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

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

OMITTED FROM SUMMARY TABLE

$\Delta(1940)$ POLE POSITION

REAL PART

VALUE (MeV)		DOCUMENT ID		TECN	COMMENT
2040 ± 50		SOKHOYAN	15A	DPWA	Multichannel
$1878\pm 11\pm5.5$	[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. • • •					
2040 ± 50		GUTZ	14	DPWA	Multichannel
$1990^{+100}_{- 50}$		ANISOVICH	12A	DPWA	Multichannel

−2×IMAGINARY PART

VALUE (MeV)		DOCUMENT ID		TECN	COMMENT
450 ± 90		SOKHOYAN	15A	DPWA	Multichannel
$212\pm21\pm6$	[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. • • •					
450 ± 90		GUTZ	14	DPWA	Multichannel
450 ± 90		ANISOVICH	12A	DPWA	Multichannel

$\Delta(1940)$ ELASTIC POLE RESIDUE

MODULUS $|r|$

VALUE (MeV)		DOCUMENT ID		TECN	COMMENT
6 ± 3		SOKHOYAN	15A	DPWA	Multichannel
$9\pm1\pm1$	[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

PHASE θ

VALUE (°)		DOCUMENT ID		TECN	COMMENT
$-\ 90\pm35$		SOKHOYAN	15A	DPWA	Multichannel
$140\pm 7\pm7$	[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. • • •					
$-\ 50\pm35$		GUTZ	14	DPWA	Multichannel

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				
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

Δ(1940) BREIT-WIGNER WIDTH

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
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

Δ(1940) DECAY MODES

	Mode	Fraction (Γ_i/Γ)
Γ_1	$N\pi$	1–7 %
Γ_2	$N\pi\pi$	
Γ_3	$\Delta(1232)\pi$	30–85 %
Γ_4	$\Delta(1232)\pi$, *S*-wave	25–65 %
Γ_5	$\Delta(1232)\pi$, *D*-wave	5–20 %

Γ_6	$N(1535)\pi$		2–14 %
Γ_7	$N\,a_0(980)$		seen
Γ_8	$\Delta(1232)\eta$		4–16 %
Γ_9	$N\gamma$, helicity=1/2		seen
Γ_{10}	$N\gamma$, helicity=3/2		seen

$\Delta(1940)$ BRANCHING RATIOS

$\Gamma(N\pi)/\Gamma_{\text{total}}$ $\qquad\qquad\qquad\qquad\qquad\qquad\qquad$ Γ_1/Γ

VALUE (%)	DOCUMENT ID		TECN	COMMENT
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

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

VALUE (%)	DOCUMENT ID		TECN	COMMENT
46 ± 20	SOKHOYAN	15A	DPWA	Multichannel

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

VALUE (%)	DOCUMENT ID		TECN	COMMENT
12 ± 7	SOKHOYAN	15A	DPWA	Multichannel

$\Gamma(N(1535)\pi)/\Gamma_{\text{total}}$ $\qquad\qquad\qquad\qquad\qquad\qquad$ Γ_6/Γ

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

$\Gamma(N\,a_0(980))/\Gamma_{\text{total}}$ $\qquad\qquad\qquad\qquad\qquad\qquad$ Γ_7/Γ

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

$\Gamma(\Delta(1232)\eta)/\Gamma_{\text{total}}$ $\qquad\qquad\qquad\qquad\qquad\qquad$ Γ_8/Γ

VALUE (%)	DOCUMENT ID		TECN	COMMENT
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

$\Delta(1940) \rightarrow N\gamma$, 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
$0.170^{+0.110}_{-0.080}$	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

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

VALUE (GeV$^{-1/2}$)	DOCUMENT ID		TECN	COMMENT
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

$\Delta(1940)$ FOOTNOTES

[1] Fit to the amplitudes of HOEHLER 79.

$\Delta(1940)$ REFERENCES

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.*	
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)