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

p, $N^+ = uud$; n, $N^0 = udd$

p

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

Mass $m = 1.00727646688 \pm 0.00000000013$ u
Mass $m = 938.27203 \pm 0.00008$ MeV [a]
$|m_p - m_{\overline{p}}|/m_p < 1.0 \times 10^{-8}$, CL = 90% [b]
$|\frac{q_{\overline{p}}}{m_{\overline{p}}}|/(\frac{q_p}{m_p}) = 0.99999999991 \pm 0.00000000009$
$|q_p + q_{\overline{p}}|/e < 1.0 \times 10^{-8}$, CL = 90% [b]
$|q_p + q_e|/e < 1.0 \times 10^{-21}$ [c]
Magnetic moment $\mu = 2.792847351 \pm 0.000000028\ \mu_N$
$(\mu_p + \mu_{\overline{p}}) / \mu_p = (-2.6 \pm 2.9) \times 10^{-3}$
Electric dipole moment $d < 0.54 \times 10^{-23}\ e$cm
Electric polarizability $\alpha = (12.0 \pm 0.6) \times 10^{-4}$ fm^3
Magnetic polarizability $\beta = (1.9 \pm 0.5) \times 10^{-4}$ fm^3
Charge radius = 0.870 ± 0.008 fm
Mean life $\tau > 2.1 \times 10^{29}$ years, CL = 90% ($p \rightarrow$ invisible mode)
Mean life $\tau > 10^{31}$ to 10^{33} years [d] (mode dependent)

See the "Note on Nucleon Decay" in our 1994 edition (Phys. Rev. **D50**, 1673) 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			
$N \rightarrow e^+\pi$	> 158 (n), > 1600 (p)	90%	459
$N \rightarrow \mu^+\pi$	> 100 (n), > 473 (p)	90%	453
$N \rightarrow \nu\pi$	> 112 (n), > 25 (p)	90%	459
$p \rightarrow e^+\eta$	> 313	90%	309
$p \rightarrow \mu^+\eta$	> 126	90%	297
$n \rightarrow \nu\eta$	> 158	90%	310
$N \rightarrow e^+\rho$	> 217 (n), > 75 (p)	90%	148
$N \rightarrow \mu^+\rho$	> 228 (n), > 110 (p)	90%	113
$N \rightarrow \nu\rho$	> 19 (n), > 162 (p)	90%	148
$p \rightarrow e^+\omega$	> 107	90%	143

$p \to \mu^+ \omega$	> 117	90%	105
$n \to \nu \omega$	> 108	90%	144
$N \to e^+ K$	> 17 (n), > 150 (p)	90%	339
$p \to e^+ K^0_S$	> 120	90%	337
$p \to e^+ K^0_L$	> 51	90%	337
$N \to \mu^+ K$	> 26 (n), > 120 (p)	90%	329
$p \to \mu^+ K^0_S$	> 150	90%	326
$p \to \mu^+ K^0_L$	> 83	90%	326
$N \to \nu K$	> 86 (n), > 670 (p)	90%	339
$n \to \nu K^0_S$	> 51	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%	149
$n \to \mu^- \rho^+$	> 7	90%	114
$n \to e^- K^+$	> 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
$n \to \nu \gamma$	> 28	90%	470
$p \to e^+ \gamma \gamma$	> 100	90%	469
$n \to \nu \gamma \gamma$	> 219	90%	470

Three (or more) leptons

$p \to e^+ e^+ e^-$	> 793	90%	469
$p \to e^+ \mu^+ \mu^-$	> 359	90%	457
$p \to e^+ \nu \nu$	> 17	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
$p \to \mu^+ \nu \nu$	> 21	90%	463
$p \to e^- \mu^+ \mu^+$	> 6	90%	457
$n \to 3\nu$	> 0.0005	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.

$pp \to \pi^+ \pi^+$	> 0.7	90%	–
$pn \to \pi^+ \pi^0$	> 2	90%	–
$nn \to \pi^+ \pi^-$	> 0.7	90%	–
$nn \to \pi^0 \pi^0$	> 3.4	90%	–
$pp \to e^+ e^+$	> 5.8	90%	–
$pp \to e^+ \mu^+$	> 3.6	90%	–
$pp \to \mu^+ \mu^+$	> 1.7	90%	–
$pn \to e^+ \overline{\nu}$	> 2.8	90%	–
$pn \to \mu^+ \overline{\nu}$	> 1.6	90%	–
$nn \to \nu_e \overline{\nu}_e$	> 0.000049	90%	–
$pp \to$ neutrinos	> 0.00005	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

$\overline{p} \rightarrow \mu^- K_S^0$	$> 4 \times 10^3$	90%	326
$\overline{p} \rightarrow e^- K_L^0$	$> 9 \times 10^3$	90%	337
$\overline{p} \rightarrow \mu^- K_L^0$	$> 7 \times 10^3$	90%	326
$\overline{p} \rightarrow e^- \gamma\gamma$	$> 2 \times 10^4$	90%	469
$\overline{p} \rightarrow \mu^- \gamma\gamma$	$> 2 \times 10^4$	90%	463
$\overline{p} \rightarrow e^- \omega$	> 200	90%	143

n

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

Mass $m = 1.0086649156 \pm 0.0000000006$ u
Mass $m = 939.56536 \pm 0.00008$ MeV [a]
$m_n - m_p = 1.2933317 \pm 0.0000005$ MeV
$= 0.0013884487 \pm 0.0000000006$ u
Mean life $\tau = 885.7 \pm 0.8$ s
$c\tau = 2.655 \times 10^8$ km
Magnetic moment $\mu = -1.9130427 \pm 0.0000005\ \mu_N$
Electric dipole moment $d < 0.63 \times 10^{-25}\ e$cm, CL = 90%
Mean-square charge radius $\langle r_n^2 \rangle = -0.1161 \pm 0.0022$ fm^2 (S = 1.3)
Electric polarizability $\alpha = (11.6 \pm 1.5) \times 10^{-4}$ fm^3
Magnetic polarizability $\beta = (3.7 \pm 2.0) \times 10^{-4}$ fm^3
Charge $q = (-0.4 \pm 1.1) \times 10^{-21}\ e$
Mean $n\overline{n}$-oscillation time $> 8.6 \times 10^7$ s, CL = 90% (free n)
Mean $n\overline{n}$-oscillation time $> 1.3 \times 10^8$ s, CL = 90% [e] (bound n)

Decay parameters [f]

$p\,e^-\,\overline{\nu}_e$	$\lambda \equiv g_A / g_V = -1.2695 \pm 0.0029$ (S = 2.0)
"	$A = -0.1173 \pm 0.0013$ (S = 2.3)
"	$B = 0.983 \pm 0.004$
"	$a = -0.103 \pm 0.004$
"	$\phi_{AV} = (180.08 \pm 0.10)^\circ$ [g]
"	$D = (-0.6 \pm 1.0) \times 10^{-3}$

n DECAY MODES	Fraction (Γ_i/Γ)	Confidence level	p (MeV/c)
$p\,e^-\,\overline{\nu}_e$	100 %		1
$p\,e^-\,\overline{\nu}_e\,\gamma$	[h] $< 6.9 \times 10^{-3}$	90%	1
Charge conservation (Q) violating mode			
$p\,\nu_e\,\overline{\nu}_e$	Q $< 8 \times 10^{-27}$	68%	1

$N(1440)\ P_{11}$

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

Breit-Wigner mass = 1430 to 1470 ($\approx$ 1440) MeV
Breit-Wigner full width = 250 to 450 ($\approx$ 350) MeV
p_{beam} = 0.61 GeV/c $\quad 4\pi\lambda\!\!\!^{-2}$ = 31.0 mb
Re(pole position) = 1345 to 1385 ($\approx$ 1365) MeV
-2Im(pole position) = 160 to 260 ($\approx$ 210) MeV

***N*(1440) DECAY MODES**	Fraction (Γ_i/Γ)	p (MeV/c)
$N\pi$	60–70 %	398
$N\pi\pi$	30–40 %	347
$\Delta\pi$	20–30 %	147
$N\rho$	<8 %	†
$N(\pi\pi)^{I=0}_{S\text{-wave}}$	5–10 %	–
$p\gamma$	0.035–0.048 %	414
$p\gamma$, helicity=1/2	0.035–0.048 %	414
$n\gamma$	0.009–0.032 %	413
$n\gamma$, helicity=1/2	0.009–0.032 %	413

$N(1520)\ D_{13}$

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

Breit-Wigner mass = 1515 to 1530 ($\approx$ 1520) MeV
Breit-Wigner full width = 110 to 135 ($\approx$ 120) MeV
p_{beam} = 0.74 GeV/c $\quad 4\pi\lambda\!\!\!^{-2}$ = 23.5 mb
Re(pole position) = 1505 to 1515 ($\approx$ 1510) MeV
-2Im(pole position) = 110 to 120 ($\approx$ 115) MeV

***N*(1520) DECAY MODES**	Fraction (Γ_i/Γ)	p (MeV/c)
$N\pi$	50–60 %	457
$N\eta$	$(2.3\pm0.4)\times10^{-3}$	154
$N\pi\pi$	40–50 %	414
$\Delta\pi$	15–25 %	230
$N\rho$	15–25 %	†
$N(\pi\pi)^{I=0}_{S\text{-wave}}$	<8 %	–
$p\gamma$	0.46–0.56 %	470
$p\gamma$, helicity=1/2	0.001–0.034 %	470
$p\gamma$, helicity=3/2	0.44–0.53 %	470
$n\gamma$	0.30–0.53 %	470
$n\gamma$, helicity=1/2	0.04–0.10 %	470
$n\gamma$, helicity=3/2	0.25–0.45 %	470

$N(1535)$ S_{11}

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

Breit-Wigner mass = 1520 to 1555 ($\approx$ 1535) MeV
Breit-Wigner full width = 100 to 200 ($\approx$ 150) MeV
$p_{\rm beam}$ = 0.76 GeV/c $\quad 4\pi\lambda\!\!\!^{-2}$ = 22.5 mb
Re(pole position) = 1495 to 1515 ($\approx$ 1505) MeV
-2Im(pole position) = 90 to 250 ($\approx$ 170) MeV

***N*(1535) DECAY MODES**	Fraction (Γ_i/Γ)	p (MeV/c)
$N\pi$	35–55 %	468
$N\eta$	30–55 %	186
$N\pi\pi$	1–10 %	426
$\Delta\pi$	<1 %	244
$N\rho$	<4 %	†
$N(\pi\pi)^{I=0}_{S\text{-wave}}$	<3 %	–
$N(1440)\pi$	<7 %	†
$p\gamma$	0.15–0.35 %	481
$p\gamma$, helicity=1/2	0.15–0.35 %	481
$n\gamma$	0.004–0.29 %	480
$n\gamma$, helicity=1/2	0.004–0.29 %	480

$N(1650)$ S_{11}

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

Breit-Wigner mass = 1640 to 1680 ($\approx$ 1650) MeV
Breit-Wigner full width = 145 to 190 ($\approx$ 150) MeV
$p_{\rm beam}$ = 0.96 GeV/c $\quad 4\pi\lambda\!\!\!^{-2}$ = 16.4 mb
Re(pole position) = 1640 to 1680 ($\approx$ 1660) MeV
-2Im(pole position) = 150 to 170 ($\approx$ 160) MeV

***N*(1650) DECAY MODES**	Fraction (Γ_i/Γ)	p (MeV/c)
$N\pi$	55–90 %	547
$N\eta$	3–10 %	348
ΛK	3–11 %	169
$N\pi\pi$	10–20 %	514
$\Delta\pi$	1–7 %	345
$N\rho$	4–12 %	†
$N(\pi\pi)^{I=0}_{S\text{-wave}}$	<4 %	–
$N(1440)\pi$	<5 %	150
$p\gamma$	0.04–0.18 %	558

$p\gamma$, helicity=1/2	0.04–0.18 %	558
$n\gamma$	0.003–0.17 %	557
$n\gamma$, helicity=1/2	0.003–0.17 %	557

$N(1675)$ D_{15}

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

Breit-Wigner mass = 1670 to 1685 ($\approx$ 1675) MeV
Breit-Wigner full width = 140 to 180 ($\approx$ 150) MeV
p_{beam} = 1.01 GeV/c $4\pi\lambda\!\!\!^{-2}$ = 15.4 mb
Re(pole position) = 1655 to 1665 ($\approx$ 1660) MeV
-2Im(pole position) = 125 to 155 ($\approx$ 140) MeV

$N(1675)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\pi$	40–50 %	564
$N\eta$	(0.0 $\pm$ 1.0) %	376
ΛK	<1 %	216
$N\pi\pi$	50–60 %	532
$\Delta\pi$	50–60 %	366
$N\rho$	< 1–3 %	†
$p\gamma$	0.004–0.023 %	575
$p\gamma$, helicity=1/2	0.0–0.015 %	575
$p\gamma$, helicity=3/2	0.0–0.011 %	575
$n\gamma$	0.02–0.12 %	574
$n\gamma$, helicity=1/2	0.006–0.046 %	574
$n\gamma$, helicity=3/2	0.01–0.08 %	574

$N(1680)$ F_{15}

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

Breit-Wigner mass = 1675 to 1690 ($\approx$ 1680) MeV
Breit-Wigner full width = 120 to 140 ($\approx$ 130) MeV
p_{beam} = 1.01 GeV/c $4\pi\lambda\!\!\!^{-2}$ = 15.2 mb
Re(pole position) = 1665 to 1675 ($\approx$ 1670) MeV
-2Im(pole position) = 105 to 135 ($\approx$ 120) MeV

$N(1680)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\pi$	60–70 %	568
$N\eta$	(0.0 $\pm$ 1.0) %	381
$N\pi\pi$	30–40 %	535
$\Delta\pi$	5–15 %	370
$N\rho$	3–15 %	†
$N(\pi\pi)^{I=0}_{S\text{-wave}}$	5–20 %	–

$p\gamma$	0.21–0.32 %	578
$p\gamma$, helicity=1/2	0.001–0.011 %	578
$p\gamma$, helicity=3/2	0.20–0.32 %	578
$n\gamma$	0.021–0.046 %	577
$n\gamma$, helicity=1/2	0.004–0.029 %	577
$n\gamma$, helicity=3/2	0.01–0.024 %	577

$N(1700)$ D_{13}

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

Breit-Wigner mass = 1650 to 1750 ($\approx$ 1700) MeV
Breit-Wigner full width = 50 to 150 ($\approx$ 100) MeV
p_{beam} = 1.05 GeV/c $4\pi\lambda\!\!\!^{-2}$ = 14.5 mb
Re(pole position) = 1630 to 1730 ($\approx$ 1680) MeV
-2Im(pole position) = 50 to 150 ($\approx$ 100) MeV

$N(1700)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\pi$	5–15 %	581
$N\eta$	(0.0$\pm$1.0) %	402
ΛK	<3 %	255
$N\pi\pi$	85–95 %	550
$N\rho$	<35 %	†
$p\gamma$	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

$N(1710)$ P_{11}

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

Breit-Wigner mass = 1680 to 1740 ($\approx$ 1710) MeV
Breit-Wigner full width = 50 to 250 ($\approx$ 100) MeV
p_{beam} = 1.07 GeV/c $4\pi\lambda\!\!\!^{-2}$ = 14.2 mb
Re(pole position) = 1670 to 1770 ($\approx$ 1720) MeV
-2Im(pole position) = 80 to 380 ($\approx$ 230) MeV

$N(1710)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\pi$	10–20 %	588
$N\eta$	(6.2$\pm$1.0) %	412
$N\omega$	(13.0$\pm$2.0) %	†
ΛK	5–25 %	269
$N\pi\pi$	40–90 %	557

$\Delta\pi$	15–40 %	394
$N\rho$	5–25 %	†
$N(\pi\pi)^{I=0}_{S\text{-wave}}$	10–40 %	–
$p\gamma$	0.002–0.05%	598
$p\gamma$, helicity=1/2	0.002–0.05%	598
$n\gamma$	0.0–0.02%	597
$n\gamma$, helicity=1/2	0.0–0.02%	597

$N(1720)$ P_{13}

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

Breit-Wigner mass = 1650 to 1750 (≈ 1720) MeV
Breit-Wigner full width = 100 to 200 (≈ 150) MeV
p_{beam} = 1.09 GeV/c $4\pi\lambda\!\!\!^{-2}$ = 13.9 mb
Re(pole position) = 1650 to 1750 (≈ 1700) MeV
−2Im(pole position) = 110 to 390 (≈ 250) MeV

$N(1720)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\pi$	10–20 %	594
$N\eta$	(4.0 ± 1.0) %	422
ΛK	1–15 %	283
$N\pi\pi$	>70 %	564
$N\rho$	70–85 %	71
$p\gamma$	0.003–0.10 %	604
$p\gamma$, helicity=1/2	0.003–0.08 %	604
$p\gamma$, helicity=3/2	0.001–0.03 %	604
$n\gamma$	0.002–0.39 %	603
$n\gamma$, helicity=1/2	0.0–0.002 %	603
$n\gamma$, helicity=3/2	0.001–0.39 %	603

$N(2190)$ G_{17}

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

Breit-Wigner mass = 2100 to 2200 (≈ 2190) MeV
Breit-Wigner full width = 350 to 550 (≈ 450) MeV
p_{beam} = 2.07 GeV/c $4\pi\lambda\!\!\!^{-2}$ = 6.21 mb
Re(pole position) = 1950 to 2150 (≈ 2050) MeV
−2Im(pole position) = 350 to 550 (≈ 450) MeV

$N(2190)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\pi$	10–20 %	888
$N\eta$	(0.0 ± 1.0) %	791

$N(2220)$ H_{19}

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

Breit-Wigner mass = 2180 to 2310 ($\approx$ 2220) MeV
Breit-Wigner full width = 320 to 550 ($\approx$ 400) MeV
p_{beam} = 2.14 GeV/c $4\pi\lambda\!\!\!^{-2}$ = 5.97 mb
Re(pole position) = 2100 to 2240 ($\approx$ 2170) MeV
-2Im(pole position) = 370 to 570 ($\approx$ 470) MeV

$N(2220)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\pi$	10–20 %	906

$N(2250)$ G_{19}

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

Breit-Wigner mass = 2170 to 2310 ($\approx$ 2250) MeV
Breit-Wigner full width = 290 to 470 ($\approx$ 400) MeV
p_{beam} = 2.21 GeV/c $4\pi\lambda\!\!\!^{-2}$ = 5.74 mb
Re(pole position) = 2080 to 2200 ($\approx$ 2140) MeV
-2Im(pole position) = 280 to 680 ($\approx$ 480) MeV

$N(2250)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\pi$	5–15 %	924

$N(2600)$ $I_{1,11}$

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

Breit-Wigner mass = 2550 to 2750 ($\approx$ 2600) MeV
Breit-Wigner full width = 500 to 800 ($\approx$ 650) MeV
p_{beam} = 3.12 GeV/c $4\pi\lambda\!\!\!^{-2}$ = 3.86 mb

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

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 = 931.494043 ± 0.000080 MeV, is less well known than are the masses in u.

[*b*] These two results are not independent, and both use the more precise measurement of $\left|q_{\overline{p}}/m_{\overline{p}}\right|/(q_p/m_p)$.

[*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 first limit is for $p \rightarrow$ 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 $\tau_{\overline{p}}/\mathrm{B}(\overline{p} \rightarrow e^- \gamma) > 7 \times 10^5$ yr.

[*e*] 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.

[*f*] 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.

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

[*h*] This limit is for γ energies between 35 and 100 keV.