NODE=B082

$\Delta(1620)\ 1/2^-$

$I(J^P) = \frac{3}{2}(\frac{1}{2}^-)$ Status: ****

Older and obsolete values are listed and referenced in the 2014 edition, Chinese Physics **C38** 070001 (2014). NODE=B082

$\Delta(1620)$ POLE POSITION

NODE=B082215

REAL PART

NODE=B082RE
NODE=B082RE

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
1590 to 1610 (≈ 1600) OUR ESTIMATE				→ UNCHECKED ←
1607 ± 2	ROENCHEN	22	DPWA	Multichannel
1597 ± 5	SOKHOYAN	15A	DPWA	Multichannel
1603 ± 7 ± 2	[1] SVARC	14	L+P	$\pi N \to \pi N$
1600 ± 15	CUTKOSKY	80	IPWA	$\pi N \to \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
1577	HUNT	19	DPWA	Multichannel
1600	ROENCHEN	15A	DPWA	Multichannel
1597 ± 4	ANISOVICH	12A	DPWA	Multichannel
1595	ARNDT	06	DPWA	$\pi N \to \pi N$, ηN
1607	VRANA	00	DPWA	Multichannel
1608	HOEHLER	93	SPED	$\pi N \to \pi N$

[1] Fit to the amplitudes of HOEHLER 79. NODE=B082RE;LINKAGE=SV

−2×IMAGINARY PART

NODE=B082IM
NODE=B082IM

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
80 to 140 (≈ 110) OUR ESTIMATE				→ UNCHECKED ←
85 ± 3	ROENCHEN	22	DPWA	Multichannel
134 ± 8	SOKHOYAN	15A	DPWA	Multichannel
114 ± 12 ± 4	[1] SVARC	14	L+P	$\pi N \to \pi N$
120 ± 20	CUTKOSKY	80	IPWA	$\pi N \to \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
101	HUNT	19	DPWA	Multichannel
65	ROENCHEN	15A	DPWA	Multichannel
130 ± 9	ANISOVICH	12A	DPWA	Multichannel
135	ARNDT	06	DPWA	$\pi N \to \pi N$, ηN
148	VRANA	00	DPWA	Multichannel
116	HOEHLER	93	SPED	$\pi N \to \pi N$

[1] Fit to the amplitudes of HOEHLER 79. NODE=B082IM;LINKAGE=SV

$\Delta(1620)$ ELASTIC POLE RESIDUE

NODE=B082220

MODULUS $|r|$

NODE=B082RER
NODE=B082RER

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
10 to 20 (≈ 15) OUR ESTIMATE				→ UNCHECKED ←
12 ± 1	ROENCHEN	22	DPWA	Multichannel
20 ± 3	SOKHOYAN	15A	DPWA	Multichannel
17 ± 2 ± 1	[1] SVARC	14	L+P	$\pi N \to \pi N$
15 ± 2	CUTKOSKY	80	IPWA	$\pi N \to \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
16	ROENCHEN	15A	DPWA	Multichannel
18 ± 2	ANISOVICH	12A	DPWA	Multichannel
15	ARNDT	06	DPWA	$\pi N \to \pi N$, ηN
19	HOEHLER	93	SPED	$\pi N \to \pi N$

[1] Fit to the amplitudes of HOEHLER 79. NODE=B082RER;LINKAGE=SV

PHASE θ

NODE=B082IMR
NODE=B082IMR

VALUE (°)	DOCUMENT ID		TECN	COMMENT
−120 to −80 (≈ −100) OUR ESTIMATE				→ UNCHECKED ←
126 ± 2	ROENCHEN	22	DPWA	Multichannel
− 90 ± 15	SOKHOYAN	15A	DPWA	Multichannel
−106 ± 10 ± 4	[1] SVARC	14	L+P	$\pi N \to \pi N$
−110 ± 20	CUTKOSKY	80	IPWA	$\pi N \to \pi N$

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

−104	ROENCHEN	15A	DPWA	Multichannel
−100 ± 5	ANISOVICH	12A	DPWA	Multichannel
− 92	ARNDT	06	DPWA	$\pi N \to \pi N$, ηN
− 95	HOEHLER	93	SPED	$\pi N \to \pi N$

[1] Fit to the amplitudes of HOEHLER 79.

NODE=B082IMR;LINKAGE=SV

Δ(1620) INELASTIC POLE RESIDUE

NODE=B082240

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

NODE=B082240

Normalized residue in $N\pi \to \Delta(1620) \to \Delta\pi$, D-wave

NODE=B082RS1
NODE=B082RS1

MODULUS	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.32±0.01	81 ± 1	ROENCHEN	22	DPWA	Multichannel
0.42±0.06	−90 ± 20	SOKHOYAN	15A	DPWA	Multichannel

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

0.57	105	ROENCHEN	15A	DPWA	Multichannel
0.38±0.09	−85 ± 30	ANISOVICH	12A	DPWA	Multichannel

Normalized residue in $N\pi \to \Delta(1620) \to \Sigma K$

NODE=B082A00
NODE=B082A00

MODULUS	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.11±0.01	−120 ± 3	ROENCHEN	22	DPWA	Multichannel

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

0.22	−105	ROENCHEN	15A	DPWA	Multichannel

Normalized residue in $N\pi \to \Delta(1620) \to N(1440)\pi$

NODE=B082RS2
NODE=B082RS2

MODULUS	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.10±0.06	−65 ± 30	SOKHOYAN	15A	DPWA	Multichannel

Δ(1620) BREIT-WIGNER MASS

NODE=B082M

NODE=B082M

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
1590 to 1630 (≈ 1610) OUR ESTIMATE				→ UNCHECKED ←
1635 ± 8	GOLOVATCH	19	DPWA	$\gamma p \to \pi^+\pi^- p$ OCCUR=2
1589 ± 3	[1] HUNT	19	DPWA	Multichannel
1595 ± 8	SOKHOYAN	15A	DPWA	Multichannel
1615.2 ± 0.4	[1] ARNDT	06	DPWA	$\pi N \to \pi N$, ηN
1620 ±20	CUTKOSKY	80	IPWA	$\pi N \to \pi N$
1610 ± 7	HOEHLER	79	IPWA	$\pi N \to \pi N$

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

1600 ± 8	ANISOVICH	12A	DPWA	Multichannel
1600 ± 1	[1] SHRESTHA	12A	DPWA	Multichannel
1612 ± 2	PENNER	02C	DPWA	Multichannel
1617 ±15	VRANA	00	DPWA	Multichannel

[1] Statistical error only.

NODE=B082M;LINKAGE=A

Δ(1620) BREIT-WIGNER WIDTH

NODE=B082W

NODE=B082W

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
110 to 150 (≈ 130) OUR ESTIMATE				→ UNCHECKED ←
144 ±16	GOLOVATCH	19	DPWA	$\gamma p \to \pi^+\pi^- p$
107 ± 7	[1] HUNT	19	DPWA	Multichannel
135 ± 9	SOKHOYAN	15A	DPWA	Multichannel
146.9 ± 1.9	[1] ARNDT	06	DPWA	$\pi N \to \pi N$, ηN
140 ±20	CUTKOSKY	80	IPWA	$\pi N \to \pi N$
139 ±18	HOEHLER	79	IPWA	$\pi N \to \pi N$

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

130 ±11	ANISOVICH	12A	DPWA	Multichannel
112 ± 2	[1] SHRESTHA	12A	DPWA	Multichannel
202 ± 7	PENNER	02C	DPWA	Multichannel
143 ±42	VRANA	00	DPWA	Multichannel

[1] Statistical error only.

NODE=B082W;LINKAGE=A

$\Delta(1620)$ DECAY MODES

NODE=B082225;NODE=B082

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

NODE=B082

	Mode	Fraction (Γ_i/Γ)	
Γ_1	$N\pi$	25–35 %	DESIG=1;OUR EST
Γ_2	$N\pi\pi$	>67 %	DESIG=2;OUR EST
Γ_3	$\Delta(1232)\pi$, D-wave	44–72 %	DESIG=3;OUR EST
Γ_4	$N\rho$	23–32%	DESIG=182;OUR EST
Γ_5	$N\rho$, S=1/2, S-wave	23–32%	DESIG=4;OUR EST
Γ_6	$N\rho$, S=3/2, D-wave	<0.04%	DESIG=5;OUR EST
Γ_7	$N(1440)\pi$	<9 %	DESIG=6;OUR EST
Γ_8	$N\gamma$, helicity=1/2	0.03–0.10 %	DESIG=7;OUR EST

$\Delta(1620)$ BRANCHING RATIOS

NODE=B082230

$\Gamma(N\pi)/\Gamma_{total}$ — Γ_1/Γ

NODE=B082R1
NODE=B082R1

VALUE (%)	DOCUMENT ID		TECN	COMMENT
25 to 35 (≈ 30) OUR ESTIMATE				→ UNCHECKED ←
24 ±2	[1] HUNT	19	DPWA	Multichannel
28 ±3	SOKHOYAN	15A	DPWA	Multichannel
31.5±0.1	[1] ARNDT	06	DPWA	$\pi N \to \pi N$, ηN
25 ±3	CUTKOSKY	80	IPWA	$\pi N \to \pi N$
35 ±6	HOEHLER	79	IPWA	$\pi N \to \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
28 ±3	ANISOVICH	12A	DPWA	Multichannel
33 ±2	[1] SHRESTHA	12A	DPWA	Multichannel
34 ±1	PENNER	02C	DPWA	Multichannel
45 ±5	VRANA	00	DPWA	Multichannel

[1] Statistical error only.

NODE=B082R1;LINKAGE=A

$\Gamma(N\pi\pi)/\Gamma_{total}$ — Γ_2/Γ

NODE=B082R00
NODE=B082R00

VALUE	DOCUMENT ID		TECN	COMMENT
0.90±0.10	GOLOVATCH	19	DPWA	$\gamma p \to \pi^+\pi^- p$

$\Gamma(\Delta(1232)\pi, D\text{-wave})/\Gamma_{total}$ — Γ_3/Γ

NODE=B082R8
NODE=B082R8

VALUE (%)	DOCUMENT ID		TECN	COMMENT
48± 4	[1] HUNT	19	DPWA	Multichannel
62±10	SOKHOYAN	15A	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
60±17	ANISOVICH	12A	DPWA	Multichannel
32± 2	[1] SHRESTHA	12A	DPWA	Multichannel
39± 2	VRANA	00	DPWA	Multichannel

[1] Statistical error only.

NODE=B082R8;LINKAGE=A

$\Gamma(N\rho, S{=}1/2, S\text{-wave})/\Gamma_{total}$ — Γ_5/Γ

NODE=B082R6
NODE=B082R6

VALUE (%)	DOCUMENT ID		TECN	COMMENT
27±4	[1] HUNT	19	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
26±2	[1] SHRESTHA	12A	DPWA	Multichannel
14±3	VRANA	00	DPWA	Multichannel

[1] Statistical error only.

NODE=B082R6;LINKAGE=A

$\Gamma(N\rho, S{=}3/2, D\text{-wave})/\Gamma_{total}$ — Γ_6/Γ

NODE=B082R7
NODE=B082R7

VALUE (%)	DOCUMENT ID		TECN	COMMENT
<0.04	[1] HUNT	19	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
2 ±1	VRANA	00	DPWA	Multichannel

[1] Statistical error only.

NODE=B082R7;LINKAGE=A

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

NODE=B082R9
NODE=B082R9

VALUE (%)	DOCUMENT ID		TECN	COMMENT
<0.02	[1] HUNT	19	DPWA	Multichannel
6 ±3	SOKHOYAN	15A	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
9 ±1	[1] SHRESTHA	12A	DPWA	Multichannel
0 ±1	VRANA	00	DPWA	Multichannel

[1] Statistical error only.

NODE=B082R9;LINKAGE=A

$\Delta(1620)$ PHOTON DECAY AMPLITUDES AT THE POLE

NODE=B082260

$\Delta(1620) \rightarrow N\gamma$, helicity-1/2 amplitude $A_{1/2}$

NODE=B082PA1
NODE=B082PA1

MODULUS (GeV$^{-1/2}$)	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.011±0.002	57 ± 12	ROENCHEN	22	DPWA	Multichannel
0.054±0.007	−6 ± 7	SOKHOYAN	15A	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.014	26	ROENCHEN	15A	DPWA	Multichannel

$\Delta(1620)$ BREIT-WIGNER PHOTON DECAY AMPLITUDES

NODE=B082235

$\Delta(1620) \rightarrow N\gamma$, helicity-1/2 amplitude $A_{1/2}$

NODE=B082A1
NODE=B082A1

VALUE (GeV$^{-1/2}$)	DOCUMENT ID		TECN	COMMENT
0.030 to 0.060 (≈ 0.050) OUR ESTIMATE				→ UNCHECKED ←
0.029 ±0.0062	GOLOVATCH	19	DPWA	$\gamma p \rightarrow \pi^+\pi^- p$
0.0124±0.0007	[1] HUNT	19	DPWA	Multichannel
0.055 ±0.007	SOKHOYAN	15A	DPWA	Multichannel
0.029 ±0.003	[1] WORKMAN	12A	DPWA	$\gamma N \rightarrow N\pi$
0.050 ±0.002	[1] DUGGER	07	DPWA	$\gamma N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.052 ±0.005	ANISOVICH	12A	DPWA	Multichannel
−0.003 ±0.003	[1] SHRESTHA	12A	DPWA	Multichannel
0.066	DRECHSEL	07	DPWA	$\gamma N \rightarrow \pi N$
−0.050	PENNER	02D	DPWA	Multichannel

[1] Statistical error only.

NODE=B082A1;LINKAGE=A

$\Delta(1620)$ REFERENCES

NODE=B082

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

NODE=B082

ROENCHEN	22	EPJ A58 229	D. Roenchen *et al.*	(JULI, GWU, BONN+)	REFID=61999
GOLOVATCH	19	PL B788 371	E. Golovatch *et al.*	(CLAS Collab.)	REFID=59418
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
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
WORKMAN	12A	PR C86 015202	R. Workman *et al.*	(GWU)	REFID=54335
DRECHSEL	07	EPJ A34 69	D. Drechsel, S.S. Kamalov, L. Tiator	(MAINZ, JINR)	REFID=52105
DUGGER	07	PR C76 025211	M. Dugger *et al.*	(JLab CLAS Collab.)	REFID=52039
ARNDT	06	PR C74 045205	R.A. Arndt *et al.*	(GWU)	REFID=51535
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