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

$I(J^P) = \frac{3}{2}(\frac{3}{2}^-)$ 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
$1878 \pm 11 \pm 5.5$	[1] SVARC	14	L+P	$\pi N \rightarrow \pi N$
1900 ± 100	CUTKOSKY	80	IPWA	$\pi N \rightarrow \pi N$
• • • 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
$212 \pm 21 \pm 6$	[1] SVARC	14	L+P	$\pi N \rightarrow \pi N$
200 ± 60	CUTKOSKY	80	IPWA	$\pi N \rightarrow \pi N$
• • • 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
$9 \pm 1 \pm 1$	[1] SVARC	14	L+P	$\pi N \rightarrow \pi N$
8 ± 3	CUTKOSKY	80	IPWA	$\pi N \rightarrow \pi N$
• • • 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
$140\pm7\pm7$	[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.

$\Delta(1940)$ 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

$\Delta(1940)$ 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.

$\Delta(1940)$ 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

$\Gamma(N\pi)/\Gamma_{\text{total}}$ 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$)/\Gamma_{\text{total}}$ 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$)/\Gamma_{\text{total}}$ 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.

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

$\Delta(1940) \to N\gamma$, 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

$\Delta(1940) \to N\gamma$, 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

$\Delta(1940) \to N\gamma$, 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.

$\Delta(1940)$ 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)