NODE=B013

# $\Delta(1930)\ 5/2^-$

$I(J^P) = \frac{3}{2}(\frac{5}{2}^-)$ Status: ***

Older and obsolete values are listed and referenced in the 2014 edition, Chinese Physics **C38** 070001 (2014). NODE=B013

## Δ(1930) POLE POSITION

NODE=B013215

### REAL PART

NODE=B013RE
NODE=B013RE

| VALUE (MeV) | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| **1820 to 1880 (≈ 1850) OUR ESTIMATE** | | | | → UNCHECKED ← |
| 1821± 2 | ROENCHEN | 22 | DPWA | Multichannel |
| 1848± 9±19 | [1] SVARC | 14 | L+P | $\pi N \to \pi N$ |
| 1890±50 | CUTKOSKY | 80 | IPWA | $\pi N \to \pi N$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 1863 | HUNT | 19 | DPWA | Multichannel |
| 1836 | ROENCHEN | 15A | DPWA | Multichannel |
| 2001 | ARNDT | 06 | DPWA | $\pi N \to \pi N, \eta N$ |
| 1883 | VRANA | 00 | DPWA | Multichannel |
| 1850 | HOEHLER | 93 | SPED | $\pi N \to \pi N$ |

[1] Fit to the amplitudes of HOEHLER 79. NODE=B013RE;LINKAGE=SV

### −2×IMAGINARY PART

NODE=B013IM
NODE=B013IM

| VALUE (MeV) | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| **300 to 450 (≈ 320) OUR ESTIMATE** | | | | → UNCHECKED ← |
| 447± 7 | ROENCHEN | 22 | DPWA | Multichannel |
| 321±17±7 | [1] SVARC | 14 | L+P | $\pi N \to \pi N$ |
| 260±60 | CUTKOSKY | 80 | IPWA | $\pi N \to \pi N$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 260 | HUNT | 19 | DPWA | Multichannel |
| 724 | ROENCHEN | 15A | DPWA | Multichannel |
| 387 | ARNDT | 06 | DPWA | $\pi N \to \pi N, \eta N$ |
| 250 | VRANA | 00 | DPWA | Multichannel |
| 180 | HOEHLER | 93 | SPED | $\pi N \to \pi N$ |

[1] Fit to the amplitudes of HOEHLER 79. NODE=B013IM;LINKAGE=SV

## Δ(1930) ELASTIC POLE RESIDUE

NODE=B013220

### MODULUS |r|

NODE=B013RER
NODE=B013RER

| VALUE (MeV) | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| **8 to 20 (≈ 14) OUR ESTIMATE** | | | | → UNCHECKED ← |
| 15±2 | ROENCHEN | 22 | DPWA | Multichannel |
| 9±1±1 | [1] SVARC | 14 | L+P | $\pi N \to \pi N$ |
| 18±6 | CUTKOSKY | 80 | IPWA | $\pi N \to \pi N$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 34 | ROENCHEN | 15A | DPWA | Multichannel |
| 7 | ARNDT | 06 | DPWA | $\pi N \to \pi N, \eta N$ |
| 20 | HOEHLER | 93 | SPED | $\pi N \to \pi N$ |

[1] Fit to the amplitudes of HOEHLER 79. NODE=B013RER;LINKAGE=SV

### PHASE θ

NODE=B013IMR
NODE=B013IMR

| VALUE (°) | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| **−100 to −10 (≈ −50) OUR ESTIMATE** | | | | → UNCHECKED ← |
| −108± 5 | ROENCHEN | 22 | DPWA | Multichannel |
| − 37± 3±7 | [1] SVARC | 14 | L+P | $\pi N \to \pi N$ |
| − 20±40 | CUTKOSKY | 80 | IPWA | $\pi N \to \pi N$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| −155 | ROENCHEN | 15A | DPWA | Multichannel |
| − 12 | ARNDT | 06 | DPWA | $\pi N \to \pi N, \eta N$ |

[1] Fit to the amplitudes of HOEHLER 79. NODE=B013IMR;LINKAGE=SV

## Δ(1930) INELASTIC POLE RESIDUE

NODE=B013240

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

NODE=B013240

### Normalized residue in $N\pi \rightarrow \Delta(1930) \rightarrow \Sigma K$

NODE=B013A00
NODE=B013A00

| MODULUS | PHASE (°) | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **0.010±0.001** | **49 ± 5** | ROENCHEN | 22 | DPWA | Multichannel |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | |
| 0.043 | −0.5 | ROENCHEN | 15A | DPWA | Multichannel |

### Normalized residue in $N\pi \rightarrow \Delta(1930) \rightarrow \Delta\pi$, $D$-wave

NODE=B013A01
NODE=B013A01

| MODULUS | PHASE (°) | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **0.12±0.02** | **64 ± 4** | ROENCHEN | 22 | DPWA | Multichannel |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | |
| 0.15 | 30 | ROENCHEN | 15A | DPWA | Multichannel |

### Normalized residue in $N\pi \rightarrow \Delta(1930) \rightarrow \Delta\pi$, $G$-wave

NODE=B013A02
NODE=B013A02

| MODULUS | PHASE (°) | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **0.008±0.001** | **148 ± 2** | ROENCHEN | 22 | DPWA | Multichannel |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | |
| 0.009 | 121 | ROENCHEN | 15A | DPWA | Multichannel |

## Δ(1930) BREIT-WIGNER MASS

NODE=B013M

NODE=B013M

| VALUE (MeV) | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| **1900 to 2000 (≈ 1950) OUR ESTIMATE** | | | | → UNCHECKED ← |
| 1988± 32 | [1] HUNT | 19 | DPWA | Multichannel |
| 2233± 53 | [1] ARNDT | 06 | DPWA | $\pi N \rightarrow \pi N$, $\eta N$ |
| 1940± 30 | CUTKOSKY | 80 | IPWA | $\pi N \rightarrow \pi N$ |
| 1901± 15 | HOEHLER | 79 | IPWA | $\pi N \rightarrow \pi N$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 1930± 12 | [1] SHRESTHA | 12A | DPWA | Multichannel |
| 1932±100 | VRANA | 00 | DPWA | Multichannel |

[1] Statistical error only.

NODE=B013M;LINKAGE=A

## Δ(1930) BREIT-WIGNER WIDTH

NODE=B013W

NODE=B013W

| VALUE (MeV) | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| **200 to 400 (≈ 300) OUR ESTIMATE** | | | | → UNCHECKED ← |
| 500±160 | [1] HUNT | 19 | DPWA | Multichannel |
| 773±187 | ARNDT | 06 | DPWA | $\pi N \rightarrow \pi N$, $\eta N$ |
| 320± 60 | CUTKOSKY | 80 | IPWA | $\pi N \rightarrow \pi N$ |
| 195± 60 | HOEHLER | 79 | IPWA | $\pi N \rightarrow \pi N$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 235± 39 | [1] SHRESTHA | 12A | DPWA | Multichannel |
| 316±237 | VRANA | 00 | DPWA | Multichannel |

[1] Statistical error only.

NODE=B013W;LINKAGE=A

## Δ(1930) DECAY MODES

NODE=B013225;NODE=B013

The following branching fractions are our estimates, not fits or averages.

NODE=B013

| | Mode | Fraction ($\Gamma_i/\Gamma$) | |
|---|---|---|---|
| $\Gamma_1$ | $N\pi$ | 5–15 % | DESIG=1;OUR EST |
| $\Gamma_2$ | $N\gamma$ | 0.0–0.01 % | DESIG=184;OUR EST |
| $\Gamma_3$ | $N\gamma$, helicity=1/2 | 0.0–0.005 % | DESIG=4;OUR EST |
| $\Gamma_4$ | $N\gamma$, helicity=3/2 | 0.0–0.004 % | DESIG=5;OUR EST |

## Δ(1930) BRANCHING RATIOS

NODE=B013230

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

NODE=B013R1
NODE=B013R1

| VALUE (%) | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| **5 to 15 (≈ 10) OUR ESTIMATE** | | | | → UNCHECKED ← |
| 9.5±0.1 | [1] HUNT | 19 | DPWA | Multichannel |
| 8.1±1.2 | [1] ARNDT | 06 | DPWA | $\pi N \to \pi N$, $\eta N$ |
| 14 ±4 | CUTKOSKY | 80 | IPWA | $\pi N \to \pi N$ |
| 4 ±3 | HOEHLER | 79 | IPWA | $\pi N \to \pi N$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 7.9±0.4 | [1] SHRESTHA | 12A | DPWA | Multichannel |
| 9 ±8 | VRANA | 00 | DPWA | Multichannel |

OCCUR=2

[1] Statistical error only.

NODE=B013R1;LINKAGE=A

## Δ(1930) PHOTON DECAY AMPLITUDES AT THE POLE

NODE=B013260

### Δ(1930) → Nγ, helicity-1/2 amplitude $A_{1/2}$

NODE=B013PA1
NODE=B013PA1

| MODULUS ($GeV^{-1/2}$) | PHASE (°) | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| 0.104±0.009 | 129 ± 8 | ROENCHEN | 22 | DPWA | Multichannel |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | |
| −0.270 | 33 | ROENCHEN | 15A | DPWA | Multichannel |

### Δ(1930) → Nγ, helicity-3/2 amplitude $A_{3/2}$

NODE=B013PA2
NODE=B013PA2

| MODULUS ($GeV^{-1/2}$) | PHASE (°) | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| 0.322±0.022 | 142 ± 4 | ROENCHEN | 22 | DPWA | Multichannel |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | |
| 0.153 | 81 | ROENCHEN | 15A | DPWA | Multichannel |

## Δ(1930) BREIT-WIGNER PHOTON DECAY AMPLITUDES

NODE=B013235

### Δ(1930) → Nγ, helicity-1/2 amplitude $A_{1/2}$

NODE=B013A1
NODE=B013A1

| VALUE ($GeV^{-1/2}$) | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| −0.043±0.008 | [1] HUNT | 19 | DPWA | Multichannel |
| −0.007±0.010 | [1] ARNDT | 96 | IPWA | $\gamma N \to \pi N$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 0.011±0.003 | [1] SHRESTHA | 12A | DPWA | Multichannel |

[1] Statistical error only.

NODE=B013A1;LINKAGE=A

### Δ(1930) → Nγ, helicity-3/2 amplitude $A_{3/2}$

NODE=B013A2
NODE=B013A2

| VALUE ($GeV^{-1/2}$) | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| −0.020±0.017 | [1] HUNT | 19 | DPWA | Multichannel |
| 0.005±0.010 | [1] ARNDT | 96 | IPWA | $\gamma N \to \pi N$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 0.002±0.002 | [1] SHRESTHA | 12A | DPWA | Multichannel |

[1] Statistical error only.

NODE=B013A2;LINKAGE=A

## Δ(1930) REFERENCES

NODE=B013

For early references, see Physics Letters **111B** 1 (1982).

NODE=B013


| | | | | | |
|---|---|---|---|---|---|
| ROENCHEN | 22 | EPJ A58 229 | D. Roenchen *et al.* | (JULI, GWU, BONN+) | REFID=61999 |
| HUNT | 19 | PR C99 055205 | B.C. Hunt, D.M. Manley | | REFID=59985 |
| ROENCHEN | 15A | EPJ A51 70 | D. Roenchen *et al.* | | REFID=58183 |
| PDG | 14 | CP C38 070001 | K. Olive *et al.* | (PDG Collab.) | REFID=55687 |
| SVARC | 14 | PR C89 045205 | A. Svarc *et al.* | (RBI Zagreb, UNI Tuzla) | REFID=55775 |
| SHRESTHA | 12A | PR C86 055203 | M. Shrestha, D.M. Manley | (KSU) | REFID=54862 |
| ARNDT | 06 | PR C74 045205 | R.A. Arndt *et al.* | (GWU) | REFID=51535 |
| VRANA | 00 | PRPL 328 181 | T.P. Vrana, S.A. Dytman, T.-S.H. Lee | (PITT, ANL) | REFID=47593 |
| ARNDT | 96 | PR C53 430 | R.A. Arndt, I.I. Strakovsky, R.L. Workman | (VPI) | REFID=44675 |
| HOEHLER | 93 | $\pi N$ Newsletter 9 1 | G. Hohler | (KARL) | REFID=43821 |
| 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) IJP | REFID=40096 |
| HOEHLER | 79 | PDAT 12-1 | G. Hohler *et al.* | (KARLT) IJP | REFID=30058 |
| Also | | Toronto Conf. 3 | R. Koch | (KARLT) IJP | REFID=30859 |