

$$N(1680) \ 5/2^+$$

$$I(J^P) = \frac{1}{2}(\frac{5}{2}^+) \text{ Status: } ****$$

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

$N(1680)$ POLE POSITION

REAL PART

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
1660 to 1680 (≈ 1670) OUR ESTIMATE			
1657 $\pm$ 2	ROENCHEN	22	DPWA Multichannel
1678 $\pm$ 5	SOKHOYAN	15A	DPWA Multichannel
1674 $\pm$ 2 $\pm$ 1	¹ SVARC	14	L+P $\pi N \rightarrow \pi N$
1667 $\pm$ 5	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
1668	HUNT	19	DPWA Multichannel
1669	ROENCHEN	15A	DPWA Multichannel
1660	SHKLYAR	13	DPWA Multichannel
1676 $\pm$ 6	ANISOVICH	12A	DPWA Multichannel
1666 $\pm$ 8	BATINIC	10	DPWA $\pi N \rightarrow N\pi, N\eta$
1674	ARNDT	06	DPWA $\pi N \rightarrow \pi N, \eta N$
1667	VRANA	00	DPWA Multichannel
1673	HOEHLER	93	ARGD $\pi N \rightarrow \pi N$

¹ Fit to the amplitudes of HOEHLER 79.

–2×IMAGINARY PART

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
110 to 135 (≈ 120) OUR ESTIMATE			
120 $\pm$ 1	ROENCHEN	22	DPWA Multichannel
113 $\pm$ 4	SOKHOYAN	15A	DPWA Multichannel
129 $\pm$ 3 $\pm$ 1	¹ SVARC	14	L+P $\pi N \rightarrow \pi N$
110 $\pm$ 10	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
118	HUNT	19	DPWA Multichannel
100	ROENCHEN	15A	DPWA Multichannel
98	SHKLYAR	13	DPWA Multichannel
113 $\pm$ 4	ANISOVICH	12A	DPWA Multichannel
135 $\pm$ 6	BATINIC	10	DPWA $\pi N \rightarrow N\pi, N\eta$
115	ARNDT	06	DPWA $\pi N \rightarrow \pi N, \eta N$
122	VRANA	00	DPWA Multichannel
135	HOEHLER	93	ARGD $\pi N \rightarrow \pi N$

¹ Fit to the amplitudes of HOEHLER 79.

***N*(1680) ELASTIC POLE RESIDUE**

MODULUS $|r|$

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
35 to 45 (≈ 40) OUR ESTIMATE			
36 ± 1	ROENCHEN	22	DPWA Multichannel
45 ± 4	SOKHOYAN	15A	DPWA Multichannel
$44 \pm 1 \pm 1$	¹ SVARC	14	L+P $\pi N \rightarrow \pi N$
34 ± 2	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
34	ROENCHEN	15A	DPWA Multichannel
33	SHKLYAR	13	DPWA Multichannel
43 ± 4	ANISOVICH	12A	DPWA Multichannel
44	BATINIC	10	DPWA $\pi N \rightarrow N\pi, N\eta$
42	ARNDT	06	DPWA $\pi N \rightarrow \pi N, \eta N$
44	HOEHLER	93	ARGD $\pi N \rightarrow \pi N$

¹Fit to the amplitudes of HOEHLER 79.

PHASE θ

VALUE ($^\circ$)	DOCUMENT ID	TECN	COMMENT
−30 to −10 (≈ -20) OUR ESTIMATE			
-31 ± 1	ROENCHEN	22	DPWA Multichannel
5 ± 10	SOKHOYAN	15A	DPWA Multichannel
$-16 \pm 1 \pm 1$	¹ SVARC	14	L+P $\pi N \rightarrow \pi N$
-25 ± 5	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
−19	ROENCHEN	15A	DPWA Multichannel
−32	SHKLYAR	13	DPWA Multichannel
-2 ± 10	ANISOVICH	12A	DPWA Multichannel
−19	BATINIC	10	DPWA $\pi N \rightarrow N\pi, N\eta$
−4	ARNDT	06	DPWA $\pi N \rightarrow \pi N, \eta N$
−17	HOEHLER	93	ARGD $\pi N \rightarrow \pi N$

¹Fit to the amplitudes of HOEHLER 79.

***N*(1680) INELASTIC POLE RESIDUE**

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

Normalized residue in $N\pi \rightarrow N(1680) \rightarrow \Delta\pi$, *P*-wave

MODULUS	PHASE ($^\circ$)	DOCUMENT ID	TECN	COMMENT
0.15 ± 0.03	-60 ± 30	SOKHOYAN	15A	DPWA Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.15 ± 0.03	-70 ± 45	ANISOVICH	12A	DPWA Multichannel

Normalized residue in $N\pi \rightarrow N(1680) \rightarrow \Delta\pi$, *F*-wave

MODULUS	PHASE ($^\circ$)	DOCUMENT ID	TECN	COMMENT
0.23 ± 0.04	90 ± 12	SOKHOYAN	15A	DPWA Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.23 ± 0.04	85 ± 15	ANISOVICH	12A	DPWA Multichannel

Normalized residue in $N\pi \rightarrow N(1680) \rightarrow N\eta$

<u>MODULUS</u>	<u>PHASE (°)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
0.006 ± 0.004	118 ± 1	ROENCHEN	22	DPWA Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.027	136	ROENCHEN	15A	DPWA Multichannel

Normalized residue in $N\pi \rightarrow N(1680) \rightarrow \Lambda K$

<u>MODULUS</u>	<u>PHASE (°)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
0.006 ± 0.001	-119 ± 2	ROENCHEN	22	DPWA Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.001	90	ROENCHEN	15A	DPWA Multichannel

Normalized residue in $N\pi \rightarrow N(1680) \rightarrow \Sigma K$

<u>MODULUS</u>	<u>PHASE (°)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
0.001 ± 0.001	-46 ± 15	ROENCHEN	22	DPWA Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.004	148	ROENCHEN	15A	DPWA Multichannel

Normalized residue in $N\pi \rightarrow N(1680) \rightarrow N(\pi\pi)_{S=0}^{I=0}$

<u>MODULUS</u>	<u>PHASE (°)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
0.29 ± 0.06	-45 ± 15	SOKHOYAN	15A	DPWA Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.26 ± 0.04	-56 ± 15	ANISOVICH	12A	DPWA Multichannel

$N(1680)$ BREIT-WIGNER MASS

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
1680 to 1690 (≈ 1685) OUR ESTIMATE			
1686 ± 5	GOLOVATCH	19	DPWA $\gamma p \rightarrow \pi^+ \pi^- p$
1681.0 ± 0.1	¹ HUNT	19	DPWA Multichannel
1690 ± 5	SOKHOYAN	15A	DPWA Multichannel
1676 ± 2	¹ SHKLYAR	13	DPWA Multichannel
1680.1 ± 0.2	¹ ARNDT	06	DPWA $\pi N \rightarrow \pi N, \eta N$
1680 ± 10	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
1684 ± 3	HOEHLER	79	IPWA $\pi N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
1689 ± 6	ANISOVICH	12A	DPWA Multichannel
1682.7 ± 0.5	¹ SHRESTHA	12A	DPWA Multichannel
1680 ± 7	BATINIC	10	DPWA $\pi N \rightarrow N\pi, N\eta$
1679 ± 3	VRANA	00	DPWA Multichannel

¹Statistical error only.

$N(1680)$ BREIT-WIGNER WIDTH

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
115 to 130 (≈ 120) OUR ESTIMATE			
118 ± 20	GOLOVATCH	19	DPWA $\gamma p \rightarrow \pi^+ \pi^- p$
123 ± 3	¹ HUNT	19	DPWA Multichannel
119 ± 4	SOKHOYAN	15A	DPWA Multichannel

115 ± 1	¹ SHKLYAR	13	DPWA	Multichannel
128.0 ± 1.1	¹ ARNDT	06	DPWA	$\pi N \rightarrow \pi N, \eta N$
120 ± 10	CUTKOSKY	80	IPWA	$\pi N \rightarrow \pi N$
128 ± 8	HOEHLER	79	IPWA	$\pi N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
118 ± 6	ANISOVICH	12A	DPWA	Multichannel
126 ± 1	¹ SHRESTHA	12A	DPWA	Multichannel
142 ± 7	BATINIC	10	DPWA	$\pi N \rightarrow N\pi, N\eta$
128 ± 9	VRANA	00	DPWA	Multichannel

¹Statistical error only.

***N*(1680) DECAY MODES**

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

Mode	Fraction (Γ_i/Γ)
Γ_1 $N\pi$	60–70 %
Γ_2 $N\eta$	<1 %
Γ_3 $N\pi\pi$	28–53 %
Γ_4 $\Delta(1232)\pi$	11–23 %
Γ_5 $\Delta(1232)\pi$, <i>P</i> -wave	4–10 %
Γ_6 $\Delta(1232)\pi$, <i>F</i> -wave	1–13 %
Γ_7 $N\rho$	8–11 %
Γ_8 $N\rho$, <i>S</i> =3/2, <i>P</i> -wave	6–8 %
Γ_9 $N\rho$, <i>S</i> =3/2, <i>F</i> -wave	2–3 %
Γ_{10} $N\sigma$	9–19 %
Γ_{11} $p\gamma$	0.21–0.32 %
Γ_{12} $p\gamma$, helicity=1/2	0.001–0.011 %
Γ_{13} $p\gamma$, helicity=3/2	0.20–0.32 %
Γ_{14} $n\gamma$	0.021–0.046 %
Γ_{15} $n\gamma$, helicity=1/2	0.004–0.029 %
Γ_{16} $n\gamma$, helicity=3/2	0.01–0.024 %

***N*(1680) BRANCHING RATIOS**

$\Gamma(N\pi)/\Gamma_{\text{total}}$					Γ_1/Γ
VALUE (%)	DOCUMENT ID	TECN	COMMENT		
60 to 70 ($\approx$ 65) OUR ESTIMATE					
68.0 $\pm$ 0.1	¹ HUNT	19	DPWA	Multichannel	
62 $\pm$ 4	SOKHOYAN	15A	DPWA	Multichannel	
68 $\pm$ 1	¹ SHKLYAR	13	DPWA	Multichannel	
70.1 $\pm$ 0.1	¹ ARNDT	06	DPWA	$\pi N \rightarrow \pi N, \eta N$	
62 $\pm$ 5	CUTKOSKY	80	IPWA	$\pi N \rightarrow \pi N$	
65 $\pm$ 2	HOEHLER	79	IPWA	$\pi N \rightarrow \pi N$	

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

64 ± 5	ANISOVICH	12A	DPWA	Multichannel
68.0 ± 0.5	¹ SHRESTHA	12A	DPWA	Multichannel
67 ± 3	BATINIC	10	DPWA	$\pi N \rightarrow N\pi, N\eta$
69 ± 2	VRANA	00	DPWA	Multichannel

¹Statistical error only.

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

Γ_2/Γ

VALUE (%)	DOCUMENT ID	TECN	COMMENT
0.2 ± 0.1	MUELLER	20	DPWA Multichannel
0.09 ± 0.02	¹ HUNT	19	DPWA Multichannel
<1	SHKLYAR	13	DPWA Multichannel
0.15 $^{+0.35}_{-0.10}$	TIATOR	99	DPWA $\gamma p \rightarrow p\eta$

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

1.0 ± 0.3	¹ SHRESTHA	12A	DPWA	Multichannel
0.4 ± 0.2	BATINIC	10	DPWA	$\pi N \rightarrow N\pi, N\eta$
<1	THOMA	08	DPWA	Multichannel
0 ± 1	VRANA	00	DPWA	Multichannel

¹Statistical error only.

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

Γ_3/Γ

VALUE (%)	DOCUMENT ID	TECN	COMMENT
28–53 % OUR ESTIMATE			
24 ± 4	GOLOVATCH	19	DPWA $\gamma p \rightarrow \pi^+\pi^-p$

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

Γ_5/Γ

VALUE (%)	DOCUMENT ID	TECN	COMMENT
13 ± 1	¹ HUNT	19	DPWA Multichannel
7 ± 3	SOKHOYAN	15A	DPWA Multichannel

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

5 ± 3	ANISOVICH	12A	DPWA	Multichannel
10.5 ± 0.9	¹ SHRESTHA	12A	DPWA	Multichannel
14 ± 3	VRANA	00	DPWA	Multichannel

¹Statistical error only.

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

Γ_6/Γ

VALUE (%)	DOCUMENT ID	TECN	COMMENT
< 0.3	¹ HUNT	19	DPWA Multichannel
10 ± 3	SOKHOYAN	15A	DPWA Multichannel

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

10 ± 3	ANISOVICH	12A	DPWA	Multichannel
1.0 ± 0.1	¹ SHRESTHA	12A	DPWA	Multichannel
1 ± 1	VRANA	00	DPWA	Multichannel

¹Statistical error only.

$\Gamma(N\rho, S=3/2, P\text{-wave})/\Gamma_{\text{total}}$ Γ_8/Γ

VALUE (%)	DOCUMENT ID	TECN	COMMENT
6–8 % OUR ESTIMATE			
7 ± 1	¹ HUNT	19	DPWA Multichannel

¹ Statistical error only. $\Gamma(N\rho, S=3/2, F\text{-wave})/\Gamma_{\text{total}}$ Γ_9/Γ

VALUE (%)	DOCUMENT ID	TECN	COMMENT
2–3 % OUR ESTIMATE			
2.4 ± 0.4	¹ HUNT	19	DPWA Multichannel

¹ Statistical error only. $\Gamma(N\sigma)/\Gamma_{\text{total}}$ Γ_{10}/Γ

VALUE (%)	DOCUMENT ID	TECN	COMMENT
8.7 ± 1.5	¹ HUNT	19	DPWA Multichannel
14 ± 5	SOKHOYAN	15A	DPWA Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •			
14 ± 7	ANISOVICH	12A	DPWA Multichannel
9.4 ± 0.8	¹ SHRESTHA	12A	DPWA Multichannel
9 ± 1	VRANA	00	DPWA Multichannel

¹ Statistical error only. **$N(1680)$ PHOTON DECAY AMPLITUDES AT THE POLE** **$N(1680) \rightarrow p\gamma$, helicity-1/2 amplitude $A_{1/2}$**

MODULUS ($\text{GeV}^{-1/2}$)	PHASE ($^\circ$)	DOCUMENT ID	TECN	COMMENT
-0.017 ± 0.003	70 ± 7	ROENCHEN	22	DPWA Multichannel
-0.013 ± 0.003	-20 ± 17	SOKHOYAN	15A	DPWA Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
-0.022	-28	ROENCHEN	15A	DPWA Multichannel

 $N(1680) \rightarrow p\gamma$, helicity-3/2 amplitude $A_{3/2}$

MODULUS ($\text{GeV}^{-1/2}$)	PHASE ($^\circ$)	DOCUMENT ID	TECN	COMMENT
0.095 ± 0.003	-57 ± 4	ROENCHEN	22	DPWA Multichannel
0.135 ± 0.005	1 ± 3	SOKHOYAN	15A	DPWA Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.102	-11	ROENCHEN	15A	DPWA Multichannel

 $N(1680) \rightarrow n\gamma$, helicity-1/2 amplitude $A_{1/2}$

MODULUS ($\text{GeV}^{-1/2}$)	PHASE ($^\circ$)	DOCUMENT ID	TECN	COMMENT
0.032 ± 0.003	-7 ± 5	ANISOVICH	17E	DPWA Multichannel

 $N(1680) \rightarrow n\gamma$, helicity-3/2 amplitude $A_{3/2}$

MODULUS ($\text{GeV}^{-1/2}$)	PHASE ($^\circ$)	DOCUMENT ID	TECN	COMMENT
-0.063 ± 0.004	-10 ± 5	ANISOVICH	17E	DPWA Multichannel

$N(1680)$ BREIT-WIGNER PHOTON DECAY AMPLITUDES **$N(1680) \rightarrow p\gamma$, helicity-1/2 amplitude $A_{1/2}$**

VALUE ($\text{GeV}^{-1/2}$)	DOCUMENT ID	TECN	COMMENT
−0.018 to −0.005 (≈ -0.010) OUR ESTIMATE			
-0.0278 ± 0.0036	GOLOVATCH	19	DPWA $\gamma p \rightarrow \pi^+ \pi^- p$
-0.026 ± 0.004	¹ HUNT	19	DPWA Multichannel
-0.015 ± 0.002	SOKHOYAN	15A	DPWA Multichannel
0.003 ± 0.001	¹ SHKLYAR	13	DPWA Multichannel
-0.007 ± 0.002	¹ WORKMAN	12A	DPWA $\gamma N \rightarrow N\pi$
-0.017 ± 0.001	¹ DUGGER	07	DPWA $\gamma N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
-0.013 ± 0.003	ANISOVICH	12A	DPWA Multichannel
-0.017 ± 0.001	¹ SHRESTHA	12A	DPWA Multichannel
-0.025	DRECHSEL	07	DPWA $\gamma N \rightarrow \pi N$

¹Statistical error only. **$N(1680) \rightarrow p\gamma$, helicity-3/2 amplitude $A_{3/2}$**

VALUE ($\text{GeV}^{-1/2}$)	DOCUMENT ID	TECN	COMMENT
0.130 to 0.140 (≈ 0.135) OUR ESTIMATE			
0.128 ± 0.011	GOLOVATCH	19	DPWA $\gamma p \rightarrow \pi^+ \pi^- p$
0.112 ± 0.005	¹ HUNT	19	DPWA Multichannel
0.136 ± 0.005	SOKHOYAN	15A	DPWA Multichannel
0.116 ± 0.001	¹ SHKLYAR	13	DPWA Multichannel
0.140 ± 0.002	¹ WORKMAN	12A	DPWA $\gamma N \rightarrow N\pi$
0.134 ± 0.002	¹ DUGGER	07	DPWA $\gamma N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
0.135 ± 0.006	ANISOVICH	12A	DPWA Multichannel
0.136 ± 0.001	¹ SHRESTHA	12A	DPWA Multichannel
0.134	DRECHSEL	07	DPWA $\gamma N \rightarrow \pi N$

¹Statistical error only. **$N(1680) \rightarrow n\gamma$, helicity-1/2 amplitude $A_{1/2}$**

VALUE ($\text{GeV}^{-1/2}$)	DOCUMENT ID	TECN	COMMENT
0.020 to 0.040 (≈ 0.030) OUR ESTIMATE			
0.005 ± 0.004	¹ HUNT	19	DPWA Multichannel
0.033 ± 0.003	ANISOVICH	17E	DPWA Multichannel
0.026 ± 0.004	¹ CHEN	12A	DPWA $\gamma N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
0.034 ± 0.006	ANISOVICH	13B	DPWA Multichannel
0.029 ± 0.002	¹ SHRESTHA	12A	DPWA Multichannel
0.028	DRECHSEL	07	DPWA $\gamma N \rightarrow \pi N$

¹Statistical error only.

$N(1680) \rightarrow n\gamma$, helicity-3/2 amplitude $A_{3/2}$

VALUE ($\text{GeV}^{-1/2}$)	DOCUMENT ID	TECN	COMMENT
–0.050 to –0.025 ($\approx$ – 0.035) OUR ESTIMATE			
–0.061 $\pm$ 0.004	¹ HUNT	19	DPWA Multichannel
–0.063 $\pm$ 0.004	ANISOVICH	17E	DPWA Multichannel
–0.029 $\pm$ 0.002	¹ CHEN	12A	DPWA $\gamma N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
–0.044 $\pm$ 0.009	ANISOVICH	13B	DPWA Multichannel
–0.059 $\pm$ 0.002	¹ SHRESTHA	12A	DPWA Multichannel
–0.038	DRECHSEL	07	DPWA $\gamma N \rightarrow \pi N$
¹ Statistical error only.			

 $N(1680)$ REFERENCES

For early references, see Physics Letters **111B** 1 (1982). For very early references, see Reviews of Modern Physics **37** 633 (1965).

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.)
GOLOVATCH	19	PL B788 371	E. Golovatch <i>et al.</i>	(CLAS 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>	
SOKHOYAN	15A	EPJ A51 95	V. Sokhoyan <i>et al.</i>	(CBELSA/TAPS Collab.)
PDG	14	CP C38 070001	K. Olive <i>et al.</i>	(PDG Collab.)
SVARC	14	PR C89 045205	A. Svarc <i>et al.</i>	(RBI Zagreb, UNI Tuzla)
ANISOVICH	13B	EPJ A49 67	A.V. Anisovich <i>et al.</i>	
SHKLYAR	13	PR C87 015201	V. Shklyar, H. Lenske, U. Mosel	(GIES)
ANISOVICH	12A	EPJ A48 15	A.V. Anisovich <i>et al.</i>	(BONN, PNPI)
CHEN	12A	PR C86 015206	W. Chen <i>et al.</i>	(DUKE, GWU, MSST, ITEP+)
SHRESTHA	12A	PR C86 055203	M. Shrestha, D.M. Manley	(KSU)
WORKMAN	12A	PR C86 015202	R. Workman <i>et al.</i>	(GWU)
BATINIC	10	PR C82 038203	M. Batinic <i>et al.</i>	(ZAGR)
THOMA	08	PL B659 87	U. Thoma <i>et al.</i>	(CB-ELSA Collab.)
DRECHSEL	07	EPJ A34 69	D. Drechsel, S.S. Kamalov, L. Tiator	(MAINZ, JINR)
DUGGER	07	PR C76 025211	M. Dugger <i>et al.</i>	(JLab CLAS Collab.)
ARNDT	06	PR C74 045205	R.A. Arndt <i>et al.</i>	(GWU)
VRANA	00	PRPL 328 181	T.P. Vrana, S.A. Dytman, T.-S.H. Lee	(PITT, ANL)
TIATOR	99	PR C60 035210	L. Tiator <i>et al.</i>	
HOEHLER	93	πN Newsletter 9 1	G. Hohler	(KARL)
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