NODE=B061

$N(1440)\ 1/2^+$

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

Older and obsolete values are listed and referenced in the 2014 edition, Chinese Physics **C38** 070001 (2014). NODE=B061

N(1440) POLE POSITION

NODE=B061215

REAL PART

NODE=B061RE
NODE=B061RE

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
1360 to 1380 (≈ 1370) OUR ESTIMATE				→ UNCHECKED ←
1366± 3	SARANTSEV	25	DPWA	Multichannel
1374± 3±4	[1] HOFERICHT...	24	RVUE	$\pi N \to \pi N$
1353± 1	ROENCHEN	22	DPWA	Multichannel
1363± 2±2	[2] SVARC	14	L+P	$\pi N \to \pi N$
1375±30	CUTKOSKY	80	IPWA	$\pi N \to \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
1360	HUNT	19	DPWA	Multichannel
1355	ROENCHEN	15A	DPWA	Multichannel
1369± 3	SOKHOYAN	15A	DPWA	Multichannel
1386	SHKLYAR	13	DPWA	Multichannel
1363±11	BATINIC	10	DPWA	$\pi N \to N\pi,\ N\eta$
1359	ARNDT	06	DPWA	$\pi N \to \pi N,\ \eta N$
1383	VRANA	00	DPWA	Multichannel
1385	HOEHLER	93	SPED	$\pi N \to \pi N$

[1] Roy-Steiner equations and Pade methods applied to πN scattering amplitudes and pionic atom data. NODE=B061RE;LINKAGE=A

[2] Fit to the amplitudes of HOEHLER 79. NODE=B061RE;LINKAGE=SV

−2×IMAGINARY PART

NODE=B061IM
NODE=B061IM

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
180 to 205 (≈ 190) OUR ESTIMATE				→ UNCHECKED ←
192± 4	SARANTSEV	25	DPWA	Multichannel
215±18±8	[1] HOFERICHT...	24	RVUE	$\pi N \to \pi N$
203± 2	ROENCHEN	22	DPWA	Multichannel
180± 4±5	[2] SVARC	14	L+P	$\pi N \to \pi N$
180±40	CUTKOSKY	80	IPWA	$\pi N \to \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
186	HUNT	19	DPWA	Multichannel
215	ROENCHEN	15A	DPWA	Multichannel
189± 5	SOKHOYAN	15A	DPWA	Multichannel
277	SHKLYAR	13	DPWA	Multichannel
151±13	BATINIC	10	DPWA	$\pi N \to N\pi,\ N\eta$
162	ARNDT	06	DPWA	$\pi N \to \pi N,\ \eta N$
316	VRANA	00	DPWA	Multichannel
164	HOEHLER	93	SPED	$\pi N \to \pi N$

[1] Roy-Steiner equations and Pade methods applied to πN scattering amplitudes and pionic atom data. NODE=B061IM;LINKAGE=B

[2] Fit to the amplitudes of HOEHLER 79. NODE=B061IM;LINKAGE=SV

N(1440) ELASTIC POLE RESIDUE

NODE=B061220

MODULUS $|r|$

NODE=B061RER
NODE=B061RER

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
50 to 60 (≈ 55) OUR ESTIMATE				→ UNCHECKED ←
58±15±17	[1] HOFERICHT...	24	RVUE	$\pi N \to \pi N$
59± 1	ROENCHEN	22	DPWA	Multichannel
49± 3	SOKHOYAN	15A	DPWA	Multichannel
50± 1± 2	[2] SVARC	14	L+P	$\pi N \to \pi N$
52± 5	CUTKOSKY	80	IPWA	$\pi N \to \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
62	ROENCHEN	15A	DPWA	Multichannel
126	SHKLYAR	13	DPWA	Multichannel
48± 3	ANISOVICH	12A	DPWA	Multichannel
44	BATINIC	10	DPWA	$\pi N \to N\pi,\ N\eta$
38	ARNDT	06	DPWA	$\pi N \to \pi N,\ \eta N$
40	HOEHLER	93	SPED	$\pi N \to \pi N$

[1] Roy-Steiner equations and Pade methods applied to πN scattering amplitudes and pionic atom data.
[2] Fit to the amplitudes of HOEHLER 79.

NODE=B061RER;LINKAGE=A
NODE=B061RER;LINKAGE=SV

PHASE θ

NODE=B061IMR
NODE=B061IMR

VALUE (°)	DOCUMENT ID		TECN	COMMENT
−100 to −80 (≈ − 90) OUR ESTIMATE				
→ UNCHECKED ←				
− 65± 2±11	[1] HOFERICHT...	24	RVUE	$\pi N \to \pi N$
−104± 2	ROENCHEN	22	DPWA	Multichannel
− 82± 5	SOKHOYAN	15A	DPWA	Multichannel
− 88± 1± 2	[2] SVARC	14	L+P	$\pi N \to \pi N$
−100±35	CUTKOSKY	80	IPWA	$\pi N \to \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
− 98	ROENCHEN	15A	DPWA	Multichannel
− 60	SHKLYAR	13	DPWA	Multichannel
− 78± 4	ANISOVICH	12A	DPWA	Multichannel
− 88	BATINIC	10	DPWA	$\pi N \to N\pi$, $N\eta$
− 98	ARNDT	06	DPWA	$\pi N \to \pi N$, ηN

[1] Roy-Steiner equations and Pade methods applied to πN scattering amplitudes and pionic atom data.
[2] Fit to the amplitudes of HOEHLER 79.

NODE=B061IMR;LINKAGE=A
NODE=B061IMR;LINKAGE=SV

$N(1440)$ INELASTIC POLE RESIDUE

NODE=B061250

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

NODE=B061250

Normalized residue in $N\pi \to N(1440) \to N\eta$

NODE=B061A02
NODE=B061A02

MODULUS	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.084±0.002	−28 ± 2	ROENCHEN	22	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.078	−27	ROENCHEN	15A	DPWA	Multichannel

Normalized residue in $N\pi \to N(1440) \to \Delta\pi$, P-wave

NODE=B061RS1
NODE=B061RS1

MODULUS	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.27±0.02	38 ± 5	SOKHOYAN	15A	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.27±0.02	40 ± 5	ANISOVICH	12A	DPWA	Multichannel

Normalized residue in $N\pi \to N(1440) \to \Lambda K$

NODE=B061A00
NODE=B061A00

MODULUS	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.025±0.005	−92 ± 43	ROENCHEN	22	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.016	145	ROENCHEN	15A	DPWA	Multichannel

Normalized residue in $N\pi \to N(1440) \to \Sigma K$

NODE=B061A01
NODE=B061A01

MODULUS	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.002±0.003	−32 ± 77	ROENCHEN	22	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.027	113	ROENCHEN	15A	DPWA	Multichannel

Normalized residue in $N\pi \to N(1440) \to N\,(\pi\pi)^{I=0}_{S-wave}$

NODE=B061RS2
NODE=B061RS2

MODULUS	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.21±0.04	−136 ± 4	SOKHOYAN	15A	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.21±0.05	−135 ± 7	ANISOVICH	12A	DPWA	Multichannel

$N(1440)$ BREIT-WIGNER MASS

NODE=B061M

NODE=B061M

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
1410 to 1470 (≈ 1440) OUR ESTIMATE				
→ UNCHECKED ←				
1410 ±10	SARANTSEV	25	DPWA	Multichannel
1417 ± 4	[1] HUNT	19	DPWA	Multichannel
1515 ±15	[1] SHKLYAR	13	DPWA	Multichannel
1485.0± 1.2	[1] ARNDT	06	DPWA	$\pi N \to \pi N$, ηN
1440 ±30	CUTKOSKY	80	IPWA	$\pi N \to \pi N$
1410 ±12	HOEHLER	79	IPWA	$\pi N \to \pi N$

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

1430 ±10		SOKHOYAN	15A	DPWA	Multichannel
1412 ± 2	[1]	SHRESTHA	12A	DPWA	Multichannel
1439 ±19		BATINIC	10	DPWA	$\pi N \to N\pi$, $N\eta$
1518 ± 5		PENNER	02C	DPWA	Multichannel
1479 ±80		VRANA	00	DPWA	Multichannel

[1] Statistical error only.

NODE=B061M;LINKAGE=A

$N(1440)$ BREIT-WIGNER WIDTH

NODE=B061W

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
250 to 450 (≈ 350) OUR ESTIMATE				
290± 30		SARANTSEV	25	DPWA Multichannel
257± 11	[1]	HUNT	19	DPWA Multichannel
605± 90	[1]	SHKLYAR	13	DPWA Multichannel
284± 18	[1]	ARNDT	06	DPWA $\pi N \to \pi N$, ηN
340± 70		CUTKOSKY	80	IPWA $\pi N \to \pi N$
135± 10		HOEHLER	79	IPWA $\pi N \to \pi N$

NODE=B061W

→ UNCHECKED ←

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

360± 30		SOKHOYAN	15A	DPWA	Multichannel
248± 5	[1]	SHRESTHA	12A	DPWA	Multichannel
437±141		BATINIC	10	DPWA	$\pi N \to N\pi$, $N\eta$
668± 41		PENNER	02C	DPWA	Multichannel
490±120		VRANA	00	DPWA	Multichannel

[1] Statistical error only.

NODE=B061W;LINKAGE=A

$N(1440)$ DECAY MODES

NODE=B061230;NODE=B061

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

NODE=B061

	Mode	Fraction (Γ_i/Γ)	
Γ_1	$N\pi$	55–75 %	DESIG=1;OUR EST
Γ_2	$N\eta$	< 1 %	DESIG=2;OUR EST
Γ_3	$N\pi\pi$	17–50 %	DESIG=4;OUR EST
Γ_4	$\Delta(1232)\pi$	6–27 %	DESIG=5;OUR EST
Γ_5	$N\rho$	(18±6) %	DESIG=186
Γ_6	$N\rho$, S=1/2	(9±4) %	DESIG=187
Γ_7	$N\rho$, S=3/2	(9±4) %	DESIG=188
Γ_8	$N\sigma$	11–23 %	DESIG=8;OUR EST
Γ_9	$p\gamma$, helicity=1/2	0.035–0.048 %	DESIG=9;OUR EST
Γ_{10}	$n\gamma$, helicity=1/2	0.02–0.04 %	DESIG=10;OUR EST

$N(1440)$ BRANCHING RATIOS

NODE=B061235

$\Gamma(N\pi)/\Gamma_{\text{total}}$ Γ_1/Γ

NODE=B061R1

VALUE (%)	*DOCUMENT ID*		*TECN*	*COMMENT*
55 to 75 (≈ 65) OUR ESTIMATE				
66 ±3		SEIFEN	25	DPWA Multichannel
59 ±2	[1]	HUNT	19	DPWA Multichannel
56 ±2	[1]	SHKLYAR	13	DPWA Multichannel
78.7±1.6	[1]	ARNDT	06	DPWA $\pi N \to \pi N$, ηN
68 ±4		CUTKOSKY	80	IPWA $\pi N \to \pi N$
51 ±5		HOEHLER	79	IPWA $\pi N \to \pi N$

NODE=B061R1

→ UNCHECKED ←

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

63 ±2		SOKHOYAN	15A	DPWA	Multichannel
64.8±0.9	[1]	SHRESTHA	12A	DPWA	Multichannel
62 ±4		BATINIC	10	DPWA	$\pi N \to N\pi$, $N\eta$
57 ±1		PENNER	02C	DPWA	Multichannel
72 ±5		VRANA	00	DPWA	Multichannel

[1] Statistical error only.

NODE=B061R1;LINKAGE=A

$\Gamma(N\eta)/\Gamma_{total}$ Γ_2/Γ

NODE=B061R7
NODE=B061R7

VALUE (%)	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0 ± 1	VRANA	00	DPWA	Multichannel

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

NODE=B061R8
NODE=B061R8

VALUE (%)	DOCUMENT ID		TECN	COMMENT
6 to 27 (≈ 15) OUR ESTIMATE				→ UNCHECKED ←
$15\ \pm7$	SARANTSEV	25	DPWA	Multichannel
$10\ \pm6$	SEIFEN	25	DPWA	Multichannel
$22\ \pm4$	[1] HUNT	19	DPWA	Multichannel
$12\ ^{+5}_{-3}$	SHKLYAR	16	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
$20\ \pm7$	SOKHOYAN	15A	DPWA	Multichannel
6.5 ± 0.8	[1] SHRESTHA	12A	DPWA	Multichannel
$16\ \pm1$	VRANA	00	DPWA	Multichannel

[1] Statistical error only.

NODE=B061R8;LINKAGE=A

$\Gamma(N\rho)/\Gamma_{total}$ Γ_5/Γ

NODE=B061R00
NODE=B061R00

VALUE (%)	DOCUMENT ID		TECN	COMMENT
18±6	SARANTSEV	25	DPWA	Multichannel

$\Gamma(N\rho, S{=}1/2)/\Gamma_{total}$ Γ_6/Γ

NODE=B061R01
NODE=B061R01

VALUE (%)	DOCUMENT ID		TECN	COMMENT
9±4	SARANTSEV	25	DPWA	Multichannel

$\Gamma(N\rho, S{=}3/2)/\Gamma_{total}$ Γ_7/Γ

NODE=B061R02
NODE=B061R02

VALUE (%)	DOCUMENT ID		TECN	COMMENT
9±4	SARANTSEV	25	DPWA	Multichannel

$\Gamma(N\sigma)/\Gamma_{total}$ Γ_8/Γ

NODE=B061R10
NODE=B061R10

VALUE (%)	DOCUMENT ID		TECN	COMMENT
15 ± 5	SARANTSEV	25	DPWA	Multichannel
17 ± 6	SEIFEN	25	DPWA	Multichannel
16 ± 3	[1] HUNT	19	DPWA	Multichannel
$27\ ^{+4}_{-9}$	SHKLYAR	16	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
17 ± 6	SOKHOYAN	15A	DPWA	Multichannel
27 ± 1	[1] SHRESTHA	12A	DPWA	Multichannel
12 ± 1	VRANA	00	DPWA	Multichannel

[1] Statistical error only.

NODE=B061R10;LINKAGE=A

$N(1440)$ PHOTON DECAY AMPLITUDES AT THE POLE

NODE=B061260

$N(1440) \rightarrow\ p\gamma$, helicity-1/2 amplitude $A_{1/2}$

NODE=B061PA1
NODE=B061PA1

MODULUS ($GeV^{-1/2}$)	PHASE (°)	DOCUMENT ID		TECN	COMMENT
-0.060 ± 0.006	$-30\ \pm7$	SARANTSEV	25	DPWA	Multichannel
-0.090 ± 0.007	$-30\ \pm3$	ROENCHEN	22	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •					
-0.060	-23	ROENCHEN	15A	DPWA	Multichannel
-0.044 ± 0.005	$-40\ \pm8$	SOKHOYAN	15A	DPWA	Multichannel

$N(1440) \rightarrow\ n\gamma$, helicity-1/2 amplitude $A_{1/2}$

NODE=B061PA2
NODE=B061PA2

MODULUS ($GeV^{-1/2}$)	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.041 ± 0.005	$23\ \pm10$	ANISOVICH	17E	DPWA	Multichannel

$N(1440)$ BREIT-WIGNER PHOTON DECAY AMPLITUDES

NODE=B061240

$N(1440) \rightarrow p\gamma$, helicity-1/2 amplitude $A_{1/2}$

NODE=B061A1
NODE=B061A1

VALUE ($GeV^{-1/2}$)	DOCUMENT ID		TECN	COMMENT
-0.080 to -0.050 (≈ -0.065) OUR ESTIMATE				
-0.076 ± 0.008	SARANTSEV	25	DPWA	Multichannel
-0.091 ± 0.007	[1] HUNT	19	DPWA	Multichannel
-0.085 ± 0.003	[1] SHKLYAR	13	DPWA	Multichannel
-0.056 ± 0.001	[1] WORKMAN	12A	DPWA	$\gamma N \rightarrow N\pi$
-0.051 ± 0.002	[1] DUGGER	07	DPWA	$\gamma N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
-0.061 ± 0.006	SOKHOYAN	15A	DPWA	Multichannel
-0.084 ± 0.003	[1] SHRESTHA	12A	DPWA	Multichannel
-0.061	DRECHSEL	07	DPWA	$\gamma N \rightarrow \pi N$
-0.087	PENNER	02D	DPWA	Multichannel

[1] Statistical error only.

NODE=B061A1;LINKAGE=A

$N(1440) \rightarrow n\gamma$, helicity-1/2 amplitude $A_{1/2}$

NODE=B061A2
NODE=B061A2

VALUE ($GeV^{-1/2}$)	DOCUMENT ID		TECN	COMMENT
0.035 to 0.055 ($\approx$ 0.045) OUR ESTIMATE				
0.013 ± 0.012	[1] HUNT	19	DPWA	Multichannel
0.053 ± 0.007	ANISOVICH	17E	DPWA	Multichannel
0.048 ± 0.004	[1] CHEN	12A	DPWA	$\gamma N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.043 ± 0.012	ANISOVICH	13B	DPWA	Multichannel
0.040 ± 0.005	[1] SHRESTHA	12A	DPWA	Multichannel
0.054	DRECHSEL	07	DPWA	$\gamma N \rightarrow \pi N$
0.121	PENNER	02D	DPWA	Multichannel

[1] Statistical error only.

NODE=B061A2;LINKAGE=A

$N(1440)$ REFERENCES

NODE=B061

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

NODE=B061

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
HOFERICHT...	24	PL B853 138698	M. Hoferichter *et al.*	(BERN, MADU, BONN+)	REFID=63010
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
ANISOVICH	17E	PR C96 055202	A.V. Anisovich *et al.*	(BONN, PNPI, JLAB+)	REFID=62311
SHKLYAR	16	PR C93 045206	V. Shklyar, H. Lenske, U. Mosel	(GIES)	REFID=58176
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	13B	EPJ A49 67	A.V. Anisovich *et al.*		REFID=56147
SHKLYAR	13	PR C87 015201	V. Shklyar, H. Lenske, U. Mosel	(GIES)	REFID=55104
ANISOVICH	12A	EPJ A48 15	A.V. Anisovich *et al.*	(BONN, PNPI)	REFID=54041
CHEN	12A	PR C86 015206	W. Chen *et al.*	(DUKE, GWU, MSST, ITEP+)	REFID=54337
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
BATINIC	10	PR C82 038203	M. Batinic *et al.*	(ZAGR)	REFID=53552
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