NODE=B117

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

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

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

NODE=B117

Δ(1920) POLE POSITION

NODE=B117215

REAL PART

NODE=B117RE
NODE=B117RE

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
1850 to 1950 (≈ 1900) OUR ESTIMATE				
1880±30	SARANTSEV	25	DPWA	Multichannel
1883± 2	ROENCHEN	22	DPWA	Multichannel
1906±10±2	[1] SVARC	14	L+P	$\pi N \to \pi N$
1900±80	CUTKOSKY	80	IPWA	$\pi N \to \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
1910	HUNT	19	DPWA	Multichannel
1715	ROENCHEN	15A	DPWA	Multichannel
1875±30	SOKHOYAN	15A	DPWA	Multichannel
1875±30	GUTZ	14	DPWA	Multichannel
1880	VRANA	00	DPWA	Multichannel
1900	HOEHLER	93	SPED	$\pi N \to \pi N$

→ UNCHECKED ←

[1] Fit to the amplitudes of HOEHLER 79.

NODE=B117RE;LINKAGE=SV

−2×IMAGINARY PART

NODE=B117IM
NODE=B117IM

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
200 to 400 (≈ 300) OUR ESTIMATE				
260± 40	SARANTSEV	25	DPWA	Multichannel
844± 5	ROENCHEN	22	DPWA	Multichannel
310± 20±11	[1] SVARC	14	L+P	$\pi N \to \pi N$
300±100	CUTKOSKY	80	IPWA	$\pi N \to \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
472	HUNT	19	DPWA	Multichannel
882	ROENCHEN	15A	DPWA	Multichannel
300± 40	SOKHOYAN	15A	DPWA	Multichannel
300± 40	GUTZ	14	DPWA	Multichannel
120	VRANA	00	DPWA	Multichannel

→ UNCHECKED ←

[1] Fit to the amplitudes of HOEHLER 79.

NODE=B117IM;LINKAGE=SV

Δ(1920) ELASTIC POLE RESIDUE

NODE=B117220

MODULUS $|r|$

NODE=B117RER
NODE=B117RER

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
15 to 35 (≈ 25) OUR ESTIMATE				
41±3	ROENCHEN	22	DPWA	Multichannel
16±6	SOKHOYAN	15A	DPWA	Multichannel
26±3±2	[1] SVARC	14	L+P	$\pi N \to \pi N$
24±4	CUTKOSKY	80	IPWA	$\pi N \to \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
38	ROENCHEN	15A	DPWA	Multichannel
16±6	GUTZ	14	DPWA	Multichannel
17±8	ANISOVICH	12A	DPWA	Multichannel

→ UNCHECKED ←

[1] Fit to the amplitudes of HOEHLER 79.

NODE=B117RER;LINKAGE=SV

PHASE θ

NODE=B117IMR
NODE=B117IMR

VALUE (°)	DOCUMENT ID		TECN	COMMENT
−150 to −50 (≈ −100) OUR ESTIMATE				
11± 4	ROENCHEN	22	DPWA	Multichannel
− 50±25	SOKHOYAN	15A	DPWA	Multichannel
−130± 5±3	[1] SVARC	14	L+P	$\pi N \to \pi N$
−150±30	CUTKOSKY	80	IPWA	$\pi N \to \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
146	ROENCHEN	15A	DPWA	Multichannel
− 50±25	GUTZ	14	DPWA	Multichannel
− 40±20	ANISOVICH	12A	DPWA	Multichannel

→ UNCHECKED ←

[1] Fit to the amplitudes of HOEHLER 79.

NODE=B117IMR;LINKAGE=SV

Δ(1920) INELASTIC POLE RESIDUE

NODE=B117240

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

NODE=B117240

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

NODE=B117RS1
NODE=B117RS1

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 $N\pi \to \Delta(1920) \to \Sigma K$

NODE=B117RS2
NODE=B117RS2

MODULUS	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.20±0.01	104 ± 2	ROENCHEN	22	DPWA	Multichannel
0.09±0.03	80 ± 40	ANISOVICH	12A	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.17	−35	ROENCHEN	15A	DPWA	Multichannel

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

NODE=B117RS3
NODE=B117RS3

MODULUS	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.057±0.003	−48 ± 3	ROENCHEN	22	DPWA	Multichannel
0.20 ±0.08	−105 ± 25	SOKHOYAN	15A	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.069	131	ROENCHEN	15A	DPWA	Multichannel
0.20 ±0.12	−120 ± 30	ANISOVICH	12A	DPWA	Multichannel

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

NODE=B117RS4
NODE=B117RS4

MODULUS	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.020±0.002	147 ± 4	ROENCHEN	22	DPWA	Multichannel
0.37 ±0.10	−90 ± 20	SOKHOYAN	15A	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.013	−115	ROENCHEN	15A	DPWA	Multichannel
0.28 ±0.07	−95 ± 35	ANISOVICH	12A	DPWA	Multichannel

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

NODE=B117RS5
NODE=B117RS5

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

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

NODE=B117RS6
NODE=B117RS6

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

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

NODE=B117RS7
NODE=B117RS7

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

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

NODE=B117RS8
NODE=B117RS8

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

Δ(1920) BREIT-WIGNER MASS

NODE=B117M

NODE=B117M

→ UNCHECKED ←

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
1870 to 1970 (≈ 1920) OUR ESTIMATE				
1890± 25	SARANTSEV	25	DPWA	Multichannel
1976± 49	HUNT	19	DPWA	Multichannel
2146± 32	[1] SHRESTHA	12A	DPWA	Multichannel
1920± 80	CUTKOSKY	80	IPWA	$\pi N \to \pi N$
1868± 10	HOEHLER	79	IPWA	$\pi N \to \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
1880± 30	SOKHOYAN	15A	DPWA	Multichannel
1880± 30	GUTZ	14	DPWA	Multichannel
2057± 1	PENNER	02C	DPWA	Multichannel
1889±100	VRANA	00	DPWA	Multichannel

[1] Statistical error only. NODE=B117M;LINKAGE=A

Δ(1920) BREIT-WIGNER WIDTH

NODE=B117W

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
240 to 360 (≈ 300) OUR ESTIMATE				
280±40	SARANTSEV	25	DPWA	Multichannel
509±170	HUNT	19	DPWA	Multichannel
400±80	[1] SHRESTHA	12A	DPWA	Multichannel
300±100	CUTKOSKY	80	IPWA	$\pi N \to \pi N$
220±80	HOEHLER	79	IPWA	$\pi N \to \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
300±40	SOKHOYAN	15A	DPWA	Multichannel
300±40	GUTZ	14	DPWA	Multichannel
525±32	PENNER	02C	DPWA	Multichannel
123±53	VRANA	00	DPWA	Multichannel

NODE=B117W
→ UNCHECKED ←

[1] Statistical error only. NODE=B117W;LINKAGE=A

Δ(1920) DECAY MODES

NODE=B117225;NODE=B117

The following branching fractions are our estimates, not fits or averages. NODE=B117

	Mode	Fraction (Γ_i/Γ)	
Γ_1	$N\pi$	5–20 %	DESIG=1
Γ_2	ΣK	2–6 %	DESIG=2
Γ_3	$N\pi\pi$	>46 %	DESIG=7;OUR EST
Γ_4	$\Delta(1232)\pi$	(38±15) %	DESIG=14
Γ_5	$\Delta(1232)\pi$, P-wave	2–28 %	DESIG=3
Γ_6	$\Delta(1232)\pi$, F-wave	44–72 %	DESIG=11
Γ_7	$N\rho$	(57± 8) %	DESIG=15
Γ_8	$N\rho$, S=1/2	(8± 4) %	DESIG=16
Γ_9	$N\rho$, S=3/2, P-wave	(14± 5) %	DESIG=17
Γ_{10}	$N\rho$, S=3/2, F-wave	(35± 6) %	DESIG=18
Γ_{11}	$N(1440)\pi$, P-wave	4–86 %	DESIG=4
Γ_{12}	$N(1520)\pi$, S-wave	< 5 %	DESIG=13
Γ_{13}	$N(1535)\pi$	< 2 %	DESIG=8
Γ_{14}	$N a_0(980)$	seen	DESIG=9
Γ_{15}	$\Delta(1232)\eta$	5–17 %	DESIG=10
Γ_{16}	$N\gamma$	0.01–0.84 %	DESIG=12;OUR EST
Γ_{17}	$N\gamma$, helicity=1/2	0.0–0.42 %	DESIG=5;OUR EST
Γ_{18}	$N\gamma$, helicity=3/2	0.01–0.42 %	DESIG=6;OUR EST

Δ(1920) BRANCHING RATIOS

NODE=B117230

$\Gamma(N\pi)/\Gamma_{total}$ — Γ_1/Γ

NODE=B117R1
NODE=B117R1

VALUE (%)	DOCUMENT ID		TECN	COMMENT
5–20 % OUR ESTIMATE				
12 ±6	SEIFEN	25	DPWA	Multichannel
10.5±3.0	[1] HUNT	19	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	SOKHOYAN	15A	DPWA	Multichannel
8 ±4	GUTZ	14	DPWA	Multichannel
16 ±4	[1] SHRESTHA	12A	DPWA	Multichannel
15 ±1	PENNER	02C	DPWA	Multichannel
5 ±4	VRANA	00	DPWA	Multichannel

→ UNCHECKED ←

[1] Statistical error only. NODE=B117R1;LINKAGE=A

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

NODE=B117R7
NODE=B117R7

VALUE (%)	DOCUMENT ID		TECN	COMMENT
2–6 % OUR ESTIMATE				
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

→ UNCHECKED ←

$\Gamma(\Delta(1232)\pi)/\Gamma_{total}$ — Γ_4/Γ

NODE=B117R09
NODE=B117R09

VALUE (%)	DOCUMENT ID		TECN	COMMENT
38±15	SARANTSEV	25	DPWA	Multichannel

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

NODE=B117R5
NODE=B117R5
→ UNCHECKED ←

VALUE (%)	DOCUMENT ID		TECN	COMMENT
2–28 % OUR ESTIMATE				
6 ± 4	SARANTSEV	25	DPWA	Multichannel
5 ± 4	SEIFEN	25	DPWA	Multichannel
< 1.6	[1] HUNT	19	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
18 ±10	SOKHOYAN	15A	DPWA	Multichannel
7 ± 5	[1] SHRESTHA	12A	DPWA	Multichannel
41 ± 3	VRANA	00	DPWA	Multichannel

[1] Statistical error only.

NODE=B117R5;LINKAGE=A

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

NODE=B117R04
NODE=B117R04
→ UNCHECKED ←

VALUE (%)	DOCUMENT ID		TECN	COMMENT
44–72 % OUR ESTIMATE				
32±15	SARANTSEV	25	DPWA	Multichannel
40±20	SEIFEN	25	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
58±14	SOKHOYAN	15A	DPWA	Multichannel

$\Gamma(N\rho)/\Gamma_{total}$ — Γ_7/Γ

NODE=B117R00
NODE=B117R00

VALUE (%)	DOCUMENT ID		TECN	COMMENT
57±8	SARANTSEV	25	DPWA	Multichannel

$\Gamma(N\rho, S=1/2)/\Gamma_{total}$ — Γ_8/Γ

NODE=B117R06
NODE=B117R06

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

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

NODE=B117R07
NODE=B117R07

VALUE (%)	DOCUMENT ID		TECN	COMMENT
14±5	SARANTSEV	25	DPWA	Multichannel

$\Gamma(N\rho, S=3/2, F\text{-wave})/\Gamma_{total}$ — Γ_{10}/Γ

NODE=B117R08
NODE=B117R08

VALUE (%)	DOCUMENT ID		TECN	COMMENT
35±6	SARANTSEV	25	DPWA	Multichannel

$\Gamma(N(1440)\pi, P\text{-wave})/\Gamma_{total}$ — Γ_{11}/Γ

NODE=B117R6
NODE=B117R6
→ UNCHECKED ←

VALUE (%)	DOCUMENT ID		TECN	COMMENT
4–86 % OUR ESTIMATE				
9±6	SEIFEN	25	DPWA	Multichannel
77±9	[1] HUNT	19	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
< 4	SOKHOYAN	15A	DPWA	Multichannel
<20	[1] SHRESTHA	12A	DPWA	Multichannel
53±8	VRANA	00	DPWA	Multichannel

[1] Statistical error only.

NODE=B117R6;LINKAGE=A

$\Gamma(N(1520)\pi, S\text{-wave})/\Gamma_{total}$ — Γ_{12}/Γ

NODE=B117R05
NODE=B117R05
→ UNCHECKED ←

VALUE (%)	DOCUMENT ID		TECN	COMMENT
< 5 OUR ESTIMATE				
10±8	SEIFEN	25	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
< 5	SOKHOYAN	15A	DPWA	Multichannel

$\Gamma(N(1535)\pi)/\Gamma_{total}$ — Γ_{13}/Γ

NODE=B117R01
NODE=B117R01
→ UNCHECKED ←

VALUE (%)	DOCUMENT ID		TECN	COMMENT
<2 OUR ESTIMATE				
5±5	SEIFEN	25	DPWA	Multichannel
<2	GUTZ	14	DPWA	Multichannel

$\Gamma(N a_0(980))/\Gamma_{total}$ Γ_{14}/Γ

NODE=B117R02
NODE=B117R02

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

→ UNCHECKED ←

$\Gamma(\Delta(1232)\eta)/\Gamma_{total}$ Γ_{15}/Γ

NODE=B117R03
NODE=B117R03

VALUE (%)	DOCUMENT ID		TECN	COMMENT
5–17 % OUR ESTIMATE				
11±6	GUTZ	14	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
15±8	ANISOVICH	12A	DPWA	Multichannel

→ UNCHECKED ←

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

NODE=B117260

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

NODE=B117PA1
NODE=B117PA1

MODULUS ($GeV^{-1/2}$)	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.040±0.025	−30 ± 25	SARANTSEV	25	DPWA	Multichannel
0.138±0.006	−8.9 ± 2.0	ROENCHEN	22	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •					
−0.192	46	ROENCHEN	15A	DPWA	Multichannel
0.110±0.030	−50 ± 20	SOKHOYAN	15A	DPWA	Multichannel

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

NODE=B117PA2
NODE=B117PA2

MODULUS ($GeV^{-1/2}$)	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.055±0.025	−50 ± 35	SARANTSEV	25	DPWA	Multichannel
0.252±0.007	14 ± 2	ROENCHEN	22	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.522	67	ROENCHEN	15A	DPWA	Multichannel
−0.100±0.040	0 ± 20	SOKHOYAN	15A	DPWA	Multichannel

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

NODE=B117235

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

NODE=B117A1
NODE=B117A1

VALUE ($GeV^{-1/2}$)	DOCUMENT ID		TECN	COMMENT
0.043±0.025	SARANTSEV	25	DPWA	Multichannel
−0.028±0.010	[1] HUNT	19	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.110±0.030	SOKHOYAN	15A	DPWA	Multichannel
0.110±0.030	GUTZ	14	DPWA	Multichannel
0.051±0.010	[1] SHRESTHA	12A	DPWA	Multichannel
−0.007	PENNER	02D	DPWA	Multichannel

[1] Statistical error only.

NODE=B117A1;LINKAGE=A

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

NODE=B117A2
NODE=B117A2

VALUE ($GeV^{-1/2}$)	DOCUMENT ID		TECN	COMMENT
0.058±0.030	SARANTSEV	25	DPWA	Multichannel
−0.043±0.014	[1] HUNT	19	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
−0.105±0.035	SOKHOYAN	15A	DPWA	Multichannel
−0.105±0.035	GUTZ	14	DPWA	Multichannel
0.017±0.015	[1] SHRESTHA	12A	DPWA	Multichannel
−0.001	PENNER	02D	DPWA	Multichannel

[1] Statistical error only.

NODE=B117A2;LINKAGE=A

Δ(1920) REFERENCES

NODE=B117

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

NODE=B117

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
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
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
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
ANISOVICH	12A	EPJ A48 15	A.V. Anisovich *et al.*	(BONN, PNPI)	REFID=54041
SHRESTHA	12A	PR C86 055203	M. Shrestha, D.M. Manley	(KSU)	REFID=54862
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
PENNER	02C	PR C66 055211	G. Penner, U. Mosel	(GIES)	REFID=49129
PENNER	02D	PR C66 055212	G. Penner, U. Mosel	(GIES)	REFID=49130
VRANA	00	PRPL 328 181	T.P. Vrana, S.A. Dytman, T.-S.H. Lee	(PITT, ANL)	REFID=47593
HOEHLER	93	πN 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