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** | | | | |
| 2040± 50 | SOKHOYAN | 15A | 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 | GUTZ | 14 | DPWA | Multichannel |
| $1990^{+100}_{-50}$ | ANISOVICH | 12A | DPWA | Multichannel |

→ UNCHECKED ←

[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** | | | | |
| 450±90 | SOKHOYAN | 15A | 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 | GUTZ | 14 | DPWA | Multichannel |
| 450±90 | ANISOVICH | 12A | DPWA | Multichannel |

→ UNCHECKED ←

[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** | | | | |
| 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 |

→ UNCHECKED ←

[1] Fit to the amplitudes of HOEHLER 79.

NODE=B136RER;LINKAGE=SV

### PHASE $\theta$

NODE=B136IMR
NODE=B136IMR

| VALUE (°) | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| **150 to 250 (≈ 200) OUR ESTIMATE** | | | | |
| − 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 |

→ UNCHECKED ←

[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 $N\pi \rightarrow \Delta(1940) \rightarrow \Delta(1232)\pi$, $S$-wave

NODE=B136RS3
NODE=B136RS3

| MODULUS | PHASE (°) | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| 0.12±0.06 | 120 ± 45 | SOKHOYAN | 15A | DPWA | Multichannel |

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

[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 ← |
| 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 |

[1] Statistical error only.

NODE=B136W;LINKAGE=A

## $\Delta(1940)$ DECAY MODES

NODE=B136225;NODE=B136

| | Mode | Fraction ($\Gamma_i/\Gamma$) | |
|---|---|---|---|
| $\Gamma_1$ | $N\pi$ | 1–20 % | DESIG=1 |
| $\Gamma_2$ | $N\pi\pi$ | >81 % | DESIG=5;OUR EST |
| $\Gamma_3$ | $\Delta(1232)\pi$ | 6–85 % | DESIG=17;OUR EST |
| $\Gamma_4$ | $\Delta(1232)\pi$, $S$-wave | 1–65 % | DESIG=11 |
| $\Gamma_5$ | $\Delta(1232)\pi$, $D$-wave | 5–20 % | DESIG=12 |
| $\Gamma_6$ | $N\rho$, $S$=3/2 , $S$-wave | 75–85 % | DESIG=19 |
| $\Gamma_7$ | $N(1535)\pi$ | 2–14 % | DESIG=14 |
| $\Gamma_8$ | $N a_0(980)$ | seen | DESIG=15 |
| $\Gamma_9$ | $\Delta(1232)\eta$ | 4–16 % | DESIG=16 |
| $\Gamma_{10}$ | $N\gamma$ | 0.06–2.53 % | DESIG=6;OUR EST |
| $\Gamma_{11}$ | $N\gamma$, helicity=1/2 | 0.06–1.51 % | DESIG=2;OUR EST |
| $\Gamma_{12}$ | $N\gamma$, helicity=3/2 | 0–1.02 % | DESIG=3;OUR EST |

## $\Delta(1940)$ BRANCHING RATIOS

NODE=B136230

### $\Gamma(N\pi)/\Gamma_{total}$ — $\Gamma_1/\Gamma$

NODE=B136R1
NODE=B136R1

| VALUE (%) | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| **1–20 % OUR ESTIMATE** | | | | → UNCHECKED ← |
| 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 |

[1] Statistical error only.

NODE=B136R1;LINKAGE=A

### $\Gamma(\Delta(1232)\pi, S\text{-wave})/\Gamma_{total}$ — $\Gamma_4/\Gamma$

NODE=B136R04
NODE=B136R04

| VALUE (%) | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| **1–65 % OUR ESTIMATE** | | | | → UNCHECKED ← |
| $< 0.9$ | [1] HUNT | 19 | DPWA | Multichannel |
| 46 ±20 | SOKHOYAN | 15A | DPWA | Multichannel |

[1] Statistical error only.

NODE=B136R04;LINKAGE=A

### $\Gamma(\Delta(1232)\pi, D\text{-wave})/\Gamma_{total}$ — $\Gamma_5/\Gamma$

NODE=B136R05
NODE=B136R05

| VALUE (%) | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| **5–20 % OUR ESTIMATE** | | | | → UNCHECKED ← |
| $< 6.3$ | [1] HUNT | 19 | DPWA | Multichannel |
| 12 ±7 | SOKHOYAN | 15A | DPWA | Multichannel |

[1] Statistical error only.

NODE=B136R05;LINKAGE=A

### $\Gamma(N\rho, S{=}3/2, S\text{-wave})/\Gamma_{total}$ — $\Gamma_6/\Gamma$

NODE=B136R00
NODE=B136R00

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

[1] Statistical error only.

NODE=B136R00;LINKAGE=A

### $\Gamma(N(1535)\pi)/\Gamma_{total}$ — $\Gamma_7/\Gamma$

NODE=B136R01
NODE=B136R01

| VALUE (%) | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| **2–14 % OUR ESTIMATE** | | | | → UNCHECKED ← |
| 8±6 | GUTZ | 14 | DPWA | Multichannel |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 2±1 | HORN | 08A | DPWA | Multichannel |

### $\Gamma(N a_0(980))/\Gamma_{total}$ — $\Gamma_8/\Gamma$

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 |

### $\Gamma(\Delta(1232)\eta)/\Gamma_{total}$ — $\Gamma_9/\Gamma$

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 |

## $\Delta(1940)$ PHOTON DECAY AMPLITUDES AT THE POLE

NODE=B136260

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

NODE=B136PA1
NODE=B136PA1

| MODULUS (GeV$^{-1/2}$) | PHASE (°) | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| $0.170^{+0.120}_{-0.100}$ | $-10 \pm 30$ | SOKHOYAN | 15A | DPWA | Multichannel |

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

NODE=B136PA2
NODE=B136PA2

| MODULUS (GeV$^{-1/2}$) | PHASE (°) | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| 0.150±0.080 | $-10 \pm 30$ | SOKHOYAN | 15A | DPWA | Multichannel |

## $\Delta(1940)$ BREIT-WIGNER PHOTON DECAY AMPLITUDES

NODE=B136235

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

NODE=B136A1
NODE=B136A1

| 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.

NODE=B136A1;LINKAGE=A

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

NODE=B136A2
NODE=B136A2

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

[1] Statistical error only.

NODE=B136A2;LINKAGE=A

## $\Delta(1940)$ REFERENCES

NODE=B136


| | | | | | |
|---|---|---|---|---|---|
| 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 |