

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

OMITTED FROM SUMMARY TABLE

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

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
1850 to 2050 (\approx 1950) OUR ESTIMATE			
2040 \pm 50	SOKHOYAN	15A	DPWA Multichannel
1878 \pm 11 \pm 5.5	¹ SVARC	14	L+P $\pi N \rightarrow \pi N$
1900 \pm 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 \pm 50	GUTZ	14	DPWA Multichannel
1990 $^{+100}_{-50}$	ANISOVICH	12A	DPWA Multichannel

¹ Fit to the amplitudes of HOEHLER 79.**-2xIMAGINARY PART**

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
200 to 500 (\approx 350) OUR ESTIMATE			
450 \pm 90	SOKHOYAN	15A	DPWA Multichannel
212 \pm 21 \pm 6	¹ SVARC	14	L+P $\pi N \rightarrow \pi N$
200 \pm 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 \pm 90	GUTZ	14	DPWA Multichannel
450 \pm 90	ANISOVICH	12A	DPWA Multichannel

¹ Fit to the amplitudes of HOEHLER 79. **$\Delta(1940)$ ELASTIC POLE RESIDUE****MODULUS $|r|$**

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

¹ Fit to the amplitudes of HOEHLER 79.**PHASE θ**

<u>VALUE ($^\circ$)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
150 to 250 (\approx 200) OUR ESTIMATE			
- 90 \pm 35	SOKHOYAN	15A	DPWA Multichannel
140 \pm 7 \pm 7	¹ SVARC	14	L+P $\pi N \rightarrow \pi N$

135±45 CUTKOSKY 80 IPWA $\pi N \rightarrow \pi N$
 ●●● We do not use the following data for averages, fits, limits, etc. ●●●
 – 50±35 GUTZ 14 DPWA Multichannel
¹Fit 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 $N\pi \rightarrow \Delta(1940) \rightarrow \Delta(1232)\eta$

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

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

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

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

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

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

<u>MODULUS</u>	<u>PHASE (°)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
0.06±0.04	–80 ± 35	SOKHOYAN	15A	DPWA Multichannel

$\Delta(1940)$ BREIT-WIGNER MASS

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
1940 to 2060 (\approx 2000) OUR ESTIMATE			
2137± 13	¹ HUNT	19	DPWA Multichannel
2050± 40	SOKHOYAN	15A	DPWA Multichannel
1940±100	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
●●● 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

¹Statistical error only.

$\Delta(1940)$ BREIT-WIGNER WIDTH

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

¹Statistical 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 $\Delta(1232)\pi$, <i>S</i> -wave	1–65 %
Γ_5 $\Delta(1232)\pi$, <i>D</i> -wave	5–20 %
Γ_6 $N\rho$, $S=3/2$, <i>S</i> -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	$\pi N \rightarrow \pi N$

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

2 ± 1	GUTZ	14	DPWA	Multichannel
-----------	------	----	------	--------------

¹Statistical error only.

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

¹Statistical error only.

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

¹Statistical error only.

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

VALUE (%) DOCUMENT ID TECN COMMENT

75–85 % OUR ESTIMATE

80 ± 5	¹ HUNT	19	DPWA	Multichannel
------------	-------------------	----	------	--------------

¹Statistical error only.

$\Gamma(N(1535)\pi)/\Gamma_{\text{total}}$ 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
-----	------	-----	-------------------

 $\Gamma(N_{a_0}(980))/\Gamma_{\text{total}}$ 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
-----	------	-----	-------------------

 $\Gamma(\Delta(1232)\eta)/\Gamma_{\text{total}}$ 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 ($\text{GeV}^{-1/2}$)	PHASE ($^\circ$)	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 ($\text{GeV}^{-1/2}$)	PHASE ($^\circ$)	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 ($\text{GeV}^{-1/2}$)	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
---	------	----	-------------------

¹Statistical error only.

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

VALUE ($\text{GeV}^{-1/2}$)	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

¹Statistical error only.

Δ(1940) REFERENCES

HUNT	19	PR C99 055205	B.C. Hunt, D.M. Manley	
SOKHOYAN	15A	EPJ A51 95	V. Sokhoyan <i>et al.</i>	(CBELSA/TAPS Collab.)
GUTZ	14	EPJ A50 74	E. Gutz <i>et al.</i>	(CBELSA/TAPS Collab.)
SVARC	14	PR C89 045205	A. Svarc <i>et al.</i>	(RBI Zagreb, UNI Tuzla)
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.)
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)
HOEHLER	79	PDAT 12-1	G. Hohler <i>et al.</i>	(KARLT)