

$N(1990) 7/2^+$ $I(J^P) = \frac{1}{2}(7^+)$ Status: **

OMITTED FROM SUMMARY TABLE

Older and obsolete values are listed and referenced in the 2014 edition, Chinese Physics **C38** 070001 (2014). **$N(1990)$ POLE POSITION****REAL PART**

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
2005 ± 25	SARANTSEV 25	DPWA	Multichannel
1861 ± 5	ROENCHEN 22	DPWA	Multichannel
1900 ± 30	CUTKOSKY 80	IPWA	$\pi N \rightarrow \pi N$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
1913	HUNT 19	DPWA	Multichannel
1738	ROENCHEN 15A	DPWA	Multichannel
2030 ± 65	ANISOVICH 12A	DPWA	Multichannel
2301	VRANA 00	DPWA	Multichannel

−2×IMAGINARY PART

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
270 ± 30	SARANTSEV 25	DPWA	Multichannel
72 ± 3	ROENCHEN 22	DPWA	Multichannel
260 ± 60	CUTKOSKY 80	IPWA	$\pi N \rightarrow \pi N$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
163	HUNT 19	DPWA	Multichannel
188	ROENCHEN 15A	DPWA	Multichannel
240 ± 60	ANISOVICH 12A	DPWA	Multichannel
202	VRANA 00	DPWA	Multichannel

 $N(1990)$ ELASTIC POLE RESIDUE**MODULUS $|r|$**

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
0.16 ± 0.01	ROENCHEN 22	DPWA	Multichannel
2 ± 1	ANISOVICH 12A	DPWA	Multichannel
9 ± 3	CUTKOSKY 80	IPWA	$\pi N \rightarrow \pi N$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
4.3	ROENCHEN 15A	DPWA	Multichannel

PHASE θ

<u>VALUE (°)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
−119 ± 2	ROENCHEN 22	DPWA	Multichannel
125 ± 65	ANISOVICH 12A	DPWA	Multichannel
−60 ± 30	CUTKOSKY 80	IPWA	$\pi N \rightarrow \pi N$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
−70	ROENCHEN 15A	DPWA	Multichannel

$\Delta(1990)$ INELASTIC POLE RESIDUE

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

Normalized residue in $N\pi \rightarrow N(1990) \rightarrow N\eta$

<u>MODULUS</u>	<u>PHASE ($^\circ$)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
0.048±0.001	−43 ± 2	ROENCHEN	22	DPWA Multichannel
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
0.013	−82	ROENCHEN	15A	DPWA Multichannel

Normalized residue in $N\pi \rightarrow N(1990) \rightarrow \Lambda K$

<u>MODULUS</u>	<u>PHASE ($^\circ$)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
0.004±0.001	133 ± 2	ROENCHEN	22	DPWA Multichannel
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
0.022	−111	ROENCHEN	15A	DPWA Multichannel

Normalized residue in $N\pi \rightarrow N(1990) \rightarrow \Sigma K$

<u>MODULUS</u>	<u>PHASE ($^\circ$)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
0.010±0.002	−54 ± 2	ROENCHEN	22	DPWA Multichannel
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
0.005	24	ROENCHEN	15A	DPWA Multichannel

 $N(1990)$ BREIT-WIGNER MASS

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
1950 to 2100 (\approx 2020) OUR ESTIMATE			
2020 ± 25	SARANTSEV 25	DPWA	Multichannel
2028 ± 19	¹ HUNT 19	DPWA	Multichannel
1970 ± 50	CUTKOSKY 80	IPWA	$\pi N \rightarrow \pi N$
2005 ± 150	HOEHLER 79	IPWA	$\pi N \rightarrow \pi N$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
2060 ± 65	ANISOVICH 12A	DPWA	Multichannel
1990 ± 45	¹ SHRESTHA 12A	DPWA	Multichannel
2311 ± 16	VRANA 00	DPWA	Multichannel

¹Statistical error only.

 $N(1990)$ BREIT-WIGNER WIDTH

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
200 to 400 (\approx 300) OUR ESTIMATE			
280 ± 30	SARANTSEV 25	DPWA	Multichannel
490 ± 110	¹ HUNT 19	DPWA	Multichannel
350 ± 120	CUTKOSKY 80	IPWA	$\pi N \rightarrow \pi N$
350 ± 100	HOEHLER 79	IPWA	$\pi N \rightarrow \pi N$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
240 ± 50	ANISOVICH 12A	DPWA	Multichannel
203 ± 161	¹ SHRESTHA 12A	DPWA	Multichannel
205 ± 72	VRANA 00	DPWA	Multichannel

¹Statistical error only.

N(1990) DECAY MODES

Mode	Fraction (Γ_i/Γ)
Γ_1 $N\pi$	2–6 %
Γ_2 $N\eta$	<3 %
Γ_3 ΛK	5.9–6.1 %
Γ_4 $N\pi\pi$	
Γ_5 $\Delta\pi$	(72 ± 15) %
Γ_6 $\Delta\pi, F\text{-wave}$	
Γ_7 $N\rho$	(10 ± 5) %
Γ_8 $N\rho, S=1/2$	(8 ± 4) %
Γ_9 $N\rho, S=3/2, F\text{-wave}$	(2.0 ± 2.0) %
Γ_{10} $N(1440)\pi$	< 2 %
Γ_{11} $N(1520)\pi, P\text{-wave}$	< 2 %
Γ_{12} $N(1535)\pi$	< 2 %
Γ_{13} $p\gamma$	0.01–0.12%
Γ_{14} $p\gamma, \text{helicity}=1/2$	0.003–0.042%
Γ_{15} $p\gamma, \text{helicity}=3/2$	0.009–0.075 %
Γ_{16} $n\gamma$	0.01–0.16 %
Γ_{17} $n\gamma, \text{helicity}=1/2$	0.003–0.066 %
Γ_{18} $n\gamma, \text{helicity}=3/2$	0.003–0.098 %

N(1990) BRANCHING RATIOS

$\Gamma(N\pi)/\Gamma_{\text{total}}$	Γ_1/Γ
<u>VALUE (%)</u>	<u>DOCUMENT ID</u> <u>TECN</u> <u>COMMENT</u>
2–6 % OUR ESTIMATE	
1 ± 1	SEIFEN 25 DPWA Multichannel
1.9 ± 0.4	¹ HUNT 19 DPWA Multichannel
6 ± 2	CUTKOSKY 80 IPWA $\pi N \rightarrow \pi N$
4 ± 2	HOEHLER 79 IPWA $\pi N \rightarrow \pi N$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●	
2 ± 1	ANISOVICH 12A DPWA Multichannel
2 ± 1	¹ SHRESTHA 12A DPWA Multichannel
22 ± 11	VRANA 00 DPWA Multichannel
¹ Statistical error only.	
$\Gamma(N\eta)/\Gamma_{\text{total}}$	Γ_2/Γ
<u>VALUE (%)</u>	<u>DOCUMENT ID</u> <u>TECN</u> <u>COMMENT</u>
<3 % OUR ESTIMATE	
1 ± 1	MUELLER 20 DPWA Multichannel
1.7 ± 0.9	¹ HUNT 19 DPWA Multichannel
¹ Statistical error only.	
$\Gamma(\Lambda K)/\Gamma_{\text{total}}$	Γ_3/Γ
<u>VALUE (%)</u>	<u>DOCUMENT ID</u> <u>TECN</u> <u>COMMENT</u>
5.9–6.1 % OUR ESTIMATE	
6.0 ± 0.1	¹ HUNT 19 DPWA Multichannel

¹Statistical error only.

$\Gamma(\Delta\pi)/\Gamma_{\text{total}}$					Γ_5/Γ
VALUE (%)	DOCUMENT ID	TECN	COMMENT		
72±15	SARANTSEV 25	DPWA	Multichannel		
$\Gamma(\Delta\pi, F\text{-wave})/\Gamma_{\text{total}}$					Γ_6/Γ
VALUE (%)	DOCUMENT ID	TECN	COMMENT		
72±15	SARANTSEV 25	DPWA	Multichannel		
65±20	SEIFEN 25	DPWA	Multichannel		
$\Gamma(N\rho)/\Gamma_{\text{total}}$					Γ_7/Γ
VALUE (%)	DOCUMENT ID	TECN	COMMENT		
10±5	SARANTSEV 25	DPWA	Multichannel		
$\Gamma(N\rho, S=1/2)/\Gamma_{\text{total}}$					Γ_8/Γ
VALUE (%)	DOCUMENT ID	TECN	COMMENT		
8±4	SARANTSEV 25	DPWA	Multichannel		
$\Gamma(N\rho, S=3/2, F\text{-wave})/\Gamma_{\text{total}}$					Γ_9/Γ
VALUE (%)	DOCUMENT ID	TECN	COMMENT		
2±2	SARANTSEV 25	DPWA	Multichannel		
$\Gamma(N(1440)\pi)/\Gamma_{\text{total}}$					Γ_{10}/Γ
VALUE (%)	DOCUMENT ID	TECN	COMMENT		
<2	SEIFEN 25	DPWA	Multichannel		
$\Gamma(N(1520)\pi, P\text{-wave})/\Gamma_{\text{total}}$					Γ_{11}/Γ
VALUE (%)	DOCUMENT ID	TECN	COMMENT		
<2	SEIFEN 25	DPWA	Multichannel		
$\Gamma(N(1535)\pi)/\Gamma_{\text{total}}$					Γ_{12}/Γ
VALUE (%)	DOCUMENT ID	TECN	COMMENT		
<2	SEIFEN 25	DPWA	Multichannel		

$N(1990)$ PHOTON DECAY AMPLITUDES AT THE POLE

$N(1990) \rightarrow p\gamma$, helicity-1/2 amplitude $A_{1/2}$

MODULUS ($\text{GeV}^{-1/2}$)	PHASE ($^\circ$)	DOCUMENT ID	TECN	COMMENT
0.011±0.006	40 ± 20	SARANTSEV 25	DPWA	Multichannel
-0.030±0.008	-135 ± 13	ROENCHEN 22	DPWA	Multichannel
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
0.029	67	ROENCHEN 15A	DPWA	Multichannel

$N(1990) \rightarrow p\gamma$, helicity-3/2 amplitude $A_{3/2}$

MODULUS ($\text{GeV}^{-1/2}$)	PHASE ($^\circ$)	DOCUMENT ID	TECN	COMMENT
0.017±0.008	90 ± 25	SARANTSEV 25	DPWA	Multichannel
-0.018±0.006	53 ± 16	ROENCHEN 22	DPWA	Multichannel
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
0.033	39	ROENCHEN 15A	DPWA	Multichannel

$N(1990) \rightarrow n\gamma$, helicity-1/2 amplitude $A_{1/2}$

<u>MODULUS ($\text{GeV}^{-1/2}$)</u>	<u>PHASE ($^\circ$)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
-0.032 ± 0.015	5 ± 20	ANISOVICH	17E	DPWA Multichannel

 $N(1990) \rightarrow n\gamma$, helicity-3/2 amplitude $A_{3/2}$

<u>MODULUS ($\text{GeV}^{-1/2}$)</u>	<u>PHASE ($^\circ$)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
-0.070 ± 0.025	0 ± 20	ANISOVICH	17E	DPWA Multichannel

 $N(1990)$ BREIT-WIGNER PHOTON DECAY AMPLITUDES **$N(1990) \rightarrow p\gamma$, helicity-1/2 amplitude $A_{1/2}$**

<u>VALUE ($\text{GeV}^{-1/2}$)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
0.012 ± 0.010	SARANTSEV 25	DPWA	Multichannel
0.006 ± 0.003	¹ HUNT 19	DPWA	Multichannel
0.040 ± 0.012	ANISOVICH 12A	DPWA	Multichannel

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

¹Statistical error only.

 $N(1990) \rightarrow p\gamma$, helicity-3/2 amplitude $A_{3/2}$

<u>VALUE ($\text{GeV}^{-1/2}$)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
0.017 ± 0.008	¹ SARANTSEV 25	DPWA	Multichannel
-0.055 ± 0.008	² HUNT 19	DPWA	Multichannel

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

0.057 ± 0.012 ANISOVICH 12A DPWA Multichannel

¹Sign is undetermined.

²Statistical error only.

 $N(1990) \rightarrow n\gamma$, helicity-1/2 amplitude $A_{1/2}$

<u>VALUE ($\text{GeV}^{-1/2}$)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
-0.027 ± 0.024	¹ HUNT 19	DPWA	Multichannel
-0.032 ± 0.015	ANISOVICH 17E	DPWA	Multichannel

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

-0.045 ± 0.020 ANISOVICH 13B DPWA Multichannel

¹Statistical error only.

 $N(1990) \rightarrow n\gamma$, helicity-3/2 amplitude $A_{3/2}$

<u>VALUE ($\text{GeV}^{-1/2}$)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
0.051 ± 0.020	¹ HUNT 19	DPWA	Multichannel
-0.072 ± 0.025	ANISOVICH 17E	DPWA	Multichannel

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

-0.052 ± 0.027 ANISOVICH 13B DPWA Multichannel

¹Statistical error only.

N(1990) REFERENCES

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

SARANTSEV	25	PR C112 015202	A.V. Sarantsev <i>et al.</i>	(Bonn-Gatchina Collab.)
SEIFEN	25	EPJ A61 173	T. Seifen <i>et al.</i>	(CBELSA/TAPS Collab.)
ROENCHEN	22	EPJ A58 229	D. Roenchen <i>et al.</i>	(JULI, GWU, BONN+)
MUELLER	20	PL B803 135323	J. Mueller <i>et al.</i>	(CBELSA/TAPS Collab.)
HUNT	19	PR C99 055205	B.C. Hunt, D.M. Manley	
ANISOVICH	17E	PR C96 055202	A.V. Anisovich <i>et al.</i>	(BONN, PNPI, JLAB+)
ROENCHEN	15A	EPJ A51 70	D. Roenchen <i>et al.</i>	
PDG	14	CP C38 070001	K. Olive <i>et al.</i>	(PDG Collab.)
ANISOVICH	13B	EPJ A49 67	A.V. Anisovich <i>et al.</i>	
ANISOVICH	12A	EPJ A48 15	A.V. Anisovich <i>et al.</i>	(BONN, PNPI)
SHRESTHA	12A	PR C86 055203	M. Shrestha, D.M. Manley	(KSU)
VRANA	00	PRPL 328 181	T.P. Vrana, S.A. Dytman, T.-S.H. Lee	(PITT, ANL)
CUTKOSKY	80	Toronto Conf. 19	R.E. Cutkosky <i>et al.</i>	(CMU, LBL) IJP
Also		PR D20 2839	R.E. Cutkosky <i>et al.</i>	(CMU, LBL) IJP
HOEHLER	79	PDAT 12-1	G. Hohler <i>et al.</i>	(KARLT) IJP
Also		Toronto Conf. 3	R. Koch	(KARLT) IJP
