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

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

OMITTED FROM SUMMARY TABLE

Δ(1940) POLE POSITION

REAL PART

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
1850 to 2050 (≈ 1950) OUR ESTIMATE				
2040± 50	SOKHOYAN	15A	DPWA	Multichannel
1878± 11±5.5	[1] SVARC	14	L+P	$\pi N \to \pi N$
1900±100	CUTKOSKY	80	IPWA	$\pi N \to \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
2139	HUNT	19	DPWA	Multichannel
2040± 50	GUTZ	14	DPWA	Multichannel
1990^{+100}_{-50}	ANISOVICH	12A	DPWA	Multichannel

[1] Fit to the amplitudes of HOEHLER 79.

−2×IMAGINARY PART

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
200 to 500 (≈ 350) OUR ESTIMATE				
450±90	SOKHOYAN	15A	DPWA	Multichannel
212±21±6	[1] SVARC	14	L+P	$\pi N \to \pi N$
200±60	CUTKOSKY	80	IPWA	$\pi N \to \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
400	HUNT	19	DPWA	Multichannel
450±90	GUTZ	14	DPWA	Multichannel
450±90	ANISOVICH	12A	DPWA	Multichannel

[1] Fit to the amplitudes of HOEHLER 79.

Δ(1940) ELASTIC POLE RESIDUE

MODULUS $|r|$

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
4 to 10 (≈ 7) OUR ESTIMATE				
6±3	SOKHOYAN	15A	DPWA	Multichannel
9±1±1	[1] SVARC	14	L+P	$\pi N \to \pi N$
8±3	CUTKOSKY	80	IPWA	$\pi N \to \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
4±3	GUTZ	14	DPWA	Multichannel
4±4	ANISOVICH	12A	DPWA	Multichannel

[1] Fit to the amplitudes of HOEHLER 79.

PHASE θ

VALUE (°)	DOCUMENT ID		TECN	COMMENT
150 to 250 (≈ 200) OUR ESTIMATE				
− 90±35	SOKHOYAN	15A	DPWA	Multichannel
140± 7±7	[1] SVARC	14	L+P	$\pi N \to \pi N$
135±45	CUTKOSKY	80	IPWA	$\pi N \to \pi N$

• • • We do not use the following data for averages, fits, limits, etc. • • •

− 50±35	GUTZ	14	DPWA	Multichannel

[1] Fit to the amplitudes of HOEHLER 79.

Δ(1940) INELASTIC POLE RESIDUE

The "normalized residue" is the residue divided by $\Gamma_{pole}/2$.

Normalized residue in $N\pi \to \Delta(1940) \to \Delta(1232)\eta$

MODULUS	PHASE (°)	DOCUMENT ID		TECN	COMMENT
<0.01	undefined	GUTZ	14	DPWA	Multichannel

Normalized residue in $N\pi \to \Delta(1940) \to N(1535)\pi$

MODULUS	PHASE (°)	DOCUMENT ID		TECN	COMMENT
<0.03	undefined	GUTZ	14	DPWA	Multichannel

Normalized residue in $N\pi \to \Delta(1940) \to \Delta(1232)\pi$, S-wave

MODULUS	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.12±0.06	120 ± 45	SOKHOYAN	15A	DPWA	Multichannel

Normalized residue in $N\pi \to \Delta(1940) \to \Delta(1232)\pi$, D-wave

MODULUS	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.06±0.04	−80 ± 35	SOKHOYAN	15A	DPWA	Multichannel

Δ(1940) BREIT-WIGNER MASS

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
1940 to 2060 (≈ 2000) OUR ESTIMATE				
2137± 13	[1] HUNT	19	DPWA	Multichannel
2050± 40	SOKHOYAN	15A	DPWA	Multichannel
1940±100	CUTKOSKY	80	IPWA	$\pi N \to \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
2050± 40	GUTZ	14	DPWA	Multichannel
1995^{+105}_{-60}	ANISOVICH	12A	DPWA	Multichannel

[1] Statistical error only.

Δ(1940) BREIT-WIGNER WIDTH

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
300 to 500 (≈ 400) OUR ESTIMATE				
400± 43	[1] HUNT	19	DPWA	Multichannel
450± 70	SOKHOYAN	15A	DPWA	Multichannel
200±100	CUTKOSKY	80	IPWA	$\pi N \to \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
450± 70	GUTZ	14	DPWA	Multichannel
450±100	ANISOVICH	12A	DPWA	Multichannel

[1] Statistical error only.

$\Delta(1940)$ DECAY MODES

	Mode	Fraction (Γ_i/Γ)
Γ_1	$N\pi$	1–20 %
Γ_2	$N\pi\pi$	>81 %
Γ_3	$\Delta(1232)\pi$	6–85 %
Γ_4	$\Delta(1232)\pi$, S-wave	1–65 %
Γ_5	$\Delta(1232)\pi$, D-wave	5–20 %
Γ_6	$N\rho$, S=3/2 , S-wave	75–85 %
Γ_7	$N(1535)\pi$	2–14 %
Γ_8	$N a_0(980)$	seen
Γ_9	$\Delta(1232)\eta$	4–16 %
Γ_{10}	$N\gamma$	0.06–2.53 %
Γ_{11}	$N\gamma$, helicity=1/2	0.06–1.51 %
Γ_{12}	$N\gamma$, helicity=3/2	0–1.02 %

$\Delta(1940)$ BRANCHING RATIOS

$\Gamma(N\pi)/\Gamma_{total}$ — Γ_1/Γ

VALUE (%)	DOCUMENT ID		TECN	COMMENT
1–20 % OUR ESTIMATE				
16±4	[1] HUNT	19	DPWA	Multichannel
2±1	SOKHOYAN	15A	DPWA	Multichannel
5±2	CUTKOSKY	80	IPWA	$\pi N \to \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
2±1	GUTZ	14	DPWA	Multichannel

[1] Statistical error only.

$\Gamma(\Delta(1232)\pi$, S-wave$)/\Gamma_{total}$ — Γ_4/Γ

VALUE (%)	DOCUMENT ID		TECN	COMMENT
1–65 % OUR ESTIMATE				
< 0.9	[1] HUNT	19	DPWA	Multichannel
46 ±20	SOKHOYAN	15A	DPWA	Multichannel

[1] Statistical error only.

$\Gamma(\Delta(1232)\pi$, D-wave$)/\Gamma_{total}$ — Γ_5/Γ

VALUE (%)	DOCUMENT ID		TECN	COMMENT
5–20 % OUR ESTIMATE				
< 6.3	[1] HUNT	19	DPWA	Multichannel
12 ±7	SOKHOYAN	15A	DPWA	Multichannel

[1] Statistical error only.

$\Gamma(N\rho$, S=3/2 , S-wave$)/\Gamma_{total}$ — Γ_6/Γ

VALUE (%)	DOCUMENT ID		TECN	COMMENT
75–85 % OUR ESTIMATE				
80±5	[1] HUNT	19	DPWA	Multichannel

[1] Statistical error only.

$\Gamma(N(1535)\pi)/\Gamma_{total}$ Γ_7/Γ

VALUE (%)	DOCUMENT ID		TECN	COMMENT
2–14 % OUR ESTIMATE				
8 ± 6	GUTZ	14	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
2 ± 1	HORN	08A	DPWA	Multichannel

$\Gamma(N a_0(980))/\Gamma_{total}$ Γ_8/Γ

VALUE (%)	DOCUMENT ID		TECN	COMMENT
seen OUR ESTIMATE				
• • • We do not use the following data for averages, fits, limits, etc. • • •				
2 ± 1	HORN	08A	DPWA	Multichannel

$\Gamma(\Delta(1232)\eta)/\Gamma_{total}$ Γ_9/Γ

VALUE (%)	DOCUMENT ID		TECN	COMMENT
4–16 % OUR ESTIMATE				
10 ± 6	GUTZ	14	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
4 ± 2	HORN	08A	DPWA	Multichannel

$\Delta(1940)$ PHOTON DECAY AMPLITUDES AT THE POLE

$\Delta(1940) \rightarrow N\gamma$, helicity-1/2 amplitude $A_{1/2}$

MODULUS (GeV$^{-1/2}$)	PHASE (°)	DOCUMENT ID		TECN	COMMENT
$0.170^{+0.120}_{-0.100}$	-10 ± 30	SOKHOYAN	15A	DPWA	Multichannel

$\Delta(1940) \rightarrow N\gamma$, helicity-3/2 amplitude $A_{3/2}$

MODULUS (GeV$^{-1/2}$)	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.150 ± 0.080	-10 ± 30	SOKHOYAN	15A	DPWA	Multichannel

$\Delta(1940)$ BREIT-WIGNER PHOTON DECAY AMPLITUDES

$\Delta(1940) \rightarrow N\gamma$, helicity-1/2 amplitude $A_{1/2}$

VALUE (GeV$^{-1/2}$)	DOCUMENT ID		TECN	COMMENT
0.1614 ± 0.0031	[1] HUNT	19	DPWA	Multichannel
$0.170^{+0.110}_{-0.080}$	SOKHOYAN	15A	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
$0.170^{+0.110}_{-0.080}$	GUTZ	14	DPWA	Multichannel

[1] Statistical error only.

$\Delta(1940) \rightarrow N\gamma$, helicity-3/2 amplitude $A_{3/2}$

VALUE (GeV$^{-1/2}$)	DOCUMENT ID		TECN	COMMENT
-0.209 ± 0.023	[1] HUNT	19	DPWA	Multichannel
0.150 ± 0.080	SOKHOYAN	15A	DPWA	Multichannel

• • • We do not use the following data for averages, fits, limits, etc. • • •

0.150±0.080	GUTZ	14	DPWA Multichannel

[1] Statistical error only.

Δ(1940) REFERENCES

HUNT	19	PR C99 055205	B.C. Hunt, D.M. Manley	
SOKHOYAN	15A	EPJ A51 95	V. Sokhoyan *et al.*	(CBELSA/TAPS Collab.)
GUTZ	14	EPJ A50 74	E. Gutz *et al.*	(CBELSA/TAPS Collab.)
SVARC	14	PR C89 045205	A. Svarc *et al.*	(RBI Zagreb, UNI Tuzla)
ANISOVICH	12A	EPJ A48 15	A.V. Anisovich *et al.*	(BONN, PNPI)
HORN	08A	EPJ A38 173	I. Horn *et al.*	(CB-ELSA Collab.)
Also		PRL 101 202002	I. Horn *et al.*	(CB-ELSA Collab.)
CUTKOSKY	80	Toronto Conf. 19	R.E. Cutkosky *et al.*	(CMU, LBL) IJP
Also		PR D20 2839	R.E. Cutkosky *et al.*	(CMU, LBL)
HOEHLER	79	PDAT 12-1	G. Hohler *et al.*	(KARLT)