NODE=B136

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

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

OMITTED FROM SUMMARY TABLE

$\Delta(1940)$ POLE POSITION

NODE=B136215

REAL PART

NODE=B136RE
NODE=B136RE

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
1850 to 2050 (≈ 1950) OUR ESTIMATE				→ UNCHECKED ←
2040± 40	SARANTSEV	25	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	SOKHOYAN	15A	DPWA	Multichannel
2040± 50	GUTZ	14	DPWA	Multichannel

[1] Fit to the amplitudes of HOEHLER 79.

NODE=B136RE;LINKAGE=SV

−2×IMAGINARY PART

NODE=B136IM
NODE=B136IM

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
200 to 500 (≈ 350) OUR ESTIMATE				→ UNCHECKED ←
450±50	SARANTSEV	25	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	SOKHOYAN	15A	DPWA	Multichannel
450±90	GUTZ	14	DPWA	Multichannel

[1] Fit to the amplitudes of HOEHLER 79.

NODE=B136IM;LINKAGE=SV

$\Delta(1940)$ ELASTIC POLE RESIDUE

NODE=B136220

MODULUS $|r|$

NODE=B136RER
NODE=B136RER

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
4 to 10 (≈ 7) OUR ESTIMATE				→ UNCHECKED ←
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.

NODE=B136RER;LINKAGE=SV

PHASE θ

NODE=B136IMR
NODE=B136IMR

VALUE (°)	DOCUMENT ID		TECN	COMMENT
150 to 250 (≈ 200) OUR ESTIMATE				→ UNCHECKED ←
− 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.

NODE=B136IMR;LINKAGE=SV

$\Delta(1940)$ INELASTIC POLE RESIDUE

NODE=B136240

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

NODE=B136240

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

NODE=B136RS1
NODE=B136RS1

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

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

NODE=B136RS2
NODE=B136RS2

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

OCCUR=2

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

NODE=B136RS3
NODE=B136RS3

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

NODE=B136RS4
NODE=B136RS4

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

$\Delta(1940)$ BREIT-WIGNER MASS

NODE=B136M

NODE=B136M

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
1940 to 2060 (≈ 2000) OUR ESTIMATE				→ UNCHECKED ←
2060± 40	SARANTSEV	25	DPWA	Multichannel
2137± 13	[1] HUNT	19	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	SOKHOYAN	15A	DPWA	Multichannel
2050± 40	GUTZ	14	DPWA	Multichannel

[1] Statistical error only.

NODE=B136M;LINKAGE=A

$\Delta(1940)$ BREIT-WIGNER WIDTH

NODE=B136W

NODE=B136W

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
300 to 500 (≈ 400) OUR ESTIMATE				→ UNCHECKED ←
460± 50	SARANTSEV	25	DPWA	Multichannel
400± 43	[1] HUNT	19	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	SOKHOYAN	15A	DPWA	Multichannel
450± 70	GUTZ	14	DPWA	Multichannel

[1] Statistical error only.

NODE=B136W;LINKAGE=A

$\Delta(1940)$ DECAY MODES

NODE=B136225;NODE=B136

	Mode	Fraction (Γ_i/Γ)	
Γ_1	$N\pi$	1–20 %	DESIG=1
Γ_2	$N\pi\pi$	>81 %	DESIG=5;OUR EST
Γ_3	$\Delta(1232)\pi$	(38±10) %	DESIG=17
Γ_4	$\Delta(1232)\pi$, S-wave	1–65 %	DESIG=11
Γ_5	$\Delta(1232)\pi$, D-wave	5–20 %	DESIG=12
Γ_6	$N\rho$	(24± 6) %	DESIG=20
Γ_7	$N\rho$, S=1/2	(6± 4) %	DESIG=21
Γ_8	$N\rho$, S=3/2 , S-wave	75–85 %	DESIG=19
Γ_9	$N\rho$, S=3/2 , D-wave	(8± 4) %	DESIG=22
Γ_{10}	$N(1440)\pi$	(5± 5) %	DESIG=23
Γ_{11}	$N(1520)\pi$, P-wave	(7± 5) %	DESIG=24
Γ_{12}	$N(1535)\pi$	2–14 %	DESIG=14
Γ_{13}	$Na_0(980)$	seen	DESIG=15
Γ_{14}	$\Delta(1232)\eta$	4–16 %	DESIG=16
Γ_{15}	$N\gamma$	0.06–2.53 %	DESIG=6;OUR EST
Γ_{16}	$N\gamma$, helicity=1/2	0.06–1.51 %	DESIG=2;OUR EST
Γ_{17}	$N\gamma$, helicity=3/2	0–1.02 %	DESIG=3;OUR EST

$\Delta(1940)$ BRANCHING RATIOS

NODE=B136230

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

NODE=B136R1
NODE=B136R1

VALUE (%)	DOCUMENT ID		TECN	COMMENT
1–20 % OUR ESTIMATE				→ UNCHECKED ←
13±6	SEIFEN	25	DPWA	Multichannel
16±4	[1] HUNT	19	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	SOKHOYAN	15A	DPWA	Multichannel
2±1	GUTZ	14	DPWA	Multichannel

[1] Statistical error only.

NODE=B136R1;LINKAGE=A

$\Gamma(\Delta(1232)\pi)/\Gamma_{total}$ Γ_3/Γ

NODE=B136R14
NODE=B136R14

VALUE (%)	DOCUMENT ID		TECN	COMMENT
38±10	SARANTSEV	25	DPWA	Multichannel

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

NODE=B136R04
NODE=B136R04

VALUE (%)	DOCUMENT ID		TECN	COMMENT
1–65 % OUR ESTIMATE				→ UNCHECKED ←
21 ± 8	SARANTSEV	25	DPWA	Multichannel
16 ± 6	SEIFEN	25	DPWA	Multichannel
< 0.9	[1] HUNT	19	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
46 ±20	SOKHOYAN	15A	DPWA	Multichannel

[1] Statistical error only.

NODE=B136R04;LINKAGE=A

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

NODE=B136R05
NODE=B136R05

VALUE (%)	DOCUMENT ID		TECN	COMMENT
5–20 % OUR ESTIMATE				→ UNCHECKED ←
17 ± 9	SARANTSEV	25	DPWA	Multichannel
30 ±12	SEIFEN	25	DPWA	Multichannel
< 6.3	[1] HUNT	19	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
12 ± 7	SOKHOYAN	15A	DPWA	Multichannel

[1] Statistical error only.

NODE=B136R05;LINKAGE=A

$\Gamma(N\rho)/\Gamma_{total}$ Γ_6/Γ

NODE=B136R06
NODE=B136R06

VALUE (%)	DOCUMENT ID		TECN	COMMENT
24±6	SARANTSEV	25	DPWA	Multichannel

$\Gamma(N\rho, S{=}1/2)/\Gamma_{total}$ Γ_7/Γ

NODE=B136R07
NODE=B136R07

VALUE (%)	DOCUMENT ID		TECN	COMMENT
6±4	SARANTSEV	25	DPWA	Multichannel

$\Gamma(N\rho, S{=}3/2, S\text{-wave})/\Gamma_{total}$ Γ_8/Γ

NODE=B136R00
NODE=B136R00

VALUE (%)	DOCUMENT ID		TECN	COMMENT
75–85 % OUR ESTIMATE				→ UNCHECKED ←
10±5	SARANTSEV	25	DPWA	Multichannel
80±5	[1] HUNT	19	DPWA	Multichannel

[1] Statistical error only.

NODE=B136R00;LINKAGE=A

$\Gamma(N\rho, S{=}3/2, D\text{-wave})/\Gamma_{total}$ Γ_9/Γ

NODE=B136R08
NODE=B136R08

VALUE (%)	DOCUMENT ID		TECN	COMMENT
8±4	SARANTSEV	25	DPWA	Multichannel

$\Gamma(N(1440)\pi)/\Gamma_{total}$ Γ_{10}/Γ

NODE=B136R09
NODE=B136R09

VALUE (%)	DOCUMENT ID		TECN	COMMENT
5±5	SEIFEN	25	DPWA	Multichannel

$\Gamma(N(1520)\pi, P\text{-wave})/\Gamma_{total}$ Γ_{11}/Γ

NODE=B136R10
NODE=B136R10

VALUE (%)	DOCUMENT ID		TECN	COMMENT
7±5	SEIFEN	25	DPWA	Multichannel

$\Gamma(N(1535)\pi)/\Gamma_{total}$ Γ_{12}/Γ

NODE=B136R01
NODE=B136R01

VALUE (%)	DOCUMENT ID		TECN	COMMENT
2–14 % OUR ESTIMATE				→ UNCHECKED ←
20±13	SEIFEN	25	DPWA	Multichannel
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_{13}/Γ

NODE=B136R02
NODE=B136R02

VALUE (%)	DOCUMENT ID		TECN	COMMENT
seen OUR ESTIMATE				→ UNCHECKED ←
• • • 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_{14}/Γ

NODE=B136R03
NODE=B136R03

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

Δ(1940) PHOTON DECAY AMPLITUDES AT THE POLE

NODE=B136260

Δ(1940) → Nγ, helicity-1/2 amplitude $A_{1/2}$

NODE=B136PA1
NODE=B136PA1

MODULUS ($GeV^{-1/2}$)	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.045±0.025	−40 ± 30	SARANTSEV	25	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$0.170^{+0.120}_{-0.100}$	−10 ± 30	SOKHOYAN	15A	DPWA	Multichannel

Δ(1940) → Nγ, helicity-3/2 amplitude $A_{3/2}$

NODE=B136PA2
NODE=B136PA2

MODULUS ($GeV^{-1/2}$)	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.080±0.030	−75 ± 30	SARANTSEV	25	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.150±0.080	−10 ± 30	SOKHOYAN	15A	DPWA	Multichannel

Δ(1940) BREIT-WIGNER PHOTON DECAY AMPLITUDES

NODE=B136235

Δ(1940) → Nγ, helicity-1/2 amplitude $A_{1/2}$

NODE=B136A1
NODE=B136A1

VALUE ($GeV^{-1/2}$)	DOCUMENT ID		TECN	COMMENT
0.052 ±0.025	SARANTSEV	25	DPWA	Multichannel
0.1614±0.0031	[1] HUNT	19	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
$0.170\ ^{+0.110}_{-0.080}$	SOKHOYAN	15A	DPWA	Multichannel
$0.170\ ^{+0.110}_{-0.080}$	GUTZ	14	DPWA	Multichannel

[1] Statistical error only.

NODE=B136A1;LINKAGE=A

Δ(1940) → Nγ, helicity-3/2 amplitude $A_{3/2}$

NODE=B136A2
NODE=B136A2

VALUE ($GeV^{-1/2}$)	DOCUMENT ID		TECN	COMMENT
0.095±0.030	SARANTSEV	25	DPWA	Multichannel
−0.209±0.023	[1] HUNT	19	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.150±0.080	SOKHOYAN	15A	DPWA	Multichannel
0.150±0.080	GUTZ	14	DPWA	Multichannel

[1] Statistical error only.

NODE=B136A2;LINKAGE=A

Δ(1940) REFERENCES

NODE=B136

SARANTSEV	25	PR C112 015202	A.V. Sarantsev *et al.*	(Bonn-Gatchina Collab.)	REFID=63294
SEIFEN	25	EPJ A61 173	T. Seifen *et al.*	(CBELSA/TAPS Collab.)	REFID=63593
HUNT	19	PR C99 055205	B.C. Hunt, D.M. Manley		REFID=59985
SOKHOYAN	15A	EPJ A51 95	V. Sokhoyan *et al.*	(CBELSA/TAPS Collab.)	REFID=56757
GUTZ	14	EPJ A50 74	E. Gutz *et al.*	(CBELSA/TAPS Collab.)	REFID=55697
SVARC	14	PR C89 045205	A. Svarc *et al.*	(RBI Zagreb, UNI Tuzla)	REFID=55775
ANISOVICH	12A	EPJ A48 15	A.V. Anisovich *et al.*	(BONN, PNPI)	REFID=54041
HORN	08A	EPJ A38 173	I. Horn *et al.*	(CB-ELSA Collab.)	REFID=52706
Also		PRL 101 202002	I. Horn *et al.*	(CB-ELSA Collab.)	REFID=52567
CUTKOSKY	80	Toronto Conf. 19	R.E. Cutkosky *et al.*	(CMU, LBL) IJP	REFID=30064
Also		PR D20 2839	R.E. Cutkosky *et al.*	(CMU, LBL)	REFID=40096
HOEHLER	79	PDAT 12-1	G. Hohler *et al.*	(KARLT)	REFID=30058