

$$\Delta(1920) \ 3/2^+$$

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

Older and obsolete values are listed and referenced in the 2014 edition, *Chinese Physics C* **38** 070001 (2014).

## $\Delta(1920)$ POLE POSITION

### REAL PART

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
<b>1850 to 1950 (<math>\approx</math> 1900) OUR ESTIMATE</b>			
1875 $\pm$ 30	SOKHOYAN	15A	DPWA Multichannel
1906 $\pm$ 10 $\pm$ 2	<sup>1</sup> SVARC	14	L+P $\pi N \rightarrow \pi N$
1900	HOEHLER	93	SPED $\pi N \rightarrow \pi N$
1900 $\pm$ 80	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
1875 $\pm$ 30	GUTZ	14	DPWA Multichannel
1890 $\pm$ 30	ANISOVICH	12A	DPWA Multichannel
2110	SHRESTHA	12A	DPWA Multichannel
1880	VRANA	00	DPWA Multichannel

### –2×IMAGINARY PART

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
<b>200 to 400 (<math>\approx</math> 300) OUR ESTIMATE</b>			
300 $\pm$ 40	SOKHOYAN	15A	DPWA Multichannel
310 $\pm$ 20 $\pm$ 11	<sup>1</sup> SVARC	14	L+P $\pi N \rightarrow \pi N$
300 $\pm$ 100	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
300 $\pm$ 40	GUTZ	14	DPWA Multichannel
300 $\pm$ 60	ANISOVICH	12A	DPWA Multichannel
386	SHRESTHA	12A	DPWA Multichannel
120	VRANA	00	DPWA Multichannel

## $\Delta(1920)$ ELASTIC POLE RESIDUE

### MODULUS $|r|$

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
16 $\pm$ 6	SOKHOYAN	15A	DPWA Multichannel
26 $\pm$ 3 $\pm$ 2	<sup>1</sup> SVARC	14	L+P $\pi N \rightarrow \pi N$
24 $\pm$ 4	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
16 $\pm$ 6	GUTZ	14	DPWA Multichannel
17 $\pm$ 8	ANISOVICH	12A	DPWA Multichannel

### PHASE $\theta$

VALUE ( $^\circ$ )	DOCUMENT ID	TECN	COMMENT
– 50 $\pm$ 25	SOKHOYAN	15A	DPWA Multichannel
– 130 $\pm$ 5 $\pm$ 3	<sup>1</sup> SVARC	14	L+P $\pi N \rightarrow \pi N$
– 150 $\pm$ 30	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
– 50 $\pm$ 25	GUTZ	14	DPWA Multichannel
– 40 $\pm$ 20	ANISOVICH	12A	DPWA Multichannel

**$\Delta(1920)$  INELASTIC POLE RESIDUE**The “normalized residue” is the residue divided by  $\Gamma_{pole}/2$ .**Normalized residue in  $N\pi \rightarrow \Delta(1920) \rightarrow \Delta\eta$** 

<u>MODULUS</u>	<u>PHASE (<math>^\circ</math>)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
$0.15 \pm 0.04$	$70 \pm 20$	GUTZ	14	DPWA Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
$0.17 \pm 0.08$	$70 \pm 20$	ANISOVICH	12A	DPWA Multichannel

**Normalized residue in  $N\pi \rightarrow \Delta(1920) \rightarrow \Sigma K$** 

<u>MODULUS</u>	<u>PHASE (<math>^\circ</math>)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
$0.09 \pm 0.03$	$80 \pm 40$	ANISOVICH	12A	DPWA Multichannel

**Normalized residue in  $N\pi \rightarrow \Delta(1920) \rightarrow \Delta\pi, P$ -wave**

<u>MODULUS</u>	<u>PHASE (<math>^\circ</math>)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
$0.20 \pm 0.08$	$-105 \pm 25$	SOKHOYAN	15A	DPWA Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
$0.20 \pm 0.12$	$-120 \pm 30$	ANISOVICH	12A	DPWA Multichannel

**Normalized residue in  $N\pi \rightarrow \Delta(1920) \rightarrow \Delta\pi, F$ -wave**

<u>MODULUS</u>	<u>PHASE (<math>^\circ</math>)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
$0.37 \pm 0.10$	$-90 \pm 20$	SOKHOYAN	15A	DPWA Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
$0.28 \pm 0.07$	$-95 \pm 35$	ANISOVICH	12A	DPWA Multichannel

**Normalized residue in  $N\pi \rightarrow \Delta(1920) \rightarrow N(1535)\pi$** 

<u>MODULUS</u>	<u>PHASE (<math>^\circ</math>)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
$0.03 \pm 0.02$	$35 \pm 45$	GUTZ	14	DPWA Multichannel

**Normalized residue in  $N\pi \rightarrow \Delta(1920) \rightarrow N_{a_0}(980)$** 

<u>MODULUS</u>	<u>PHASE (<math>^\circ</math>)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
$0.03 \pm 0.02$	$-85 \pm 45$	GUTZ	14	DPWA Multichannel

**Normalized residue in  $N\pi \rightarrow \Delta(1920) \rightarrow N(1440)\pi$** 

<u>MODULUS</u>	<u>PHASE (<math>^\circ</math>)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
$0.04 \pm 0.03$	undefined	SOKHOYAN	15A	DPWA Multichannel

**Normalized residue in  $N\pi \rightarrow \Delta(1920) \rightarrow N(1520)\pi, S$ -wave**

<u>MODULUS</u>	<u>PHASE (<math>^\circ</math>)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
$0.05 \pm 0.05$	undefined	SOKHOYAN	15A	DPWA Multichannel

 **$\Delta(1920)$  BREIT-WIGNER MASS**

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>1900 to 1970 (<math>\approx 1920</math>) OUR ESTIMATE</b>			
$1880 \pm 30$	SOKHOYAN	15A	DPWA Multichannel
$1920 \pm 80$	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
$1868 \pm 10$	HOEHLER	79	IPWA $\pi N \rightarrow \pi N$

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

1880 ± 30	GUTZ	14	DPWA	Multichannel
1900 ± 30	ANISOVICH	12A	DPWA	Multichannel
2146 ± 32	SHRESTHA	12A	DPWA	Multichannel
2057 ± 1	PENNER	02C	DPWA	Multichannel
1889 ± 100	VRANA	00	DPWA	Multichannel

### $\Delta(1920)$ BREIT-WIGNER WIDTH

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
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#### 180 to 300 ( $\approx 260$ ) OUR ESTIMATE

300 ± 40	SOKHOYAN	15A	DPWA	Multichannel
300 ± 100	CUTKOSKY	80	IPWA	$\pi N \rightarrow \pi N$
220 ± 80	HOEHLER	79	IPWA	$\pi N \rightarrow \pi N$

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

300 ± 40	GUTZ	14	DPWA	Multichannel
310 ± 60	ANISOVICH	12A	DPWA	Multichannel
400 ± 80	SHRESTHA	12A	DPWA	Multichannel
525 ± 32	PENNER	02C	DPWA	Multichannel
123 ± 53	VRANA	00	DPWA	Multichannel

### $\Delta(1920)$ DECAY MODES

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

Mode	Fraction ( $\Gamma_i/\Gamma$ )
$\Gamma_1$ $N\pi$	5–20 %
$\Gamma_2$ $\Sigma K$	2–6 %
$\Gamma_3$ $N\pi\pi$	
$\Gamma_4$ $\Delta(1232)\pi$	50–90 %
$\Gamma_5$ $\Delta(1232)\pi$ , $P$ -wave	8–28 %
$\Gamma_6$ $\Delta(1232)\pi$ , $F$ -wave	44–72 %
$\Gamma_7$ $N(1440)\pi$ , $P$ -wave	<4 %
$\Gamma_8$ $N(1520)\pi$ , $S$ -wave	<5 %
$\Gamma_9$ $N(1535)\pi$	<2 %
$\Gamma_{10}$ $N a_0(980)$	seen
$\Gamma_{11}$ $\Delta(1232)\eta$	5–17 %

### $\Delta(1920)$ BRANCHING RATIOS

<u><math>\Gamma(N\pi)/\Gamma_{\text{total}}</math></u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>	<u><math>\Gamma_1/\Gamma</math></u>
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VALUE (%)

#### 5 to 20 OUR ESTIMATE

8 ± 4	SOKHOYAN	15A	DPWA	Multichannel
20 ± 5	CUTKOSKY	80	IPWA	$\pi N \rightarrow \pi N$
14 ± 4	HOEHLER	79	IPWA	$\pi N \rightarrow \pi N$

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

$8 \pm 4$	GUTZ	14	DPWA	Multichannel
$8 \pm 4$	ANISOVICH	12A	DPWA	Multichannel
$16 \pm 4$	SHRESTHA	12A	DPWA	Multichannel
$15 \pm 1$	PENNER	02C	DPWA	Multichannel
$5 \pm 4$	VRANA	00	DPWA	Multichannel

 **$\Gamma(\Sigma K)/\Gamma_{\text{total}}$**  **$\Gamma_2/\Gamma$** 

<u>VALUE (%)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>	
$4 \pm 2$	ANISOVICH	12A	DPWA	Multichannel

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

$2.1 \pm 0.3$	PENNER	02C	DPWA	Multichannel
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 **$\Gamma(\Delta(1232)\pi, P\text{-wave})/\Gamma_{\text{total}}$**  **$\Gamma_5/\Gamma$** 

<u>VALUE (%)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>	
$18 \pm 10$	SOKHOYAN	15A	DPWA	Multichannel

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

$22 \pm 12$	ANISOVICH	12A	DPWA	Multichannel
$7 \pm 5$	SHRESTHA	12A	DPWA	Multichannel
$41 \pm 3$	VRANA	00	DPWA	Multichannel

 **$\Gamma(\Delta(1232)\pi, F\text{-wave})/\Gamma_{\text{total}}$**  **$\Gamma_6/\Gamma$** 

<u>VALUE (%)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>	
$58 \pm 14$	SOKHOYAN	15A	DPWA	Multichannel

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

$45 \pm 20$	ANISOVICH	12A	DPWA	Multichannel
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 **$\Gamma(N(1440)\pi, P\text{-wave})/\Gamma_{\text{total}}$**  **$\Gamma_7/\Gamma$** 

<u>VALUE (%)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>	
$< 4$	SOKHOYAN	15A	DPWA	Multichannel

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

$< 20$	SHRESTHA	12A	DPWA	Multichannel
$53 \pm 8$	VRANA	00	DPWA	Multichannel

 **$\Gamma(N(1520)\pi, S\text{-wave})/\Gamma_{\text{total}}$**  **$\Gamma_8/\Gamma$** 

<u>VALUE (%)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>	
$< 5$	SOKHOYAN	15A	DPWA	Multichannel

 **$\Gamma(N(1535)\pi)/\Gamma_{\text{total}}$**  **$\Gamma_9/\Gamma$** 

<u>VALUE (%)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>	
$< 2$	GUTZ	14	DPWA	Multichannel

 **$\Gamma(N_{a_0}(980))/\Gamma_{\text{total}}$**  **$\Gamma_{10}/\Gamma$** 

<u>VALUE (%)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>	
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• • • We do not use the following data for averages, fits, limits, etc. • • •

$4 \pm 2$	HORN	08A	DPWA	Multichannel
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$\Gamma(\Delta(1232)\eta)/\Gamma_{\text{total}}$				$\Gamma_{11}/\Gamma$
VALUE (%)	DOCUMENT ID	TECN	COMMENT	
11±6	GUTZ	14	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
15±8	ANISOVICH	12A	DPWA	Multichannel

### $\Delta(1920)$ PHOTON DECAY AMPLITUDES AT THE POLE

#### $\Delta(1920) \rightarrow N\gamma$ , helicity-1/2 amplitude $A_{1/2}$

MODULUS ( $\text{GeV}^{-1/2}$ )	PHASE ( $^\circ$ )	DOCUMENT ID	TECN	COMMENT
0.110±0.030	-50 ± 20	SOKHOYAN	15A	DPWA Multichannel

#### $\Delta(1920) \rightarrow N\gamma$ , helicity-3/2 amplitude $A_{3/2}$

MODULUS ( $\text{GeV}^{-1/2}$ )	PHASE ( $^\circ$ )	DOCUMENT ID	TECN	COMMENT
-0.100±0.040	0 ± 20	SOKHOYAN	15A	DPWA Multichannel

### $\Delta(1920)$ BREIT-WIGNER PHOTON DECAY AMPLITUDES

#### $\Delta(1920) \rightarrow N\gamma$ , helicity-1/2 amplitude $A_{1/2}$

VALUE ( $\text{GeV}^{-1/2}$ )	DOCUMENT ID	TECN	COMMENT
0.110±0.030	SOKHOYAN	15A	DPWA Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •			
0.110±0.030	GUTZ	14	DPWA Multichannel
0.130 <sup>+0.030</sup> <sub>-0.060</sub>	ANISOVICH	12A	DPWA Multichannel
0.051±0.010	SHRESTHA	12A	DPWA Multichannel
-0.007	PENNER	02D	DPWA Multichannel

#### $\Delta(1920) \rightarrow N\gamma$ , helicity-3/2 amplitude $A_{3/2}$

VALUE ( $\text{GeV}^{-1/2}$ )	DOCUMENT ID	TECN	COMMENT
-0.105±0.035	SOKHOYAN	15A	DPWA Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •			
-0.105±0.035	GUTZ	14	DPWA Multichannel
-0.115 <sup>+0.025</sup> <sub>-0.050</sub>	ANISOVICH	12A	DPWA Multichannel
0.017±0.015	SHRESTHA	12A	DPWA Multichannel
-0.001	PENNER	02D	DPWA Multichannel

### $\Delta(1920)$ FOOTNOTES

<sup>1</sup> Fit to the amplitudes of HOEHLER 79.

### $\Delta(1920)$ REFERENCES

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

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.)
PDG	14	CPC 38 070001	K. Olive <i>et al.</i>	(PDG Collab.)
SVARC	14	PR C89 045205	A. Svarc <i>et al.</i>	

ANISOVICH	12A	EPJ A48 15	A.V. Anisovich <i>et al.</i>	(BONN, PNPI)
SHRESTHA	12A	PR C86 055203	M. Shrestha, D.M. Manley	(KSU)
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.)
PENNER	02C	PR C66 055211	G. Penner, U. Mosel	(GIES)
PENNER	02D	PR C66 055212	G. Penner, U. Mosel	(GIES)
VRANA	00	PRPL 328 181	T.P. Vrana, S.A. Dytman, T.-S.H. Lee	(PITT, ANL)
HOEHLER	93	$\pi N$ Newsletter 9 1	G. Hohler	(KARL)
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) IJP
HOEHLER	79	PDAT 12-1	G. Hohler <i>et al.</i>	(KARLT) IJP
Also		Toronto Conf. 3	R. Koch	(KARLT) IJP

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