

Λ BARYONS

(S = -1, I = 0)

$$\Lambda^0 = uds$$



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

Mass $m = 1115.683 \pm 0.006$ MeV

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

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

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

$$c\tau = 7.845$$
 cm

Magnetic moment $\mu = -0.613 \pm 0.004 \mu_N$

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

Decay parameters

$$p\pi^- \quad \alpha_- = 0.748 \pm 0.008 \quad (S = 2.4)$$

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

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

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

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

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

$$p\pi^- \quad \gamma_- = 0.66 \pm 0.01 \text{ [a]}$$

$$p\pi^- \quad \Delta_- = (5.7 \pm 3.0)^\circ \text{ [a]}$$

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

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

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

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

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

$\pi^+ e^-$	L,B	< 6	× 10 ⁻⁷	90%	549
$\pi^+ \mu^-$	L,B	< 6	× 10 ⁻⁷	90%	544
$\pi^- e^+$	L,B	< 4	× 10 ⁻⁷	90%	549
$\pi^- \mu^+$	L,B	< 6	× 10 ⁻⁷	90%	544
$K^+ e^-$	L,B	< 2	× 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)
$N \bar{K}$	(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)
$N \bar{K}$	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) MeVFull width $\Gamma = 25$ to 35 (≈ 30) MeV

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

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

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

Mass $m = 1685$ to 1695 (≈ 1690) MeVFull 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) MeVFull 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 \pm 5) %	487
$\Sigma(1385)\pi$	(40 \pm 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 \pm 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 \pm 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) MeVFull width $\Gamma = 100$ to 250 (≈ 150) MeV

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