

$\Delta(1940) 3/2^-$ $I(J^P) = \frac{3}{2}(\frac{3}{2}^-)$ Status: **

OMITTED FROM SUMMARY TABLE

The latest GWU analysis (ARNDT 06) finds no evidence for this resonance.

 $\Delta(1940)$ BREIT-WIGNER MASS

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
1940 to 2060 (≈ 2000) OUR ESTIMATE			
1995 $+^{105}$ $-_{60}$	ANISOVICH	12A DPWA	Multichannel
2057 ± 110	MANLEY	92 IPWA	$\pi N \rightarrow \pi N$ & $N\pi\pi$
2058.1 ± 34.5	CHEW	80 BPWA	$\pi^+ p \rightarrow \pi^+ p$
1940 ± 100	CUTKOSKY	80 IPWA	$\pi N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
1990 ± 40	HORN	08A DPWA	Multichannel

 $\Delta(1940)$ BREIT-WIGNER WIDTH

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
450 ± 100	ANISOVICH	12A DPWA	Multichannel
460 ± 320	MANLEY	92 IPWA	$\pi N \rightarrow \pi N$ & $N\pi\pi$
198.4 ± 45.5	CHEW	80 BPWA	$\pi^+ p \rightarrow \pi^+ p$
200 ± 100	CUTKOSKY	80 IPWA	$\pi N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
410 ± 70	HORN	08A DPWA	Multichannel

 $\Delta(1940)$ POLE POSITION**REAL PART**

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
1990 $+^{100}$ $-_{50}$	ANISOVICH	12A DPWA	Multichannel
1900 ± 100	CUTKOSKY	80 IPWA	$\pi N \rightarrow \pi N$
1915 or 1926	¹ LONGACRE	78 IPWA	$\pi N \rightarrow N\pi\pi$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
1985 ± 30	HORN	08A DPWA	Multichannel

-2xIMAGINARY PART

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
450 ± 90	ANISOVICH	12A DPWA	Multichannel
200 ± 60	CUTKOSKY	80 IPWA	$\pi N \rightarrow \pi N$
190 or 186	¹ LONGACRE	78 IPWA	$\pi N \rightarrow N\pi\pi$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
390 ± 50	HORN	08A DPWA	Multichannel

$\Delta(1940)$ ELASTIC POLE RESIDUE

MODULUS $|r|$

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
4 ± 4	ANISOVICH	12A	DPWA Multichannel
8 ± 3	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$

PHASE θ

<u>VALUE ($^\circ$)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
135 ± 45	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$

$\Delta(1940)$ DECAY MODES

Mode	
Γ_1	$N\pi$
Γ_2	ΣK
Γ_3	$N\pi\pi$
Γ_4	$\Delta(1232)\pi$, S-wave
Γ_5	$\Delta(1232)\pi$, D-wave
Γ_6	$N\rho$, $S=3/2$, S-wave
Γ_7	$N(1535)\pi$
Γ_8	$N a_0(980)$
Γ_9	$\Delta(1232)\eta$
Γ_{10}	$N\gamma$, helicity=1/2
Γ_{11}	$N\gamma$, helicity=3/2

$\Delta(1940)$ BRANCHING RATIOS

<u>$\Gamma(N\pi)/\Gamma_{\text{total}}$</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>	<u>Γ_1/Γ</u>
18 ± 12	MANLEY	92	IPWA $\pi N \rightarrow \pi N$ & $N\pi\pi$	
18	CHEW	80	BPWA $\pi^+ p \rightarrow \pi^+ p$	
5 ± 2	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$	
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
9 ± 4	HORN	08A	DPWA Multichannel	

<u>$(\Gamma_i \Gamma_f)^{1/2}/\Gamma_{\text{total}}$ in $N\pi \rightarrow \Delta(1940) \rightarrow \Sigma K$</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>	<u>$(\Gamma_1 \Gamma_2)^{1/2}/\Gamma$</u>
< 0.015	CANDLIN	84	DPWA $\pi^+ p \rightarrow \Sigma^+ K^+$	

<u>$(\Gamma_i \Gamma_f)^{1/2}/\Gamma_{\text{total}}$ in $N\pi \rightarrow \Delta(1940) \rightarrow \Delta(1232)\pi$, S-wave</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>	<u>$(\Gamma_1 \Gamma_4)^{1/2}/\Gamma$</u>
$+0.11 \pm 0.10$	MANLEY	92	IPWA $\pi N \rightarrow \pi N$ & $N\pi\pi$	

<u>$(\Gamma_i \Gamma_f)^{1/2}/\Gamma_{\text{total}}$ in $N\pi \rightarrow \Delta(1940) \rightarrow \Delta(1232)\pi$, D-wave</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>	<u>$(\Gamma_1 \Gamma_5)^{1/2}/\Gamma$</u>
$+0.27 \pm 0.16$	MANLEY	92	IPWA $\pi N \rightarrow \pi N$ & $N\pi\pi$	

$(\Gamma_i \Gamma_f)^{1/2} / \Gamma_{\text{total}}$ in $N\pi \rightarrow \Delta(1940) \rightarrow N\rho, S=3/2, S\text{-wave}$	$(\Gamma_1 \Gamma_6)^{1/2} / \Gamma$		
VALUE	DOCUMENT ID	TECN	COMMENT
$+0.25 \pm 0.10$	MANLEY	92	IPWA $\pi N \rightarrow \pi N$ & $N\pi\pi$

$\Gamma(N(1535)\pi) / \Gamma_{\text{total}}$	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
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$\Gamma(N a_0(980)) / \Gamma_{\text{total}}$	Γ_8 / Γ		
VALUE (%)	DOCUMENT ID	TECN	COMMENT

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

2 ± 1	HORN	08A	DPWA Multichannel
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$\Gamma(\Delta(1232)\eta) / \Gamma_{\text{total}}$	Γ_9 / Γ		
VALUE (%)	DOCUMENT ID	TECN	COMMENT

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

4 ± 2	HORN	08A	DPWA Multichannel
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$\Delta(1940)$ PHOTON DECAY AMPLITUDES

Papers on γN amplitudes predating 1981 may be found in our 2006 edition, Journal of Physics, G **33** 1 (2006).

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

VALUE ($\text{GeV}^{-1/2}$)	DOCUMENT ID	TECN	COMMENT
-0.036 ± 0.058	AWAJI	81	DPWA $\gamma N \rightarrow \pi N$
0.160 ± 0.040	HORN	08A	DPWA Multichannel

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

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

VALUE ($\text{GeV}^{-1/2}$)	DOCUMENT ID	TECN	COMMENT
-0.031 ± 0.012	AWAJI	81	DPWA $\gamma N \rightarrow \pi N$
0.110 ± 0.030	HORN	08A	DPWA Multichannel

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

$\Delta(1940)$ FOOTNOTES

¹ LONGACRE 78 values are from a search for poles in the unitarized T-matrix. The first (second) value uses, in addition to $\pi N \rightarrow N\pi\pi$ data, elastic amplitudes from a Saclay (CERN) partial-wave analysis.

Δ(1940) REFERENCES

ANISOVICH	12A	EPJ A48 15	A.V. Anisovich <i>et al.</i>	(BONN, PNPI)
HORN	08A	EPJ A38 173	I. Horn <i>et al.</i>	(CB-ELSA Collab.)
Also		PRL 101 202002	I. Horn <i>et al.</i>	(CB-ELSA Collab.)
ARNDT	06	PR C74 045205	R.A. Arndt <i>et al.</i>	(GWU)
PDG	06	JPG 33 1	W.-M. Yao <i>et al.</i>	(PDG Collab.)
MANLEY	92	PR D45 4002	D.M. Manley, E.M. Saleski	(KENT) IJP
Also		PR D30 904	D.M. Manley <i>et al.</i>	(VPI)
CANDLIN	84	NP B238 477	D.J. Candlin <i>et al.</i>	(EDIN, RAL, LOWC)
AWAJI	81	Bonn Conf. 352	N. Awaji, R. Kajikawa	(NAGO)
Also		NP B197 365	K. Fujii <i>et al.</i>	(NAGO)
CHEW	80	Toronto Conf. 123	D.M. Chew	(LBL) IJP
CUTKOSKY	80	Toronto Conf. 19	R.E. Cutkosky <i>et al.</i>	(CMU, LBL) IJP
Also		PR D20 2839	R.E. Cutkosky <i>et al.</i>	(CMU, LBL)
LONGACRE	78	PR D17 1795	R.S. Longacre <i>et al.</i>	(LBL, SLAC)
