

# 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  $m = 1.00727646688 \pm 0.00000000013$  u

Mass  $m = 938.27200 \pm 0.00004$  MeV [a]

$$|m_p - m_{\bar{p}}|/m_p < 6 \times 10^{-8}, \text{ CL} = 90\% [b]$$

$$|\frac{q_{\bar{p}}}{m_{\bar{p}}}|/(\frac{q_p}{m_p}) = 0.99999999991 \pm 0.00000000009$$

$$|q_p + q_{\bar{p}}|/e < 6 \times 10^{-8}, \text{ CL} = 90\% [b]$$

$$|q_p + q_e|/e < 1.0 \times 10^{-21} [c]$$

Magnetic moment  $\mu = 2.792847337 \pm 0.000000029$   $\mu_N$

$$(\mu_p + \mu_{\bar{p}}) / \mu_p = (-2.6 \pm 2.9) \times 10^{-3}$$

Electric dipole moment  $d = (-4 \pm 6) \times 10^{-23}$  e cm

Electric polarizability  $\bar{\alpha} = (12.0 \pm 0.7) \times 10^{-4}$  fm<sup>3</sup>

Magnetic polarizability  $\bar{\beta} = (1.6 \pm 0.6) \times 10^{-4}$  fm<sup>3</sup>

Charge radius =  $0.870 \pm 0.008$  fm

Mean life  $\tau > 1.6 \times 10^{25}$  years (independent of mode)

$> 10^{31}$  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  $\tau/B_i$ , where  $\tau$  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.

<b>p DECAY MODES</b>	Partial mean life ( $10^{30}$ years)	Confidence level	$p$ (MeV/c)
<b>Antilepton + meson</b>			
$N \rightarrow e^+ \pi$	$> 158$ ( $n$ ), $> 1600$ ( $p$ )	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%	296
$n \rightarrow \nu \eta$	$> 158$	90%	310
$N \rightarrow e^+ \rho$	$> 217$ ( $n$ ), $> 75$ ( $p$ )	90%	153
$N \rightarrow \mu^+ \rho$	$> 228$ ( $n$ ), $> 110$ ( $p$ )	90%	119
$N \rightarrow \nu \rho$	$> 19$ ( $n$ ), $> 162$ ( $p$ )	90%	153
$p \rightarrow e^+ \omega$	$> 107$	90%	142

$p \rightarrow \mu^+ \omega$	> 117	90%	104
$n \rightarrow \nu \omega$	> 108	90%	144
$N \rightarrow e^+ K$	> 17 ( $n$ ), > 150 ( $p$ )	90%	337
$p \rightarrow e^+ K_S^0$	> 120	90%	337
$p \rightarrow e^+ K_L^0$	> 51	90%	337
$N \rightarrow \mu^+ K$	> 26 ( $n$ ), > 120 ( $p$ )	90%	326
$p \rightarrow \mu^+ K_S^0$	> 150	90%	326
$p \rightarrow \mu^+ K_L^0$	> 83	90%	326
$N \rightarrow \nu K$	> 86 ( $n$ ), > 670 ( $p$ )	90%	339
$n \rightarrow \nu K_S^0$	> 51	90%	–
$p \rightarrow e^+ K^*(892)^0$	> 84	90%	45
$N \rightarrow \nu K^*(892)$	> 78 ( $n$ ), > 51 ( $p$ )	90%	45

### Antilepton + mesons

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

### Lepton + meson

$n \rightarrow e^- \pi^+$	> 65	90%	459
$n \rightarrow \mu^- \pi^+$	> 49	90%	453
$n \rightarrow e^- \rho^+$	> 62	90%	154
$n \rightarrow \mu^- \rho^+$	> 7	90%	120
$n \rightarrow e^- K^+$	> 32	90%	340
$n \rightarrow \mu^- K^+$	> 57	90%	330

### Lepton + mesons

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

### Antilepton + photon(s)

$p \rightarrow e^+ \gamma$	> 670	90%	469
$p \rightarrow \mu^+ \gamma$	> 478	90%	463
$n \rightarrow \nu \gamma$	> 28	90%	470
$p \rightarrow e^+ \gamma \gamma$	> 100	90%	469
$n \rightarrow \nu \gamma \gamma$	> 219	90%	470

### Three (or more) leptons

$p \rightarrow e^+ e^+ e^-$	> 793	90%	469
$p \rightarrow e^+ \mu^+ \mu^-$	> 359	90%	457
$p \rightarrow e^+ \nu \nu$	> 17	90%	469
$n \rightarrow e^+ e^- \nu$	> 257	90%	470
$n \rightarrow \mu^+ e^- \nu$	> 83	90%	464
$n \rightarrow \mu^+ \mu^- \nu$	> 79	90%	458
$p \rightarrow \mu^+ e^+ e^-$	> 529	90%	464
$p \rightarrow \mu^+ \mu^+ \mu^-$	> 675	90%	439
$p \rightarrow \mu^+ \nu \nu$	> 21	90%	463
$p \rightarrow e^- \mu^+ \mu^+$	> 6	90%	457
$n \rightarrow 3\nu$	> 0.0005	90%	470
$n \rightarrow 5\nu$	—	—	—

### Inclusive modes

$N \rightarrow e^+$ anything	> 0.6 ( $n, p$ )	90%	—
$N \rightarrow \mu^+$ anything	> 12 ( $n, p$ )	90%	—
$N \rightarrow \nu$ anything	—	—	—
$N \rightarrow e^+ \pi^0$ anything	> 0.6 ( $n, p$ )	90%	—
$N \rightarrow 2$ bodies, $\nu$ -free	—	—	—

### $\Delta B = 2$ dinucleon modes

The following are lifetime limits per iron nucleus.

$pp \rightarrow \pi^+ \pi^+$	> 0.7	90%	—
$pn \rightarrow \pi^+ \pi^0$	> 2	90%	—
$nn \rightarrow \pi^+ \pi^-$	> 0.7	90%	—
$nn \rightarrow \pi^0 \pi^0$	> 3.4	90%	—
$pp \rightarrow e^+ e^+$	> 5.8	90%	—
$pp \rightarrow e^+ \mu^+$	> 3.6	90%	—
$pp \rightarrow \mu^+ \mu^+$	> 1.7	90%	—
$pn \rightarrow e^+ \bar{\nu}$	> 2.8	90%	—
$pn \rightarrow \mu^+ \bar{\nu}$	> 1.6	90%	—
$nn \rightarrow \nu_e \bar{\nu}_e$	> 0.000012	90%	—
$nn \rightarrow \nu_\mu \bar{\nu}_\mu$	> 0.000006	90%	—
$pp \rightarrow$ neutrinos	> 0.00000055	90%	—

## $\bar{p}$ DECAY MODES

$\bar{p}$ DECAY MODES	Partial mean life (years)	Confidence level	$p$ (MeV/c)
$\bar{p} \rightarrow e^- \gamma$	$> 7 \times 10^5$	90%	469
$\bar{p} \rightarrow \mu^- \gamma$	$> 5 \times 10^4$	90%	463
$\bar{p} \rightarrow e^- \pi^0$	$> 4 \times 10^5$	90%	459
$\bar{p} \rightarrow \mu^- \pi^0$	$> 5 \times 10^4$	90%	453
$\bar{p} \rightarrow e^- \eta$	$> 2 \times 10^4$	90%	309
$\bar{p} \rightarrow \mu^- \eta$	$> 8 \times 10^3$	90%	296
$\bar{p} \rightarrow e^- K_S^0$	$> 900$	90%	337
$\bar{p} \rightarrow \mu^- K_S^0$	$> 4 \times 10^3$	90%	326
$\bar{p} \rightarrow e^- K_L^0$	$> 9 \times 10^3$	90%	337
$\bar{p} \rightarrow \mu^- K_L^0$	$> 7 \times 10^3$	90%	326
$\bar{p} \rightarrow e^- \gamma \gamma$	$> 2 \times 10^4$	90%	469
$\bar{p} \rightarrow \mu^- \gamma \gamma$	$> 2 \times 10^4$	90%	463
$\bar{p} \rightarrow e^- \rho$	—		153
$\bar{p} \rightarrow e^- \omega$	$> 200$	90%	142
$\bar{p} \rightarrow e^- K^*(892)^0$	—		141

**n**

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

Mass  $m = 1.0086649158 \pm 0.0000000006$  u

Mass  $m = 939.56533 \pm 0.00004$  MeV [a]

$m_n - m_p = 1.2933318 \pm 0.0000005$  MeV  
 $= 0.0013884489 \pm 0.0000000006$  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  $\langle r_n^2 \rangle = -0.1161 \pm 0.0022$   
 $\text{fm}^2$  (S = 1.3)

Electric polarizability  $\alpha = (9.8_{-2.3}^{+1.9}) \times 10^{-4}$  fm<sup>3</sup> (S = 1.1)

Charge  $q = (-0.4 \pm 1.1) \times 10^{-21}$  e

Mean  $n\bar{n}$ -oscillation time  $> 8.6 \times 10^7$  s, CL = 90% (free  $n$ )  
 $> 1.2 \times 10^8$  s, CL = 90% [e] (bound  $n$ )

**Decay parameters [f]**

$p e^- \bar{\nu}_e$   $\lambda \equiv g_A / g_V = -1.2670 \pm 0.0030$  (S = 1.6)

"  $A = -0.1162 \pm 0.0013$  (S = 1.8)

"  $B = 0.983 \pm 0.004$

"  $a = -0.102 \pm 0.005$

"  $\phi_{AV} = (180.08 \pm 0.10)^\circ$  [g]

"  $D = (-0.6 \pm 1.0) \times 10^{-3}$

<b>n DECAY MODES</b>	Fraction ( $\Gamma_i/\Gamma$ )	Confidence level	$\frac{p}{\text{MeV}/c}$
$p e^- \bar{\nu}_e$	100 %		1.19
<b>Charge conservation (Q) violating mode</b>			
$p \nu_e \bar{\nu}_e$	$Q < 8 \times 10^{-27}$	68%	1.29

**$N(1440) P_{11}$** 

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

Breit-Wigner mass = 1430 to 1470 ( $\approx 1440$ ) MeVBreit-Wigner full width = 250 to 450 ( $\approx 350$ ) MeV

$$p_{\text{beam}} = 0.61 \text{ GeV}/c \quad 4\pi\lambda^2 = 31.0 \text{ mb}$$

Re(pole position) = 1345 to 1385 ( $\approx 1365$ ) MeV $-2\text{Im}(\text{pole position}) = 160$  to 260 ( $\approx 210$ ) MeV

<b><math>N(1440)</math> DECAY MODES</b>	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$N\pi$	60–70 %	397
$N\pi\pi$	30–40 %	342
$\Delta\pi$	20–30 %	143
$N\rho$	<8 %	†
$N(\pi\pi)_{S\text{-wave}}^{I=0}$	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 ( $\approx 1520$ ) MeVBreit-Wigner full width = 110 to 135 ( $\approx 120$ ) MeV

$$p_{\text{beam}} = 0.74 \text{ GeV}/c \quad 4\pi\lambda^2 = 23.5 \text{ mb}$$

Re(pole position) = 1505 to 1515 ( $\approx 1510$ ) MeV $-2\text{Im}(\text{pole position}) = 110$  to 120 ( $\approx 115$ ) MeV

<b><math>N(1520)</math> DECAY MODES</b>	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$N\pi$	50–60 %	456
$N\eta$	(0.0 $\pm$ 1.0) %	149
$N\pi\pi$	40–50 %	410
$\Delta\pi$	15–25 %	228
$N\rho$	15–25 %	†
$N(\pi\pi)_{S\text{-wave}}^{I=0}$	<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  
 $p_{\text{beam}} = 0.76 \text{ GeV}/c$        $4\pi\lambda^2 = 22.5 \text{ mb}$   
 Re(pole position) = 1495 to 1515 ( $\approx 1505$ ) MeV  
 $-2\text{Im}(\text{pole position}) = 90 \text{ to } 250$  ( $\approx 170$ ) MeV

<b><math>N(1535)</math> DECAY MODES</b>	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$N\pi$	35–55 %	467
$N\eta$	30–55 %	182
$N\pi\pi$	1–10 %	422
$\Delta\pi$	<1 %	242
$N\rho$	<4 %	†
$N(\pi\pi)_{S\text{-wave}}^{I=0}$	<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  
 $p_{\text{beam}} = 0.96 \text{ GeV}/c$        $4\pi\lambda^2 = 16.4 \text{ mb}$   
 Re(pole position) = 1640 to 1680 ( $\approx 1660$ ) MeV  
 $-2\text{Im}(\text{pole position}) = 150 \text{ to } 170$  ( $\approx 160$ ) MeV

<b><math>N(1650)</math> DECAY MODES</b>	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$N\pi$	55–90 %	547
$N\eta$	3–10 %	346
$\Lambda K$	3–11 %	161
$N\pi\pi$	10–20 %	511
$\Delta\pi$	1–7 %	344
$N\rho$	4–12 %	†
$N(\pi\pi)_{S\text{-wave}}^{I=0}$	<4 %	–
$N(1440)\pi$	<5 %	147
$p\gamma$	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  
 $p_{\text{beam}} = 1.01 \text{ GeV}/c$        $4\pi\lambda^2 = 15.4 \text{ mb}$   
 Re(pole position) = 1655 to 1665 ( $\approx 1660$ ) MeV  
 $-2\text{Im}(\text{pole position}) = 125 \text{ to } 155$  ( $\approx 140$ ) MeV

<b><math>N(1675)</math> DECAY MODES</b>	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$N\pi$	40–50 %	563
$N\eta$	$(0.0 \pm 1.0)$ %	374
$\Lambda K$	<1 %	209
$N\pi\pi$	50–60 %	529
$\Delta\pi$	50–60 %	364
$N\rho$	< 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  
 $p_{\text{beam}} = 1.01 \text{ GeV}/c$        $4\pi\lambda^2 = 15.2 \text{ mb}$   
 Re(pole position) = 1665 to 1675 ( $\approx 1670$ ) MeV  
 $-2\text{Im}(\text{pole position}) = 105 \text{ to } 135$  ( $\approx 120$ ) MeV

<b><math>N(1680)</math> DECAY MODES</b>	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$N\pi$	60–70 %	567
$N\eta$	( $0.0 \pm 1.0$ ) %	379
$N\pi\pi$	30–40 %	532
$\Delta\pi$	5–15 %	369
$N\rho$	3–15 %	†
$N(\pi\pi)_{S\text{-wave}}^{I=0}$	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 ( $\approx 1700$ ) MeVBreit-Wigner full width = 50 to 150 ( $\approx 100$ ) MeV

$$p_{\text{beam}} = 1.05 \text{ GeV}/c \quad 4\pi\lambda^2 = 14.5 \text{ mb}$$

Re(pole position) = 1630 to 1730 ( $\approx 1680$ ) MeV $-2\text{Im}(\text{pole position}) = 50 \text{ to } 150$  ( $\approx 100$ ) MeV

<b><math>N(1700)</math> DECAY MODES</b>	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$N\pi$	5–15 %	580
$N\eta$	$(0.0 \pm 1.0)$ %	400
$\Lambda K$	<3 %	250
$N\pi\pi$	85–95 %	547
$N\rho$	<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 ( $\approx 1710$ ) MeVBreit-Wigner full width = 50 to 250 ( $\approx 100$ ) MeV

$$p_{\text{beam}} = 1.07 \text{ GeV}/c \quad 4\pi\lambda^2 = 14.2 \text{ mb}$$

Re(pole position) = 1670 to 1770 ( $\approx 1720$ ) MeV $-2\text{Im}(\text{pole position}) = 80 \text{ to } 380$  ( $\approx 230$ ) MeV

<b><math>N(1710)</math> DECAY MODES</b>	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$N\pi$	10–20 %	587
$N\eta$	$(6.0 \pm 1.0)$ %	410
$\Lambda K$	5–25 %	264
$N\pi\pi$	40–90 %	554
$\Delta\pi$	15–40 %	393
$N\rho$	5–25 %	48
$N(\pi\pi)_{S\text{-wave}}^{I=0}$	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 ( $\approx 1720$ ) MeV  
 Breit-Wigner full width = 100 to 200 ( $\approx 150$ ) MeV  
 $p_{\text{beam}} = 1.09 \text{ GeV}/c$        $4\pi\lambda^2 = 13.9 \text{ mb}$   
 Re(pole position) = 1650 to 1750 ( $\approx 1700$ ) MeV  
 $-2\text{Im}(\text{pole position}) = 110 \text{ to } 390$  ( $\approx 250$ ) MeV

<b><math>N(1720)</math> DECAY MODES</b>	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$N\pi$	10–20 %	594
$N\eta$	$(4.0 \pm 1.0)$ %	420
$\Lambda K$	1–15 %	278
$N\pi\pi$	>70 %	561
$N\rho$	70–85 %	104
$p\gamma$	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 ( $\approx 2190$ ) MeV  
 Breit-Wigner full width = 350 to 550 ( $\approx 450$ ) MeV  
 $p_{\text{beam}} = 2.07 \text{ GeV}/c$        $4\pi\lambda^2 = 6.21 \text{ mb}$   
 Re(pole position) = 1950 to 2150 ( $\approx 2050$ ) MeV  
 $-2\text{Im}(\text{pole position}) = 350 \text{ to } 550$  ( $\approx 450$ ) MeV

<b><math>N(2190)</math> DECAY MODES</b>	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$N\pi$	10–20 %	888
$N\eta$	$(0.0 \pm 1.0)$ %	790

**$N(2220) H_{19}$**

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

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

<b><math>N(2220)</math> DECAY MODES</b>	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$N\pi$	10–20 %	905

**$N(2250) G_{19}$**

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

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

<b><math>N(2250)</math> DECAY MODES</b>	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$N\pi$	5–15 %	923

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

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

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

<b><math>N(2600)</math> DECAY MODES</b>	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$N\pi$	5–10 %	1126