	15–30 %	343
$\Sigma\pi$	10–60 %	338
$\Lambda\sigma$	(19 $\pm$ 4) %	–
$\Sigma(1385)\pi$	(9 $\pm$ 4) %	158

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

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

Mass $m = 1670$ to 1678 (≈ 1674) MeV
Full width $\Gamma = 25$ to 35 (≈ 30) MeV

$\Lambda(1670)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\overline{K}$	20–30 %	418
$\Sigma\pi$	25–55 %	398
$\Lambda\eta$	10–25 %	88
$\Sigma(1385)\pi$, D -wave	(6.0 $\pm$ 2.0) %	235
$N\overline{K}^*(892)$, $S=3/2$, D -wave	(5 $\pm$ 4) %	†
$\Lambda\sigma$	(20 $\pm$ 8) %	–

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

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

Mass $m = 1685$ to 1695 (≈ 1690) MeV
Full width $\Gamma = 60$ to 80 (≈ 70) MeV

$\Lambda(1690)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\bar{K}$	20–30 %	433
$\Sigma\pi$	20–40 %	410
$\Lambda\sigma$	(5.0 ± 2.0) %	–
$\Lambda\pi\pi$	~ 25 %	419
$\Sigma\pi\pi$	~ 20 %	358
$\Sigma(1385)\pi$, S -wave	(9 ± 5) %	251
$\Sigma(1385)\pi$, D -wave	(3.0 ± 2.0) %	251

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

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

Mass $m = 1750$ to 1850 (≈ 1800) MeV
Full width $\Gamma = 150$ to 250 (≈ 200) MeV

$\Lambda(1800)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\bar{K}$	25–40 %	528
$\Sigma\pi$	(27 ± 6) %	494
$\Lambda\sigma$	(15 ± 4) %	–
$\Sigma(1385)\pi$	(9 ± 4) %	349
$\Lambda\eta$	0.01 to 0.10	326
$N\bar{K}^*(892)$	seen	†

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

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

Mass $m = 1740$ to 1840 (≈ 1790) MeV
Full width $\Gamma = 50$ to 170 (≈ 110) MeV

$\Lambda(1810)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\bar{K}$	0.05 to 0.35	520
$\Sigma\pi$	(16 ± 5) %	487
$\Sigma(1385)\pi$	(40 ± 15) %	340
$N\bar{K}^*(892)$	30–60 %	†

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

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

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

$\Lambda(1820)$ DECAY MODES	Fraction (Γ_i/Γ)	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 ± 1.0) %	†

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

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

Mass $m = 1820$ to 1830 (≈ 1825) MeV
Full width $\Gamma = 60$ to 120 (≈ 90) MeV

$\Lambda(1830)$ DECAY MODES	Fraction (Γ_i/Γ)	Scale factor	p (MeV/c)
$N\bar{K}$	0.04 to 0.08		549
$\Sigma\pi$	35–75 %		512
$\Sigma(1385)\pi$	>15 %		370
$\Sigma(1385)\pi$, D -wave	(40 ± 15) %	3.2	370

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

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

Mass $m = 1870$ to 1910 (≈ 1890) MeV
Full width $\Gamma = 80$ to 160 (≈ 120) MeV

$\Lambda(1890)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\bar{K}$	0.24 to 0.36	599
$\Sigma\pi$	3–10 %	560
$\Sigma(1385)\pi$	seen	423
$\Sigma(1385)\pi$, P -wave	(6.0 ± 3.0) %	423
$\Sigma(1385)\pi$, F -wave	(4.0 ± 2.0) %	423
$N\bar{K}^*(892)$	seen	236

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

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

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

$\Lambda(2100)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\bar{K}$	25–35 %	751
$\Sigma\pi$	~ 5 %	705
$\Lambda\eta$	<3 %	617
ΞK	<3 %	491
$\Lambda\omega$	<8 %	443
$\Sigma(1385)\pi$, G-wave	(1.0 ± 1.0) %	584
$N\bar{K}^*(892)$	10–20 %	515
$N\bar{K}^*(892)$, $S=3/2$, D-wave	(4.0 ± 2.0) %	515

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

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

Mass $m = 2050$ to 2130 (≈ 2090) MeV
Full width $\Gamma = 200$ to 300 (≈ 250) MeV

$\Lambda(2110)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\bar{K}$	5–25 %	744
$\Sigma\pi$	10–40 %	698
$\Lambda\omega$	seen	432
$\Lambda\omega$, $S=3/2$, P -wave	(5.0 ± 2.0) %	432
$\Sigma(1385)\pi$	seen	576
$N\bar{K}^*(892)$	10–60 %	505

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

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

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

$\Lambda(2350)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\bar{K}$	~ 12 %	915
$\Sigma\pi$	~ 10 %	867

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

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