N BARYONS
$(S = 0,\ I = 1/2)$

$p,\ N^{+} = uud;\quad n,\ N^{0} = udd$

p

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

Mass $m = 1.00727646688 \pm 0.00000000009$ u
Mass $m = 938.272081 \pm 0.000006$ MeV [a]
$\left|m_{p} - m_{\overline{p}}\right|/m_{p} < 7 \times 10^{-10}$, CL = 90% [b]
$\left|\frac{q_{\overline{p}}}{m_{\overline{p}}}\right|/(\frac{q_{p}}{m_{p}}) = 1.00000000000 \pm 0.00000000007$
$\left|q_{p} + q_{\overline{p}}\right|/e < 7 \times 10^{-10}$, CL = 90% [b]
$\left|q_{p} + q_{e}\right|/e < 1 \times 10^{-21}$ [c]
Magnetic moment $\mu = 2.792847351 \pm 0.000000009\ \mu_{N}$
$(\mu_{p} + \mu_{\overline{p}})\ /\ \mu_{p} = (0.3 \pm 0.8) \times 10^{-6}$
Electric dipole moment $d < 0.021 \times 10^{-23}$ e cm
Electric polarizability $\alpha = (11.2 \pm 0.4) \times 10^{-4}$ fm^{3}
Magnetic polarizability $\beta = (2.5 \pm 0.4) \times 10^{-4}$ fm^{3} (S = 1.2)
Charge radius, μp Lamb shift = 0.84087 ± 0.00039 fm [d]
Charge radius, $e p$ CODATA value = 0.8751 ± 0.0061 fm [d]
Magnetic radius = 0.78 ± 0.04 fm [e]
Mean life $\tau > 2.1 \times 10^{29}$ years, CL = 90% [f] ($p \to$ invisible mode)
Mean life $\tau > 10^{31}$ to 10^{33} years [f] (mode dependent)

See the "Note on Nucleon Decay" in our 1994 edition (Phys. Rev. **D50**, 1173) for a short review.

The "partial mean life" limits tabulated here are the limits on τ/B_{i}, where τ is the total mean life and B_{i} is the branching fraction for the mode in question. For N decays, p and n indicate proton and neutron partial lifetimes.

p DECAY MODES	Partial mean life (10^{30} years)	Confidence level	p (MeV/c)
Antilepton + meson			
$N \to e^{+}\pi$	> 2000 (n), > 8200 (p)	90%	459
$N \to \mu^{+}\pi$	> 1000 (n), > 6600 (p)	90%	453
$N \to \nu\pi$	> 1100 (n), > 390 (p)	90%	459
$p \to e^{+}\eta$	> 4200	90%	309
$p \to \mu^{+}\eta$	> 1300	90%	297
$n \to \nu\eta$	> 158	90%	310
$N \to e^{+}\rho$	> 217 (n), > 710 (p)	90%	149
$N \to \mu^{+}\rho$	> 228 (n), > 160 (p)	90%	113

$N \to \nu \rho$	> 19 (n), > 162 (p)	90%	149
$p \to e^+ \omega$	> 320	90%	143
$p \to \mu^+ \omega$	> 780	90%	105
$n \to \nu \omega$	> 108	90%	144
$N \to e^+ K$	> 17 (n), > 1000 (p)	90%	339
$N \to \mu^+ K$	> 26 (n), > 1600 (p)	90%	329
$N \to \nu K$	> 86 (n), > 5900 (p)	90%	339
$n \to \nu K^0_S$	> 260	90%	338
$p \to e^+ K^*(892)^0$	> 84	90%	45
$N \to \nu K^*(892)$	> 78 (n), > 51 (p)	90%	45

Antilepton + mesons

$p \to e^+ \pi^+ \pi^-$	> 82	90%	448
$p \to e^+ \pi^0 \pi^0$	> 147	90%	449
$n \to e^+ \pi^- \pi^0$	> 52	90%	449
$p \to \mu^+ \pi^+ \pi^-$	> 133	90%	425
$p \to \mu^+ \pi^0 \pi^0$	> 101	90%	427
$n \to \mu^+ \pi^- \pi^0$	> 74	90%	427
$n \to e^+ K^0 \pi^-$	> 18	90%	319

Lepton + meson

$n \to e^- \pi^+$	> 65	90%	459
$n \to \mu^- \pi^+$	> 49	90%	453
$n \to e^- \rho^+$	> 62	90%	150
$n \to \mu^- \rho^+$	> 7	90%	115
$n \to e^- K^+$	> 32	90%	340
$n \to \mu^- K^+$	> 57	90%	330

Lepton + mesons

$p \to e^- \pi^+ \pi^+$	> 30	90%	448
$n \to e^- \pi^+ \pi^0$	> 29	90%	449
$p \to \mu^- \pi^+ \pi^+$	> 17	90%	425
$n \to \mu^- \pi^+ \pi^0$	> 34	90%	427
$p \to e^- \pi^+ K^+$	> 75	90%	320
$p \to \mu^- \pi^+ K^+$	> 245	90%	279

Antilepton + photon(s)

$p \to e^+ \gamma$	> 670	90%	469
$p \to \mu^+ \gamma$	> 478	90%	463
$n \to \nu \gamma$	> 550	90%	470
$p \to e^+ \gamma \gamma$	> 100	90%	469
$n \to \nu \gamma \gamma$	> 219	90%	470

Antilepton + single massless

$p \to e^+ X$	> 790	90%	–
$p \to \mu^+ X$	> 410	90%	–

Three (or more) leptons

$p \to e^+ e^+ e^-$	> 793	90%	469
$p \to e^+ \mu^+ \mu^-$	> 359	90%	457
$p \to e^+ \nu \nu$	> 170	90%	469
$n \to e^+ e^- \nu$	> 257	90%	470
$n \to \mu^+ e^- \nu$	> 83	90%	464
$n \to \mu^+ \mu^- \nu$	> 79	90%	458
$p \to \mu^+ e^+ e^-$	> 529	90%	463
$p \to \mu^+ \mu^+ \mu^-$	> 675	90%	439
$p \to \mu^+ \nu \nu$	> 220	90%	463
$p \to e^- \mu^+ \mu^+$	> 6	90%	457
$n \to 3\nu$	$> 5 \times 10^{-4}$	90%	470

Inclusive modes

$N \to e^+$ anything	> 0.6 (n, p)	90%	–
$N \to \mu^+$ anything	> 12 (n, p)	90%	–
$N \to e^+ \pi^0$ anything	> 0.6 (n, p)	90%	–

$\Delta B = 2$ dinucleon modes

The following are lifetime limits per iron nucleus.

$p p \to \pi^+ \pi^+$	> 72.2	90%	–
$p n \to \pi^+ \pi^0$	> 170	90%	–
$n n \to \pi^+ \pi^-$	> 0.7	90%	–
$n n \to \pi^0 \pi^0$	> 404	90%	–
$p p \to K^+ K^+$	> 170	90%	–
$p p \to e^+ e^+$	> 5.8	90%	–
$p p \to e^+ \mu^+$	> 3.6	90%	–
$p p \to \mu^+ \mu^+$	> 1.7	90%	–
$p n \to e^+ \overline{\nu}$	> 260	90%	–
$p n \to \mu^+ \overline{\nu}$	> 200	90%	–
$p n \to \tau^+ \overline{\nu}_\tau$	> 29	90%	–
$n n \to \nu_e \overline{\nu}_e$	> 1.4	90%	–
$n n \to \nu_\mu \overline{\nu}_\mu$	> 1.4	90%	–
$p n \to$ invisible	$> 2.1 \times 10^{-5}$	90%	–
$p p \to$ invisible	$> 5 \times 10^{-5}$	90%	–

$\overline{p}$ DECAY MODES

$\overline{p}$ DECAY MODES	Partial mean life (years)	Confidence level	p (MeV/c)
$\overline{p} \to e^- \gamma$	$> 7 \times 10^5$	90%	469
$\overline{p} \to \mu^- \gamma$	$> 5 \times 10^4$	90%	463
$\overline{p} \to e^- \pi^0$	$> 4 \times 10^5$	90%	459
$\overline{p} \to \mu^- \pi^0$	$> 5 \times 10^4$	90%	453
$\overline{p} \to e^- \eta$	$> 2 \times 10^4$	90%	309

$\overline{p} \to \mu^- \eta$	$> 8 \times 10^3$	90%	297
$\overline{p} \to e^- K^0_S$	> 900	90%	337
$\overline{p} \to \mu^- K^0_S$	$> 4 \times 10^3$	90%	326
$\overline{p} \to e^- K^0_L$	$> 9 \times 10^3$	90%	337
$\overline{p} \to \mu^- K^0_L$	$> 7 \times 10^3$	90%	326
$\overline{p} \to e^- \gamma\gamma$	$> 2 \times 10^4$	90%	469
$\overline{p} \to \mu^- \gamma\gamma$	$> 2 \times 10^4$	90%	463
$\overline{p} \to e^- \omega$	> 200	90%	143

n

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

Mass $m = 1.0086649159 \pm 0.0000000005$ u
Mass $m = 939.565413 \pm 0.000006$ MeV [a]
$(m_n - m_{\overline{n}})/ m_n = (9 \pm 6) \times 10^{-5}$
$m_n - m_p = 1.2933321 \pm 0.0000005$ MeV
$= 0.00138844919(45)$ u
Mean life $\tau = 880.2 \pm 1.0$ s (S = 1.9)
$c\tau = 2.6387 \times 10^8$ km
Magnetic moment $\mu = -1.9130427 \pm 0.0000005\ \mu_N$
Electric dipole moment $d < 0.30 \times 10^{-25}\ e$ cm, CL = 90%
Mean-square charge radius $\langle r^2_n \rangle = -0.1161 \pm 0.0022$ fm^2 (S = 1.3)
Magnetic radius $\sqrt{\langle r^2_M \rangle} = 0.864^{+0.009}_{-0.008}$ fm
Electric polarizability $\alpha = (11.8 \pm 1.1) \times 10^{-4}$ fm^3
Magnetic polarizability $\beta = (3.7 \pm 1.2) \times 10^{-4}$ fm^3
Charge $q = (-0.2 \pm 0.8) \times 10^{-21}\ e$
Mean $n\overline{n}$-oscillation time $> 2.7 \times 10^8$ s, CL = 90% (free n)
Mean $n\overline{n}$-oscillation time $> 1.3 \times 10^8$ s, CL = 90% [g] (bound n)
Mean $n n'$-oscillation time > 414 s, CL = 90% [h]

$p e^- \nu_e$ decay parameters [i]

$\lambda \equiv g_A / g_V = -1.2723 \pm 0.0023$ (S = 2.2)
$A = -0.1184 \pm 0.0010$ (S = 2.4)
$B = 0.9807 \pm 0.0030$
$C = -0.2377 \pm 0.0026$
$a = -0.103 \pm 0.004$
$\phi_{AV} = (180.017 \pm 0.026)^\circ$ [j]
$D = (-1.2 \pm 2.0) \times 10^{-4}$ [k]
$R = 0.004 \pm 0.013$ [k]

n DECAY MODES		Fraction (Γ_i/Γ)	Confidence level	p (MeV/c)
$p e^- \overline{\nu}_e$		100 %		1
$p e^- \overline{\nu}_e \gamma$	[l]	(9.2±0.7) × 10^{-3}		1
Charge conservation (Q) violating mode				
$p \nu_e \overline{\nu}_e$	Q	< 8 × 10^{-27}	68%	1

N(1440) 1/2$^+$

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

Re(pole position) = 1360 to 1385 (≈ 1370) MeV
−2Im(pole position) = 160 to 195 (≈ 180) MeV
Breit-Wigner mass = 1410 to 1450 (≈ 1430) MeV
Breit-Wigner full width = 250 to 450 (≈ 350) MeV

N(1440) DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\pi$	55–75 %	391
$N\eta$	<1 %	†
$N\pi\pi$	25–50 %	338
$\Delta(1232)\pi$	20–30 %	135
$\Delta(1232)\pi$, P-wave	13–27 %	135
$N\sigma$	11–23 %	–
$p\gamma$, helicity=1/2	0.035–0.048 %	407
$n\gamma$, helicity=1/2	0.02–0.04 %	406

N(1520) 3/2$^-$

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

Re(pole position) = 1505 to 1515 (≈ 1510) MeV
−2Im(pole position) = 105 to 120 (≈ 110) MeV
Breit-Wigner mass = 1510 to 1520 (≈ 1515) MeV
Breit-Wigner full width = 100 to 125 (≈ 115) MeV

N(1520) DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\pi$	55–65 %	453
$N\eta$	< 1 %	142
$N\pi\pi$	25–35 %	410
$\Delta(1232)\pi$	22–34 %	225
$\Delta(1232)\pi$, S-wave	15–23 %	225
$\Delta(1232)\pi$, D-wave	7–11 %	225

$N\sigma$	< 2 %	–
$p\gamma$	0.31–0.52 %	467
$p\gamma$, helicity=1/2	0.01–0.02 %	467
$p\gamma$, helicity=3/2	0.30–0.50 %	467
$n\gamma$	0.30–0.53 %	466
$n\gamma$, helicity=1/2	0.04–0.10 %	466
$n\gamma$, helicity=3/2	0.25–0.45 %	466

N(1535) 1/2$^-$

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

Re(pole position) = 1490 to 1530 ($\approx$ 1510) MeV
-2Im(pole position) = 90 to 250 ($\approx$ 170) MeV
Breit-Wigner mass = 1525 to 1545 ($\approx$ 1535) MeV
Breit-Wigner full width = 125 to 175 ($\approx$ 150) MeV

N(1535) DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\pi$	35–55 %	468
$N\eta$	32–52 %	186
$N\pi\pi$	3–14 %	426
$\Delta(1232)\pi$, D-wave	1–4 %	244
$N\sigma$	2–10 %	–
$N(1440)\pi$	5–12 %	†
$p\gamma$, helicity=1/2	0.15–0.30 %	481
$n\gamma$, helicity=1/2	0.01–0.25 %	480

N(1650) 1/2$^-$

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

Re(pole position) = 1640 to 1670 ($\approx$ 1655) MeV
-2Im(pole position) = 100 to 170 ($\approx$ 135) MeV
Breit-Wigner mass = 1645 to 1670 ($\approx$ 1655) MeV
Breit-Wigner full width = 110 to 170 ($\approx$ 140) MeV

N(1650) DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\pi$	50–70 %	551
$N\eta$	14–22 %	354
ΛK	5–15 %	179
$N\pi\pi$	8–36 %	517
$\Delta(1232)\pi$, D-wave	6–18 %	349
$N\sigma$	2–18 %	–
$N(1440)\pi$	6–26 %	168

$p\gamma$, helicity=1/2	0.04–0.20 %	562
$n\gamma$, helicity=1/2	0.003–0.17 %	561

N(1675) 5/2$^-$

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

Re(pole position) = 1655 to 1665 (≈ 1660) MeV
−2Im(pole position) = 125 to 150 (≈ 135) MeV
Breit-Wigner mass = 1670 to 1680 (≈ 1675) MeV
Breit-Wigner full width = 130 to 165 (≈ 150) MeV

***N*(1675) DECAY MODES**	Fraction (Γ_i/Γ)	p (MeV/c)
$N\pi$	35–45 %	564
$N\eta$	< 1 %	376
$N\pi\pi$	25–45 %	532
$\Delta(1232)\pi$, D-wave	23–37 %	366
$N\sigma$	3–7 %	–
$p\gamma$	0–0.02 %	575
$p\gamma$, helicity=1/2	0–0.01 %	575
$p\gamma$, helicity=3/2	0–0.01 %	575
$n\gamma$	0–0.15 %	574
$n\gamma$, helicity=1/2	0–0.05 %	574
$n\gamma$, helicity=3/2	0–0.10 %	574

N(1680) 5/2$^+$

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

Re(pole position) = 1665 to 1680 (≈ 1675) MeV
−2Im(pole position) = 110 to 135 (≈ 120) MeV
Breit-Wigner mass = 1680 to 1690 (≈ 1685) MeV
Breit-Wigner full width = 120 to 140 (≈ 130) MeV

***N*(1680) DECAY MODES**	Fraction (Γ_i/Γ)	p (MeV/c)
$N\pi$	65–70 %	571
$N\eta$	<1 %	386
$N\pi\pi$	20–40 %	539
$\Delta(1232)\pi$	11–23 %	374
$\Delta(1232)\pi$, P-wave	4–10 %	374
$\Delta(1232)\pi$, F-wave	7–13 %	374
$N\sigma$	9–19 %	–

$p\gamma$	0.21–0.32 %	581
$p\gamma$, helicity=1/2	0.001–0.011 %	581
$p\gamma$, helicity=3/2	0.20–0.32 %	581
$n\gamma$	0.021–0.046 %	581
$n\gamma$, helicity=1/2	0.004–0.029 %	581
$n\gamma$, helicity=3/2	0.01–0.024 %	581

N(1700) 3/2$^-$

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

Re(pole position) = 1650 to 1750 (≈ 1700) MeV
−2Im(pole position) = 100 to 300 MeV
Breit-Wigner mass = 1650 to 1750 (≈ 1700) MeV
Breit-Wigner full width = 100 to 250 (≈ 150) MeV

***N*(1700) DECAY MODES**	Fraction (Γ_i/Γ)	p (MeV/c)
$N\pi$	7–17 %	581
$N\eta$	seen	402
$N\pi\pi$	60–90 %	550
$\Delta(1232)\pi$	55–85 %	386
$\Delta(1232)\pi$, *S*-wave	50–80 %	386
$\Delta(1232)\pi$, *D*-wave	4–14 %	386
$N(1440)\pi$	3–11 %	215
$N(1520)\pi$	<4 %	120
$N\rho$, *S*=3/2, *S*-wave	seen	†
$N\sigma$	2–14 %	–
$p\gamma$	0.01–0.05 %	591
$p\gamma$, helicity=1/2	0.0–0.024 %	591
$p\gamma$, helicity=3/2	0.002–0.026 %	591
$n\gamma$	0.01–0.13 %	590
$n\gamma$, helicity=1/2	0.0–0.09 %	590
$n\gamma$, helicity=3/2	0.01–0.05 %	590

N(1710) 1/2$^+$

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

Re(pole position) = 1670 to 1770 (≈ 1720) MeV
−2Im(pole position) = 80 to 380 (≈ 230) MeV
Breit-Wigner mass = 1680 to 1740 (≈ 1710) MeV
Breit-Wigner full width = 50 to 250 (≈ 100) MeV

N(1710) DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\pi$	5–20 %	588
$N\eta$	10–50 %	412
$N\omega$	1–5 %	†
ΛK	5–25 %	269
ΣK	seen	138
$N\pi\pi$	seen	557
$\Delta(1232)\pi$, P-wave	seen	394
$N(1535)\pi$	9–21 %	106
$N\rho$, S=1/2, P-wave	seen	†
$p\gamma$, helicity=1/2	0.002–0.08 %	598
$n\gamma$, helicity=1/2	0.0–0.02%	597

N(1720) $3/2^+$

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

Re(pole position) = 1660 to 1690 (≈ 1675) MeV
−2Im(pole position) = 150 to 400 (≈ 250) MeV
Breit-Wigner mass = 1700 to 1750 (≈ 1720) MeV
Breit-Wigner full width = 150 to 400 (≈ 250) MeV

N(1720) DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\pi$	8–14 %	594
$N\eta$	1–5 %	422
ΛK	4–5 %	283
$N\pi\pi$	50–90 %	564
$\Delta(1232)\pi$, P-wave	47–77 %	402
$\Delta(1232)\pi$, F-wave	<12 %	402
$N\rho$	70–85 %	74
$N\rho$, S=1/2, P-wave	seen	74
$N\sigma$	2–14 %	–
$N(1440)\pi$	<2 %	235
$N(1520)\pi$, S-wave	1–5 %	145
$p\gamma$	0.05–0.25 %	604
$p\gamma$, helicity=1/2	0.05–0.15 %	604
$p\gamma$, helicity=3/2	0.002–0.16 %	604
$n\gamma$	0.0–0.016 %	603
$n\gamma$, helicity=1/2	0.0–0.01 %	603
$n\gamma$, helicity=3/2	0.0–0.015 %	603

$N(1875)\ 3/2^-$

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

Re(pole position) = 1800 to 1950 MeV
−2Im(pole position) = 150 to 250 MeV
Breit-Wigner mass = 1820 to 1920 (≈ 1875) MeV
Breit-Wigner full width = 250 ± 70 MeV

N(1875) DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\pi$	2–14 %	695
$N\eta$	<1 %	559
$N\omega$	15–25 %	371
ΛK	seen	454
ΣK	seen	384
$N\pi\pi$		670
$\Delta(1232)\pi$	10–35 %	520
$\Delta(1232)\pi$, S-wave	7–21 %	520
$\Delta(1232)\pi$, D-wave	2–12 %	520
$N\rho$, S=3/2, S-wave	seen	379
$N\sigma$	30–60 %	–
$N(1440)\pi$	2–8 %	373
$N(1520)\pi$	<2 %	301
$p\gamma$	0.001–0.025 %	703
$p\gamma$, helicity=1/2	0.001–0.021 %	703
$p\gamma$, helicity=3/2	<0.003 %	703
$n\gamma$	<0.040 %	702
$n\gamma$, helicity=1/2	<0.007 %	702
$n\gamma$, helicity=3/2	<0.033 %	702

$N(1900)\ 3/2^+$

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

Re(pole position) = 1900 to 1940 (≈ 1920) MeV
−2Im(pole position) = 130 to 300 MeV
Breit-Wigner mass = 1900 ± 30 MeV
Breit-Wigner full width = 200 ± 50 MeV

N(1900) DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\pi$	<10 %	710
$N\eta$	2–14 %	579
$N\omega$	7–13 %	401
ΛK	2–20 %	477
ΣK	3–7 %	410
$N\pi\pi$	40–80 %	686

$\Delta(1232)\pi$	30–70 %	539
$\Delta(1232)\pi$, P-wave	9–25 %	539
$\Delta(1232)\pi$, F-wave	21–45 %	539
$N\sigma$	1–7 %	–
$N(1520)\pi$	7–23 %	324
$N(1535)\pi$	4–10 %	306
$p\gamma$	0.001–0.025 %	718
$p\gamma$, helicity=1/2	0.001–0.021 %	718
$p\gamma$, helicity=3/2	<0.003 %	718
$n\gamma$	<0.040 %	718
$n\gamma$, helicity=1/2	<0.007 %	718
$n\gamma$, helicity=3/2	<0.033 %	718

N(2190) 7/2$^-$

$I(J^P) = \frac{1}{2}(\frac{7}{2}^-)$

Re(pole position) = 2050 to 2100 (≈ 2075) MeV
−2Im(pole position) = 400 to 520 (≈ 450) MeV
Breit-Wigner mass = 2100 to 2200 (≈ 2190) MeV
Breit-Wigner full width = 300 to 700 (≈ 500) MeV

N(2190) DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\pi$	10–20 %	888
$N\eta$	seen	791
ΛK	0.2–0.8;%	712
$N\pi\pi$	22–80;%	870
$\Delta(1232)\pi$, D-wave	19–31 %	740
$N\rho$, S=3/2, D-wave	seen	680
$N\sigma$	3–9 %	–
$p\gamma$	0.014–0.077 %	894
$p\gamma$, helicity=1/2	0.013–0.062;%	894
$p\gamma$, helicity=3/2	0.001–0.014;%	894
$n\gamma$	<0.04 %	893
$n\gamma$, helicity=1/2	<0.01;%	893
$n\gamma$, helicity=3/2	<0.03 %	893

N(2220) 9/2$^+$

$I(J^P) = \frac{1}{2}(\frac{9}{2}^+)$

Re(pole position) = 2130 to 2200 (≈ 2170) MeV
−2Im(pole position) = 400 to 560 (≈ 480) MeV
Breit-Wigner mass = 2200 to 2300 (≈ 2250) MeV
Breit-Wigner full width = 350 to 500 (≈ 400) MeV

***N*(2220) DECAY MODES**	Fraction (Γ_i/Γ)	p (MeV/c)
$N\pi$	15–25 %	924

***N*(2250) 9/2$^-$**

$I(J^P) = \frac{1}{2}(\frac{9}{2}^-)$

Re(pole position) = 2150 to 2250 (≈ 2200) MeV
−2Im(pole position) = 350 to 550 (≈ 450) MeV
Breit-Wigner mass = 2250 to 2320 (≈ 2280) MeV
Breit-Wigner full width = 300 to 600 (≈ 500) MeV

***N*(2250) DECAY MODES**	Fraction (Γ_i/Γ)	p (MeV/c)
$N\pi$	5–15 %	941

***N*(2600) 11/2$^-$**

$I(J^P) = \frac{1}{2}(\frac{11}{2}^-)$

Breit-Wigner mass = 2550 to 2750 (≈ 2600) MeV
Breit-Wigner full width = 500 to 800 (≈ 650) MeV

***N*(2600) DECAY MODES**	Fraction (Γ_i/Γ)	p (MeV/c)
$N\pi$	5–10 %	1126

Δ BARYONS
($S=0$, $I=3/2$)

$\Delta^{++} = uuu, \quad \Delta^{+} = uud, \quad \Delta^{0} = udd, \quad \Delta^{-} = ddd$

***Δ*(1232) 3/2$^+$**

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

Re(pole position) = 1209 to 1211 (≈ 1210) MeV
−2Im(pole position) = 98 to 102 (≈ 100) MeV
Breit-Wigner mass (mixed charges) = 1230 to 1234 (≈ 1232) MeV
Breit-Wigner full width (mixed charges) = 114 to 120 (≈ 117) MeV

Δ(1232) DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\pi$	99.4 %	229
$N\gamma$	0.55–0.65 %	259
$N\gamma$, helicity=1/2	0.11–0.13 %	259
$N\gamma$, helicity=3/2	0.44–0.52 %	259

Δ(1600) 3/2⁺

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

Re(pole position) = 1460 to 1560 (≈ 1510) MeV
−2Im(pole position) = 200 to 350 (≈ 275) MeV
Breit-Wigner mass = 1500 to 1700 (≈ 1600) MeV
Breit-Wigner full width = 220 to 420 (≈ 320) MeV

Δ(1600) DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\pi$	10–25 %	513
$N\pi\pi$	75–90 %	477
$\Delta(1232)\pi$	73–83 %	303
$\Delta(1232)\pi$, P-wave	72–82 %	303
$\Delta(1232)\pi$, F-wave	<2 %	303
$N(1440)\pi$, P-wave	seen	98
$N\gamma$	0.001–0.035 %	525
$N\gamma$, helicity=1/2	0.0–0.02 %	525
$N\gamma$, helicity=3/2	0.001–0.015 %	525

Δ(1620) 1/2⁻

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

Re(pole position) = 1590 to 1610 (≈ 1600) MeV
−2Im(pole position) = 120 to 140 (≈ 130) MeV
Breit-Wigner mass = 1600 to 1660 (≈ 1630) MeV
Breit-Wigner full width = 130 to 150 (≈ 140) MeV

Δ(1620) DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\pi$	20–30 %	534
$N\pi\pi$	55–80 %	499
$\Delta(1232)\pi$, D-wave	52–72 %	328
$N\rho$, S=1/2, S-wave	seen	†
$N\rho$, S=3/2, D-wave	seen	†
$N(1440)\pi$	3–9 %	138
$N\gamma$, helicity=1/2	0.03–0.10 %	545

$\Delta(1700)$ $3/2^-$

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

Re(pole position) = 1620 to 1680 ($\approx$ 1650) MeV
$-$2Im(pole position) = 160 to 300 ($\approx$ 230) MeV
Breit-Wigner mass = 1670 to 1750 ($\approx$ 1700) MeV
Breit-Wigner full width = 200 to 400 ($\approx$ 300) MeV

Δ(1700) DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\pi$	10–20 %	581
$N\pi\pi$	10–55 %	550
$\Delta(1232)\pi$	10–50 %	386
$\Delta(1232)\pi$, S-wave	5–35 %	386
$\Delta(1232)\pi$, D-wave	4–16 %	386
$N\rho$, S=3/2, S-wave	seen	†
$N(1520)\pi$, P-wave	1–5 %	120
$N(1535)\pi$	0.5–1.5 %	90
$\Delta(1232)\eta$	3–7 %	†
$N\gamma$	0.22–0.60 %	591
$N\gamma$, helicity=1/2	0.12–0.30 %	591
$N\gamma$, helicity=3/2	0.10–0.30 %	591

$\Delta(1905)$ $5/2^+$

$I(J^P) = \frac{3}{2}(\frac{5}{2}^+)$

Re(pole position) = 1805 to 1835 ($\approx$ 1820) MeV
$-$2Im(pole position) = 265 to 300 ($\approx$ 280) MeV
Breit-Wigner mass = 1855 to 1910 ($\approx$ 1880) MeV
Breit-Wigner full width = 270 to 400 ($\approx$ 330) MeV

Δ(1905) DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\pi$	9–15 %	698
$N\pi\pi$		673
$\Delta(1232)\pi$, P-wave	23–43 %	524
$\Delta(1232)\pi$, F-wave	seen	524
$N\rho$, S=3/2, P-wave	seen	385
$N(1535)\pi$	$<$ 1 %	288
$N(1680)\pi$, P-wave	5–15 %	133
$\Delta(1232)\eta$	2–6 %	282
$N\gamma$	0.012–0.036 %	706
$N\gamma$, helicity=1/2	0.002–0.006 %	706
$N\gamma$, helicity=3/2	0.01–0.03 %	706

$\Delta(1910)\ 1/2^{+}$

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

Re(pole position) = 1830 to 1880 (≈ 1855) MeV
−2Im(pole position) = 200 to 500 (≈ 350) MeV
Breit-Wigner mass = 1860 to 1910 (≈ 1890) MeV
Breit-Wigner full width = 220 to 340 (≈ 280) MeV

Δ(1910) DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\pi$	15–30 %	704
ΣK	4–14 %	400
$N\pi\pi$		680
$\Delta(1232)\pi$	34–66 %	531
$N(1440)\pi$	3–9 %	386
$\Delta(1232)\eta$	5–13 %	296
$N\gamma$, helicity=1/2	0.0–0.02 %	712

$\Delta(1920)\ 3/2^{+}$

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

Re(pole position) = 1850 to 1950 (≈ 1900) MeV
−2Im(pole position) = 200 to 400 (≈ 300) MeV
Breit-Wigner mass = 1900 to 1970 (≈ 1920) MeV
Breit-Wigner full width = 180 to 300 (≈ 260) MeV

Δ(1920) DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\pi$	5–20 %	723
ΣK	2–6 %	431
$N\pi\pi$		699
$\Delta(1232)\pi$	50–90 %	553
$\Delta(1232)\pi$, P-wave	8–28 %	553
$\Delta(1232)\pi$, F-wave	44–72 %	553
$N(1440)\pi$, P-wave	<4 %	411
$N(1520)\pi$, S-wave	<5 %	341
$N(1535)\pi$	<2 %	324
$N a_0(980)$	seen	41
$\Delta(1232)\eta$	5–17 %	336

$\Delta(1930)\ 5/2^-$

$I(J^P) = \frac{3}{2}(\frac{5}{2}^-)$

Re(pole position) = 1840 to 1960 (≈ 1900) MeV
−2Im(pole position) = 175 to 360 (≈ 270) MeV
Breit-Wigner mass = 1900 to 2000 (≈ 1950) MeV
Breit-Wigner full width = 220 to 500 (≈ 360) MeV

Δ(1930) DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\pi$	5–15 %	742
$N\gamma$	0.0–0.01 %	749
$N\gamma$, helicity=1/2	0.0–0.005 %	749
$N\gamma$, helicity=3/2	0.0–0.004 %	749

$\Delta(1950)\ 7/2^+$

$I(J^P) = \frac{3}{2}(\frac{7}{2}^+)$

Re(pole position) = 1870 to 1890 (≈ 1880) MeV
−2Im(pole position) = 220 to 260 (≈ 240) MeV
Breit-Wigner mass = 1915 to 1950 (≈ 1930) MeV
Breit-Wigner full width = 235 to 335 (≈ 285) MeV

Δ(1950) DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\pi$	35–45 %	729
ΣK	0.3–0.5 %	441
$N\pi\pi$		706
$\Delta(1232)\pi$, F-wave	1–9 %	560
$N(1680)\pi$, P-wave	3–9 %	191
$\Delta(1232)\eta$	< 1 %	349

$\Delta(2420)\ 11/2^+$

$I(J^P) = \frac{3}{2}(\frac{11}{2}^+)$

Re(pole position) = 2260 to 2400 (≈ 2330) MeV
−2Im(pole position) = 350 to 750 (≈ 550) MeV
Breit-Wigner mass = 2300 to 2500 (≈ 2420) MeV
Breit-Wigner full width = 300 to 500 (≈ 400) MeV

Δ(2420) DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\pi$	5–15 %	1023

Λ BARYONS
$(S = -1, I = 0)$

$\Lambda^0 = uds$

Λ

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

Mass $m = 1115.683 \pm 0.006$ MeV
$(m_\Lambda - m_{\overline{\Lambda}}) \;/\; m_\Lambda = (-0.1 \pm 1.1) \times 10^{-5}$ (S = 1.6)
Mean life $\tau = (2.632 \pm 0.020) \times 10^{-10}$ s (S = 1.6)
$(\tau_\Lambda - \tau_{\overline{\Lambda}}) \;/\; \tau_\Lambda = -0.001 \pm 0.009$
$c\tau = 7.89$ 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

$p\pi^-$	$\alpha_- = 0.642 \pm 0.013$
$\overline{p}\pi^+$	$\alpha_+ = -0.71 \pm 0.08$
$p\pi^-$	$\phi_- = (-6.5 \pm 3.5)^\circ$
"	$\gamma_- = 0.76$ [n]
"	$\Delta_- = (8 \pm 4)^\circ$ [n]
$n\pi^0$	$\alpha_0 = 0.65 \pm 0.04$
$pe^-\overline{\nu}_e$	$g_A/g_V = -0.718 \pm 0.015$ [i]

Λ DECAY MODES		Fraction (Γ_i/Γ)	Confidence level	p (MeV/c)
$p\pi^-$		(63.9 ± 0.5) %		101
$n\pi^0$		(35.8 ± 0.5) %		104
$n\gamma$		$(1.75 \pm 0.15) \times 10^{-3}$		162
$p\pi^-\gamma$	[o]	$(8.4 \pm 1.4) \times 10^{-4}$		101
$pe^-\overline{\nu}_e$		$(8.32 \pm 0.14) \times 10^{-4}$		163
$p\mu^-\overline{\nu}_\mu$		$(1.57 \pm 0.35) \times 10^{-4}$		131

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

$\pi^+ e^-$	L,B	$< 6 \times 10^{-7}$	90%	549
$\pi^+ \mu^-$	L,B	$< 6 \times 10^{-7}$	90%	544
$\pi^- e^+$	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
$K^0_S \nu$	L,B	< 2	$\times 10^{-5}$	90%	447
$\overline{p} \pi^+$	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 $\overline{K} N$ 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 $m = 1519.5 \pm 1.0$ MeV [p]
Full width $\Gamma = 15.6 \pm 1.0$ MeV [p]

$\Lambda(1520)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N \overline{K}$	(45 ±1) %	243
$\Sigma \pi$	(42 ±1) %	268
$\Lambda \pi \pi$	(10 ±1) %	259
$\Sigma \pi \pi$	(0.9 ±0.1) %	169
$\Lambda \gamma$	(0.85±0.15) %	350

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

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

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

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

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

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

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

Λ(1670) DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\overline{K}$	20–30 %	414
$\Sigma\pi$	25–55 %	394
$\Lambda\eta$	10–25 %	69
$N\overline{K}^*(892)$, S=3/2, D-wave	(5±4) %	†

Λ(1690) 3/2$^-$

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

Mass m = 1685 to 1695 (≈ 1690) MeV
Full width Γ = 50 to 70 (≈ 60) MeV

Λ(1690) DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\overline{K}$	20–30 %	433
$\Sigma\pi$	20–40 %	410
$\Lambda\pi\pi$	∼ 25 %	419
$\Sigma\pi\pi$	∼ 20 %	358

Λ(1800) 1/2$^-$

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

Mass m = 1720 to 1850 (≈ 1800) MeV
Full width Γ = 200 to 400 (≈ 300) MeV

Λ(1800) DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\overline{K}$	25–40 %	528
$\Sigma\pi$	seen	494
$\Sigma(1385)\pi$	seen	349
$\Lambda\eta$	(6±5) %	326
$N\overline{K}^*(892)$	seen	†

Λ(1810) 1/2$^+$

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

Mass m = 1750 to 1850 (≈ 1810) MeV
Full width Γ = 50 to 250 (≈ 150) MeV

Λ(1810) DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\overline{K}$	20–50 %	537
$\Sigma\pi$	10–40 %	501

$\Sigma(1385)\pi$	seen	357
$N\overline{K}^*(892)$	30–60 %	†

Λ(1820) 5/2$^+$

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

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

Λ(1820) DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\overline{K}$	55–65 %	545
$\Sigma\pi$	8–14 %	509
$\Sigma(1385)\pi$	5–10 %	366
$N\overline{K}^*(892)$, S=3/2, P-wave	(3.0±1.0) %	†

Λ(1830) 5/2$^-$

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

Mass m = 1810 to 1830 (≈ 1830) MeV
Full width Γ = 60 to 110 (≈ 95) MeV

Λ(1830) DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\overline{K}$	3–10 %	553
$\Sigma\pi$	35–75 %	516
$\Sigma(1385)\pi$	>15 %	374
$\Sigma(1385)\pi$, D-wave	(52±6) %	374

Λ(1890) 3/2$^+$

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

Mass m = 1850 to 1910 (≈ 1890) MeV
Full width Γ = 60 to 200 (≈ 100) MeV

Λ(1890) DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\overline{K}$	20–35 %	599
$\Sigma\pi$	3–10 %	560
$\Sigma(1385)\pi$	seen	423
$N\overline{K}^*(892)$	seen	236

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

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

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

Λ(2100) DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\overline{K}$	25–35 %	751
$\Sigma\pi$	$\sim$ 5 %	705
$\Lambda\eta$	<3 %	617
ΞK	<3 %	491
$\Lambda\omega$	<8 %	443
$N\overline{K}^*(892)$	10–20 %	515

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

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

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

Λ(2110) DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\overline{K}$	5–25 %	757
$\Sigma\pi$	10–40 %	711
$\Lambda\omega$	seen	455
$\Sigma(1385)\pi$	seen	591
$N\overline{K}^*(892)$	10–60 %	525

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

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

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

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

Σ BARYONS
$(S=-1, I=1)$

$\Sigma^+ = uus, \quad \Sigma^0 = uds, \quad \Sigma^- = dds$

Σ^+

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

Mass $m = 1189.37 \pm 0.07$ MeV (S = 2.2)
Mean life $\tau = (0.8018 \pm 0.0026) \times 10^{-10}$ s
$c\tau = 2.404$ cm
$(\tau_{\Sigma^+} - \tau_{\overline{\Sigma}^-}) / \tau_{\Sigma^+} = -0.0006 \pm 0.0012$
Magnetic moment $\mu = 2.458 \pm 0.010\ \mu_N$ (S = 2.1)
$(\mu_{\Sigma^+} + \mu_{\overline{\Sigma}^-}) / \mu_{\Sigma^+} = 0.014 \pm 0.015$
$\Gamma(\Sigma^+ \to n\ell^+\nu)/\Gamma(\Sigma^- \to n\ell^-\overline{\nu}) < 0.043$

Decay parameters

$p\pi^0$	$\alpha_0 = -0.980^{+0.017}_{-0.015}$
"	$\phi_0 = (36 \pm 34)^\circ$
"	$\gamma_0 = 0.16$ [n]
"	$\Delta_0 = (187 \pm 6)^\circ$ [n]
$n\pi^+$	$\alpha_+ = 0.068 \pm 0.013$
"	$\phi_+ = (167 \pm 20)^\circ$ (S = 1.1)
"	$\gamma_+ = -0.97$ [n]
"	$\Delta_+ = (-73^{+133}_{-10})^\circ$ [n]
$p\gamma$	$\alpha_\gamma = -0.76 \pm 0.08$

Σ^+ DECAY MODES		Fraction (Γ_i/Γ)	Confidence level	p (MeV/c)
$p\pi^0$		(51.57 ± 0.30) %		189
$n\pi^+$		(48.31 ± 0.30) %		185
$p\gamma$		$(1.23 \pm 0.05) \times 10^{-3}$		225
$n\pi^+\gamma$	[o]	$(4.5 \pm 0.5) \times 10^{-4}$		185
$\Lambda e^+\nu_e$		$(2.0 \pm 0.5) \times 10^{-5}$		71
$\Delta S = \Delta Q$ (SQ) violating modes or $\Delta S = 1$ weak neutral current ($S1$) modes				
$ne^+\nu_e$	SQ	$< 5 \times 10^{-6}$	90%	224
$n\mu^+\nu_\mu$	SQ	$< 3.0 \times 10^{-5}$	90%	202
pe^+e^-	$S1$	$< 7 \times 10^{-6}$		225
$p\mu^+\mu^-$	$S1$	$(9^{+9}_{-8}) \times 10^{-8}$		121

Σ^0

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

Mass $m = 1192.642 \pm 0.024$ MeV
$m_{\Sigma^-} - m_{\Sigma^0} = 4.807 \pm 0.035$ MeV (S = 1.1)
$m_{\Sigma^0} - m_{\Lambda} = 76.959 \pm 0.023$ MeV
Mean life $\tau = (7.4 \pm 0.7) \times 10^{-20}$ s
$c\tau = 2.22 \times 10^{-11}$ m
Transition magnetic moment $\left|\mu_{\Sigma\Lambda}\right| = 1.61 \pm 0.08\ \mu_N$

Σ^0 DECAY MODES	Fraction (Γ_i/Γ)	Confidence level	p (MeV/c)
$\Lambda\gamma$	100 %		74
$\Lambda\gamma\gamma$	< 3 %	90%	74
$\Lambda e^+ e^-$	[q] 5×10^{-3}		74

Σ^-

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

Mass $m = 1197.449 \pm 0.030$ MeV (S = 1.2)
$m_{\Sigma^-} - m_{\Sigma^+} = 8.08 \pm 0.08$ MeV (S = 1.9)
$m_{\Sigma^-} - m_{\Lambda} = 81.766 \pm 0.030$ MeV (S = 1.2)
Mean life $\tau = (1.479 \pm 0.011) \times 10^{-10}$ s (S = 1.3)
$c\tau = 4.434$ cm
Magnetic moment $\mu = -1.160 \pm 0.025\ \mu_N$ (S = 1.7)
Σ^- charge radius $= 0.78 \pm 0.10$ fm

Decay parameters

$n\pi^-$	$\alpha_- = -0.068 \pm 0.008$
"	$\phi_- = (10 \pm 15)^\circ$
"	$\gamma_- = 0.98$ [n]
"	$\Delta_- = (249^{+\ 12}_{-120})^\circ$ [n]
$n e^- \overline{\nu}_e$	$g_A/g_V = 0.340 \pm 0.017$ [i]
"	$f_2(0)/f_1(0) = 0.97 \pm 0.14$
"	$D = 0.11 \pm 0.10$
$\Lambda e^- \overline{\nu}_e$	$g_V/g_A = 0.01 \pm 0.10$ [i] (S = 1.5)
"	$g_{WM}/g_A = 2.4 \pm 1.7$ [i]

Σ^- DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$n\pi^-$	(99.848 ± 0.005) %	193
$n\pi^-\gamma$	[o] $(4.6 \pm 0.6) \times 10^{-4}$	193
$n e^- \overline{\nu}_e$	$(1.017 \pm 0.034) \times 10^{-3}$	230

$n\mu^-\overline{\nu}_\mu$	$(4.5 \pm 0.4) \times 10^{-4}$	210
$\Lambda e^-\overline{\nu}_e$	$(5.73 \pm 0.27) \times 10^{-5}$	79

$\Sigma(1385)\ 3/2^+$

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

$\Sigma(1385)^+$ mass $m = 1382.80 \pm 0.35$ MeV (S = 1.9)
$\Sigma(1385)^0$ mass $m = 1383.7 \pm 1.0$ MeV (S = 1.4)
$\Sigma(1385)^-$ mass $m = 1387.2 \pm 0.5$ MeV (S = 2.2)
$\Sigma(1385)^+$ full width $\Gamma = 36.0 \pm 0.7$ MeV
$\Sigma(1385)^0$ full width $\Gamma = 36 \pm 5$ MeV
$\Sigma(1385)^-$ full width $\Gamma = 39.4 \pm 2.1$ MeV (S = 1.7)
Below $\overline{K}N$ threshold

Σ(1385) DECAY MODES	Fraction (Γ_i/Γ)	Confidence level	p (MeV/c)
$\Lambda\pi$	(87.0 ± 1.5) %		208
$\Sigma\pi$	(11.7 ± 1.5) %		129
$\Lambda\gamma$	$(1.25^{+0.13}_{-0.12})$ %		241
$\Sigma^+\gamma$	$(7.0 \pm 1.7) \times 10^{-3}$		180
$\Sigma^-\gamma$	$< 2.4 \times 10^{-4}$	90%	173

$\Sigma(1660)\ 1/2^+$

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

Mass $m = 1630$ to 1690 (≈ 1660) MeV
Full width $\Gamma = 40$ to 200 (≈ 100) MeV

Σ(1660) DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\overline{K}$	10–30 %	405
$\Lambda\pi$	seen	440
$\Sigma\pi$	seen	387

$\Sigma(1670)\ 3/2^-$

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

Mass $m = 1665$ to 1685 (≈ 1670) MeV
Full width $\Gamma = 40$ to 80 (≈ 60) MeV

Σ(1670) DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\overline{K}$	7–13 %	414
$\Lambda\pi$	5–15 %	448
$\Sigma\pi$	30–60 %	394

Σ(1750) 1/2⁻

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

Mass m = 1730 to 1800 (≈ 1750) MeV
Full width Γ = 60 to 160 (≈ 90) MeV

Σ(1750) DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\overline{K}$	10–40 %	486
$\Lambda\pi$	seen	507
$\Sigma\pi$	<8 %	456
$\Sigma\eta$	15–55 %	98
$N\overline{K}^*(892)$, S=1/2	(8±4) %	†

Σ(1775) 5/2⁻

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

Mass m = 1770 to 1780 (≈ 1775) MeV
Full width Γ = 105 to 135 (≈ 120) MeV

Σ(1775) DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\overline{K}$	37–43%	508
$\Lambda\pi$	14–20%	525
$\Sigma\pi$	2–5%	475
$\Sigma(1385)\pi$	8–12%	327
$\Lambda(1520)\pi$, P-wave	17–23%	201

Σ(1915) 5/2⁺

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

Mass m = 1900 to 1935 (≈ 1915) MeV
Full width Γ = 80 to 160 (≈ 120) MeV

Σ(1915) DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\overline{K}$	5–15 %	618
$\Lambda\pi$	seen	623

$\Sigma\pi$	seen	577
$\Sigma(1385)\pi$	<5 %	443

$\Sigma(1940)$ 3/2$^-$

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

Mass m = 1900 to 1950 (≈ 1940) MeV
Full width Γ = 150 to 300 (≈ 220) MeV

$\Sigma(1940)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\overline{K}$	<20 %	637
$\Lambda\pi$	seen	640
$\Sigma\pi$	seen	595
$\Sigma(1385)\pi$	seen	463
$\Lambda(1520)\pi$	seen	355
$\Delta(1232)\overline{K}$	seen	410
$N\overline{K}^*(892)$	seen	322

$\Sigma(2030)$ 7/2$^+$

$I(J^P) = 1(\frac{7}{2}^+)$

Mass m = 2025 to 2040 (≈ 2030) MeV
Full width Γ = 150 to 200 (≈ 180) MeV

$\Sigma(2030)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\overline{K}$	17–23 %	702
$\Lambda\pi$	17–23 %	700
$\Sigma\pi$	5–10 %	657
ΞK	<2 %	422
$\Sigma(1385)\pi$	5–15 %	532
$\Lambda(1520)\pi$	10–20 %	430
$\Delta(1232)\overline{K}$	10–20 %	498
$N\overline{K}^*(892)$	<5 %	439

$\Sigma(2250)$

$I(J^P) = 1(?^?)$

Mass m = 2210 to 2280 (≈ 2250) MeV
Full width Γ = 60 to 150 (≈ 100) MeV

Σ(2250) DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\overline{K}$	<10 %	851
$\Lambda\pi$	seen	842
$\Sigma\pi$	seen	803

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

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

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) $\times 10^{-3}$		184
$\Lambda e^+ e^-$	(7.6 ±0.6) $\times 10^{-6}$		184
$\Sigma^0\gamma$	(3.33 ±0.10) $\times 10^{-3}$		117
$\Sigma^+ e^- \overline{\nu}_e$	(2.52 ±0.08) $\times 10^{-4}$		120
$\Sigma^+ \mu^- \overline{\nu}_\mu$	(2.33 ±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
$p e^- \overline{\nu}_e$	$S2$	< 1.3	$\times 10^{-3}$		323
$p \mu^- \overline{\nu}_\mu$	$S2$	< 1.3	$\times 10^{-3}$		309

Ξ^-

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

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

Mass $m = 1321.71 \pm 0.07$ MeV
$(m_{\Xi^-} - m_{\overline{\Xi}^+}) \,/\, m_{\Xi^-} = (-3 \pm 9) \times 10^{-5}$
Mean life $\tau = (1.639 \pm 0.015) \times 10^{-10}$ s
$c\tau = 4.91$ cm
$(\tau_{\Xi^-} - \tau_{\overline{\Xi}^+}) \,/\, \tau_{\Xi^-} = -0.01 \pm 0.07$
Magnetic moment $\mu = -0.6507 \pm 0.0025\ \mu_N$
$(\mu_{\Xi^-} + \mu_{\overline{\Xi}^+}) \,/\, \left|\mu_{\Xi^-}\right| = +0.01 \pm 0.05$

Decay parameters

$\Lambda\pi^-$ $\alpha = -0.458 \pm 0.012$ (S = 1.8)
$[\alpha(\Xi^-)\alpha_-(\Lambda) - \alpha(\overline{\Xi}^+)\alpha_+(\overline{\Lambda})] \,/\, [\text{ sum }] = (0 \pm 7) \times 10^{-4}$
" $\phi = (-2.1 \pm 0.8)^\circ$
" $\gamma = 0.89$ [n]
" $\Delta = (175.9 \pm 1.5)^\circ$ [n]
$\Lambda e^- \overline{\nu}_e$ $g_A/g_V = -0.25 \pm 0.05$ [i]

Ξ^- DECAY MODES	Fraction (Γ_i/Γ)	Confidence level	p (MeV/c)
$\Lambda\pi^-$	(99.887 ± 0.035) %		140
$\Sigma^-\gamma$	$(1.27 \pm 0.23) \times 10^{-4}$		118
$\Lambda e^- \overline{\nu}_e$	$(5.63 \pm 0.31) \times 10^{-4}$		190
$\Lambda \mu^- \overline{\nu}_\mu$	$(3.5 ^{+3.5}_{-2.2}) \times 10^{-4}$		163
$\Sigma^0 e^- \overline{\nu}_e$	$(8.7 \pm 1.7) \times 10^{-5}$		123
$\Sigma^0 \mu^- \overline{\nu}_\mu$	$< 8 \times 10^{-4}$	90%	70
$\Xi^0 e^- \overline{\nu}_e$	$< 2.3 \times 10^{-3}$	90%	7

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

$n\pi^-$	$S2$	$<$	1.9	$\times 10^{-5}$	90%	304
$n e^- \overline{\nu}_e$	$S2$	$<$	3.2	$\times 10^{-3}$	90%	327
$n\mu^- \overline{\nu}_\mu$	$S2$	$<$	1.5	%	90%	314
$p\pi^-\pi^-$	$S2$	$<$	4	$\times 10^{-4}$	90%	223
$p\pi^- e^- \overline{\nu}_e$	$S2$	$<$	4	$\times 10^{-4}$	90%	305
$p\pi^- \mu^- \overline{\nu}_\mu$	$S2$	$<$	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

Ξ(1530) DECAY MODES	Fraction (Γ_i/Γ)	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 [p]
Full width $\Gamma < 30$ MeV

Ξ(1690) DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\Lambda\overline{K}$	seen	240
$\Sigma\overline{K}$	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 [p]
Full width $\Gamma = 24^{+15}_{-10}$ MeV [p]

$\Xi(1820)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\Lambda\overline{K}$	large	402
$\Sigma\overline{K}$	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 [p]
Full width $\Gamma = 60 \pm 20$ MeV [p]

$\Xi(1950)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\Lambda\overline{K}$	seen	522
$\Sigma\overline{K}$	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 [p]
Full width $\Gamma = 20^{+15}_{-\ 5}$ MeV [p]

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

Ω BARYONS
$(S = -3, I = 0)$

$\Omega^- = sss$

Ω^-

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

$J^P = \frac{3}{2}^+$ is the quark-model prediction; and $J = 3/2$ is fairly well established.

Mass $m = 1672.45 \pm 0.29$ MeV
$(m_{\Omega^-} - m_{\overline{\Omega}^+}) \, / \, m_{\Omega^-} = (-1 \pm 8) \times 10^{-5}$
Mean life $\tau = (0.821 \pm 0.011) \times 10^{-10}$ s
$c\tau = 2.461$ cm
$(\tau_{\Omega^-} - \tau_{\overline{\Omega}^+}) \, / \, \tau_{\Omega^-} = 0.00 \pm 0.05$
Magnetic moment $\mu = -2.02 \pm 0.05 \, \mu_N$

Decay parameters

ΛK^-	$\alpha = 0.0180 \pm 0.0024$
ΛK^-, $\overline{\Lambda} K^+$	$(\alpha + \overline{\alpha})/(\alpha - \overline{\alpha}) = -0.02 \pm 0.13$
$\Xi^0 \pi^-$	$\alpha = 0.09 \pm 0.14$
$\Xi^- \pi^0$	$\alpha = 0.05 \pm 0.21$

Ω^- DECAY MODES		Fraction (Γ_i/Γ)	Confidence level	p (MeV/c)
ΛK^-		(67.8 ± 0.7) %		211
$\Xi^0 \pi^-$		(23.6 ± 0.7) %		294
$\Xi^- \pi^0$		(8.6 ± 0.4) %		289
$\Xi^- \pi^+ \pi^-$		$(3.7^{+0.7}_{-0.6}) \times 10^{-4}$		189
$\Xi(1530)^0 \pi^-$		$< 7 \times 10^{-5}$	90%	17
$\Xi^0 e^- \overline{\nu}_e$		$(5.6 \pm 2.8) \times 10^{-3}$		319
$\Xi^- \gamma$		$< 4.6 \times 10^{-4}$	90%	314
$\Delta S = 2$ forbidden ($S2$) modes				
$\Lambda \pi^-$	$S2$	$< 2.9 \times 10^{-6}$	90%	449

$\Omega(2250)^-$

$I(J^P) = 0(?^?)$

Mass $m = 2252 \pm 9$ MeV
Full width $\Gamma = 55 \pm 18$ MeV

$\Omega(2250)^-$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\Xi^- \pi^+ K^-$	seen	532
$\Xi(1530)^0 K^-$	seen	437

CHARMED BARYONS ($C=+1$)

$\Lambda_c^+ = udc$, $\Sigma_c^{++} = uuc$, $\Sigma_c^+ = udc$, $\Sigma_c^0 = ddc$,
$\Xi_c^+ = usc$, $\Xi_c^0 = dsc$, $\Omega_c^0 = ssc$

Λ_c^+

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

J is not well measured; $\frac{1}{2}$ is the quark-model prediction.

Mass $m = 2286.46 \pm 0.14$ MeV
Mean life $\tau = (200 \pm 6) \times 10^{-15}$ s (S = 1.6)
$c\tau = 59.9$ μm

Decay asymmetry parameters

$\Lambda\pi^+$ $\alpha = -0.91 \pm 0.15$
$\Sigma^+\pi^0$ $\alpha = -0.45 \pm 0.32$
$\Lambda\ell^+\nu_\ell$ $\alpha = -0.86 \pm 0.04$
$(\alpha + \overline{\alpha})/(\alpha - \overline{\alpha})$ in $\Lambda_c^+ \to \Lambda\pi^+$, $\overline{\Lambda}_c^- \to \overline{\Lambda}\pi^- = -0.07 \pm 0.31$
$(\alpha + \overline{\alpha})/(\alpha - \overline{\alpha})$ in $\Lambda_c^+ \to \Lambda e^+\nu_e$, $\overline{\Lambda}_c^- \to \overline{\Lambda} e^- \overline{\nu}_e = 0.00 \pm 0.04$

Λ_c^+ DECAY MODES		Fraction (Γ_i/Γ)	Scale factor/ Confidence level	p (MeV/c)
Hadronic modes with a p: $S = -1$ final states				
pK_S^0		(1.58± 0.08) %	S=1.2	873
$pK^-\pi^+$		(6.35± 0.33) %	S=1.4	823
$p\overline{K}^*(892)^0$	[r]	(1.98± 0.28) %		685
$\Delta(1232)^{++}K^-$		(1.09± 0.25) %		710
$\Lambda(1520)\pi^+$	[r]	(2.2 ± 0.5) %		627
$pK^-\pi^+$ nonresonant		(3.5 ± 0.4) %		823
$pK_S^0\pi^0$		(1.99± 0.13) %	S=1.1	823

$p\overline{K}^0\eta$		(1.6 ± 0.4) %		568
$pK^0_S\pi^+\pi^-$		(1.66 ± 0.12) %	S=1.1	754
$pK^-\pi^+\pi^0$		(4.9 ± 0.4) %	S=1.3	759
$pK^*(892)^-\pi^+$	[r]	(1.5 ± 0.5) %		580
$p(K^-\pi^+)_{\text{nonresonant}}\pi^0$		(4.6 ± 0.9) %		759
$\Delta(1232)\overline{K}^*(892)$		seen		419
$pK^-2\pi^+\pi^-$		$(1.4 \pm 1.0) \times 10^{-3}$		671
$pK^-\pi^+2\pi^0$		(1.0 ± 0.5) %		678

Hadronic modes with a p: $S = 0$ final states

$p\pi^+\pi^-$		$(4.3 \pm 0.4) \times 10^{-3}$		927
$pf_0(980)$	[r]	$(3.5 \pm 2.3) \times 10^{-3}$		614
$p2\pi^+2\pi^-$		$(2.3 \pm 1.5) \times 10^{-3}$		852
pK^+K^-		$(10 \pm 4) \times 10^{-4}$		616
$p\phi$	[r]	$(1.08 \pm 0.14) \times 10^{-3}$		590
pK^+K^- non-ϕ		$(5.3 \pm 1.2) \times 10^{-4}$		616

Hadronic modes with a hyperon: $S = -1$ final states

$\Lambda\pi^+$		(1.30 ± 0.07) %	S=1.2	864
$\Lambda\pi^+\pi^0$		(7.1 ± 0.4) %	S=1.2	844
$\Lambda\rho^+$		< 6 %	CL=95%	636
$\Lambda\pi^-2\pi^+$		(3.7 ± 0.4) %	S=1.9	807
$\Sigma(1385)^+\pi^+\pi^-$, $\Sigma^{*+} \to \Lambda\pi^+$		(1.0 ± 0.5) %		688
$\Sigma(1385)^-2\pi^+$, $\Sigma^{*-} \to \Lambda\pi^-$		$(7.8 \pm 1.6) \times 10^{-3}$		688
$\Lambda\pi^+\rho^0$		(1.5 ± 0.6) %		524
$\Sigma(1385)^+\rho^0$, $\Sigma^{*+} \to \Lambda\pi^+$		$(5 \pm 4) \times 10^{-3}$		363
$\Lambda\pi^-2\pi^+$ nonresonant		< 1.1 %	CL=90%	807
$\Lambda\pi^-\pi^0 2\pi^+$ total		(2.3 ± 0.8) %		757
$\Lambda\pi^+\eta$	[r]	(2.3 ± 0.5) %		691
$\Sigma(1385)^+\eta$	[r]	(1.08 ± 0.32) %		570
$\Lambda\pi^+\omega$	[r]	(1.5 ± 0.5) %		517
$\Lambda\pi^-\pi^0 2\pi^+$, no η or ω		$< 8 \times 10^{-3}$	CL=90%	757
$\Lambda K^+\overline{K}^0$		$(5.7 \pm 1.1) \times 10^{-3}$	S=2.0	443
$\Xi(1690)^0K^+$, $\Xi^{*0} \to \Lambda\overline{K}^0$		$(1.6 \pm 0.5) \times 10^{-3}$		286
$\Sigma^0\pi^+$		(1.29 ± 0.07) %	S=1.1	825
$\Sigma^+\pi^0$		(1.24 ± 0.10) %		827
$\Sigma^+\eta$		$(7.0 \pm 2.3) \times 10^{-3}$		713
$\Sigma^+\pi^+\pi^-$		(4.57 ± 0.29) %	S=1.2	804
$\Sigma^+\rho^0$		< 1.7 %	CL=95%	575
$\Sigma^-2\pi^+$		(2.1 ± 0.4) %		799
$\Sigma^0\pi^+\pi^0$		(2.3 ± 0.9) %		803
$\Sigma^0\pi^-2\pi^+$		(1.13 ± 0.29) %		763
$\Sigma^+\pi^+\pi^-\pi^0$		—		767

$\Sigma^+ \omega$	[r]	(1.74 ± 0.21) %		569
$\Sigma^+ K^+ K^-$		$(3.6 \pm 0.4) \times 10^{-3}$		349
$\Sigma^+ \phi$	[r]	$(4.0 \pm 0.6) \times 10^{-3}$	S=1.1	295
$\Xi(1690)^0 K^+$, $\Xi^{*0} \to \Sigma^+ K^-$		$(1.03 \pm 0.26) \times 10^{-3}$		286
$\Sigma^+ K^+ K^-$ nonresonant		$< 8 \times 10^{-4}$	CL=90%	349
$\Xi^0 K^+$		$(5.0 \pm 1.2) \times 10^{-3}$		653
$\Xi^- K^+ \pi^+$		$(6.2 \pm 0.6) \times 10^{-3}$	S=1.1	565
$\Xi(1530)^0 K^+$	[r]	$(3.3 \pm 0.9) \times 10^{-3}$		473

Hadronic modes with a hyperon: $S = 0$ final states

ΛK^+		$(6.1 \pm 1.2) \times 10^{-4}$		781
$\Lambda K^+ \pi^+ \pi^-$		$< 5 \times 10^{-4}$	CL=90%	637
$\Sigma^0 K^+$		$(5.2 \pm 0.8) \times 10^{-4}$		735
$\Sigma^0 K^+ \pi^+ \pi^-$		$< 2.6 \times 10^{-4}$	CL=90%	574
$\Sigma^+ K^+ \pi^-$		$(2.1 \pm 0.6) \times 10^{-3}$		670
$\Sigma^+ K^*(892)^0$	[r]	$(3.6 \pm 1.0) \times 10^{-3}$		469
$\Sigma^- K^+ \pi^+$		$< 1.2 \times 10^{-3}$	CL=90%	664

Doubly Cabibbo-suppressed modes

$p K^+ \pi^-$		$(1 \pm 13) \times 10^{-4}$		823

Semileptonic modes

$\Lambda e^+ \nu_e$		(3.6 ± 0.4) %		871

Inclusive modes

e^+ anything		(4.5 ± 1.7) %		–
$p e^+$ anything		(1.8 ± 0.9) %		–
p anything		(50 ± 16) %		–
p anything (no Λ)		(12 ± 19) %		–
n anything		(50 ± 16) %		–
n anything (no Λ)		(29 ± 17) %		–
Λ anything		(35 ± 11) %	S=1.4	–
$\Sigma^\pm$ anything	[s]	(10 ± 5) %		–
3prongs		(24 ± 8) %		–

$\Delta C = 1$ weak neutral current ($C1$) modes, or Lepton Family number (LF), or Lepton number (L), or Baryon number (B) violating modes

$p e^+ e^-$	$C1$	$< 5.5 \times 10^{-6}$	CL=90%	951
$p \mu^+ \mu^-$	$C1$	$< 4.4 \times 10^{-5}$	CL=90%	937
$p e^+ \mu^-$	LF	$< 9.9 \times 10^{-6}$	CL=90%	947
$p e^- \mu^+$	LF	$< 1.9 \times 10^{-5}$	CL=90%	947

$\overline{p}2e^+$	L,B	< 2.7	$\times 10^{-6}$	CL=90%	951
$\overline{p}2\mu^+$	L,B	< 9.4	$\times 10^{-6}$	CL=90%	937
$\overline{p}e^+\mu^+$	L,B	< 1.6	$\times 10^{-5}$	CL=90%	947
$\Sigma^-\mu^+\mu^+$	L	< 7.0	$\times 10^{-4}$	CL=90%	812

$\Lambda_c(2595)^+$

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

The spin-parity follows from the fact that $\Sigma_c(2455)\pi$ decays, with little available phase space, are dominant. This assumes that $J^P = 1/2^+$ for the $\Sigma_c(2455)$.

Mass $m = 2592.25 \pm 0.28$ MeV
$m - m_{\Lambda_c^+} = 305.79 \pm 0.24$ MeV
Full width $\Gamma = 2.6 \pm 0.6$ MeV

$\Lambda_c^+\pi\pi$ and its submode $\Sigma_c(2455)\pi$ — the latter just barely — are the only strong decays allowed to an excited Λ_c^+ having this mass; and the submode seems to dominate.

$\Lambda_c(2595)^+$ DECAY MODES		Fraction (Γ_i/Γ)	p (MeV/c)
$\Lambda_c^+\pi^+\pi^-$	[t]	—	117
$\Sigma_c(2455)^{++}\pi^-$		24 ± 7 %	†
$\Sigma_c(2455)^0\pi^+$		24 ± 7 %	†
$\Lambda_c^+\pi^+\pi^-$ 3-body		18 ± 10 %	117
$\Lambda_c^+\pi^0$	[u]	not seen	258
$\Lambda_c^+\gamma$		not seen	288

$\Lambda_c(2625)^+$

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

J^P has not been measured; $\frac{3}{2}^-$ is the quark-model prediction.

Mass $m = 2628.11 \pm 0.19$ MeV (S = 1.1)
$m - m_{\Lambda_c^+} = 341.65 \pm 0.13$ MeV (S = 1.1)
Full width $\Gamma < 0.97$ MeV, CL = 90%

$\Lambda_c^+\pi\pi$ and its submode $\Sigma(2455)\pi$ are the only strong decays allowed to an excited Λ_c^+ having this mass.

$\Lambda_c(2625)^+$ DECAY MODES		Fraction (Γ_i/Γ)	Confidence level	p (MeV/c)
$\Lambda_c^+\pi^+\pi^-$	[t]	≈ 67%		184
$\Sigma_c(2455)^{++}\pi^-$		<5	90%	102

$\Sigma_c(2455)^0 \pi^+$		<5	90%	102
$\Lambda_c^+ \pi^+ \pi^-$ 3-body		large		184
$\Lambda_c^+ \pi^0$	[u]	not seen		293
$\Lambda_c^+ \gamma$		not seen		319

$\Lambda_c(2880)^+$

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

There is some good evidence that indeed $J^P = 5/2^+$

Mass $m = 2881.53 \pm 0.35$ MeV
$m - m_{\Lambda_c^+} = 595.1 \pm 0.4$ MeV
Full width $\Gamma = 5.8 \pm 1.1$ MeV

$\Lambda_c(2880)^+$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\Lambda_c^+ \pi^+ \pi^-$	seen	471
$\Sigma_c(2455)^{0,++} \pi^\pm$	seen	376
$\Sigma_c(2520)^{0,++} \pi^\pm$	seen	317
$p D^0$	seen	316

$\Lambda_c(2940)^+$

$I(J^P) = 0(?^?)$

Mass $m = 2939.3^{+1.4}_{-1.5}$ MeV
Full width $\Gamma = 17^{+8}_{-6}$ MeV

$\Lambda_c(2940)^+$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$p D^0$	seen	420
$\Sigma_c(2455)^{0,++} \pi^\pm$	seen	–

$\Sigma_c(2455)$

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

$\Sigma_c(2455)^{++}$ mass $m = 2453.97 \pm 0.14$ MeV
$\Sigma_c(2455)^{+}$ mass $m = 2452.9 \pm 0.4$ MeV
$\Sigma_c(2455)^{0}$ mass $m = 2453.75 \pm 0.14$ MeV
$m_{\Sigma_c^{++}} - m_{\Lambda_c^+} = 167.510 \pm 0.017$ MeV
$m_{\Sigma_c^{+}} - m_{\Lambda_c^+} = 166.4 \pm 0.4$ MeV
$m_{\Sigma_c^{0}} - m_{\Lambda_c^+} = 167.290 \pm 0.017$ MeV
$m_{\Sigma_c^{++}} - m_{\Sigma_c^0} = 0.220 \pm 0.013$ MeV
$m_{\Sigma_c^{+}} - m_{\Sigma_c^0} = -0.9 \pm 0.4$ MeV

$\Sigma_c(2455)^{++}$ full width $\Gamma = 1.89^{+0.09}_{-0.18}$ MeV (S = 1.1)
$\Sigma_c(2455)^{+}$ full width $\Gamma < 4.6$ MeV, CL = 90%
$\Sigma_c(2455)^{0}$ full width $\Gamma = 1.83^{+0.11}_{-0.19}$ MeV (S = 1.2)

$\Lambda_c^+ \pi$ is the only strong decay allowed to a Σ_c having this mass.

Σ_c(2455) DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\Lambda_c^+ \pi$	≈ 100 %	94

$\Sigma_c(2520)$

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

J^P has not been measured; $\frac{3}{2}^+$ is the quark-model prediction.

$\Sigma_c(2520)^{++}$ mass $m = 2518.41^{+0.21}_{-0.19}$ MeV (S = 1.1)
$\Sigma_c(2520)^{+}$ mass $m = 2517.5 \pm 2.3$ MeV
$\Sigma_c(2520)^{0}$ mass $m = 2518.48 \pm 0.20$ MeV (S = 1.1)
$m_{\Sigma_c(2520)^{++}} - m_{\Lambda_c^+} = 231.95^{+0.17}_{-0.12}$ MeV (S = 1.3)
$m_{\Sigma_c(2520)^{+}} - m_{\Lambda_c^+} = 231.0 \pm 2.3$ MeV
$m_{\Sigma_c(2520)^{0}} - m_{\Lambda_c^+} = 232.02^{+0.15}_{-0.14}$ MeV (S = 1.3)
$m_{\Sigma_c(2520)^{++}} - m_{\Sigma_c(2520)^{0}} = 0.01 \pm 0.15$ MeV
$\Sigma_c(2520)^{++}$ full width $\Gamma = 14.78^{+0.30}_{-0.40}$ MeV
$\Sigma_c(2520)^{+}$ full width $\Gamma < 17$ MeV, CL = 90%
$\Sigma_c(2520)^{0}$ full width $\Gamma = 15.3^{+0.4}_{-0.5}$ MeV

$\Lambda_c^+ \pi$ is the only strong decay allowed to a Σ_c having this mass.

Σ_c(2520) DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\Lambda_c^+ \pi$	≈ 100 %	179

$\Sigma_c(2800)$

$I(J^P) = 1(?^?)$

$\Sigma_c(2800)^{++}$ mass $m = 2801^{+4}_{-6}$ MeV
$\Sigma_c(2800)^{+}$ mass $m = 2792^{+14}_{-\ 5}$ MeV
$\Sigma_c(2800)^{0}$ mass $m = 2806^{+5}_{-7}$ MeV (S = 1.3)
$m_{\Sigma_c(2800)^{++}} - m_{\Lambda_c^+} = 514^{+4}_{-6}$ MeV
$m_{\Sigma_c(2800)^{+}} - m_{\Lambda_c^+} = 505^{+14}_{-\ 5}$ MeV
$m_{\Sigma_c(2800)^{0}} - m_{\Lambda_c^+} = 519^{+5}_{-7}$ MeV (S = 1.3)

$\Sigma_c(2800)^{++}$ full width $\Gamma = 75^{+22}_{-17}$ MeV
$\Sigma_c(2800)^{+}$ full width $\Gamma = 62^{+60}_{-40}$ MeV
$\Sigma_c(2800)^{0}$ full width $\Gamma = 72^{+22}_{-15}$ MeV

Σ_c(2800) DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\Lambda_c^+ \pi$	seen	443

Ξ_c^+

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

J^P has not been measured; $\frac{1}{2}^+$ is the quark-model prediction.

Mass $m = 2467.87 \pm 0.30$ MeV (S = 1.1)
Mean life $\tau = (442 \pm 26) \times 10^{-15}$ s (S = 1.3)
$c\tau = 132\ \mu$m

Ξ_c^+ DECAY MODES		Fraction (Γ_i/Γ)	Confidence level	p (MeV/c)
No absolute branching fractions have been measured. The following are branching *ratios* relative to $\Xi^- 2\pi^+$.				
Cabibbo-favored ($S = -2$) decays — relative to $\Xi^- 2\pi^+$				
$p 2K_S^0$		0.087 ± 0.021		767
$\Lambda \overline{K}^0 \pi^+$		—		852
$\Sigma(1385)^+ \overline{K}^0$	[r]	1.0 ± 0.5		746
$\Lambda K^- 2\pi^+$		0.323 ± 0.033		787
$\Lambda \overline{K}^*(892)^0 \pi^+$	[r]	<0.16	90%	608
$\Sigma(1385)^+ K^- \pi^+$	[r]	<0.23	90%	678
$\Sigma^+ K^- \pi^+$		0.94 ± 0.10		811
$\Sigma^+ \overline{K}^*(892)^0$	[r]	0.81 ± 0.15		658
$\Sigma^0 K^- 2\pi^+$		0.27 ± 0.12		735
$\Xi^0 \pi^+$		0.55 ± 0.16		877
$\Xi^- 2\pi^+$		**DEFINED AS 1**		851
$\Xi(1530)^0 \pi^+$	[r]	<0.10	90%	750
$\Xi^0 \pi^+ \pi^0$		2.3 ± 0.7		856
$\Xi^0 \pi^- 2\pi^+$		1.7 ± 0.5		818
$\Xi^0 e^+ \nu_e$		$2.3 ^{+0.7}_{-0.8}$		884
$\Omega^- K^+ \pi^+$		0.07 ± 0.04		399

Cabibbo-suppressed decays — relative to $\Xi^- 2\pi^+$

$p K^- \pi^+$		0.21 ± 0.04		944
$p \overline{K}^*(892)^0$	[r]	0.116 ± 0.030		828
$\Sigma^+ \pi^+ \pi^-$		0.48 ± 0.20		922
$\Sigma^- 2\pi^+$		0.18 ± 0.09		918
$\Sigma^+ K^+ K^-$		0.15 ± 0.06		579
$\Sigma^+ \phi$	[r]	<0.11	90%	549
$\Xi(1690)^0 K^+$, $\Xi^0 \to \Sigma^+ K^-$		<0.05	90%	501

Ξ_c^0

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

J^P has not been measured; $\frac{1}{2}^+$ is the quark-model prediction.

Mass $m = 2470.87^{+0.28}_{-0.31}$ MeV

$m_{\Xi_c^0} - m_{\Xi_c^+} = 3.00 \pm 0.24$ MeV

Mean life $\tau = (112^{+13}_{-10}) \times 10^{-15}$ s

$c\tau = 33.6\ \mu$m

Decay asymmetry parameters

$\Xi^- \pi^+$ $\qquad \alpha = -0.6 \pm 0.4$

No absolute branching fractions have been measured. Several measurements of ratios of fractions may be found in the Listings that follow.

Ξ_c^0 DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)

No absolute branching fractions have been measured.
The following are branching *ratios* relative to $\Xi^- \pi^+$.

Cabibbo-favored (S = −2) decays — relative to $\Xi^- \pi^+$

$p K^- K^- \pi^+$	0.34 ± 0.04	676
$p K^- \overline{K}^*(892)^0$	0.21 ± 0.05	413
$p K^- K^- \pi^+$ (no $\overline{K}^{*0}$)	0.21 ± 0.04	676
ΛK^0_S	0.210 ± 0.028	906
$\Lambda K^- \pi^+$	1.07 ± 0.14	856
$\Lambda \overline{K}^0 \pi^+ \pi^-$	seen	787
$\Lambda K^- \pi^+ \pi^+ \pi^-$	seen	703
$\Xi^- \pi^+$	**DEFINED AS 1**	875
$\Xi^- \pi^+ \pi^+ \pi^-$	3.3 ± 1.4	816
$\Omega^- K^+$	0.297 ± 0.024	522
$\Xi^- e^+ \nu_e$	3.1 ± 1.1	882
$\Xi^- \ell^+$ anything	1.0 ± 0.5	–

Cabibbo-suppressed decays — relative to $\Xi^- \pi^+$

$\Xi^- K^+$	0.028 ± 0.006	790
$\Lambda K^+ K^-$ (no ϕ)	0.029 ± 0.007	648
$\Lambda \phi$	0.034 ± 0.007	621

$\Xi_c'^+$

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

J^P has not been measured; $\frac{1}{2}^+$ is the quark-model prediction.

Mass $m = 2577.4 \pm 1.2$ MeV (S = 2.9)
$m_{\Xi_c'^+} - m_{\Xi_c^+} = 109.5 \pm 1.2$ MeV (S = 3.7)
$m_{\Xi_c'^+} - m_{\Xi_c'^0} = -1.4 \pm 1.3$ MeV (S = 2.5)

The $\Xi_c'^+$–Ξ_c^+ mass difference is too small for any strong decay to occur.

$\Xi_c'^+$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\Xi_c^+ \gamma$	seen	107

$\Xi_c'^0$

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

J^P has not been measured; $\frac{1}{2}^+$ is the quark-model prediction.

Mass $m = 2578.8 \pm 0.5$ MeV (S = 1.2)
$m_{\Xi_c'^0} - m_{\Xi_c^0} = 108.0 \pm 0.4$ MeV (S = 1.2)

The $\Xi_c'^0 - \Xi_c^0$ mass difference is too small for any strong decay to occur.

$\Xi_c'^0$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\Xi_c^0 \gamma$	seen	106

$\Xi_c(2645)$

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

J^P has not been measured; $\frac{3}{2}^+$ is the quark-model prediction.

$\Xi_c(2645)^+$ mass $m = 2645.53 \pm 0.31$ MeV
$\Xi_c(2645)^0$ mass $m = 2646.32 \pm 0.31$ MeV (S = 1.1)
$m_{\Xi_c(2645)^+} - m_{\Xi_c^0} = 174.66 \pm 0.09$ MeV
$m_{\Xi_c(2645)^0} - m_{\Xi_c^+} = 178.44 \pm 0.11$ MeV (S = 1.1)
$m_{\Xi_c(2645)^+} - m_{\Xi_c(2645)^0} = -0.79 \pm 0.27$ MeV
$\Xi_c(2645)^+$ full width $\Gamma = 2.14 \pm 0.19$ MeV (S = 1.1)
$\Xi_c(2645)^0$ full width $\Gamma = 2.35 \pm 0.22$ MeV

$\Xi_c \pi$ is the only strong decay allowed to a Ξ_c resonance having this mass.

Ξ_c(2645) DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\Xi_c^0 \pi^+$	seen	102
$\Xi_c^+ \pi^-$	seen	106

$\Xi_c(2790)$

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

J^P has not been measured; $\frac{1}{2}^-$ is the quark-model prediction.

$\Xi_c(2790)^+$ mass $= 2792.0 \pm 0.5$ MeV (S = 1.2)
$\Xi_c(2790)^0$ mass $= 2792.8 \pm 1.2$ MeV (S = 2.9)
$m_{\Xi_c(2790)^+} - m_{\Xi_c^0} = 321.1 \pm 0.4$ MeV (S = 1.2)
$m_{\Xi_c(2790)^0} - m_{\Xi_c^+} = 324.9 \pm 1.2$ MeV (S = 3.7)
$m_{\Xi_c(2790)^+} - m_{\Xi_c'^0} = 213.10 \pm 0.26$ MeV (S = 1.2)
$m_{\Xi_c(2790)^0} - m_{\Xi_c'^+} = 215.4 \pm 0.8$ MeV (S = 3.7)
$m_{\Xi_c(2790)^+} - m_{\Xi_c(2790)^0} = -0.9 \pm 1.3$ MeV (S = 2.5)
$\Xi_c(2790)^+$ width $= 8.9 \pm 1.0$ MeV
$\Xi_c(2790)^0$ width $= 10.0 \pm 1.1$ MeV

Ξ_c(2790) DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\Xi_c \pi$	seen	–
$\Xi'_c \pi$	seen	160

$\Xi_c(2815)$

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

J^P has not been measured; $\frac{3}{2}^-$ is the quark-model prediction.

$\Xi_c(2815)^+$ mass $m = 2816.67 \pm 0.31$ MeV (S = 1.1)
$\Xi_c(2815)^0$ mass $m = 2820.22 \pm 0.32$ MeV
$m_{\Xi_c(2815)^+} - m_{\Xi_c^+} = 348.80 \pm 0.10$ MeV
$m_{\Xi_c(2815)^0} - m_{\Xi_c^0} = 349.35 \pm 0.11$ MeV
$m_{\Xi_c(2815)^+} - m_{\Xi_c(2815)^0} = -3.55 \pm 0.28$ MeV
$\Xi_c(2815)^+$ full width $\Gamma = 2.43 \pm 0.26$ MeV
$\Xi_c(2815)^0$ full width $\Gamma = 2.54 \pm 0.25$ MeV

The $\Xi_c \pi\pi$ modes are consistent with being entirely via $\Xi_c(2645)\pi$.

Ξ_c(2815) DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\Xi_c \pi$	seen	–
$\Xi_c^+ \pi^+ \pi^-$	seen	196
$\Xi_c^0 \pi^+ \pi^-$	seen	191

Ξ_c(2970)
was Ξ_c(2980)

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

$\Xi_c(2970)^+$ $m = 2969.4 \pm 0.8$ MeV (S = 1.1)
$\Xi_c(2970)^0$ $m = 2967.8 \pm 0.8$ MeV (S = 1.1)
$m_{\Xi_c(2970)^+} - m_{\Xi_c^0} = 498.5 \pm 0.8$ MeV (S = 1.1)
$m_{\Xi_c(2970)^0} - m_{\Xi_c^+} = 499.9^{+0.8}_{-0.7}$ MeV (S = 1.1)
$m_{\Xi_c(2970)^+} - m_{\Xi_c(2970)^0} = 1.6 \pm 1.1$ MeV (S = 1.1)
$\Xi_c(2970)^+$ width $\Gamma = 20.9^{+2.4}_{-3.5}$ MeV (S = 1.2)
$\Xi_c(2970)^0$ width $\Gamma = 28.1^{+3.4}_{-4.0}$ MeV (S = 1.5)

Ξ_c(2970) DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\Lambda_c^+ \overline{K} \pi$	seen	231
$\quad\Sigma_c(2455) \overline{K}$	seen	133
$\Lambda_c^+ \overline{K}$	not seen	414
$\Xi_c 2\pi$	seen	385
$\quad\Xi_c(2645)\pi$	seen	277

Ξ_c(3055)

$I(J^P) = ?(?^?)$

Mass $m = 3055.9 \pm 0.4$ MeV
Full width $\Gamma = 7.8 \pm 1.9$ MeV

Ξ_c(3055) DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\Sigma^{++} K^-$	seen	–
ΛD^+	seen	317

$\Xi_c(3080)$

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

$\Xi_c(3080)^+$ $m = 3077.2 \pm 0.4$ MeV
$\Xi_c(3080)^0$ $m = 3079.9 \pm 1.4$ MeV (S = 1.3)
$\Xi_c(3080)^+$ width $\Gamma = 3.6 \pm 1.1$ MeV (S = 1.5)
$\Xi_c(3080)^0$ width $\Gamma = 5.6 \pm 2.2$ MeV

Ξ_c(3080) DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\Lambda_c^+ \overline{K} \pi$	seen	415
$\Sigma_c(2455) \overline{K}$	seen	342
$\Sigma_c(2455)^{++} K^-$	seen	342
$\Sigma_c(2520)^{++} K^-$	seen	239
$\Sigma_c(2455) \overline{K} + \Sigma_c(2520) \overline{K}$	seen	–
$\Lambda_c^+ \overline{K}$	not seen	536
$\Lambda_c^+ \overline{K} \pi^+ \pi^-$	not seen	144
ΛD^+	seen	362

Ω_c^0

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

J^P has not been measured; $\frac{1}{2}^+$ is the quark-model prediction.

Mass $m = 2695.2 \pm 1.7$ MeV (S = 1.3)
Mean life $\tau = (69 \pm 12) \times 10^{-15}$ s
$c\tau = 21$ μm

No absolute branching fractions have been measured.

Ω_c^0 DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\Sigma^+ K^- K^- \pi^+$	seen	689
$\Xi^0 K^- \pi^+$	seen	901
$\Xi^- K^- \pi^+ \pi^+$	seen	830
$\Omega^- e^+ \nu_e$	seen	829
$\Omega^- \pi^+$	seen	821
$\Omega^- \pi^+ \pi^0$	seen	797
$\Omega^- \pi^- \pi^+ \pi^+$	seen	753

$\Omega_c(2770)^0$

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

J^P has not been measured; $\frac{3}{2}^+$ is the quark-model prediction.

Mass $m = 2765.9 \pm 2.0$ MeV (S = 1.2)
$m_{\Omega_c(2770)^0} - m_{\Omega_c^0} = 70.7^{+0.8}_{-0.9}$ MeV

The $\Omega_c(2770)^0$–Ω_c^0 mass difference is too small for any strong decay to occur.

$\Omega_c(2770)^0$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\Omega_c^0 \gamma$	presumably 100%	70

BOTTOM BARYONS ($B = -1$)

$\Lambda_b^0 = u\,d\,b$, $\Xi_b^0 = u\,s\,b$, $\Xi_b^- = d\,s\,b$, $\Omega_b^- = s\,s\,b$

Λ_b^0

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

$I(J^P)$ not yet measured; $0(\frac{1}{2}^+)$ is the quark model prediction.

Mass $m = 5619.58 \pm 0.17$ MeV

$m_{\Lambda_b^0} - m_{B^0} = 339.2 \pm 1.4$ MeV

$m_{\Lambda_b^0} - m_{B^+} = 339.72 \pm 0.28$ MeV

Mean life $\tau = (1.470 \pm 0.010) \times 10^{-12}$ s

$c\tau = 440.7$ μm

$A_{CP}(\Lambda_b \to p\pi^-) = 0.06 \pm 0.08$

$A_{CP}(\Lambda_b \to pK^-) = -0.10 \pm 0.09$

$A_{CP}(\Lambda_b \to p\overline{K}^0\pi^-) = 0.22 \pm 0.13$

$\Delta A_{CP}(J/\psi\, p\pi^-/K^-) \equiv A_{CP}(J/\psi\, p\pi^-) - A_{CP}(J/\psi\, pK^-) = (5.7 \pm 2.7) \times 10^{-2}$

$A_{CP}(\Lambda_b \to \Lambda K^+\pi^-) = -0.53 \pm 0.25$

$A_{CP}(\Lambda_b \to \Lambda K^+K^-) = -0.28 \pm 0.12$

α decay parameter for $\Lambda_b \to J/\psi\Lambda = 0.18 \pm 0.13$

$A^{\ell}_{FB}(\mu\mu)$ in $\Lambda_b \to \Lambda\mu^+\mu^- = -0.05 \pm 0.09$

$A^{h}_{FB}(p\pi)$ in $\Lambda_b \to \Lambda(p\pi)\mu^+\mu^- = -0.29 \pm 0.08$

$f_L(\mu\mu)$ longitudinal polarization fraction in $\Lambda_b \to \Lambda\mu^+\mu^- = 0.61^{+0.11}_{-0.14}$

The branching fractions B(b-baryon $\to \Lambda\ell^-\overline{\nu}_\ell$ anything) and B($\Lambda_b^0 \to \Lambda_c^+\ell^-\overline{\nu}_\ell$ anything) are not pure measurements because the underlying measured products of these with B($b \to b$-baryon) were used to determine B($b \to b$-baryon), as described in the note "Production and Decay of b-Flavored Hadrons."

For inclusive branching fractions, *e.g.*, $\Lambda_b \to \overline{\Lambda}_c$ anything, the values usually are multiplicities, not branching fractions. They can be greater than one.

Λ_b^0 DECAY MODES		Fraction (Γ_i/Γ)	Scale factor/ Confidence level	p (MeV/c)
$J/\psi(1S)\Lambda \times$ B($b \to \Lambda_b^0$)		$(5.8 \pm 0.8) \times 10^{-5}$		1740
$p D^0 \pi^-$		$(6.5 \pm 0.7) \times 10^{-4}$		2370
$p D^0 K^-$		$(4.7 \pm 0.8) \times 10^{-5}$		2269
$p J/\psi \pi^-$		$(2.6 {}^{+0.5}_{-0.4}) \times 10^{-5}$		1755
$p J/\psi K^-$		$(3.2 {}^{+0.6}_{-0.5}) \times 10^{-4}$		1589
$P_c(4380)^+ K^-$, $P_c \to p J/\psi$	[v]	$(2.7 \pm 1.4) \times 10^{-5}$		–
$P_c(4450)^+ K^-$, $P_c \to p J/\psi$	[v]	$(1.3 \pm 0.4) \times 10^{-5}$		–
$p J/\psi(1S) \pi^+ \pi^- K^-$		$(6.6 {}^{+1.3}_{-1.1}) \times 10^{-5}$		1410
$p \psi(2S) K^-$		$(6.6 {}^{+1.2}_{-1.0}) \times 10^{-5}$		1063
$p \overline{K}^0 \pi^-$		$(1.3 \pm 0.4) \times 10^{-5}$		2693
$p K^0 K^-$		$< 3.5 \times 10^{-6}$	CL=90%	2639
$\Lambda_c^+ \pi^-$		$(4.9 \pm 0.4) \times 10^{-3}$	S=1.2	2342
$\Lambda_c^+ K^-$		$(3.59 \pm 0.30) \times 10^{-4}$	S=1.2	2314
$\Lambda_c^+ a_1(1260)^-$		seen		2153
$\Lambda_c^+ D^-$		$(4.6 \pm 0.6) \times 10^{-4}$		1886
$\Lambda_c^+ D_s^-$		(1.10 ± 0.10) %		1833
$\Lambda_c^+ \pi^+ \pi^- \pi^-$		$(7.7 \pm 1.1) \times 10^{-3}$	S=1.1	2323
$\Lambda_c(2595)^+ \pi^-$, $\Lambda_c(2595)^+ \to \Lambda_c^+ \pi^+ \pi^-$		$(3.4 \pm 1.5) \times 10^{-4}$		2210
$\Lambda_c(2625)^+ \pi^-$, $\Lambda_c(2625)^+ \to \Lambda_c^+ \pi^+ \pi^-$		$(3.3 \pm 1.3) \times 10^{-4}$		2193
$\Sigma_c(2455)^0 \pi^+ \pi^-$, $\Sigma_c^0 \to \Lambda_c^+ \pi^-$		$(5.7 \pm 2.2) \times 10^{-4}$		2265
$\Sigma_c(2455)^{++} \pi^- \pi^-$, $\Sigma_c^{++} \to \Lambda_c^+ \pi^+$		$(3.2 \pm 1.6) \times 10^{-4}$		2265
$\Lambda_c^+ \ell^- \overline{\nu}_\ell$ anything	[x]	(10.4 ± 2.2) %		–
$\Lambda_c^+ \ell^- \overline{\nu}_\ell$		$(6.2 {}^{+1.4}_{-1.3})$ %		2345
$\Lambda_c^+ \pi^+ \pi^- \ell^- \overline{\nu}_\ell$		(5.6 ± 3.1) %		2335
$\Lambda_c(2595)^+ \ell^- \overline{\nu}_\ell$		$(7.9 {}^{+4.0}_{-3.5}) \times 10^{-3}$		2212
$\Lambda_c(2625)^+ \ell^- \overline{\nu}_\ell$		$(1.3 {}^{+0.6}_{-0.5})$ %		2195
$p h^-$	[y]	$< 2.3 \times 10^{-5}$	CL=90%	2730
$p \pi^-$		$(4.3 \pm 0.8) \times 10^{-6}$		2730

pK^-	$(5.1 \pm 0.9) \times 10^{-6}$		2709
pD_s^-	$< 4.8 \times 10^{-4}$	CL=90%	2364
$p\mu^-\overline{\nu}_\mu$	$(4.1 \pm 1.0) \times 10^{-4}$		2730
$\Lambda\mu^+\mu^-$	$(1.08 \pm 0.28) \times 10^{-6}$		2695
$\Lambda\gamma$	$< 1.3 \times 10^{-3}$	CL=90%	2699
$\Lambda^0\eta$	$(9 \, {}^{+7}_{-5}) \times 10^{-6}$		–
$\Lambda^0\eta'(958)$	$< 3.1 \times 10^{-6}$	CL=90%	–
$\Lambda\pi^+\pi^-$	$(4.7 \pm 1.9) \times 10^{-6}$		2692
$\Lambda K^+\pi^-$	$(5.7 \pm 1.3) \times 10^{-6}$		2660
ΛK^+K^-	$(1.61 \pm 0.23) \times 10^{-5}$		2605
$\Lambda^0\phi$	$(2.0 \pm 0.5) \times 10^{-6}$		–

$\Lambda_b(5912)^0$

$J^P = \frac{1}{2}^-$

Mass $m = 5912.18 \pm 0.21$ MeV
Full width $\Gamma < 0.66$ MeV, CL = 90%

$\Lambda_b(5912)^0$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\Lambda_b^0\pi^+\pi^-$	seen	86

$\Lambda_b(5920)^0$

$J^P = \frac{3}{2}^-$

Mass $m = 5919.90 \pm 0.19$ MeV (S = 1.1)
Full width $\Gamma < 0.63$ MeV, CL = 90%

$\Lambda_b(5920)^0$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\Lambda_b^0\pi^+\pi^-$	seen	108

Σ_b

$I(J^P) = 1(\frac{1}{2}^+)$
I, J, P need confirmation.

Mass $m(\Sigma_b^+) = 5811.3 \pm 1.9$ MeV
Mass $m(\Sigma_b^-) = 5815.5 \pm 1.8$ MeV
$m_{\Sigma_b^+} - m_{\Sigma_b^-} = -4.2 \pm 1.1$ MeV
$\Gamma(\Sigma_b^+) = 9.7^{+4.0}_{-3.0}$ MeV
$\Gamma(\Sigma_b^-) = 4.9^{+3.3}_{-2.4}$ MeV

Σ_b DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\Lambda_b^0 \pi$	dominant	134

Σ_b^*

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

Mass $m(\Sigma_b^{*+}) = 5832.1 \pm 1.9$ MeV
Mass $m(\Sigma_b^{*-}) = 5835.1 \pm 1.9$ MeV
$m_{\Sigma_b^{*+}} - m_{\Sigma_b^{*-}} = -3.0^{+1.0}_{-0.9}$ MeV
$\Gamma(\Sigma_b^{*+}) = 11.5 \pm 2.8$ MeV
$\Gamma(\Sigma_b^{*-}) = 7.5 \pm 2.3$ MeV
$m_{\Sigma_b^*} - m_{\Sigma_b} = 21.2 \pm 2.0$ MeV

Σ_b^* DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\Lambda_b^0 \pi$	dominant	161

Ξ_b^0, Ξ_b^-

$I(J^P) = \frac{1}{2}(\frac{1}{2}^+)$
I, J, P need confirmation.

$m(\Xi_b^-) = 5794.5 \pm 1.4$ MeV (S = 4.0)
$m(\Xi_b^0) = 5791.9 \pm 0.5$ MeV
$m_{\Xi_b^-} - m_{\Lambda_b^0} = 177.9 \pm 0.9$ MeV (S = 2.1)
$m_{\Xi_b^0} - m_{\Lambda_b^0} = 172.5 \pm 0.4$ MeV
$m_{\Xi_b^-} - m_{\Xi_b^0} = 5.9 \pm 0.6$ MeV
Mean life $\tau_{\Xi_b^-} = (1.571 \pm 0.040) \times 10^{-12}$ s
Mean life $\tau_{\Xi_b^0} = (1.479 \pm 0.031) \times 10^{-12}$ s

Ξ_b DECAY MODES	Fraction (Γ_i/Γ)	Scale factor/ Confidence level	p (MeV/c)
$\Xi^- \ell^- \overline{\nu}_\ell X \times$ B($\overline{b} \to \Xi_b$)	$(3.9 \pm 1.2) \times 10^{-4}$	S=1.4	–
$J/\psi \Xi^- \times$ B($b \to \Xi_b^-$)	$(1.02^{+0.26}_{-0.21}) \times 10^{-5}$		1782
$p D^0 K^- \times$ B($\overline{b} \to \Xi_b$)	$(1.8 \pm 0.6) \times 10^{-6}$		2374
$p \overline{K}^0 \pi^- \times$ B($\overline{b} \to \Xi_b$)/B($\overline{b} \to B^0$)	$< 1.6 \times 10^{-6}$	CL=90%	2783
$p K^0 K^- \times$ B($\overline{b} \to \Xi_b$)/B($\overline{b} \to B^0$)	$< 1.1 \times 10^{-6}$	CL=90%	2730

$pK^-K^- \times$ B($\overline{b} \rightarrow \Xi_b$)	(3.6 $\pm$0.8) $\times 10^{-8}$		2731
$\Lambda\pi^+\pi^- \times$ B($b \rightarrow \Xi_b^0$)/B($b \rightarrow \Lambda_b^0$)	< 1.7 $\times 10^{-6}$	CL=90%	2781
$\Lambda K^-\pi^+ \times$ B($b \rightarrow \Xi_b^0$)/B($b \rightarrow \Lambda_b^0$)	< 8 $\times 10^{-7}$	CL=90%	2751
$\Lambda K^+K^- \times$ B($b \rightarrow \Xi_b^0$)/B($b \rightarrow \Lambda_b^0$)	< 3 $\times 10^{-7}$	CL=90%	2698
$\Lambda_c^+ K^- \times$ B($\overline{b} \rightarrow \Xi_b$)	(6 $\pm$4) $\times 10^{-7}$		2416
$\Lambda_b^0\pi^- \times$ B($b \rightarrow \Xi_b^-$)/B($b \rightarrow \Lambda_b^0$)	(5.7 $\pm$2.0) $\times 10^{-4}$		99

$\Xi_b'(5935)^-$

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

Mass $m = 5935.02 \pm 0.05$ MeV
$m_{\Xi_b'(5935)^-} - m_{\Xi_b^0} - m_{\pi^-} = 3.653 \pm 0.019$ MeV
Full width $\Gamma < 0.08$ MeV, CL = 95%

$\Xi_b'(5935)^-$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\Xi_b^0\pi^- \times$ B($\overline{b} \rightarrow \Xi_b'(5935)^-$)/B($\overline{b} \rightarrow \Xi_b^0$)	(11.8$\pm$1.8) %	31

$\Xi_b(5945)^0$

$J^P = \frac{3}{2}^+$

Mass $m = 5949.8 \pm 1.4$ MeV
Full width $\Gamma = 0.90 \pm 0.18$ MeV

$\Xi_b(5945)^0$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\Xi_b^-\pi^+$	seen	73

$\Xi_b^*(5955)^-$

$J^P = \frac{3}{2}^+$

Mass $m = 5955.33 \pm 0.13$ MeV
$m_{\Xi_b^*(5955)^-} - m_{\Xi_b^0} - m_{\pi^-} = 23.96 \pm 0.13$ MeV
Full width $\Gamma = 1.65 \pm 0.33$ MeV

$\Xi_b^*(5955)^-$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\Xi_b^0\pi^- \times$ B($\overline{b} \rightarrow \Xi_b^*(5955)^-$)/B($\overline{b} \rightarrow \Xi_b^0$)	(20.7$\pm$3.5) %	84

Ω_b^-

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

Mass $m = 6046.1 \pm 1.7$ MeV
$m_{\Omega_b^-} - m_{\Lambda_b^0} = 426.4 \pm 2.2$ MeV
$m_{\Omega_b^-} - m_{\Xi_b^-} = 247.3 \pm 3.2$ MeV
Mean life $\tau = (1.64^{+0.18}_{-0.17}) \times 10^{-12}$ s
Mean life $\tau = 1.11 \pm 0.16$

Ω_b^- DECAY MODES	Fraction (Γ_i/Γ)	Confidence level	p (MeV/c)
$J/\psi\,\Omega^- \times$B($b \to \Omega_b$)	$(2.9^{+1.1}_{-0.8}) \times 10^{-6}$		1806
$pK^-K^- \times$B($\overline{b} \to \Omega_b$)	$< 2.5 \times 10^{-9}$	90%	2866
$p\pi^-\pi^- \times$B($\overline{b} \to \Omega_b$)	$< 1.5 \times 10^{-8}$	90%	2943
$pK^-\pi^- \times$B($\overline{b} \to \Omega_b$)	$< 7 \times 10^{-9}$	90%	2915

b-baryon ADMIXTURE (Λ_b, Ξ_b, Σ_b, Ω_b)

These branching fractions are actually an average over weakly decaying b-baryons weighted by their production rates at the LHC, LEP, and Tevatron, branching ratios, and detection efficiencies. They scale with the b-baryon production fraction B($b \to$ b-baryon).

The branching fractions B(b-baryon $\to \Lambda\ell^-\overline{\nu}_\ell$anything) and B($\Lambda_b^0 \to \Lambda_c^+\ell^-\overline{\nu}_\ell$anything) are not pure measurements because the underlying measured products of these with B($b \to$ b-baryon) were used to determine B($b \to$ b-baryon), as described in the note "Production and Decay of b-Flavored Hadrons."

For inclusive branching fractions, *e.g.*, $B \to D^\pm$anything, the values usually are multiplicities, not branching fractions. They can be greater than one.

b-baryon ADMIXTURE DECAY MODES (Λ_b,Ξ_b,Σ_b,Ω_b)	Fraction (Γ_i/Γ)	p (MeV/c)
$p\mu^-\overline{\nu}$anything	$(5.6^{+2.2}_{-1.9})$ %	–
$p\ell\overline{\nu}_\ell$anything	(5.4 ± 1.2) %	–
$p$anything	(67 ± 21) %	–
$\Lambda\ell^-\overline{\nu}_\ell$anything	(3.6 ± 0.6) %	–
$\Lambda\ell^+\nu_\ell$anything	(3.0 ± 0.8) %	–
Λanything	(38 ± 7) %	–
$\Xi^-\ell^-\overline{\nu}_\ell$anything	$(6.3 \pm 1.6) \times 10^{-3}$	–

EXOTIC BARYONS

$P_c(4380)^+$

Mass $m = 4380 \pm 30$ MeV
Full width $\Gamma = 205 \pm 90$ MeV

Mode

Mode	Fraction (Γ_i/Γ)	p (MeV/c)
$J/\psi\, p$	seen	741

$P_c(4450)^+$

Mass $m = 4449.8 \pm 3.0$ MeV
Full width $\Gamma = 39 \pm 20$ MeV

Mode

Mode	Fraction (Γ_i/Γ)	p (MeV/c)
$J/\psi\, p$	seen	820

NOTES

[*a*] The masses of the p and n are most precisely known in u (unified atomic mass units). The conversion factor to MeV, 1 u = 931.494061(21) MeV, is less well known than are the masses in u.

[*b*] The $|m_p - m_{\overline{p}}|/m_p$ and $|q_p + q_{\overline{p}}|/e$ are not independent, and both use the more precise measurement of $|q_{\overline{p}}/m_{\overline{p}}|/(q_p/m_p)$.

[*c*] The limit is from neutrality-of-matter experiments; it assumes $q_n = q_p + q_e$. See also the charge of the neutron.

[*d*] The μp and $e p$ values for the charge radius are much too different to average them. The disagreement is not yet understood.

[*e*] There is a lot of disagreement about the value of the proton magnetic charge radius. See the Listings.

[*f*] The first limit is for $p \to$ anything or "disappearance" modes of a bound proton. The second entry, a rough range of limits, assumes the dominant decay modes are among those investigated. For antiprotons the best limit, inferred from the observation of cosmic ray $\overline{p}$'s is $\tau_{\overline{p}} > 10^7$ yr, the cosmic-ray storage time, but this limit depends on a number of assumptions. The best direct observation of stored antiprotons gives $\tau_{\overline{p}}/\mathrm{B}(\overline{p} \to e^- \gamma) > 7 \times 10^5$ yr.

[g] There is some controversy about whether nuclear physics and model dependence complicate the analysis for bound neutrons (from which the best limit comes). The first limit here is from reactor experiments with free neutrons.

[h] Lee and Yang in 1956 proposed the existence of a mirror world in an attempt to restore global parity symmetry—thus a search for oscillations between the two worlds. Oscillations between the worlds would be maximal when the magnetic fields B and B' were equal. The limit for any B' in the range 0 to 12.5 μT is $>$12 s (95% CL).

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

[j] Time-reversal invariance requires this to be 0° or 180°.

[k] This coefficient is zero if time invariance is not violated.

[l] This limit is for γ energies between 0.4 and 782 keV.

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

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

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

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

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

[q] A theoretical value using QED.

[r] This branching fraction includes all the decay modes of the final-state resonance.

[s] The value is for the sum of the charge states or particle/antiparticle states indicated.

[t] See AALTONEN 11H, Fig. 8, for the calculated ratio of $\Lambda_c^+\pi^0\pi^0$ and $\Lambda_c^+\pi^+\pi^-$ partial widths as a function of the $\Lambda_c(2595)^+ - \Lambda_c^+$ mass difference. At our value of the mass difference, the ratio is about 4.

[u] A test that the isospin is indeed 0, so that the particle is indeed a Λ_c^+.

[v] P_c^+ is a pentaquark-charmonium state.

[x] Not a pure measurement. See note at head of Λ_b^0 Decay Modes.

[y] Here h^- means π^- or K^-.