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

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

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

Δ(1920) POLE POSITION

REAL PART

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

−2×IMAGINARY PART

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

Δ(1920) ELASTIC POLE RESIDUE

MODULUS $|r|$

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

PHASE θ

VALUE (°)	DOCUMENT ID		TECN	COMMENT
− 50±25	SOKHOYAN	15A	DPWA	Multichannel
−130± 5±3	[1] SVARC	14	L+P	$\pi N \rightarrow \pi N$
−150±30	CUTKOSKY	80	IPWA	$\pi N \rightarrow \pi N$

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

$-$ 50±25	GUTZ	14	DPWA	Multichannel
$-$ 40±20	ANISOVICH	12A	DPWA	Multichannel

$\Delta(1920)$ INELASTIC POLE RESIDUE

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

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

MODULUS	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.15±0.04	70 ± 20	GUTZ	14	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.17±0.08	70 ± 20	ANISOVICH	12A	DPWA	Multichannel

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

MODULUS	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.09±0.03	80 ± 40	ANISOVICH	12A	DPWA	Multichannel

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

MODULUS	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.20±0.08	$-$105 ± 25	SOKHOYAN	15A	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.20±0.12	$-$120 ± 30	ANISOVICH	12A	DPWA	Multichannel

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

MODULUS	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.37±0.10	$-$90 ± 20	SOKHOYAN	15A	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.28±0.07	$-$95 ± 35	ANISOVICH	12A	DPWA	Multichannel

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

MODULUS	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.03±0.02	35 ± 45	GUTZ	14	DPWA	Multichannel

Normalized residue in $N\pi \rightarrow \Delta(1920) \rightarrow N a_0(980)$

MODULUS	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.03±0.02	$-$85 ± 45	GUTZ	14	DPWA	Multichannel

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

MODULUS	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.04±0.03	undefined	SOKHOYAN	15A	DPWA	Multichannel

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

MODULUS	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.05±0.05	undefined	SOKHOYAN	15A	DPWA	Multichannel

$\Delta(1920)$ BREIT-WIGNER MASS

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
1900 to 1970 (≈ 1920) OUR ESTIMATE				
1880±30	SOKHOYAN	15A	DPWA	Multichannel
1920±80	CUTKOSKY	80	IPWA	$\pi N \rightarrow \pi N$
1868±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

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
180 to 300 (≈ 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 (Γ_i/Γ)
Γ_1	$N\pi$	5–20 %
Γ_2	ΣK	2–6 %
Γ_3	$N\pi\pi$	
Γ_4	$\Delta(1232)\pi$	50–90 %
Γ_5	$\Delta(1232)\pi$, P-wave	8–28 %
Γ_6	$\Delta(1232)\pi$, F-wave	44–72 %
Γ_7	$N(1440)\pi$, P-wave	<4 %
Γ_8	$N(1520)\pi$, S-wave	<5 %
Γ_9	$N(1535)\pi$	<2 %
Γ_{10}	$N a_0(980)$	seen
Γ_{11}	$\Delta(1232)\eta$	5–17 %

$\Delta(1920)$ BRANCHING RATIOS

$\Gamma(N\pi)/\Gamma_{total}$ — Γ_1/Γ

VALUE (%)	DOCUMENT ID		TECN	COMMENT
5 to 20 OUR ESTIMATE				
8±4	SOKHOYAN	15A	DPWA	Multichannel
20±5	CUTKOSKY	80	IPWA	$\pi N \to \pi N$
14±4	HOEHLER	79	IPWA	$\pi N \to \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
8±4	GUTZ	14	DPWA	Multichannel
8±4	ANISOVICH	12A	DPWA	Multichannel
16±4	SHRESTHA	12A	DPWA	Multichannel
15±1	PENNER	02C	DPWA	Multichannel
5±4	VRANA	00	DPWA	Multichannel

$\Gamma(\Sigma K)/\Gamma_{total}$ — Γ_2/Γ

VALUE (%)	DOCUMENT ID		TECN	COMMENT
4 ±2	ANISOVICH	12A	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
2.1±0.3	PENNER	02C	DPWA	Multichannel

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

VALUE (%)	DOCUMENT ID		TECN	COMMENT
18±10	SOKHOYAN	15A	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
22±12	ANISOVICH	12A	DPWA	Multichannel
7± 5	SHRESTHA	12A	DPWA	Multichannel
41± 3	VRANA	00	DPWA	Multichannel

$\Gamma(\Delta(1232)\pi$, F-wave$)/\Gamma_{total}$ — Γ_6/Γ

VALUE (%)	DOCUMENT ID		TECN	COMMENT
58±14	SOKHOYAN	15A	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
45±20	ANISOVICH	12A	DPWA	Multichannel

$\Gamma(N(1440)\pi$, P-wave$)/\Gamma_{total}$ — Γ_7/Γ

VALUE (%)	DOCUMENT ID		TECN	COMMENT
< 4	SOKHOYAN	15A	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
<20	SHRESTHA	12A	DPWA	Multichannel
53±8	VRANA	00	DPWA	Multichannel

$\Gamma(N(1520)\pi$, S-wave$)/\Gamma_{total}$ — Γ_8/Γ

VALUE (%)	DOCUMENT ID		TECN	COMMENT
<5	SOKHOYAN	15A	DPWA	Multichannel

$\Gamma(N(1535)\pi)/\Gamma_{total}$ — Γ_9/Γ

VALUE (%)	DOCUMENT ID		TECN	COMMENT
<2	GUTZ	14	DPWA	Multichannel

$\Gamma(N a_0(980))/\Gamma_{total}$ — Γ_{10}/Γ

VALUE (%)	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
4 ± 2	HORN	08A	DPWA	Multichannel

$\Gamma(\Delta(1232)\eta)/\Gamma_{total}$ — Γ_{11}/Γ

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

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

MODULUS ($GeV^{-1/2}$)	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.110 ± 0.030	-50 ± 20	SOKHOYAN	15A	DPWA	Multichannel
$0.190^{+0.050}_{-0.022}$	-160^{+24}_{-11}	ROENCHEN	14	DPWA	

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

MODULUS ($GeV^{-1/2}$)	PHASE (°)	DOCUMENT ID		TECN	COMMENT
-0.100 ± 0.040	0 ± 20	SOKHOYAN	15A	DPWA	Multichannel
$-0.398^{+0.070}_{-0.067}$	-110^{+4}_{-5}	ROENCHEN	14	DPWA	

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

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

VALUE ($GeV^{-1/2}$)	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
$0.130^{+0.030}_{-0.060}$	ANISOVICH	12A	DPWA	Multichannel
0.051 ± 0.010	SHRESTHA	12A	DPWA	Multichannel
-0.007	PENNER	02D	DPWA	Multichannel

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

VALUE ($GeV^{-1/2}$)	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
$-0.115^{+0.025}_{-0.050}$	ANISOVICH	12A	DPWA	Multichannel
0.017 ± 0.015	SHRESTHA	12A	DPWA	Multichannel
-0.001	PENNER	02D	DPWA	Multichannel

Δ(1920) FOOTNOTES

[1] Fit to the amplitudes of HOEHLER 79.

Δ(1920) REFERENCES

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

SOKHOYAN	15A	EPJ A51 95	V. Sokhoyan *et al.*	(CBELSA/TAPS Collab.)
GUTZ	14	EPJ A50 74	E. Gutz *et al.*	(CBELSA/TAPS Collab.)
PDG	14	CP C38 070001	K. Olive *et al.*	(PDG Collab.)
ROENCHEN	14	EPJ A50 101	D. Roenchen *et al.*	
Also		EPJ A51 63 (errat.)	D. Roenchen *et al.*	
SVARC	14	PR C89 045205	A. Svarc *et al.*	
ANISOVICH	12A	EPJ A48 15	A.V. Anisovich *et al.*	(BONN, PNPI)
SHRESTHA	12A	PR C86 055203	M. Shrestha, D.M. Manley	(KSU)
HORN	08A	EPJ A38 173	I. Horn *et al.*	(CB-ELSA Collab.)
Also		PRL 101 202002	I. Horn *et al.*	(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	πN Newsletter 9 1	G. Hohler	(KARL)
CUTKOSKY	80	Toronto Conf. 19	R.E. Cutkosky *et al.*	(CMU, LBL) IJP
Also		PR D20 2839	R.E. Cutkosky *et al.*	(CMU, LBL) IJP
HOEHLER	79	PDAT 12-1	G. Hohler *et al.*	(KARLT) IJP
Also		Toronto Conf. 3	R. Koch	(KARLT) IJP