$N(1720)\ 3/2^+$

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

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

N(1720) POLE POSITION

REAL PART

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
1660 to 1690 (≈ 1675) OUR ESTIMATE				
1670±25	SOKHOYAN	15A	DPWA	Multichannel
1677± 4±1	[1] SVARC	14	L+P	$\pi N \to \pi N$
1680±30	CUTKOSKY	80	IPWA	$\pi N \to \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
1710	ROENCHEN	15A	DPWA	Multichannel
1670	SHKLYAR	13	DPWA	Multichannel
1660±30	ANISOVICH	12A	DPWA	Multichannel
1687	SHRESTHA	12A	DPWA	Multichannel
1691±23	BATINIC	10	DPWA	$\pi N \to N\pi,\ N\eta$
1666	ARNDT	06	DPWA	$\pi N \to \pi N,\ \eta N$
1692	VRANA	00	DPWA	Multichannel
1686	HOEHLER	93	SPED	$\pi N \to \pi N$

[1] Fit to the amplitudes of HOEHLER 79.

−2×IMAGINARY PART

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
150 to 400 (≈ 250) OUR ESTIMATE				
430±100	SOKHOYAN	15A	DPWA	Multichannel
184± 8±1	[1] SVARC	14	L+P	$\pi N \to \pi N$
120± 40	CUTKOSKY	80	IPWA	$\pi N \to \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
219	ROENCHEN	15A	DPWA	Multichannel
118	SHKLYAR	13	DPWA	Multichannel
450±100	ANISOVICH	12A	DPWA	Multichannel
175	SHRESTHA	12A	DPWA	Multichannel
233± 23	BATINIC	10	DPWA	$\pi N \to N\pi,\ N\eta$
355	ARNDT	06	DPWA	$\pi N \to \pi N,\ \eta N$
94	VRANA	00	DPWA	Multichannel
187	HOEHLER	93	SPED	$\pi N \to \pi N$

[1] Fit to the amplitudes of HOEHLER 79.

N(1720) ELASTIC POLE RESIDUE

MODULUS $|r|$

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
10 to 25 (≈ 15) OUR ESTIMATE				
26 ±10	SOKHOYAN	15A	DPWA	Multichannel
13 ± 1	[1] SVARC	14	L+P	$\pi N \to \pi N$
8 ± 2	CUTKOSKY	80	IPWA	$\pi N \to \pi N$

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

4.2	ROENCHEN	15A	DPWA	Multichannel
12	SHKLYAR	13	DPWA	Multichannel
22 ± 8	ANISOVICH	12A	DPWA	Multichannel
20	BATINIC	10	DPWA	$\pi N \rightarrow N\pi, N\eta$
25	ARNDT	06	DPWA	$\pi N \rightarrow \pi N, \eta N$
15	HOEHLER	93	SPED	$\pi N \rightarrow \pi N$

[1] Fit to the amplitudes of HOEHLER 79.

PHASE θ

VALUE (°)	DOCUMENT ID		TECN	COMMENT
−160 to −100 (≈ −130) OUR ESTIMATE				
−100±25	SOKHOYAN	15A	DPWA	Multichannel
−115± 3±2	[1] SVARC	14	L+P	$\pi N \rightarrow \pi N$
−160±30	CUTKOSKY	80	IPWA	$\pi N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
− 47	ROENCHEN	15A	DPWA	Multichannel
− 45	SHKLYAR	13	DPWA	Multichannel
−115±30	ANISOVICH	12A	DPWA	Multichannel
−109	BATINIC	10	DPWA	$\pi N \rightarrow N\pi, N\eta$
− 94	ARNDT	06	DPWA	$\pi N \rightarrow \pi N, \eta N$

[1] Fit to the amplitudes of HOEHLER 79.

$N(1720)$ INELASTIC POLE RESIDUE

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

Normalized residue in $N\pi \rightarrow N(1720) \rightarrow N\eta$

MODULUS	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.03 ±0.02		ANISOVICH	12A	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.007	106	ROENCHEN	15A	DPWA	Multichannel

Normalized residue in $N\pi \rightarrow N(1720) \rightarrow \Lambda K$

MODULUS	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.06 ±0.04	−150 ± 45	ANISOVICH	12A	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.011	−70	ROENCHEN	15A	DPWA	Multichannel

Normalized residue in $N\pi \rightarrow N(1720) \rightarrow \Sigma K$

MODULUS	PHASE (°)	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.002	79	ROENCHEN	15A	DPWA	Multichannel

Normalized residue in $N\pi \rightarrow N(1720) \rightarrow \Delta\pi$, P-wave

MODULUS	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.28±0.09	95 ± 30	SOKHOYAN	15A	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.29±0.08	80 ± 40	ANISOVICH	12A	DPWA	Multichannel

Normalized residue in $N\pi \rightarrow N(1720) \rightarrow \Delta\pi$, F-wave

MODULUS	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.07±0.05		SOKHOYAN	15A	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.03±0.03		ANISOVICH	12A	DPWA	Multichannel

Normalized residue in $N\pi \rightarrow N(1720) \rightarrow N\sigma$

MODULUS	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.08±0.04	−110 ± 35	SOKHOYAN	15A	DPWA	Multichannel

Normalized residue in $N\pi \rightarrow N(1720) \rightarrow N(1520)\pi$, S-wave

MODULUS	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.05±0.04	undefined	SOKHOYAN	15A	DPWA	Multichannel

N(1720) BREIT-WIGNER MASS

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
1680 to 1750 (≈ 1720) OUR ESTIMATE				
1690 ± 30	SOKHOYAN	15A	DPWA	Multichannel
1700 ± 10	[1] SHKLYAR	13	DPWA	Multichannel
1720 ± 5	[1] SHRESTHA	12A	DPWA	Multichannel
1763.8± 4.6	ARNDT	06	DPWA	$\pi N \rightarrow \pi N, \eta N$
1700 ± 50	CUTKOSKY	80	IPWA	$\pi N \rightarrow \pi N$
1710 ± 20	HOEHLER	79	IPWA	$\pi N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
1690 $^{+70}_{-35}$	ANISOVICH	12A	DPWA	Multichannel
1720 ± 18	BATINIC	10	DPWA	$\pi N \rightarrow N\pi, N\eta$
1705 ± 10	PENNER	02C	DPWA	Multichannel
1716 ±112	VRANA	00	DPWA	Multichannel

[1] Statistical error only.

N(1720) BREIT-WIGNER WIDTH

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
150 to 400 (≈ 250) OUR ESTIMATE				
420± 80	SOKHOYAN	15A	DPWA	Multichannel
152± 2	[1] SHKLYAR	13	DPWA	Multichannel
200± 20	[1] SHRESTHA	12A	DPWA	Multichannel
210± 22	ARNDT	06	DPWA	$\pi N \rightarrow \pi N, \eta N$
125± 70	CUTKOSKY	80	IPWA	$\pi N \rightarrow \pi N$
190± 30	HOEHLER	79	IPWA	$\pi N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
420±100	ANISOVICH	12A	DPWA	Multichannel
244± 28	BATINIC	10	DPWA	$\pi N \rightarrow N\pi, N\eta$
237± 73	PENNER	02C	DPWA	Multichannel
121± 39	VRANA	00	DPWA	Multichannel

[1] Statistical error only.

N(1720) DECAY MODES

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

	Mode	Fraction (Γ_i/Γ)
Γ_1	$N\pi$	8–14 %
Γ_2	$N\eta$	1–5 %
Γ_3	$N\omega$	12–40 %
Γ_4	ΛK	4–5 %
Γ_5	$N\pi\pi$	50–90 %
Γ_6	$\Delta(1232)\pi$	47–89 %
Γ_7	$\Delta(1232)\pi$, P-wave	47–77 %
Γ_8	$\Delta(1232)\pi$, F-wave	<12 %
Γ_9	$N\rho$	
Γ_{10}	$N\rho$, S=1/2, P-wave	1–2 %
Γ_{11}	$N\sigma$	2–14 %
Γ_{12}	$N(1440)\pi$	<2 %
Γ_{13}	$N(1520)\pi$, S-wave	1–5 %
Γ_{14}	$p\gamma$	0.05–0.25 %
Γ_{15}	$p\gamma$, helicity=1/2	0.05–0.15 %
Γ_{16}	$p\gamma$, helicity=3/2	0.002–0.16 %
Γ_{17}	$n\gamma$	0.0–0.016 %
Γ_{18}	$n\gamma$, helicity=1/2	0.0–0.01 %
Γ_{19}	$n\gamma$, helicity=3/2	0.0–0.015 %

N(1720) BRANCHING RATIOS

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

VALUE (%)	*DOCUMENT ID*		*TECN*	*COMMENT*
8 to 14 (≈ 11) OUR ESTIMATE				
11 ±4	SOKHOYAN	15A	DPWA	Multichannel
17 ±2	[1] SHKLYAR	13	DPWA	Multichannel
13.6±0.6	[1] SHRESTHA	12A	DPWA	Multichannel
9.4±0.5	ARNDT	06	DPWA	$\pi N \to \pi N, \eta N$
10 ±4	CUTKOSKY	80	IPWA	$\pi N \to \pi N$
14 ±3	HOEHLER	79	IPWA	$\pi N \to \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
10 ±5	ANISOVICH	12A	DPWA	Multichannel
18 ±3	BATINIC	10	DPWA	$\pi N \to N\pi, N\eta$
17 ±2	PENNER	02C	DPWA	Multichannel
5 ±5	VRANA	00	DPWA	Multichannel

[1] Statistical error only.

$\Gamma(N\eta)/\Gamma_{\text{total}}$ Γ_2/Γ

VALUE (%)	DOCUMENT ID		TECN	COMMENT
1 to 5 (≈ 3) OUR ESTIMATE				
< 1	SHKLYAR	13	DPWA	Multichannel
3 ±2	ANISOVICH	12A	DPWA	Multichannel
< 1	[1] SHRESTHA	12A	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0 ±1	BATINIC	10	DPWA	$\pi N \to N\pi, N\eta$
10 ±7	THOMA	08	DPWA	Multichannel
0.2±0.2	PENNER	02C	DPWA	Multichannel
4 ±1	VRANA	00	DPWA	Multichannel

[1] Statistical error only.

$\Gamma(N\omega)/\Gamma_{\text{total}}$ Γ_3/Γ

VALUE (%)	DOCUMENT ID		TECN	COMMENT
26±14	DENISENKO	16	DPWA	Multichannel

$\Gamma(\Lambda K)/\Gamma_{\text{total}}$ Γ_4/Γ

VALUE (%)	DOCUMENT ID		TECN	COMMENT
2.8±0.4	[1] SHRESTHA	12A	DPWA	Multichannel
4.3±0.4	SHKLYAR	05	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
12 ±9	THOMA	08	DPWA	Multichannel
9 ±3	PENNER	02C	DPWA	Multichannel

[1] Statistical error only.

$\Gamma(\Delta(1232)\pi, P\text{-wave})/\Gamma_{\text{total}}$ Γ_7/Γ

VALUE (%)	DOCUMENT ID		TECN	COMMENT
62±15	SOKHOYAN	15A	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
75±15	ANISOVICH	12A	DPWA	Multichannel

$\Gamma(\Delta(1232)\pi, F\text{-wave})/\Gamma_{\text{total}}$ Γ_8/Γ

VALUE (%)	DOCUMENT ID		TECN	COMMENT
6±6	SOKHOYAN	15A	DPWA	Multichannel

$\Gamma(N\rho, S{=}1/2, P\text{-wave})/\Gamma_{\text{total}}$ Γ_{10}/Γ

VALUE (%)	DOCUMENT ID		TECN	COMMENT
1.4±0.5	[1] SHRESTHA	12A	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
91 ±1	VRANA	00	DPWA	Multichannel

[1] Statistical error only.

$\Gamma(N\sigma)/\Gamma_{\text{total}}$ Γ_{11}/Γ

VALUE (%)	DOCUMENT ID		TECN	COMMENT
8±6	SOKHOYAN	15A	DPWA	Multichannel

$\Gamma(N(1440)\pi)/\Gamma_{total}$ Γ_{12}/Γ

VALUE (%)	DOCUMENT ID		TECN	COMMENT
<2	SOKHOYAN	15A	DPWA	Multichannel

$\Gamma(N(1520)\pi, S\text{-wave})/\Gamma_{total}$ Γ_{13}/Γ

VALUE (%)	DOCUMENT ID		TECN	COMMENT
3±2	SOKHOYAN	15A	DPWA	Multichannel

N(1720) PHOTON DECAY AMPLITUDES AT THE POLE

N(1720) → pγ, helicity-1/2 amplitude $A_{1/2}$

MODULUS ($GeV^{-1/2}$)	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.115±0.045	0 ± 35	SOKHOYAN	15A	DPWA	Multichannel
$0.051^{+0.005}_{-0.004}$	57^{+9}_{-4}	ROENCHEN	14	DPWA	
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.039	5.3	ROENCHEN	15A	DPWA	Multichannel

N(1720) → pγ, helicity-3/2 amplitude $A_{3/2}$

MODULUS ($GeV^{-1/2}$)	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.140±0.040	65 ± 35	SOKHOYAN	15A	DPWA	Multichannel
$0.014^{+0.009}_{-0.003}$	102^{+29}_{-59}	ROENCHEN	14	DPWA	
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.032	66	ROENCHEN	15A	DPWA	Multichannel

N(1720) BREIT-WIGNER PHOTON DECAY AMPLITUDES

N(1720) → pγ, helicity-1/2 amplitude $A_{1/2}$

VALUE ($GeV^{-1/2}$)	DOCUMENT ID		TECN	COMMENT
0.080 to 0.120 (≈ 0.100) OUR ESTIMATE				
0.115±0.045	SOKHOYAN	15A	DPWA	Multichannel
−0.065±0.002	[1] SHKLYAR	13	DPWA	Multichannel
0.095±0.002	WORKMAN	12A	DPWA	$\gamma N \to N\pi$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.110±0.045	ANISOVICH	12A	DPWA	Multichannel
0.057±0.003	[1] SHRESTHA	12A	DPWA	Multichannel
0.073	DRECHSEL	07	DPWA	$\gamma N \to \pi N$
0.097±0.003	DUGGER	07	DPWA	$\gamma N \to \pi N$
−0.053	PENNER	02D	DPWA	Multichannel

[1] Statistical error only.

N(1720) → pγ, helicity-3/2 amplitude $A_{3/2}$

VALUE ($GeV^{-1/2}$)	DOCUMENT ID		TECN	COMMENT
0.135±0.040	SOKHOYAN	15A	DPWA	Multichannel
0.035±0.002	[1] SHKLYAR	13	DPWA	Multichannel
−0.048±0.002	WORKMAN	12A	DPWA	$\gamma N \to N\pi$

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

0.150±0.030	ANISOVICH	12A	DPWA	Multichannel
−0.019±0.002	[1] SHRESTHA	12A	DPWA	Multichannel
−0.011	DRECHSEL	07	DPWA	$\gamma N \rightarrow \pi N$
−0.039±0.003	DUGGER	07	DPWA	$\gamma N \rightarrow \pi N$
0.027	PENNER	02D	DPWA	Multichannel

[1] Statistical error only.

$N(1720) \rightarrow n\gamma$, helicity-1/2 amplitude $A_{1/2}$

VALUE ($GeV^{-1/2}$)	*DOCUMENT ID*		*TECN*	*COMMENT*
−0.080±0.050	ANISOVICH	13B	DPWA	Multichannel

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

−0.002±0.001	[1] SHRESTHA	12A	DPWA	Multichannel
−0.003	DRECHSEL	07	DPWA	$\gamma N \rightarrow \pi N$
−0.004	PENNER	02D	DPWA	Multichannel

[1] Statistical error only.

$N(1720) \rightarrow n\gamma$, helicity-3/2 amplitude $A_{3/2}$

VALUE ($GeV^{-1/2}$)	*DOCUMENT ID*		*TECN*	*COMMENT*
−0.140±0.065	ANISOVICH	13B	DPWA	Multichannel

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

−0.001±0.002	[1] SHRESTHA	12A	DPWA	Multichannel
−0.031	DRECHSEL	07	DPWA	$\gamma N \rightarrow \pi N$
0.003	PENNER	02D	DPWA	Multichannel

[1] Statistical error only.

$N(1720)$ REFERENCES

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

DENISENKO	16	PL B755 97	I. Denisenko *et al.*	
ROENCHEN	15A	EPJ A51 70	D. Roenchen *et al.*	
SOKHOYAN	15A	EPJ A51 95	V. Sokhoyan *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.*	(RBI Zagreb, UNI Tuzla)
ANISOVICH	13B	EPJ A49 67	A.V. Anisovich *et al.*	
SHKLYAR	13	PR C87 015201	V. Shklyar, H. Lenske, U. Mosel	(GIES)
ANISOVICH	12A	EPJ A48 15	A.V. Anisovich *et al.*	(BONN, PNPI)
SHRESTHA	12A	PR C86 055203	M. Shrestha, D.M. Manley	(KSU)
WORKMAN	12A	PR C86 015202	R. Workman *et al.*	(GWU)
BATINIC	10	PR C82 038203	M. Batinic *et al.*	(ZAGR)
THOMA	08	PL B659 87	U. Thoma *et al.*	(CB-ELSA Collab.)
DRECHSEL	07	EPJ A34 69	D. Drechsel, S.S. Kamalov, L. Tiator	(MAINZ, JINR)
DUGGER	07	PR C76 025211	M. Dugger *et al.*	(JLab CLAS Collab.)
ARNDT	06	PR C74 045205	R.A. Arndt *et al.*	(GWU)
SHKLYAR	05	PR C72 015210	V. Shklyar, H. Lenske, U. Mosel	(GIES)
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