

Δ BARYONS $(S = 0, I = 3/2)$

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

$\Delta(1232) \ 3/2^+$

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

Breit-Wigner mass (mixed charges) = 1230 to 1234 (≈ 1232) MeV

Breit-Wigner full width (mixed charges) = 114 to 120 (≈ 117) MeV

$$p_{\text{beam}} = 0.30 \text{ GeV}/c \quad 4\pi\chi^2 = 94.8 \text{ mb}$$

Re(pole position) = 1209 to 1211 (≈ 1210) MeV

$-2\text{Im}(\text{pole position}) = 98 \text{ to } 102$ (≈ 100) MeV

$\Delta(1232)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\pi$	100 %	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

$\Delta(1600) \ 3/2^+$

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

Breit-Wigner mass = 1500 to 1700 (≈ 1600) MeV

Breit-Wigner full width = 220 to 420 (≈ 320) MeV

$$p_{\text{beam}} = 0.87 \text{ GeV}/c \quad 4\pi\chi^2 = 18.6 \text{ mb}$$

Re(pole position) = 1460 to 1560 (≈ 1510) MeV

$-2\text{Im}(\text{pole position}) = 200 \text{ to } 350$ (≈ 275) MeV

$\Delta(1600)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\pi$	10–25 %	513
$N\pi\pi$	75–90 %	477
$\Delta\pi$	40–70 %	303
$N\rho$	<25 %	†
$N(1440)\pi$	10–35 %	82
$N\gamma$	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

$\Delta(1620) \ 1/2^-$

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

Breit-Wigner mass = 1600 to 1660 (≈ 1630) MeVBreit-Wigner full width = 130 to 150 (≈ 140) MeV

$$p_{\text{beam}} = 0.93 \text{ GeV}/c \quad 4\pi\chi^2 = 17.2 \text{ mb}$$

Re(pole position) = 1590 to 1610 (≈ 1600) MeV $-2\text{Im}(\text{pole position}) = 120 \text{ to } 140$ (≈ 130) MeV

$\Delta(1620)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\pi$	20–30 %	534
$N\pi\pi$	70–80 %	499
$\Delta\pi$	30–60 %	328
$N\rho$	7–25 %	†
$N\gamma$	0.03–0.10 %	545
$N\gamma$, helicity=1/2	0.03–0.10 %	545

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

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

Breit-Wigner mass = 1670 to 1750 (≈ 1700) MeVBreit-Wigner full width = 200 to 400 (≈ 300) MeV

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

Re(pole position) = 1620 to 1680 (≈ 1650) MeV $-2\text{Im}(\text{pole position}) = 160 \text{ to } 300$ (≈ 230) MeV

$\Delta(1700)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\pi$	10–20 %	581
$N\pi\pi$	80–90 %	550
$\Delta\pi$	30–60 %	386
$\Delta(1232)\pi$, S -wave	25–50 %	386
$\Delta(1232)\pi$, D -wave	5–15 %	386
$N\rho$	30–55 %	†
$N\rho$, $S=3/2$, S -wave	5–20 %	†
$\Delta(1232)\eta$	(5.0 ± 2.0) %	†
$N\gamma$	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

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

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

Breit-Wigner mass = 1855 to 1910 (≈ 1880) MeVBreit-Wigner full width = 270 to 400 (≈ 330) MeV

$$p_{\text{beam}} = 1.40 \text{ GeV}/c \quad 4\pi\chi^2 = 10.1 \text{ mb}$$

Re(pole position) = 1805 to 1835 (≈ 1820) MeV $-2\text{Im}(\text{pole position}) = 265 \text{ to } 300$ (≈ 280) MeV

$\Delta(1905)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\pi$	9–15 %	698
$N\pi\pi$	85–95 %	673
$\Delta\pi$	<25 %	524
$N\rho$	>60 %	385
$N\gamma$	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

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

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

Breit-Wigner mass = 1860 to 1910 (≈ 1890) MeVBreit-Wigner full width = 220 to 340 (≈ 280) MeV

$$p_{\text{beam}} = 1.42 \text{ GeV}/c \quad 4\pi\chi^2 = 9.89 \text{ mb}$$

Re(pole position) = 1830 to 1880 (≈ 1855) MeV $-2\text{Im}(\text{pole position}) = 200 \text{ to } 500$ (≈ 350) MeV

$\Delta(1910)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\pi$	15–30 %	704
ΣK	(9 ± 5) %	400
$\Delta\pi$	(60 ± 28) %	531
$N\gamma$	0.0–0.02 %	712
$N\gamma$, helicity=1/2	0.0–0.02 %	712

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

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

Breit-Wigner mass = 1900 to 1970 (≈ 1920) MeVBreit-Wigner full width = 180 to 300 (≈ 260) MeV

$$p_{\text{beam}} = 1.48 \text{ GeV}/c \quad 4\pi\chi^2 = 9.37 \text{ mb}$$

Re(pole position) = 1850 to 1950 (≈ 1900) MeV $-2\text{Im}(\text{pole position}) = 200 \text{ to } 400$ (≈ 300) MeV

$\Delta(1920)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\pi$	5–20 %	723
ΣK	(2.14 ± 0.30) %	431
$\Delta(1232)\eta$	(15 ± 8) %	336
$N\gamma$	0.0–0.4 %	731
$N\gamma$, helicity=1/2	0.0–0.2 %	731
$N\gamma$, helicity=3/2	0.0–0.2 %	731

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

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

Breit-Wigner mass = 1900 to 2000 (≈ 1950) MeVBreit-Wigner full width = 220 to 500 (≈ 360) MeV

$$p_{\text{beam}} = 1.54 \text{ GeV}/c \quad 4\pi\chi^2 = 8.91 \text{ mb}$$

Re(pole position) = 1840 to 1960 (≈ 1900) MeV $-2\text{Im}(\text{pole position}) = 175 \text{ to } 360$ (≈ 270) MeV

$\Delta(1930)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\pi$	5–15 %	742
$N\gamma$	0.0–0.02 %	749
$N\gamma$, helicity=1/2	0.0–0.01 %	749
$N\gamma$, helicity=3/2	0.0–0.01 %	749

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

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

Breit-Wigner mass = 1915 to 1950 (≈ 1930) MeVBreit-Wigner full width = 235 to 335 (≈ 285) MeV

$$p_{\text{beam}} = 1.50 \text{ GeV}/c \quad 4\pi\chi^2 = 9.21 \text{ mb}$$

Re(pole position) = 1870 to 1890 (≈ 1880) MeV $-2\text{Im}(\text{pole position}) = 220 \text{ to } 260$ (≈ 240) MeV

$\Delta(1950)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\pi$	35–45 %	729
$N\pi\pi$		706
$\Delta\pi$	20–30 %	560
$N\rho$	<10 %	442
$N\gamma$	0.08–0.13 %	737
$N\gamma$, helicity=1/2	0.03–0.055 %	737
$N\gamma$, helicity=3/2	0.05–0.075 %	737

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

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

Breit-Wigner mass = 2300 to 2500 (≈ 2420) MeV

Breit-Wigner full width = 300 to 500 (≈ 400) MeV

$$p_{\text{beam}} = 2.64 \text{ GeV}/c \quad 4\pi\tilde{\chi}^2 = 4.68 \text{ mb}$$

Re(pole position) = 2260 to 2400 (≈ 2330) MeV

–2Im(pole position) = 350 to 750 (≈ 550) MeV

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