

$$N(1535) \ 1/2^-$$

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

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

$N(1535)$ POLE POSITION

REAL PART

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
1500 to 1520 (≈ 1510) OUR ESTIMATE			
1504 $\pm$ 0	ROENCHEN	22	DPWA Multichannel
1496 $\pm$ 4	AFZAL	20	DPWA Multichannel
1500 $\pm$ 4	SOKHOYAN	15A	DPWA Multichannel
1509 $\pm$ 4 $\pm$ 2	¹ SVARC	14	L+P $\pi N \rightarrow \pi N$
1510 $\pm$ 50	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
1496	HUNT	19	DPWA Multichannel
1499	ROENCHEN	15A	DPWA Multichannel
1490	SHKLYAR	13	DPWA Multichannel
1501 $\pm$ 4	ANISOVICH	12A	DPWA Multichannel
1521 $\pm$ 14	BATINIC	10	DPWA $\pi N \rightarrow N\pi, N\eta$
1502	ARNDT	06	DPWA $\pi N \rightarrow \pi N, \eta N$
1525	VRANA	00	DPWA Multichannel
1487	HOEHLER	93	SPED $\pi N \rightarrow \pi N$

¹Fit to the amplitudes of HOEHLER 79.

–2×IMAGINARY PART

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
80 to 130 (≈ 110) OUR ESTIMATE			
74 $\pm$ 1	ROENCHEN	22	DPWA Multichannel
125 $\pm$ 6	AFZAL	20	DPWA Multichannel
128 $\pm$ 9	SOKHOYAN	15A	DPWA Multichannel
118 $\pm$ 9 $\pm$ 2	² SVARC	14	L+P $\pi N \rightarrow \pi N$
260 $\pm$ 80	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
119	HUNT	19	DPWA Multichannel
104	ROENCHEN	15A	DPWA Multichannel
100	SHKLYAR	13	DPWA Multichannel
134 $\pm$ 11	ANISOVICH	12A	DPWA Multichannel
190 $\pm$ 28	BATINIC	10	DPWA $\pi N \rightarrow N\pi, N\eta$
95	ARNDT	06	DPWA $\pi N \rightarrow \pi N, \eta N$
102	VRANA	00	DPWA Multichannel

²Fit to the amplitudes of HOEHLER 79.

$N(1535)$ ELASTIC POLE RESIDUE**MODULUS $|r|$**

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
15 to 35 (≈ 25) OUR ESTIMATE			
18 ± 1	ROENCHEN	22	DPWA Multichannel
29 ± 4	SOKHOYAN	15A	DPWA Multichannel
$22 \pm 2 \pm 0.4$	³ SVARC	14	L+P $\pi N \rightarrow \pi N$
120 ± 40	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
22	ROENCHEN	15A	DPWA Multichannel
15	SHKLYAR	13	DPWA Multichannel
31 ± 4	ANISOVICH	12A	DPWA Multichannel
68	BATINIC	10	DPWA $\pi N \rightarrow N\pi, N\eta$
16	ARNDT	06	DPWA $\pi N \rightarrow \pi N, \eta N$

³Fit to the amplitudes of HOEHLER 79.**PHASE θ**

VALUE ($^\circ$)	DOCUMENT ID	TECN	COMMENT
-40 to 0 (≈ -20) OUR ESTIMATE			
-37 ± 2	ROENCHEN	22	DPWA Multichannel
-20 ± 10	SOKHOYAN	15A	DPWA Multichannel
$-5 \pm 5 \pm 3$	⁴ SVARC	14	L+P $\pi N \rightarrow \pi N$
$+15 \pm 45$	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
-46	ROENCHEN	15A	DPWA Multichannel
-51	SHKLYAR	13	DPWA Multichannel
-29 ± 5	ANISOVICH	12A	DPWA Multichannel
12	BATINIC	10	DPWA $\pi N \rightarrow N\pi, N\eta$
-16	ARNDT	06	DPWA $\pi N \rightarrow \pi N, \eta N$

⁴Fit to the amplitudes of HOEHLER 79. **$N(1535)$ INELASTIC POLE RESIDUE**The "normalized residue" is the residue divided by $\Gamma_{pole}/2$.**Normalized residue in $N\pi \rightarrow N(1535) \rightarrow N\eta$**

MODULUS	PHASE ($^\circ$)	DOCUMENT ID	TECN	COMMENT
0.50 ± 0.02	118 ± 1	ROENCHEN	22	DPWA Multichannel
0.43 ± 0.03	-76 ± 5	ANISOVICH	12A	DPWA Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.51	112	ROENCHEN	15A	DPWA Multichannel

Normalized residue in $N\pi \rightarrow N(1535) \rightarrow \Lambda K$

MODULUS	PHASE ($^\circ$)	DOCUMENT ID	TECN	COMMENT
0.26 ± 0.01	-67 ± 2	ROENCHEN	22	DPWA Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.05	32	ROENCHEN	15A	DPWA Multichannel

Normalized residue in $N\pi \rightarrow N(1535) \rightarrow \Sigma K$

<u>MODULUS</u>	<u>PHASE ($^{\circ}$)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
0.28 ± 0.01	92 ± 2	ROENCHEN	22	DPWA Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.05	-69	ROENCHEN	15A	DPWA Multichannel

Normalized residue in $N\pi \rightarrow N(1535) \rightarrow \Delta\pi$, *D*-wave

<u>MODULUS</u>	<u>PHASE ($^{\circ}$)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
0.11 ± 0.02	160 ± 20	SOKHOYAN	15A	DPWA Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.12 ± 0.03	145 ± 17	ANISOVICH	12A	DPWA Multichannel

Normalized residue in $N\pi \rightarrow N(1535) \rightarrow N\sigma$

<u>MODULUS</u>	<u>PHASE ($^{\circ}$)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
0.16 ± 0.07	25 ± 40	SOKHOYAN	15A	DPWA Multichannel

Normalized residue in $N\pi \rightarrow N(1535) \rightarrow N(1440)\pi$

<u>MODULUS</u>	<u>PHASE ($^{\circ}$)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
0.21 ± 0.14	-45 ± 50	SOKHOYAN	15A	DPWA Multichannel

 $N(1535)$ BREIT-WIGNER MASS

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
1515 to 1545 (≈ 1530) OUR ESTIMATE			
1525 ± 2	⁵ HUNT 19	DPWA	Multichannel
1528 ± 6	KASHEVAROV 17	DPWA	$\gamma p \rightarrow \eta p, \eta' p$
1517 ± 4	SOKHOYAN 15A	DPWA	Multichannel
1526 ± 2	⁵ SHKLYAR 13	DPWA	Multichannel
1547.0 ± 0.7	⁵ ARNDT 06	DPWA	$\pi N \rightarrow \pi N, \eta N$
1550 ± 40	CUTKOSKY 80	IPWA	$\pi N \rightarrow \pi N$
1526 ± 7	HOEHLER 79	IPWA	$\pi N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
1519 ± 5	ANISOVICH 12A	DPWA	Multichannel
1538 ± 1	⁵ SHRESTHA 12A	DPWA	Multichannel
1553 ± 8	BATINIC 10	DPWA	$\pi N \rightarrow N\pi, N\eta$
1546.7 ± 2.2	ARNDT 04	DPWA	$\pi N \rightarrow \pi N, \eta N$
1526 ± 2	PENNER 02C	DPWA	Multichannel
1530 ± 10	BAI 01B	BES	$J/\psi \rightarrow p\bar{p}\eta$
1522 ± 11	THOMPSON 01	CLAS	$\gamma^* p \rightarrow p\eta$
1542 ± 3	VRANA 00	DPWA	Multichannel
1532 ± 5	ARMSTRONG 99B	DPWA	$\gamma^* p \rightarrow p\eta$

⁵Statistical error only. **$N(1535)$ BREIT-WIGNER WIDTH**

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
125 to 175 (≈ 150) OUR ESTIMATE			
147 ± 5	⁶ HUNT 19	DPWA	Multichannel
163 ± 25	KASHEVAROV 17	DPWA	$\gamma p \rightarrow \eta p, \eta' p$
120 ± 10	SOKHOYAN 15A	DPWA	Multichannel

131 ± 12	⁶ SHKLYAR	13	DPWA	Multichannel
188.4 ± 3.8	⁶ ARNDT	06	DPWA	$\pi N \rightarrow \pi N, \eta N$
240 ± 80	CUTKOSKY	80	IPWA	$\pi N \rightarrow \pi N$
120 ± 20	HOEHLER	79	IPWA	$\pi N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
128 ± 14	ANISOVICH	12A	DPWA	Multichannel
141 ± 4	⁶ SHRESTHA	12A	DPWA	Multichannel
182 ± 25	BATINIC	10	DPWA	$\pi N \rightarrow N\pi, N\eta$
129 ± 8	PENNER	02C	DPWA	Multichannel
95 ± 25	BAI	01B	BES	$J/\psi \rightarrow p\bar{p}\eta$
143 ± 18	THOMPSON	01	CLAS	$\gamma^* p \rightarrow p\eta$
112 ± 19	VRANA	00	DPWA	Multichannel
154 ± 20	ARMSTRONG	99B	DPWA	$\gamma^* p \rightarrow p\eta$

⁶ Statistical error only.

***N*(1535) DECAY MODES**

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

Mode	Fraction (Γ_i/Γ)
Γ_1 $N\pi$	32–52 %
Γ_2 $N\eta$	30–55 %
Γ_3 $N\pi\pi$	4–31 %
Γ_4 $\Delta(1232)\pi$, <i>D</i> -wave	1–4 %
Γ_5 $N\rho$	2–17 %
Γ_6 $N\rho$, $S=1/2$, <i>S</i> -wave	2–16 %
Γ_7 $N\rho$, $S=3/2$, <i>D</i> -wave	<1 %
Γ_8 $N\sigma$	2–10 %
Γ_9 $N(1440)\pi$	5–12 %
Γ_{10} $p\gamma$, helicity=1/2	0.15–0.30 %
Γ_{11} $n\gamma$, helicity=1/2	0.01–0.25 %

***N*(1535) BRANCHING RATIOS**

$\Gamma(N\pi)/\Gamma_{\text{total}}$				Γ_1/Γ
VALUE (%)	DOCUMENT ID	TECN	COMMENT	
32–52 % OUR ESTIMATE				
42 ± 2	⁷ HUNT	19	DPWA	Multichannel
52 ± 5	SOKHOYAN	15A	DPWA	Multichannel
35 ± 3	⁷ SHKLYAR	13	DPWA	Multichannel
35.5 ± 0.2	⁷ ARNDT	06	DPWA	$\pi N \rightarrow \pi N, \eta N$
50 ± 10	CUTKOSKY	80	IPWA	$\pi N \rightarrow \pi N$
38 ± 4	HOEHLER	79	IPWA	$\pi N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
54 ± 5	ANISOVICH	12A	DPWA	Multichannel
37 ± 1	⁷ SHRESTHA	12A	DPWA	Multichannel
46 ± 7	BATINIC	10	DPWA	$\pi N \rightarrow N\pi, N\eta$

36 $\pm$ 1	PENNER	02C	DPWA	Multichannel
35 $\pm$ 8	VRANA	00	DPWA	Multichannel

⁷ Statistical error only.

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

VALUE (%)	DOCUMENT ID	TECN	COMMENT
30–55 % OUR ESTIMATE			
41 $\pm$ 4	MUELLER	20	DPWA Multichannel
43 $\pm$ 3	⁸ HUNT	19	DPWA Multichannel
41 $\pm$ 4	⁹ KASHEVAROV	17	DPWA $\gamma p \rightarrow \eta p, \eta' p$
58 $\pm$ 4	⁸ SHKLYAR	13	DPWA Multichannel
33 $\pm$ 5	ANISOVICH	12A	DPWA Multichannel
53 $\pm$ 1	PENNER	02C	DPWA Multichannel
51 $\pm$ 5	VRANA	00	DPWA Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •			
41 $\pm$ 2	⁸ SHRESTHA	12A	DPWA Multichannel
50 $\pm$ 7	BATINIC	10	DPWA $\pi N \rightarrow N\pi, N\eta$

⁸ Statistical error only.⁹ Assuming $A_{1/2} = 0.115 \text{ GeV}^{-1/2}$.

$\Gamma(N\eta)/\Gamma(N\pi)$ Γ_2/Γ_1

VALUE	DOCUMENT ID	TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •			
0.95 $\pm$ 0.03	AZNAURYAN	09	CLAS π, η electroproduction

$\Gamma(\Delta(1232)\pi, D\text{-wave})/\Gamma_{\text{total}}$ Γ_4/Γ

VALUE (%)	DOCUMENT ID	TECN	COMMENT
1–4 % OUR ESTIMATE			
3 $\pm$ 1	ADAMCZEW...	20	DPWA Multichannel
<1.1	¹⁰ HUNT	19	DPWA Multichannel
2.5 $\pm$ 1.5	SOKHOYAN	15A	DPWA Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •			
2.5 $\pm$ 1.5	ANISOVICH	12A	DPWA Multichannel
1.8 $\pm$ 0.8	¹⁰ SHRESTHA	12A	DPWA Multichannel
1 $\pm$ 1	VRANA	00	DPWA Multichannel

¹⁰ Statistical error only.

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

VALUE (%)	DOCUMENT ID	TECN	COMMENT
2–16 % OUR ESTIMATE			
2.7 $\pm$ 0.6	ADAMCZEW...	20	DPWA Multichannel
14 $\pm$ 2	¹¹ HUNT	19	DPWA Multichannel

¹¹ Statistical error only.

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

VALUE (%)	DOCUMENT ID	TECN	COMMENT
<1 % OUR ESTIMATE			
0.5 $\pm$ 0.5	ADAMCZEW...	20	DPWA Multichannel
<0.3	¹² HUNT	19	DPWA Multichannel

¹² Statistical error only.

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

VALUE (%)	DOCUMENT ID	TECN	COMMENT
2–10 % OUR ESTIMATE			
<1	¹³ HUNT	19	DPWA Multichannel
6 ±4	SOKHOYAN	15A	DPWA Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •			
1.5±0.5	¹³ SHRESTHA	12A	DPWA Multichannel
2 ±1	VRANA	00	DPWA Multichannel
¹³ Statistical error only.			

 $\Gamma(N(1440)\pi)/\Gamma_{\text{total}}$ Γ_9/Γ

VALUE (%)	DOCUMENT ID	TECN	COMMENT
5–12 % OUR ESTIMATE			
< 0.01	¹⁴ HUNT	19	DPWA Multichannel
12 ±8	SOKHOYAN	15A	DPWA Multichannel
8 ±2	¹⁴ STAROSTIN	03	$\pi^- p \rightarrow n 3\pi^0$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
< 1	¹⁴ SHRESTHA	12A	DPWA Multichannel
10 ±9	VRANA	00	DPWA Multichannel
¹⁴ This value is an estimate made using simplest assumptions.			

 $N(1535)$ PHOTON DECAY AMPLITUDES AT THE POLE **$N(1535) \rightarrow p\gamma$, helicity-1/2 amplitude $A_{1/2}$**

MODULUS ($\text{GeV}^{-1/2}$)	PHASE ($^\circ$)	DOCUMENT ID	TECN	COMMENT
0.084±0.002	−12 ± 2	ROENCHEN	22	DPWA Multichannel
0.093±0.009	8 ± 4	ANISOVICH	17D	DPWA Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.114±0.008	10 ± 5	ANISOVICH	15A	DPWA Multichannel
0.106	5.2	ROENCHEN	15A	DPWA Multichannel
0.114±0.008	10 ± 5	SOKHOYAN	15A	DPWA Multichannel

 $N(1535) \rightarrow n\gamma$, helicity-1/2 amplitude $A_{1/2}$

MODULUS ($\text{GeV}^{-1/2}$)	PHASE ($^\circ$)	DOCUMENT ID	TECN	COMMENT
−0.088±0.004	5 ± 4	ANISOVICH	17D	DPWA Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
−0.095±0.006	8 ± 5	ANISOVICH	15A	DPWA Multichannel

 $N(1535)$ BREIT-WIGNER PHOTON DECAY AMPLITUDES **$N(1535) \rightarrow p\gamma$, helicity-1/2 amplitude $A_{1/2}$**

VALUE ($\text{GeV}^{-1/2}$)	DOCUMENT ID	TECN	COMMENT
0.090 to 0.120 (≈ 0.105) OUR ESTIMATE			
0.107±0.003	¹⁵ HUNT	19	DPWA Multichannel
0.101±0.007	SOKHOYAN	15A	DPWA Multichannel
0.091±0.004	¹⁵ SHKLYAR	13	DPWA Multichannel
0.128±0.004	¹⁵ WORKMAN	12A	DPWA $\gamma N \rightarrow N\pi$
0.091±0.002	¹⁵ DUGGER	07	DPWA $\gamma N \rightarrow \pi N$

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

0.105 ± 0.010	ANISOVICH	12A	DPWA	Multichannel
0.059 ± 0.003	¹⁵ SHRESTHA	12A	DPWA	Multichannel
0.066	DRECHSEL	07	DPWA	$\gamma N \rightarrow \pi N$
0.090	PENNER	02D	DPWA	Multichannel

¹⁵ Statistical error only.

$N(1535) \rightarrow n\gamma$, helicity-1/2 amplitude $A_{1/2}$

VALUE ($\text{GeV}^{-1/2}$)	DOCUMENT ID	TECN	COMMENT
−0.095 to −0.055 ($\approx$ −0.075) OUR ESTIMATE			
$−0.055 \pm 0.006$	¹⁶ HUNT	19	DPWA Multichannel
$−0.081 \pm 0.006$	ANISOVICH	17E	DPWA Multichannel
$−0.058 \pm 0.006$	¹⁶ CHEN	12A	DPWA $\gamma N \rightarrow \pi N$

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

$−0.093 \pm 0.011$	ANISOVICH	13B	DPWA Multichannel
$−0.049 \pm 0.003$	¹⁶ SHRESTHA	12A	DPWA Multichannel
−0.051	DRECHSEL	07	DPWA $\gamma N \rightarrow \pi N$
−0.024	PENNER	02D	DPWA Multichannel

¹⁶ Statistical error only.

$N(1535) \rightarrow N\gamma$, ratio $A_{1/2}^n/A_{1/2}^p$

VALUE ($\text{GeV}^{-1/2}$)	DOCUMENT ID	TECN
$−0.84 \pm 0.15$	MUKHOPAD... 95B	IPWA

$N(1535)$ REFERENCES

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

ROENCHEN	22	EPJ A58 229	D. Roenchen <i>et al.</i>	(JULI, GWU, BONN+)
ADAMCZEW...	20	PR C102 024001	J. Adamczewski-Musch <i>et al.</i>	(HADES Collab.)
AFZAL	20	PRL 125 152002	F. Afzal <i>et al.</i>	(CBELSA/TAPS Collab.)
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	17D	PR C95 035211	A.V. Anisovich <i>et al.</i>	
ANISOVICH	17E	PR C96 055202	A.V. Anisovich <i>et al.</i>	(BONN, PNPI, JLAB+)
KASHEVAROV	17	PRL 118 212001	V.L. Kashevarov <i>et al.</i>	(A2/MAMI Collab.)
ANISOVICH	15A	EPJ A51 72	A.V. Anisovich <i>et al.</i>	
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)
AZNAURYAN	09	PR C80 055203	I.G. Aznauryan <i>et al.</i>	(JLab CLAS 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)
ARNDT	04	PR C69 035213	R.A. Arndt <i>et al.</i>	(GWU, TRIU)
STAROSTIN	03	PR C67 068201	A. Starostin <i>et al.</i>	(BNL Crystal Ball Collab.)
PENNER	02C	PR C66 055211	G. Penner, U. Mosel	(GIES)

PENNER	02D	PR C66 055212	G. Penner, U. Mosel	(GIES)
BAI	01B	PL B510 75	J.Z. Bai <i>et al.</i>	(BES Collab.)
THOMPSON	01	PRL 86 1702	R. Thompson <i>et al.</i>	(JLab CLAS Collab.)
VRANA	00	PRPL 328 181	T.P. Vrana, S.A. Dytman, T.-S.H. Lee	(PITT, ANL)
ARMSTRONG	99B	PR D60 052004	C.S. Armstrong <i>et al.</i>	
MUKHOPAD...	95B	PL B364 1	N.C. Mukhopadhyay, J.F. Zhang, M. Benmerrouche	
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
