

$N(1720) \ 3/2^+$ $I(J^P) = \frac{1}{2}(3^+)$ Status: ****

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

 $N(1720)$ POLE POSITION**REAL PART**

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
1660 to 1690 (\approx 1675) OUR ESTIMATE			
1670 \pm 25	SOKHOYAN	15A	DPWA Multichannel
1677 \pm 4 \pm 1	¹ SVARC	14	L+P $\pi N \rightarrow \pi N$
1680 \pm 30	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
1654	HUNT	19	DPWA Multichannel
1710	ROENCHEN	15A	DPWA Multichannel
1670	SHKLYAR	13	DPWA Multichannel
1660 \pm 30	ANISOVICH	12A	DPWA Multichannel
1691 \pm 23	BATINIC	10	DPWA $\pi N \rightarrow N\pi, N\eta$
1666	ARNDT	06	DPWA $\pi N \rightarrow \pi N, \eta N$
1692	VRANA	00	DPWA Multichannel
1686	HOEHLER	93	SPED $\pi N \rightarrow \pi N$

¹Fit to the amplitudes of HOEHLER 79.

– 2×IMAGINARY PART

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
150 to 400 (\approx 250) OUR ESTIMATE			
430 \pm 100	SOKHOYAN	15A	DPWA Multichannel
184 \pm 8 \pm 1	¹ SVARC	14	L+P $\pi N \rightarrow \pi N$
120 \pm 40	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
100	HUNT	19	DPWA Multichannel
219	ROENCHEN	15A	DPWA Multichannel
118	SHKLYAR	13	DPWA Multichannel
450 \pm 100	ANISOVICH	12A	DPWA Multichannel
233 \pm 23	BATINIC	10	DPWA $\pi N \rightarrow N\pi, N\eta$
355	ARNDT	06	DPWA $\pi N \rightarrow \pi N, \eta N$
94	VRANA	00	DPWA Multichannel
187	HOEHLER	93	SPED $\pi N \rightarrow \pi N$

¹Fit to the amplitudes of HOEHLER 79.

 $N(1720)$ ELASTIC POLE RESIDUE**MODULUS $|r|$**

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
10 to 25 (\approx 15) OUR ESTIMATE			
26 \pm 10	SOKHOYAN	15A	DPWA Multichannel
13 \pm 1	¹ SVARC	14	L+P $\pi N \rightarrow \pi N$
8 \pm 2	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$

• • • 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

<u>VALUE (°)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
−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 $N\pi \rightarrow N(1720) \rightarrow N\eta$

<u>MODULUS</u>	<u>PHASE (°)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
0.03 ± 0.02		ANISOVICH	12A	DPWA Multichannel
• • •				
0.007	106	ROENCHEN	15A	DPWA Multichannel

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

<u>MODULUS</u>	<u>PHASE (°)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
0.06 ± 0.04	−150 ± 45	ANISOVICH	12A	DPWA Multichannel
• • •				
0.011	−70	ROENCHEN	15A	DPWA Multichannel

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

<u>MODULUS</u>	<u>PHASE (°)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
• • •				
0.002	79	ROENCHEN	15A	DPWA Multichannel

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

<u>MODULUS</u>	<u>PHASE (°)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
0.28 ± 0.09	95 ± 30	SOKHOYAN	15A	DPWA Multichannel
• • •				
0.29 ± 0.08	80 ± 40	ANISOVICH	12A	DPWA Multichannel

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

<u>MODULUS</u>	<u>PHASE ($^\circ$)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
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 $N\pi \rightarrow N(1720) \rightarrow N\sigma$

<u>MODULUS</u>	<u>PHASE ($^\circ$)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
0.08 ± 0.04	-110 ± 35	SOKHOYAN	15A	DPWA Multichannel

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

<u>MODULUS</u>	<u>PHASE ($^\circ$)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
0.05 ± 0.04	undefined	SOKHOYAN	15A	DPWA Multichannel

 $N(1720)$ BREIT-WIGNER MASS

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
1680 to 1750 (≈ 1720) OUR ESTIMATE			
1745 ± 6	GOLOVATCH	19	DPWA $\gamma p \rightarrow \pi^+ \pi^- p$
1711 ± 4	¹ HUNT	19	DPWA Multichannel
1690 ± 30	SOKHOYAN	15A	DPWA Multichannel
1700 ± 10	¹ SHKLYAR	13	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. • • •			
$1690 \begin{smallmatrix} + 70 \\ - 35 \end{smallmatrix}$	ANISOVICH	12A	DPWA Multichannel
1720 ± 5	¹ SHRESTHA	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

¹Statistical error only. **$N(1720)$ BREIT-WIGNER WIDTH**

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
150 to 400 (≈ 250) OUR ESTIMATE			
116 ± 27	GOLOVATCH	19	DPWA $\gamma p \rightarrow \pi^+ \pi^- p$
229 ± 22	¹ HUNT	19	DPWA Multichannel
420 ± 80	SOKHOYAN	15A	DPWA Multichannel
152 ± 2	¹ SHKLYAR	13	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
200 ± 20	¹ SHRESTHA	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

¹Statistical 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 $\Delta(1232)\pi, P\text{-wave}$	47–77 %
Γ_8 $\Delta(1232)\pi, F\text{-wave}$	<12 %
Γ_9 $N\rho$	
Γ_{10} $N\rho, S=1/2, P\text{-wave}$	1–2 %
Γ_{11} $N\sigma$	2–14 %
Γ_{12} $N(1440)\pi$	<2 %
Γ_{13} $N(1520)\pi, S\text{-wave}$	1–5 %
Γ_{14} $p\gamma$	0.05–0.25 %
Γ_{15} $p\gamma, \text{helicity}=1/2$	0.05–0.15 %
Γ_{16} $p\gamma, \text{helicity}=3/2$	0.002–0.16 %
Γ_{17} $n\gamma$	0.0–0.016 %
Γ_{18} $n\gamma, \text{helicity}=1/2$	0.0–0.01 %
Γ_{19} $n\gamma, \text{helicity}=3/2$	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					
18 ± 2	¹ HUNT	19	DPWA	Multichannel	
11 ± 4	SOKHOYAN	15A	DPWA	Multichannel	
17 ± 2	¹ SHKLYAR	13	DPWA	Multichannel	
9.4 ± 0.5	ARNDT	06	DPWA	$\pi N \rightarrow \pi N, \eta N$	
10 ± 4	CUTKOSKY	80	IPWA	$\pi N \rightarrow \pi N$	
14 ± 3	HOEHLER	79	IPWA	$\pi N \rightarrow \pi N$	

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

10 ±5	ANISOVICH	12A	DPWA	Multichannel
13.6±0.6	¹ SHRESTHA	12A	DPWA	Multichannel
18 ±3	BATINIC	10	DPWA	$\pi N \rightarrow N\pi, N\eta$
17 ±2	PENNER	02C	DPWA	Multichannel
5 ±5	VRANA	00	DPWA	Multichannel

¹Statistical error only.

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

<u>VALUE (%)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
1 to 5 (≈ 3) OUR ESTIMATE			
3.8±0.5	¹ HUNT	19	DPWA Multichannel
< 1	SHKLYAR	13	DPWA Multichannel
3 ±2	ANISOVICH	12A	DPWA Multichannel

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

< 1	¹ SHRESTHA	12A	DPWA	Multichannel
0 ±1	BATINIC	10	DPWA	$\pi N \rightarrow N\pi, N\eta$
10 ±7	THOMA	08	DPWA	Multichannel
0.2±0.2	PENNER	02C	DPWA	Multichannel
4 ±1	VRANA	00	DPWA	Multichannel

¹Statistical error only.

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

<u>VALUE (%)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
26±14	DENISENKO	16	DPWA Multichannel

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

<u>VALUE (%)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
16 ±3	¹ HUNT	19	DPWA Multichannel
4.3±0.4	SHKLYAR	05	DPWA Multichannel

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

2.8±0.4	¹ SHRESTHA	12A	DPWA	Multichannel
12 ±9	THOMA	08	DPWA	Multichannel
9 ±3	PENNER	02C	DPWA	Multichannel

¹Statistical error only.

$\Gamma(N\pi\pi)/\Gamma_{\text{total}}$ **Γ_5/Γ**

<u>VALUE</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
0.84±0.16	GOLOVATCH	19	DPWA $\gamma p \rightarrow \pi^+ \pi^- p$

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

<u>VALUE (%)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
62±15	SOKHOYAN	15A	DPWA Multichannel

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

75±15	ANISOVICH	12A	DPWA	Multichannel
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$\Gamma(\Delta(1232)\pi, F\text{-wave})/\Gamma_{\text{total}}$ **Γ_8/Γ**

<u>VALUE (%)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
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
91 ±1	VRANA 00	DPWA	Multichannel

¹Statistical error only. $\Gamma(N\sigma)/\Gamma_{\text{total}}$ Γ_{11}/Γ

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

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

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

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

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

 $N(1720)$ PHOTON DECAY AMPLITUDES AT THE POLE **$N(1720) \rightarrow p\gamma$, helicity-1/2 amplitude $A_{1/2}$**

MODULUS ($\text{GeV}^{-1/2}$)	PHASE ($^\circ$)	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
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 $N(1720) \rightarrow p\gamma$, helicity-3/2 amplitude $A_{3/2}$

MODULUS ($\text{GeV}^{-1/2}$)	PHASE ($^\circ$)	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
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 $N(1720)$ BREIT-WIGNER PHOTON DECAY AMPLITUDES **$N(1720) \rightarrow p\gamma$, helicity-1/2 amplitude $A_{1/2}$**

VALUE ($\text{GeV}^{-1/2}$)	DOCUMENT ID	TECN	COMMENT
0.080 to 0.120 (≈ 0.100) OUR ESTIMATE			
0.0809±0.0115	GOLOVATCH 19	DPWA	$\gamma p \rightarrow \pi^+ \pi^- p$
0.068 ±0.004	¹ HUNT 19	DPWA	Multichannel
0.115 ±0.045	SOKHOYAN 15A	DPWA	Multichannel
-0.065 ±0.002	¹ SHKLYAR 13	DPWA	Multichannel
0.095 ±0.002	WORKMAN 12A	DPWA	$\gamma N \rightarrow N\pi$

• • • 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	$\gamma N \rightarrow \pi N$
0.097 ± 0.003	DUGGER	07	DPWA	$\gamma N \rightarrow \pi N$
−0.053	PENNER	02D	DPWA	Multichannel

¹Statistical error only.

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

<u>VALUE (GeV^{−1/2})</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
−0.034 ± 0.0076	GOLOVATCH	19	DPWA $\gamma p \rightarrow \pi^+ \pi^- p$
0.028 ± 0.003	¹ HUNT	19	DPWA Multichannel
0.135 ± 0.040	SOKHOYAN	15A	DPWA Multichannel
0.035 ± 0.002	¹ SHKLYAR	13	DPWA Multichannel
−0.048 ± 0.002	WORKMAN	12A	DPWA $\gamma N \rightarrow N\pi$

• • • 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

¹Statistical error only.

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

<u>VALUE (GeV^{−1/2})</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
−0.064 ± 0.006	¹ HUNT	19	DPWA Multichannel
−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

¹Statistical error only.

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

<u>VALUE (GeV^{−1/2})</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
−0.004 ± 0.006	¹ HUNT	19	DPWA Multichannel
−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

¹Statistical error only.

N(1720) REFERENCESFor early references, see Physics Letters **111B** 1 (1982).

GOLOVATCH	19	PL B788 371	E. Golovatch <i>et al.</i>	(CLAS Collab.)
HUNT	19	PR C99 055205	B.C. Hunt, D.M. Manley	
DENISENKO	16	PL B755 97	I. Denisenko <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.)
ROENCHEN	14	EPJ A50 101	D. Roenchen <i>et al.</i>	
Also		EPJ A51 63 (errat.)	D. Roenchen <i>et al.</i>	
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)
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)
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 <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