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

Most of the results published before 1975 were last included in our 1982 edition, Physics Letters **111B** 1 (1982). Some further obsolete results published before 1984 were last included in our 2006 edition, Journal of Physics (generic for all A,B,E,G) **G33** 1 (2006).

The latest GWU analysis (ARNDT 06) finds no evidence for this resonance.

N(1710) BREIT-WIGNER MASS

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT		
1680 to 1740 (\approx 1710) OUR ESTIMATE						
1737 ± 17	SHKLYAR	13	DPWA	Multichannel		
1710 ± 20	ANISOVICH	12A	DPWA	Multichannel		
1700 ± 50	CUTKOSKY	80	IPWA	$\pi N \rightarrow \pi N$		
1723± 9	HOEHLER	79	IPWA	$\pi N \rightarrow \pi N$		
\bullet \bullet \bullet We do not use the following	data for averages	, fits,	limits, e	tc. ● ● ●		
$1662\pm$ 7	SHRESTHA	12A	DPWA	Multichannel		
1725 ± 25	ANISOVICH	10	DPWA	Multichannel		
1729 ± 16	¹ BATINIC	10	DPWA	$\pi N \rightarrow N \pi, N \eta$		
$1752\pm$ 3	PENNER	02C	DPWA	Multichannel		
1699 ± 65	VRANA	00	DPWA	Multichannel		
1720 ± 10	ARNDT	96	IPWA	$\gamma N \rightarrow \pi N$		
1717 ± 28	MANLEY	92	IPWA	$\pi N \rightarrow \pi N \& N \pi \pi$		
1706	CUTKOSKY	90	IPWA	$\pi N \rightarrow \pi N$		
1730	SAXON	80	DPWA	$\pi^- p \rightarrow \Lambda K^0$		
1720	² LONGACRE	77	IPWA	$\pi N \rightarrow N \pi \pi$		
1710	³ LONGACRE	75	IPWA	$\pi N \rightarrow N \pi \pi$		

N(1710) BREIT-WIGNER WIDTH

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
50 to 250 (\approx 100) OUR ESTIMA	TE			
368 ± 120	SHKLYAR	13	DPWA	Multichannel
$200\pm~18$	ANISOVICH	12A	DPWA	Multichannel
93± 30	CUTKOSKY	90	IPWA	$\pi N \rightarrow \pi N$
90± 30	CUTKOSKY	80	IPWA	$\pi N \rightarrow \pi N$
$120\pm~15$	HOEHLER	79	IPWA	$\pi N \rightarrow \pi N$
$\bullet~\bullet~\bullet$ We do not use the following	data for averages	, fits,	limits, e	tc. ● ● ●
116± 17	SHRESTHA	12A	DPWA	Multichannel
$200\pm$ 35	ANISOVICH	10	DPWA	Multichannel
$180\pm~17$	¹ BATINIC	10	DPWA	$\pi N ightarrow N \pi$, $N \eta$
$386\pm$ 59	PENNER	02C	DPWA	Multichannel
143 ± 100	VRANA	00	DPWA	Multichannel
$105\pm~10$	ARNDT	96	IPWA	$\gamma N \rightarrow \pi N$

480±230	MANLEY	92	IPWA $\pi N \rightarrow \pi N \& N \pi \pi$
540	BELL	83	DPWA $\pi^- p \rightarrow \Lambda K^0$
550	SAXON	80	DPWA $\pi^- p \rightarrow \Lambda K^0$
120	² LONGACRE	77	IPWA $\pi N \rightarrow N \pi \pi$
75	³ LONGACRE	75	IPWA $\pi N \rightarrow N \pi \pi$

N(1710) POLE POSITION

REAL PART				
VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
1670 to 1770 (≈ 1720) OUR ESTI	MATE			
1687 ± 17	ANISOVICH	12A	DPWA	Multichannel
1690	⁴ HOEHLER	93	SPED	$\pi N \rightarrow \pi N$
1698	CUTKOSKY	90	IPWA	$\pi N \rightarrow \pi N$
1690 ± 20	CUTKOSKY	80	IPWA	$\pi N \rightarrow \pi N$
• • • We do not use the following	data for averages	, fits,	limits, e	tc. ● ● ●
1670	SHKLYAR	13	DPWA	Multichannel
1644	SHRESTHA	12A	DPWA	Multichannel
1708 ± 18	ANISOVICH	10	DPWA	Multichannel
1711 ± 15	¹ BATINIC	10	DPWA	$\pi N \rightarrow N \pi, N \eta$
1679	VRANA	00	DPWA	Multichannel
1770	ARNDT	95	DPWA	$\pi N \rightarrow N \pi$
1636	ARNDT	91	DPWA	$\pi N \rightarrow \pi N$ Soln SM90
1708 or 1712	⁵ LONGACRE	78	IPWA	$\pi N \rightarrow N \pi \pi$
1720 or 1711	² LONGACRE	77	IPWA	$\pi N \rightarrow N \pi \pi$
-2×IMACINARY PART				
VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
80 to 380 (~ 230) OUR ESTIMA	TE			
200±25	ANISOVICH	12A	DPWA	Multichannel
200	⁴ HOEHLER	93	SPED	$\pi N \rightarrow \pi N$
88	CUTKOSKY	90	IPWA	$\pi N \rightarrow \pi N$
80±20	CUTKOSKY	80	IPWA	$\pi N \rightarrow \pi N$
\bullet \bullet \bullet We do not use the following	data for averages	, fits,	limits, e	tc. ● ● ●
159	SHKLYAR	13	DPWA	Multichannel
104	SHRESTHA	12A	DPWA	Multichannel
200 ± 20	ANISOVICH	10	DPWA	Multichannel
174 ± 16	¹ BATINIC	10	DPWA	$\pi N \rightarrow N \pi, N \eta$
132	VRANA	00	DPWA	Multichannel
378	ARNDT	95	DPWA	$\pi N \rightarrow N \pi$
544	ARNDT	91	DPWA	$\pi N \rightarrow \pi N$ Soln SM90
17 or 22	⁵ LONGACRE	78	IPWA	$\pi N \rightarrow N \pi \pi$
123 or 115	² LONGACRE	77	IPWA	$\pi N \rightarrow N \pi \pi$

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N(1710) ELASTIC POLE RESIDUE

MODULUS r				
VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
6±4	ANISOVICH	12A	DPWA	Multichannel
15	HOEHLER	93	SPED	$\pi N \rightarrow \pi N$
9	CUTKOSKY	90	IPWA	$\pi N \rightarrow \pi N$
8±2	CUTKOSKY	80	IPWA	$\pi N \rightarrow \pi N$
• • • We do not use the following	data for averages	s, fits,	limits, e	tc. ● ● ●
11	SHKLYAR	13	DPWA	Multichannel
24	¹ BATINIC	10	DPWA	$\pi {\it N} ightarrow {\it N} \pi$, ${\it N} \eta$
37	ARNDT	95	DPWA	$\pi N \rightarrow N \pi$
149	ARNDT	91	DPWA	$\pi N \rightarrow \pi N$ Soln SM90
PHASE A				
VALUE (°)	DOCUMENT ID		TECN	COMMENT
120±70	ANISOVICH	12A	DPWA	Multichannel
-167	CUTKOSKY	90	IPWA	$\pi N \rightarrow \pi N$
175 ± 35	CUTKOSKY	80	IPWA	$\pi N \rightarrow \pi N$
• • • We do not use the following	data for averages	s, fits,	limits, e	tc. ● ● ●
9	SHKLYAR	13	DPWA	Multichannel
20	¹ BATINIC	10	DPWA	$\pi N \rightarrow N \pi$, $N \eta$
-167	ARNDT	95	DPWA	$\pi N \rightarrow N \pi$
149	ARNDT	91	DPWA	$\pi N \rightarrow \pi N$ Soln SM90

N(1710) INELASTIC POLE RESIDUE

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

Normalized re	sidue in $N\pi ightarrow$	$N(1710) \rightarrow N\eta$		
MODULUS (%)	PHASE (°)	DOCUMENT ID	TECN	COMMENT
12±4	0 ± 45	ANISOVICH 12A	DPWA	Multichannel
Normalized re	sidue in $N\pi \rightarrow$	$N(1710) \rightarrow \Lambda K$		
Normalized re MODULUS (%)	sidue in $N\pi \rightarrow PHASE(^{\circ})$	$N(1710) \rightarrow \Lambda K$ <u>DOCUMENT ID</u>	TECN	COMMENT

N(1710) DECAY MODES

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

	Mode		Fraction (Γ_i/Γ)	Scale factor
Γ_1	$N\pi$		5–20 %	
Г2	$N\eta$		10-30 %	
Γ ₃	$N\omega$		(8±5) %	3.5
Γ ₄	ΛK		5–25 %	
Γ ₅	ΣΚ			
Г ₆	$N\pi\pi$		40–90 %	
Γ ₇	$\Delta\pi$		15–40 %	
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Г ₈	$arDelta(1232)\pi$, $\mathit{P} ext{-wave}$	
Г9	N ho	5-25 %
Γ ₁₀	N $ ho$, S=1/2, P-wave	
Γ_{11}	N $ ho$, S=3/2, P-wave	
Г ₁₂	$N(\pi\pi)^{I=0}_{S-wave}$	10-40 %
Γ ₁₃	$p\gamma$	0.002-0.08 %
Γ ₁₄	$p\gamma$, helicity ${=}1/2$	0.002-0.08 %
Γ ₁₅	$n\gamma$	0.0-0.02%
Г ₁₆	$n\gamma$, helicity=1/2	0.0-0.02%

N(1710) BRANCHING RATIOS

$\Gamma(N\pi)/\Gamma_{\text{total}}$				Γ_1/Γ
VALUE (%)	DOCUMENT ID		TECN	COMMENT
5 to 20 OUR ESTIMATE				
2 ± 2	SHKLYAR	13	PWA	Multichannel
5± 4	ANISOVICH	12A	DPWA	Multichannel
$20\pm$ 4	CUTKOSKY	80	IPWA	$\pi N \rightarrow \pi N$
$12\pm$ 4	HOEHLER	79	IPWA	$\pi N \rightarrow \pi N$
\bullet \bullet \bullet We do not use the following of	data for averages	s, fits,	limits, e	tc. ● ● ●
$15\pm$ 4	SHRESTHA	12A	DPWA	Multichannel
12± 6	ANISOVICH	10	DPWA	Multichannel
22±24	¹ BATINIC	10	DPWA	$\pi N \rightarrow N \pi, N \eta$
$14\pm$ 8	PENNER	02C	DPWA	Multichannel
27±13	VRANA	00	DPWA	Multichannel
9± 4	MANLEY	92	IPWA	$\pi N \rightarrow \pi N \& N \pi \pi$
$\Gamma(N\eta)/\Gamma_{\text{total}}$				Г2/Г
VALUE (%)	DOCUMENT ID		TECN	COMMENT
10 to 30 OUR ESTIMATE				_
45± 4	SHKLYAR	13	DPWA	Multichannel
17 ± 10	ANISOVICH	12A	DPWA	Multichannel
36 ± 11	PENNER	02C	DPWA	Multichannel
$6\pm$ 1	VRANA	00	DPWA	Multichannel
\bullet \bullet \bullet We do not use the following of	data for averages	s, fits,	limits, e	tc. ● ● ●
$11\pm$ 7	SHRESTHA	12A	DPWA	Multichannel
6± 8	¹ BATINIC	10	DPWA	$\pi N \rightarrow N \pi$, $N \eta$
$\Gamma(N\omega)/\Gamma_{\rm total}$				Г ₃ /Г
VALUE (%)	DOCUMENT ID		TECN	COMMENT
8±5 OUR AVERAGE Error inclu	des scale factor o	of 3.5		
3±2	SHKLYAR	13	DPWA	Multichannel
13±2	PENNER	0 2C	DPWA	Multichannel
$(\Gamma_i \Gamma_f)^{\frac{1}{2}} / \Gamma_{\text{total}} \text{ in } N \pi \to N(17)$	10) → <i>∧K</i>			(Γ ₁ Γ ₄) ^½ /Γ
VALUE	DOCUMENT ID		TECN	COMMENT
+0.12 to +0.18 OUR ESTIMATE				0
+0.16	BELL	83	DPWA	$\pi^- p \rightarrow \Lambda K^0$
+0.14	SAXON	80	DPWA	$\pi^- p \rightarrow \Lambda K^0$
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Citation: K.A. Olive et al. (Particle Data Group), Chin. Phys. C38, 090001 (2014) (URL: http://pdg.lbl.gov)

$\Gamma(\Lambda K)/\Gamma_{\text{total}}$					Г₄/Г
VALUE (%)	DOCUMENT ID		TECN	COMMENT	
5 to 25 OUR ESTIMATE 23± 7 5± 3 5± 2 10+10	ANISOVICH SHKLYAR PENNER VRANA	12A 05 02C 00	DPWA DPWA DPWA DPWA	Multichannel Multichannel Multichannel Multichannel	
• • • We do not use the fe	ollowing data for average	es, fits,	limits, e	etc. • • •	
8± 4	SHRESTHA	12A	DPWA	Multichannel	
$\Gamma(\Sigma K) / \Gamma_{\text{total}}$					Г ₅ /Г
VALUE (%)	DOCUMENT ID		TECN	COMMENT	
• • • We do not use the fo	ollowing data for average	es, fits,	limits, e	etc. ● ● ●	
7±7	PENNER	0 2C	DPWA	Multichannel	
$(\Gamma_i \Gamma_f)^{\frac{1}{2}} / \Gamma_{\text{total}} \text{ in } N\pi$ -	$\rightarrow N(1710) \rightarrow \Sigma K$		TECN	(Г 1	¯₅) ^½ /Γ
• • • We do not use the f	<u>DOCOMENT ID</u>	es fits	limits e		
		00			
-0.034	LIVANOS	80	DPVVA	$\pi p \rightarrow 2 \kappa$	
Note: Signs of con 1986 edition to ag ambiguity is resol coupling to $\Delta(123)$	uplings from $\pi N \rightarrow N \pi$ gree with the baryon-firs lved by choosing a nega 32) π .	π anal t conve tive sig	yses were ention; t gn for th	e changed in the he overall phase $\Delta(1620)~S_{31}$	
Note: Signs of country 1986 edition to age ambiguity is resolated coupling to $\Delta(123)$ ($\Gamma_i \Gamma_f$) ^{1/2} / Γ_{total} in $N\pi$ – VALUE	uplings from $\pi N \rightarrow N \pi$ gree with the baryon-firs (ved by choosing a nega 32) π . $\rightarrow N(1710) \rightarrow \Delta(123)$ DOCUMENT ID	π analytic conversion of π analytic conversion of π and π , $32)\pi$,	yses were ention; t gn for th P-wave <u>TECN</u>	the overall phase $\Delta(1620) S_{31}$	[−] 8) ^½ /Γ
Note: Signs of con 1986 edition to ag ambiguity is resol coupling to $\Delta(123)$ $(\Gamma_i\Gamma_f)^{\frac{1}{2}}/\Gamma_{\text{total}} \text{ in } N\pi - \frac{VALUE}{\pm 0.16 \text{ to } \pm 0.22 \text{ OU}}$	uplings from $\pi N \rightarrow N\pi$ gree with the baryon-firs (ved by choosing a nega 32) π . $\rightarrow N(1710) \rightarrow \Delta(123)$ <u>DOCUMENT ID</u> JR ESTIMATE ² LONGACRE	π analysis for the signal sector π and π	yses were ention; t gn for th P-wave <u>TECN</u>	the changed in the he overall phase in $\Delta(1620) S_{31}$	⁻ 8) ^½ /Γ
Note: Signs of country 1986 edition to age ambiguity is resolated coupling to $\Delta(123)$ $(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{\text{total}} \text{ in } N\pi - \frac{VALUE}{\pm 0.16 \text{ to } \pm 0.22 \text{ OU}}$ -0.17 +0.20	uplings from $\pi N \rightarrow N\pi$ gree with the baryon-firs lved by choosing a nega 32) π . $\rightarrow N(1710) \rightarrow \Delta(123)$ <u>DOCUMENT ID</u> JR ESTIMATE ² LONGACRE ³ LONGACRE	π analysis and the second state of the seco	yses were ention; t gn for th P-wave <u>TECN</u> IPWA IPWA	the changed in the he overall phase the $\Delta(1620) S_{31}$ $\Delta(\Gamma_1 I = \frac{\Gamma_1 I}{COMMENT}$ $\pi N \rightarrow N \pi \pi$ $\pi N \rightarrow N \pi \pi$	[−] 8) ^½ /Γ
Note: Signs of con 1986 edition to ag ambiguity is resol coupling to $\Delta(123)$ $(\Gamma_i\Gamma_f)^{\frac{1}{2}}/\Gamma_{\text{total}} \text{ in } N\pi - \frac{VALUE}{\pm 0.16 \text{ to } \pm 0.22 \text{ OU}}$ -0.17 +0.20 ••• We do not use the formula to the second s	uplings from $\pi N \rightarrow N\pi$ gree with the baryon-firs (ved by choosing a nega 32) π . $\rightarrow N(1710) \rightarrow \Delta(123)$ $\underline{DOCUMENT ID}$ JR ESTIMATE ² LONGACRE ³ LONGACRE ollowing data for average	π anal t conve tive sig 32)π, 77 75 es, fits,	yses were ention; t gn for th <u>P-wave</u> <u>TECN</u> IPWA IPWA limits, e	the changed in the he overall phase in $\Delta(1620) S_{31}$ $\frac{\Gamma_1}{COMMENT}$ $\pi N \rightarrow N \pi \pi$ $\pi N \rightarrow N \pi \pi$ itt. • • •	⁻ 8) ^½ /Γ
Note: Signs of con 1986 edition to ag ambiguity is resol coupling to $\Delta(123)$ ($\Gamma_i\Gamma_f$) ^{1/2} / Γ_{total} in $N\pi$ – <u>VALUE</u> ±0.16 to ±0.22 OU -0.17 +0.20 ••• We do not use the for -0.21±0.04	uplings from $\pi N \rightarrow N\pi$ gree with the baryon-firs (ved by choosing a nega 32) π . $\rightarrow N(1710) \rightarrow \Delta(123)$ $\underline{DOCUMENT ID}$ JR ESTIMATE ² LONGACRE ³ LONGACRE ollowing data for average MANLEY	π anal t conve tive sig 32)π, 77 75 es, fits, 92	yses were ention; t gn for th <u>P-wave</u> <u>TECN</u> IPWA IPWA limits, e IPWA	the changed in the the overall phase in $\Delta(1620) \ S_{31}$ $\frac{\Gamma_1}{COMMENT}$ $\frac{\pi N \rightarrow N \pi \pi}{\pi N \rightarrow N \pi \pi}$ itc. ••• $\pi N \rightarrow \pi N \&$	- <mark>8)^{1/2}/Γ</mark> Νππ
Note: Signs of cou 1986 edition to ag ambiguity is resol coupling to $\Delta(123)$ $(\Gamma_i\Gamma_f)^{\frac{1}{2}}/\Gamma_{\text{total}} \text{ in } N\pi - \frac{VALUE}{\pm 0.16 \text{ to } \pm 0.22 \text{ OU}}$ -0.17 +0.20 ••• We do not use the for -0.21 ± 0.04 $\Gamma(\Delta(1232)\pi, P\text{-wave})$	uplings from $\pi N \rightarrow N\pi$ gree with the baryon-firs lved by choosing a nega 32) π . $\rightarrow N(1710) \rightarrow \Delta(123)$ $\xrightarrow{DOCUMENT ID}$ IR ESTIMATE ² LONGACRE ³ LONGACRE ollowing data for average MANLEY // Ttotal	π anal t conve tive sig 32)π, 77 75 es, fits, 92	yses were ention; t gn for th P-wave <u>TECN</u> IPWA IPWA Iimits, e IPWA	the changed in the he overall phase in $\Delta(1620) \ S_{31}$ $\frac{\Gamma_1}{COMMENT}$ $\pi N \rightarrow N \pi \pi$ $\pi N \rightarrow N \pi \pi$ etc. • • • $\pi N \rightarrow \pi N \&$	⁻ 8) ^{1⁄2} /Γ ^{Νππ} Γ8/Γ
Note: Signs of con 1986 edition to ag ambiguity is resol coupling to $\Delta(123)$ $(\Gamma_i\Gamma_f)^{\frac{1}{2}}/\Gamma_{\text{total}} \text{ in } N\pi - \frac{VALUE}{\pm 0.16 \text{ to } \pm 0.22 \text{ OU}}$ $\pm 0.16 \text{ to } \pm 0.22 \text{ OU}$ -0.17 ± 0.20 ••• We do not use the formula to the for	uplings from $\pi N \rightarrow N\pi$ gree with the baryon-firs lived by choosing a nega 32) π . $\rightarrow N(1710) \rightarrow \Delta(123)$ $\xrightarrow{DOCUMENT ID}$ JR ESTIMATE ² LONGACRE ³ LONGACRE ollowing data for average MANLEY // Ttotal $\xrightarrow{DOCUMENT ID}$ $\xrightarrow{DOCUMENT ID}$	π anal t conve tive sig 32)π, 77 75 es, fits, 92	P-wave TECN IPWA IPWA IPWA Imits, e IPWA	the changed in the he overall phase the overall phase the $\Delta(1620) \ S_{31}$ $\pi N \rightarrow N \pi \pi$ $\pi N \rightarrow N \pi \pi$	⁻ 8) ^{1⁄2} /Γ ^{Νππ} Γ8/Γ
Note: Signs of con 1986 edition to ag ambiguity is resol coupling to $\Delta(123)$ ($\Gamma_i\Gamma_f$) ^{1/2} / Γ_{total} in $N\pi - \frac{VALUE}{\pm 0.16 \text{ to } \pm 0.22 \text{ OU}}$ -0.17 +0.20 •••We do not use the for -0.21 ± 0.04 $\Gamma(\Delta(1232)\pi, P\text{-wave}), \frac{VALUE(\%)}{39\pm 8}$ •••We do not use the formula to the form	uplings from $\pi N \rightarrow N\pi$ gree with the baryon-firs led by choosing a nega 32) π . $\rightarrow N(1710) \rightarrow \Delta(123)$ <u>DOCUMENT ID</u> JR ESTIMATE ² LONGACRE ³ LONGACRE ollowing data for average MANLEY // T_{total} <u>DOCUMENT ID</u> VRANA ollowing data for average	π anal t conve tive sig 32)π, 77 75 es, fits, 92 00 es, fits,	yses were ention; t gn for th P-wave <u>TECN</u> IPWA IPWA Iimits, e IPWA <u>TECN</u> DPWA Iimits, e	the changed in the he overall phase the overall phase the $\Delta(1620) \ S_{31}$ $\pi N \rightarrow N\pi\pi$ $\pi N \rightarrow N\pi\pi$ $\pi N \rightarrow N\pi\pi$ $\pi N \rightarrow N\pi\pi$ tc. ••• $\pi N \rightarrow \pi N \&$ $\underline{COMMENT}$ Multichannel tc. •••	⁻ 8) ^½ /Γ ^{Νππ} Γ₈/Γ
Note: Signs of con 1986 edition to ag ambiguity is resol coupling to $\Delta(123)$ ($\Gamma_i\Gamma_f$) ^{1/2} / Γ_{total} in $N\pi$ – <u>VALUE</u> ±0.16 to ±0.22 OU -0.17 +0.20 ••• We do not use the for -0.21±0.04 $\Gamma(\Delta(1232)\pi, P\text{-wave}),$ <u>VALUE</u> (%) 39±8 ••• We do not use the for 6±3	uplings from $\pi N \rightarrow N\pi$ gree with the baryon-firs lved by choosing a nega 32) π . $\rightarrow N(1710) \rightarrow \Delta(123)$ $\xrightarrow{DOCUMENT ID}$ JR ESTIMATE ² LONGACRE ³ LONGACRE ollowing data for average MANLEY // Γ_{total} $\xrightarrow{DOCUMENT ID}$ VRANA ollowing data for average SHRESTHA	π anal t conve tive sig 32)π, 77 75 es, fits, 92 00 es, fits, 12A	yses were ention; t gn for th P-wave <u>TECN</u> IPWA Imits, e IPWA <u>TECN</u> DPWA Imits, e DPWA	the changed in the the overall phase and $\Delta(1620) \ S_{31}$ $\frac{\Gamma_1}{COMMENT}$ $\pi N \rightarrow N \pi \pi$ $\pi N \rightarrow N \pi \pi$ ttc. • • • $\pi N \rightarrow \pi N \&$ $\frac{COMMENT}{Multichannel}$	⁻ 8) ^{1⁄2} /Γ ^{Νππ} Γ₈/Γ
Note: Signs of con 1986 edition to ag ambiguity is resol coupling to $\Delta(123)$ ($\Gamma_i\Gamma_f$) ^{1/2} / Γ_{total} in $N\pi$ – <u>VALUE</u> ±0.16 to ±0.22 OU -0.17 +0.20 ••• We do not use the for -0.21±0.04 $\Gamma(\Delta(1232)\pi, P\text{-wave}),$ <u>VALUE (%)</u> 39±8 ••• We do not use the for 6±3 ($\Gamma_i\Gamma_f$) ^{1/2} / Γ_{total} in $N\pi$ – <u>VALUE</u>	uplings from $\pi N \rightarrow N\pi$ gree with the baryon-firs lived by choosing a nega 32) π . $\rightarrow N(1710) \rightarrow \Delta(123)$ $\xrightarrow{DOCUMENT ID}$ JR ESTIMATE ² LONGACRE ³ LONGACRE ollowing data for average MANLEY // Total $\xrightarrow{DOCUMENT ID}$ VRANA ollowing data for average SHRESTHA $\rightarrow N(1710) \rightarrow N\rho, S$ DOCUMENT ID	π analy t conversion tive signal 32) π , 77 75 es, fits, 92 00 es, fits, 12A 5=1/2	yses were ention; t gn for th P-wave <u>TECN</u> IPWA IPWA Imits, e IPWA <u>TECN</u> DPWA Imits, e DPWA	the changed in the he overall phase in $\Delta(1620) S_{31}$ $\pi N \rightarrow N \pi \pi$ $\pi N \rightarrow \pi N \&$ $\pi N \rightarrow \pi N \&$ <u>COMMENT</u> Multichannel Multichannel $\pi (\Gamma_1 \Gamma_1)$	⁻ 8) ^{1/2} /Γ ^{Νππ} Γ8/Γ
Note: Signs of con 1986 edition to ag ambiguity is resol coupling to $\Delta(123)$ ($\Gamma_i\Gamma_f$) ^{1/2} / Γ_{total} in $N\pi - \frac{VALUE}{\pm 0.16 \text{ to } \pm 0.22 \text{ OU}}$ - 0.17 + 0.20 • • We do not use the for - 0.21 \pm 0.04 $\Gamma(\Delta(1232)\pi, P\text{-wave}), \frac{VALUE}{(\%)}$ 39 ± 8 • • We do not use the for 6 ± 3 ($\Gamma_i\Gamma_f$) ^{1/2} / Γ_{total} in $N\pi - \frac{VALUE}{\Delta(128)}$ ± 0.09 to ± 0.19 OU	uplings from $\pi N \rightarrow N\pi$ gree with the baryon-firs lived by choosing a nega 32) π . $\rightarrow N(1710) \rightarrow \Delta(123)$ $\xrightarrow{DOCUMENT ID}$ JR ESTIMATE ² LONGACRE ³ LONGACRE ollowing data for average MANLEY // Γ_{total} $\xrightarrow{DOCUMENT ID}$ VRANA ollowing data for average SHRESTHA $\rightarrow N(1710) \rightarrow N\rho, S$ $\xrightarrow{DOCUMENT ID}$ JR ESTIMATE	π analytic conversions of the signal strain of t	P-wave TECN IPWA IPWA IPWA Imits, e IPWA Imits, e DPWA Imits, e DPWA	the changed in the he overall phase in $\Delta(1620) S_{31}$ $\pi N \rightarrow N \pi \pi$ $\pi N \rightarrow \pi N \&$ $\frac{COMMENT}{Multichannel}$ ttc. • • • Multichannel $\frac{COMMENT}{COMMENT}$	⁻ 8) ^{1/2} /Γ ^{Νππ} Γ8/Γ 10) ^{1/2} /Γ
Note: Signs of con 1986 edition to ag ambiguity is resol coupling to $\Delta(123)$ ($\Gamma_i\Gamma_f$) ^{1/2} / Γ_{total} in $N\pi - \frac{VALUE}{\pm 0.16 \text{ to } \pm 0.22 \text{ OU}}$ = 0.17 $\pm 0.16 \text{ to } \pm 0.22 \text{ OU}$ = 0.17 ± 0.20 = 0.40 We do not use the formula of the second state of the	uplings from $\pi N \rightarrow N\pi$ gree with the baryon-firs lived by choosing a nega 32) π . $\rightarrow N(1710) \rightarrow \Delta(123)$ $\xrightarrow{DOCUMENT ID}$ JR ESTIMATE ² LONGACRE ³ LONGACRE ³ LONGACRE ³ LONGACRE ³ LONGACRE $\xrightarrow{DOCUMENT ID}$ VRANA collowing data for average SHRESTHA $\rightarrow N(1710) \rightarrow N\rho, S$ $\xrightarrow{DOCUMENT ID}$ JR ESTIMATE ² LONGACRE ² LONGACRE	π analy t converse tive signal 32) π , 77 75 es, fits, 92 00 es, fits, 12A $\mathbf{\hat{s}=1/2}$ 77	P-wave TECN IPWA IPWA IPWA Imits, e IPWA MUMA Imits, e DPWA Imits, e DPWA Imits, e DPWA	the changed in the he overall phase in $\Delta(1620) S_{31}$ $\pi N \rightarrow N \pi \pi$ $\pi N \rightarrow \pi N \&$ $\frac{COMMENT}{Multichannel}$ Multichannel multichannel multichannel multichannel multichannel multichannel multichannel multichannel multichannel multichannel multichannel multichannel	⁻ 8) ^{1/2} /Γ ^{Νππ} Γ8/Γ 10) ^{1/2} /Γ
Note: Signs of con 1986 edition to a ambiguity is resol coupling to $\Delta(123)$ ($\Gamma_i\Gamma_f$) ^{1/2} / Γ_{total} in $N\pi - \frac{VALUE}{\pm 0.16 \text{ to } \pm 0.22 \text{ OU}}$ - 0.17 + 0.20 • • We do not use the form - 0.21 \pm 0.04 $\Gamma(\Delta(1232)\pi, P\text{-wave}), \frac{VALUE}{(\%)}$ 39 ± 8 • • We do not use the form 6 ± 3 ($\Gamma_i\Gamma_f$) ^{1/2} / Γ_{total} in $N\pi - \frac{VALUE}{\pm 0.09 \text{ to } \pm 0.19 \text{ OU}}$ + 0.19 - 0.20	uplings from $\pi N \rightarrow N\pi$ gree with the baryon-firs lived by choosing a nega 32) π . $\rightarrow N(1710) \rightarrow \Delta(123)$ $\xrightarrow{DOCUMENT ID}$ JR ESTIMATE ² LONGACRE ³ LONGACRE ollowing data for average MANLEY // Γ_{total} $\xrightarrow{DOCUMENT ID}$ VRANA ollowing data for average SHRESTHA $\rightarrow N(1710) \rightarrow N\rho, S$ $\xrightarrow{DOCUMENT ID}$ JR ESTIMATE ² LONGACRE ³ LONGACRE ³ LONGACRE ³ LONGACRE	π analy t conversion tive signal 32) π , 77 75 es, fits, 92 00 es, fits, 12A $\Sigma = 1/2$ 77 75	yses were ention; t gn for th P-wave <u>TECN</u> IPWA IPWA Imits, e IPWA Imits, e DPWA Imits, e DPWA Imits, e DPWA	the changed in the he overall phase he overall phase he $\Delta(1620) \ S_{31}$ $\pi N \rightarrow N \pi \pi$ $\pi N \rightarrow N \pi \pi$ $\pi N \rightarrow N \pi \pi$ $\pi N \rightarrow \pi N \&$ $\frac{COMMENT}{Multichannel}$ $\frac{COMMENT}{Multichannel}$ $\frac{COMMENT}{\pi N \rightarrow N \pi \pi}$ $\pi N \rightarrow N \pi \pi$	⁻ 8) ^{1/2} /Γ ^{Νππ} Γ8/Γ 10) ^{1/2} /Γ
Note: Signs of con 1986 edition to ag ambiguity is resol coupling to $\Delta(123)$ ($\Gamma_i\Gamma_f$) ^{1/2} / Γ_{total} in $N\pi - \frac{VALUE}{\pm 0.16 \text{ to } \pm 0.22 \text{ OU}}$ = 0.17 $\pm 0.16 \text{ to } \pm 0.22 \text{ OU}$ = 0.17 ± 0.20 $= 0.21 \pm 0.04$ $\Gamma(\Delta(1232)\pi, P\text{-wave}), \frac{VALUE(\%)}{39\pm 8}$ $= 0.04 We do not use the form 6\pm 3(\Gamma_i\Gamma_f)1/2/\Gamma_{total} in N\pi - \frac{VALUE}{\pm 0.09 \text{ to } \pm 0.19 \text{ OU}}\pm 0.09 \text{ to } \pm 0.19 \text{ OU}\pm 0.20= 0.20= 0.00 We do not use the form = 0.20$	uplings from $\pi N \rightarrow N\pi$ gree with the baryon-firs lved by choosing a nega 32) π . $\rightarrow N(1710) \rightarrow \Delta(123)$ $\xrightarrow{DOCUMENT ID}$ JR ESTIMATE ² LONGACRE ³ LONGACRE ollowing data for average MANLEY // Γ_{total} $\xrightarrow{DOCUMENT ID}$ VRANA ollowing data for average SHRESTHA $\rightarrow N(1710) \rightarrow N\rho, S$ $\xrightarrow{DOCUMENT ID}$ JR ESTIMATE ² LONGACRE ³ LONGACRE ³ LONGACRE ³ LONGACRE ³ LONGACRE ³ LONGACRE ³ LONGACRE ³ LONGACRE ³ LONGACRE	π analy t conversion tive signal 32) π , 77 75 es, fits, 92 00 es, fits, 12A 5=1/2 77 75 es, fits,	yses were ention; t gn for th P-wave <u>TECN</u> IPWA Imits, e IPWA Imits, e DPWA Imits, e DPWA Imits, e IPWA IPWA IPWA IPWA	the changed in the he overall phase the overall phase in $\Delta(1620) S_{31}$ $\pi N \rightarrow N\pi\pi$ $\pi N \rightarrow N\pi\pi$ $\pi N \rightarrow N\pi\pi$ $\pi N \rightarrow \pi N \&$ COMMENT Multichannel Multichannel COMMENT $\pi N \rightarrow N\pi\pi$ $\pi N \rightarrow N\pi\pi$	⁻ 8) ^{1/2} /Γ ^{Νππ} Γ8/Γ 10) ^{1/2} /Γ

$\Gamma(N\rho, S=1/2, P-wave)/\Gamma_{total}$				Г ₁₀ /Г
VALUE (%)	DOCUMENT ID		TECN	COMMENT
17 ± 1	VRANA	00	DPWA	Multichannel
\bullet \bullet We do not use the following	data for average	s, fits,	limits, e	etc. • • •
17±6	SHRESTHA	12A	DPWA	Multichannel
$(\Gamma_i \Gamma_f)^{\frac{1}{2}} / \Gamma_{\text{total}} \text{ in } N\pi \to N(17)$	$(10) \rightarrow N\rho, S=$	=3/2	, <i>P-</i> wav	е (Г ₁ Г ₁₁) ^½ /Г
VALUE	2 DOCUMENT ID		<u>TECN</u>	COMMENT
+0.31	² LONGACRE	77	IPWA	$\pi N \rightarrow N \pi \pi$
$(\Gamma_i \Gamma_f)^{\frac{1}{2}} / \Gamma_{\text{total}} \text{ in } N \pi \to N(17)$	$(10) \rightarrow N(\pi\pi)$ <u>DOCUMENT ID</u>)/=0 S-wa	ve <u>TECN</u>	(Γ ₁ Γ ₁₂) ^{1/2} /Γ
\pm 0.14 to \pm 0.22 OUR ESTI	MATE			
-0.26	² LONGACRE	77	IPWA	$\pi N \rightarrow N \pi \pi$
-0.28	³ LONGACRE	75	IPWA	$\pi N \rightarrow N \pi \pi$
\bullet \bullet We do not use the following	data for average	s, fits,	limits, e	etc. ● ● ●
$+0.04 \pm 0.05$	MANLEY	92	IPWA	$\pi N \rightarrow \pi N \& N \pi \pi$
$\Gamma(N(\pi\pi)^{I=0}_{S-wave})/\Gamma_{total}$				Г ₁₂ /Г
VALUE (%)	DOCUMENT ID		TECN	COMMENT
1 ± 1	VRANA	00	DPWA	Multichannel
\bullet \bullet We do not use the following	data for average	s, fits,	limits, e	etc. • • •
<1	SHRESTHA	12A	DPWA	Multichannel

N(1710) PHOTON DECAY AMPLITUDES

Papers on γN amplitudes predating 1981 may be found in our 2006 edition, Journal of Physics (generic for all A,B,E,G) **G33** 1 (2006).

$N(1710) \rightarrow p\gamma$, helicity-1/2 amplitude A_{1/2}

VALUE (GeV $^{-1/2}$)	DOCUMENT ID		TECN	COMMENT
0.040 ± 0.020 OUR ESTIMATE				
$0.052 {\pm} 0.015$	ANISOVICH	12A	DPWA	Multichannel
0.007 ± 0.015	ARNDT	96	IPWA	$\gamma N \rightarrow \pi N$
0.006 ± 0.018	CRAWFORD	83	IPWA	$\gamma N \rightarrow \pi N$
0.028 ± 0.009	AWAJI	81	DPWA	$\gamma N \rightarrow \pi N$
\bullet \bullet We do not use the following c	lata for averages	s, fits,	limits, e	etc. ● ● ●
-0.050 ± 0.001	SHKLYAR	13	DPWA	Multichannel
-0.008 ± 0.003	SHRESTHA	12A	DPWA	Multichannel
0.025 ± 0.010	ANISOVICH	10	DPWA	Multichannel
0.044	PENNER	0 2D	DPWA	Multichannel
-0.037 ± 0.002	LI	93	IPWA	$\gamma N \rightarrow \pi N$

Citation: K.A. Olive et al. (Particle Data Group), Chin. Phys. C38, 090001 (2014) (URL: http://pdg.lbl.gov)

$N(1710) \rightarrow n\gamma$, helicity-1/2 amplitude A_{1/2}

VALUE (GeV $^{-1/2}$)	DOCUMENT ID		TECN	COMMENT
-0.040 ± 0.020 OUR ESTIMATE				
-0.002 ± 0.015	ARNDT	96	IPWA	$\gamma N \rightarrow \pi N$
0.000 ± 0.018	AWAJI	81	DPWA	$\gamma N \rightarrow \pi N$
-0.001 ± 0.003	FUJII	81	DPWA	$\gamma N \rightarrow \pi N$
\bullet \bullet \bullet We do not use the following d	ata for averages	, fits,	limits, et	tc. ● ● ●
0.017 ± 0.003	SHRESTHA	12A	DPWA	Multichannel
-0.024	PENNER	0 2D	DPWA	Multichannel
0.052 ± 0.003	LI	93	IPWA	$\gamma N \rightarrow \pi N$

$N(1710) \gamma p \rightarrow \Lambda K^+ \text{ AMPLITUDES}$

$(\Gamma_i \Gamma_f)^{\frac{1}{2}} / \Gamma_{\text{total}} \text{ in } p\gamma \rightarrow N(17)$	(<i>M</i> ₁ _ amplitude)					
VALUE (units 10^{-3})	DOCUMENT ID		TECN			
\bullet \bullet \bullet We do not use the following c	lata for averages	, fits,	limits, etc.	• • •		
-10.6 ± 0.4	WORKMAN	90	DPWA			
- 7.21	TANABE	89	DPWA			
$p\gamma \rightarrow N(1710) \rightarrow \Lambda K^+$ phase angle θ (M_{1-} amplitude)						
$p\gamma \rightarrow N(1710) \rightarrow \Lambda K^+$ phase	se angle θ			(<i>M</i> ₁ _ amplitude)		
$p\gamma \rightarrow N(1710) \rightarrow \Lambda K^+$ phase VALUE (degrees)	se angle θ DOCUMENT ID		TECN	(<i>M</i> ₁₋ amplitude)		
$p\gamma \rightarrow N(1710) \rightarrow \Lambda K^+$ phase <u>VALUE (degrees)</u> ••• We do not use the following compared to th	se angle θ <u>DOCUMENT ID</u> lata for averages	, fits,	<u>TECN</u> limits, etc.	(<i>M</i> ₁₋ amplitude)		

N(1710) FOOTNOTES

¹ BATINIC 10 finds evidence for a second P_{11} state with all parameters except for the phase of the pole residue very similar to the parameters we give here.

- ²LONGACRE 77 pole positions are from a search for poles in the unitarized T-matrix; the first (second) value uses, in addition to $\pi N \rightarrow N\pi\pi$ data, elastic amplitudes from a Saclay (CERN) partial-wave analysis. The other LONGACRE 77 values are from eyeball fits with Breit-Wigner circles to the T-matrix amplitudes.
- ³ From method II of LONGACRE 75: eyeball fits with Breit-Wigner circles to the T-matrix amplitudes.

⁴ See HOEHLER 93 for a detailed discussion of the evidence for and the pole parameters of N and Δ resonances as determined from Argand diagrams of πN elastic partial-wave amplitudes and from plots of the speeds with which the amplitudes traverse the diagrams.

⁵ LONGACRE 78 values are from a search for poles in the unitarized T-matrix. The first (second) value uses, in addition to $\pi N \rightarrow N \pi \pi$ data, elastic amplitudes from a Saclay (CERN) partial-wave analysis.

N(1710) REFERENCES

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

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)
ANISOVICH	10	EPJ A44 203	A.V. Anisovich <i>et al.</i>	(BONN, PNPI)
BATINIC	10	PR C82 038203	M. Batinic <i>et al.</i>	(ZAGR)
ARNDT	06	PR C74 045205	R.A. Arndt <i>et al.</i>	(GWU)
PDG	06	JP G33 1	WM. Yao <i>et al.</i>	(PDG Collab.)
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,, TS.H. Le	e (PÌTT+Ĵ
ARNDT	96	PR C53 430	R.A. Arndt, I.I. Strakovsky, R.L. Work	man (VPI)
ARNDT	95	PR C52 2120	R.A. Arndt <i>et al.</i>	(VPI, BŘCO)
HOEHLER	93	π N Newsletter 9 1	G. Hohler	(KARL)
LI	93	PR C47 2759	Z.J. Li <i>et al.</i>) (VPI)
MANLEY	92	PR D45 4002	D.M. Manley, E.M. Saleski	(ŘSA) IJP
Also		PR D30 904	D.M. Manley et al.	(VPI)
ARNDT	91	PR D43 2131	R.A. Arndt <i>et al.</i>	(VPI, TELE) IJP
CUTKOSKY	90	PR D42 235	R.E. Cutkosky, S. Wang	Č (CMU)
WORKMAN	90	PR C42 781	R.L. Workman	`(VPI)
TANABE	89	PR C39 741	H. Tanabe, M. Kohno, C. Bennhold	(MÀNZ)
Also		NC 102A 193	M. Kohno, H. Tanabe, C. Bennhold	(MANZ)
BELL	83	NP B222 389	K.W. Bell <i>et al.</i>	(RL) IJP
CRAWFORD	83	NP B211 1	R.L. Crawford, W.T. Morton	(GLAS)
PDG	82	PL 111B 1	M. Roos <i>et al.</i>	(HELS, CIT, CERN)
AWAJI	81	Bonn Conf. 352	N. Awaji, R. Kajikawa	(NAGO)
Also		NP B197 365	K. Fujii <i>et al.</i>	(NAGO)
FUJII	81	NP B187 53	K. Fujii <i>et al.</i>	(NAGO, OSAK)
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
LIVANOS	80	Toronto Conf. 35	P. Livanos <i>et al.</i>	(SACL) IJP
SAXON	80	NP B162 522	D.H. Saxon <i>et al.</i>	(RHEL, BRIS) IJP
HOEHLER	79	PDAT 12-1	G. Hohler <i>et al.</i>	(KARLT) IJP
Also		Toronto Conf. 3	R. Koch	(KARLT) IJP
LONGACRE	78	PR D17 1795	R.S. Longacre <i>et al.</i>	(LBL, SLAC)
LONGACRE	77	NP B122 493	R.S. Longacre, J. Dolbeau	(SACL) IJP
Also		NP B108 365	J. Dolbeau <i>et al.</i>	(SACL) IJP
LONGACRE	75	PL 55B 415	R.S. Longacre <i>et al.</i>	(LBL, SLAC) IJP