

**$N(1720) P_{13}$** 

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

Most of the results published before 1975 are now obsolete and have been omitted. They may be found in our 1982 edition, Physics Letters **111B** (1982).

 **$N(1720)$  BREIT-WIGNER MASS**

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>1650 to 1750 (<math>\approx 1720</math>) OUR ESTIMATE</b>			
1717 $\pm$ 31	MANLEY	92	IPWA $\pi N \rightarrow \pi N$ & $N\pi\pi$
1700 $\pm$ 50	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
1710 $\pm$ 20	HOEHLER	79	IPWA $\pi N \rightarrow \pi N$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
1713 $\pm$ 10	ARNDT	96	IPWA $\gamma N \rightarrow \pi N$
1820	ARNDT	95	DPWA $\pi N \rightarrow N\pi$
1711 $\pm$ 26	BATINIC	95	DPWA $\pi N \rightarrow N\pi, N\eta$
1720	LI	93	IPWA $\gamma N \rightarrow \pi N$
1785	CRAWFORD	80	DPWA $\gamma N \rightarrow \pi N$
1690	SAXON	80	DPWA $\pi^- p \rightarrow \Lambda K^0$
1710 to 1790	BAKER	78	DPWA $\pi^- p \rightarrow \Lambda K^0$
1809	BARBOUR	78	DPWA $\gamma N \rightarrow \pi N$
1640 $\pm$ 10	<sup>1</sup> BAKER	77	IPWA $\pi^- p \rightarrow \Lambda K^0$
1710	<sup>1</sup> BAKER	77	DPWA $\pi^- p \rightarrow \Lambda K^0$
1750	<sup>2</sup> LONGACRE	77	IPWA $\pi N \rightarrow N\pi\pi$
1850	KNASEL	75	DPWA $\pi^- p \rightarrow \Lambda K^0$
1720	<sup>3</sup> LONGACRE	75	IPWA $\pi N \rightarrow N\pi\pi$

 **$N(1720)$  BREIT-WIGNER WIDTH**

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>100 to 200 (<math>\approx 150</math>) OUR ESTIMATE</b>			
380 $\pm$ 180	MANLEY	92	IPWA $\pi N \rightarrow \pi N$ & $N\pi\pi$
125 $\pm$ 70	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
190 $\pm$ 30	HOEHLER	79	IPWA $\pi N \rightarrow \pi N$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
153 $\pm$ 15	ARNDT	96	IPWA $\gamma N \rightarrow \pi N$
354	ARNDT	95	DPWA $\pi N \rightarrow N\pi$
235 $\pm$ 51	BATINIC	95	DPWA $\pi N \rightarrow N\pi, N\eta$
200	LI	93	IPWA $\gamma N \rightarrow \pi N$
308	CRAWFORD	80	DPWA $\gamma N \rightarrow \pi N$
120	SAXON	80	DPWA $\pi^- p \rightarrow \Lambda K^0$
447	BAKER	79	DPWA $\pi^- p \rightarrow n\eta$

300 to 400	BAKER	78	DPWA	$\pi^- p \rightarrow \Lambda K^0$
285	BARBOUR	78	DPWA	$\gamma N \rightarrow \pi N$
200 ± 50	<sup>1</sup> BAKER	77	IPWA	$\pi^- p \rightarrow \Lambda K^0$
500	<sup>1</sup> BAKER	77	DPWA	$\pi^- p \rightarrow \Lambda K^0$
130	<sup>2</sup> LONGACRE	77	IPWA	$\pi N \rightarrow N\pi\pi$
327	KNASEL	75	DPWA	$\pi^- p \rightarrow \Lambda K^0$
150	<sup>3</sup> LONGACRE	75	IPWA	$\pi N \rightarrow N\pi\pi$

## N(1720) POLE POSITION

### REAL PART

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>1650 to 1750 (≈ 1700) OUR ESTIMATE</b>			
1717	ARNDT	95	DPWA $\pi N \rightarrow N\pi$
1686	<sup>4</sup> HOEHLER	93	SPED $\pi N \rightarrow \pi N$
1680 ± 30	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
1675	ARNDT	91	DPWA $\pi N \rightarrow \pi N$ Soln SM90
1716 or 1716	<sup>5</sup> LONGACRE	78	IPWA $\pi N \rightarrow N\pi\pi$
1745 or 1748	<sup>2</sup> LONGACRE	77	IPWA $\pi N \rightarrow N\pi\pi$

### − 2×IMAGINARY PART

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>110 to 390 (≈ 250) OUR ESTIMATE</b>			
388	ARNDT	95	DPWA $\pi N \rightarrow N\pi$
187	<sup>4</sup> HOEHLER	93	SPED $\pi N \rightarrow \pi N$
120 ± 40	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
114	ARNDT	91	DPWA $\pi N \rightarrow \pi N$ Soln SM90
124 or 126	<sup>5</sup> LONGACRE	78	IPWA $\pi N \rightarrow N\pi\pi$
135 or 123	<sup>2</sup> LONGACRE	77	IPWA $\pi N \rightarrow N\pi\pi$

## N(1720) ELASTIC POLE RESIDUE

### MODULUS |r|

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
39	ARNDT	95	DPWA $\pi N \rightarrow N\pi$
15	HOEHLER	93	SPED $\pi N \rightarrow \pi N$
8 ± 2	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
11	ARNDT	91	DPWA $\pi N \rightarrow \pi N$ Soln SM90

### PHASE $\theta$

<u>VALUE (°)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
− 70	ARNDT	95	DPWA $\pi N \rightarrow N\pi$
− 160 ± 30	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
− 130	ARNDT	91	DPWA $\pi N \rightarrow \pi N$ Soln SM90

## N(1720) DECAY MODES

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

Mode	Fraction ( $\Gamma_i/\Gamma$ )
$\Gamma_1$ $N\pi$	10–20 %
$\Gamma_2$ $N\eta$	
$\Gamma_3$ $\Lambda K$	1–15 %
$\Gamma_4$ $\Sigma K$	
$\Gamma_5$ $N\pi\pi$	>70 %
$\Gamma_6$ $\Delta\pi$	
$\Gamma_7$ $\Delta(1232)\pi$ , <i>P</i> -wave	
$\Gamma_8$ $N\rho$	70–85 %
$\Gamma_9$ $N\rho$ , $S=1/2$ , <i>P</i> -wave	
$\Gamma_{10}$ $N\rho$ , $S=3/2$ , <i>P</i> -wave	
$\Gamma_{11}$ $N(\pi\pi)_{S\text{-wave}}^{I=0}$	
$\Gamma_{12}$ $p\gamma$	0.003–0.10 %
$\Gamma_{13}$ $p\gamma$ , helicity=1/2	0.003–0.08 %
$\Gamma_{14}$ $p\gamma$ , helicity=3/2	0.001–0.03 %
$\Gamma_{15}$ $n\gamma$	0.002–0.39 %
$\Gamma_{16}$ $n\gamma$ , helicity=1/2	0.0–0.002 %
$\Gamma_{17}$ $n\gamma$ , helicity=3/2	0.001–0.39 %

## N(1720) BRANCHING RATIOS

### $\Gamma(N\pi)/\Gamma_{\text{total}}$ $\Gamma_1/\Gamma$

<u>VALUE</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>0.10 to 0.20 OUR ESTIMATE</b>			
0.13±0.05	MANLEY	92	IPWA $\pi N \rightarrow \pi N$ & $N\pi\pi$
0.10±0.04	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
0.14±0.03	HOEHLER	79	IPWA $\pi N \rightarrow \pi N$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
0.16	ARNDT	95	DPWA $\pi N \rightarrow N\pi$
0.18±0.04	BATINIC	95	DPWA $\pi N \rightarrow N\pi, N\eta$

### $\Gamma(N\eta)/\Gamma_{\text{total}}$ $\Gamma_2/\Gamma$

<u>VALUE</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
0.002±0.01	BATINIC	95	DPWA $\pi N \rightarrow N\pi, N\eta$

### $(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{\text{total}}$ in $N\pi \rightarrow N(1720) \rightarrow N\eta$ $(\Gamma_1\Gamma_2)^{1/2}/\Gamma$

<u>VALUE</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
–0.08	BAKER	79	DPWA $\pi^- p \rightarrow n\eta$

$(\Gamma_i \Gamma_f)^{1/2} / \Gamma_{\text{total}}$ in $N\pi \rightarrow N(1720) \rightarrow \Lambda K$				$(\Gamma_1 \Gamma_3)^{1/2} / \Gamma$
VALUE	DOCUMENT ID	TECN	COMMENT	
<b>-0.14 to -0.06 OUR ESTIMATE</b>				
-0.09	BELL	83	DPWA	$\pi^- p \rightarrow \Lambda K^0$
-0.11	SAXON	80	DPWA	$\pi^- p \rightarrow \Lambda K^0$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
-0.09	<sup>6</sup> BAKER	78	DPWA	See SAXON 80
-0.06 ± 0.02	<sup>1</sup> BAKER	77	IPWA	$\pi^- p \rightarrow \Lambda K^0$
-0.09	<sup>1</sup> BAKER	77	DPWA	$\pi^- p \rightarrow \Lambda K^0$

$(\Gamma_i \Gamma_f)^{1/2} / \Gamma_{\text{total}}$ in $N\pi \rightarrow N(1720) \rightarrow \Sigma K$				$(\Gamma_1 \Gamma_4)^{1/2} / \Gamma$
VALUE	DOCUMENT ID	TECN	COMMENT	
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.051 to 0.087	<sup>7</sup> DEANS	75	DPWA	$\pi N \rightarrow \Sigma K$

Note: Signs of couplings from  $\pi N \rightarrow N\pi\pi$  analyses were changed in the 1986 edition to agree with the baryon-first convention; the overall phase ambiguity is resolved by choosing a negative sign for the  $\Delta(1620) S_{31}$  coupling to  $\Delta(1232)\pi$ .

$(\Gamma_i \Gamma_f)^{1/2} / \Gamma_{\text{total}}$ in $N\pi \rightarrow N(1720) \rightarrow \Delta(1232)\pi$ , P-wave				$(\Gamma_1 \Gamma_7)^{1/2} / \Gamma$
VALUE	DOCUMENT ID	TECN	COMMENT	
<b>±0.27 to ±0.37 OUR ESTIMATE</b>				
-0.17	<sup>2</sup> LONGACRE	77	IPWA	$\pi N \rightarrow N\pi\pi$

$(\Gamma_i \Gamma_f)^{1/2} / \Gamma_{\text{total}}$ in $N\pi \rightarrow N(1720) \rightarrow N\rho$ , S=1/2, P-wave				$(\Gamma_1 \Gamma_9)^{1/2} / \Gamma$
VALUE	DOCUMENT ID	TECN	COMMENT	
+0.34 ± 0.05	MANLEY	92	IPWA	$\pi N \rightarrow \pi N$ & $N\pi\pi$
-0.26	<sup>2</sup> LONGACRE	77	IPWA	$\pi N \rightarrow N\pi\pi$
+0.40	<sup>3</sup> LONGACRE	75	IPWA	$\pi N \rightarrow N\pi\pi$

$(\Gamma_i \Gamma_f)^{1/2} / \Gamma_{\text{total}}$ in $N\pi \rightarrow N(1720) \rightarrow N\rho$ , S=3/2, P-wave				$(\Gamma_1 \Gamma_{10})^{1/2} / \Gamma$
VALUE	DOCUMENT ID	TECN	COMMENT	
+0.15	<sup>2</sup> LONGACRE	77	IPWA	$\pi N \rightarrow N\pi\pi$

$(\Gamma_i \Gamma_f)^{1/2} / \Gamma_{\text{total}}$ in $N\pi \rightarrow N(1720) \rightarrow N(\pi\pi)_{S=0}^{I=0}$				$(\Gamma_1 \Gamma_{11})^{1/2} / \Gamma$
VALUE	DOCUMENT ID	TECN	COMMENT	
-0.19	<sup>2</sup> LONGACRE	77	IPWA	$\pi N \rightarrow N\pi\pi$

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

<u>VALUE (GeV<sup>-1/2</sup>)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>+0.018±0.030 OUR ESTIMATE</b>			
-0.015±0.015	ARNDT	96	IPWA $\gamma N \rightarrow \pi N$
0.044±0.066	CRAWFORD	83	IPWA $\gamma N \rightarrow \pi N$
-0.004±0.007	AWAJI	81	DPWA $\gamma N \rightarrow \pi N$
0.051±0.009	ARAI	80	DPWA $\gamma N \rightarrow \pi N$ (fit 1)
0.071±0.010	ARAI	80	DPWA $\gamma N \rightarrow \pi N$ (fit 2)
0.038±0.050	CRAWFORD	80	DPWA $\gamma N \rightarrow \pi N$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
0.012±0.003	LI	93	IPWA $\gamma N \rightarrow \pi N$
+0.111±0.047	BARBOUR	78	DPWA $\gamma N \rightarrow \pi N$

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

<u>VALUE (GeV<sup>-1/2</sup>)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>-0.019±0.020 OUR ESTIMATE</b>			
0.007±0.010	ARNDT	96	IPWA $\gamma N \rightarrow \pi N$
-0.024±0.006	CRAWFORD	83	IPWA $\gamma N \rightarrow \pi N$
-0.040±0.016	AWAJI	81	DPWA $\gamma N \rightarrow \pi N$
-0.058±0.010	ARAI	80	DPWA $\gamma N \rightarrow \pi N$ (fit 1)
-0.011±0.011	ARAI	80	DPWA $\gamma N \rightarrow \pi N$ (fit 2)
-0.014±0.040	CRAWFORD	80	DPWA $\gamma N \rightarrow \pi N$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
-0.022±0.003	LI	93	IPWA $\gamma N \rightarrow \pi N$
-0.063±0.032	BARBOUR	78	DPWA $\gamma N \rightarrow \pi N$

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

<u>VALUE (GeV<sup>-1/2</sup>)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>+0.001±0.015 OUR ESTIMATE</b>			
0.007±0.015	ARNDT	96	IPWA $\gamma N \rightarrow \pi N$
0.002±0.005	AWAJI	81	DPWA $\gamma N \rightarrow \pi N$
-0.019±0.033	ARAI	80	DPWA $\gamma N \rightarrow \pi N$ (fit 1)
0.001±0.038	ARAI	80	DPWA $\gamma N \rightarrow \pi N$ (fit 2)
-0.003±0.034	CRAWFORD	80	DPWA $\gamma N \rightarrow \pi N$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
0.050±0.004	LI	93	IPWA $\gamma N \rightarrow \pi N$
+0.007±0.020	BARBOUR	78	DPWA $\gamma N \rightarrow \pi N$

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

<u>VALUE (GeV<sup>-1/2</sup>)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>-0.029±0.061 OUR ESTIMATE</b>			
-0.005±0.025	ARNDT	96	IPWA $\gamma N \rightarrow \pi N$
-0.015±0.019	AWAJI	81	DPWA $\gamma N \rightarrow \pi N$
-0.139±0.039	ARAI	80	DPWA $\gamma N \rightarrow \pi N$ (fit 1)
-0.134±0.044	ARAI	80	DPWA $\gamma N \rightarrow \pi N$ (fit 2)
0.018±0.028	CRAWFORD	80	DPWA $\gamma N \rightarrow \pi N$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			

$-0.017 \pm 0.004$	LI	93	IPWA	$\gamma N \rightarrow \pi N$
$+0.051 \pm 0.051$	BARBOUR	78	DPWA	$\gamma N \rightarrow \pi N$

### $N(1720) \quad \gamma p \rightarrow \Lambda K^+$ AMPLITUDES

$(\Gamma_i \Gamma_f)^{1/2} / \Gamma_{\text{total}}$  in  $p\gamma \rightarrow N(1720) \rightarrow \Lambda K^+$  ( $E_{1+}$  amplitude)

<u>VALUE (units <math>10^{-3}</math>)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>
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• • • We do not use the following data for averages, fits, limits, etc. • • •

$10.2 \pm 0.2$	WORKMAN	90	DPWA
9.52	TANABE	89	DPWA

$p\gamma \rightarrow N(1720) \rightarrow \Lambda K^+$  phase angle  $\theta$  ( $E_{1+}$  amplitude)

<u>VALUE (degrees)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>
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• • • We do not use the following data for averages, fits, limits, etc. • • •

$-124 \pm 2$	WORKMAN	90	DPWA
$-103.4$	TANABE	89	DPWA

$(\Gamma_i \Gamma_f)^{1/2} / \Gamma_{\text{total}}$  in  $p\gamma \rightarrow N(1720) \rightarrow \Lambda K^+$  ( $M_{1+}$  amplitude)

<u>VALUE (units <math>10^{-3}</math>)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>
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• • • We do not use the following data for averages, fits, limits, etc. • • •

$-4.5 \pm 0.2$	WORKMAN	90	DPWA
3.18	TANABE	89	DPWA

### $N(1720)$ FOOTNOTES

- <sup>1</sup> The two BAKER 77 entries are from an IPWA using the Barrelet-zero method and from a conventional energy-dependent analysis.
- <sup>2</sup> LONGACRE 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.
- <sup>3</sup> From method II of LONGACRE 75: eyeball fits with Breit-Wigner circles to the T-matrix amplitudes.
- <sup>4</sup> See HOEHLER 93 for a detailed discussion of the evidence for and the pole parameters of  $N$  and  $\Delta$  resonances as determined from Argand diagrams of  $\pi N$  elastic partial-wave amplitudes and from plots of the speeds with which the amplitudes traverse the diagrams.
- <sup>5</sup> 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.
- <sup>6</sup> The overall phase of BAKER 78 couplings has been changed to agree with previous conventions.
- <sup>7</sup> The range given is from the four best solutions. DEANS 75 disagrees with  $\pi^+ p \rightarrow \Sigma^+ K^+$  data of WINNIK 77 around 1920 MeV.

## N(1720) REFERENCES

For early references, see Physics Letters **111B** 70 (1982).

ARNDT	96	PR C53 430	+Strakovsky, Workman	(VPI)
ARNDT	95	PR C52 2120	+Strakovsky, Workman, Pavan	(VPI, BRCO)
BATINIC	95	PR C51 2310	+Slaus, Svarc, Nefkens	(BOSK, UCLA)
Also	98	PR C57 1004 (erratum)	M. Batinic+	
HOEHLER	93	$\pi$ N Newsletter 9 1		(KARL)
LI	93	PR C47 2759	+Arndt, Roper, Workman	(VPI)
MANLEY	92	PR D45 4002	+Saleski	(KENT) IJP
Also	84	PR D30 904	Manley, Arndt, Goradia, Teplitz	(VPI)
ARNDT	91	PR D43 2131	+Li, Roper, Workman, Ford	(VPI, TELE) IJP
WORKMAN	90	PR C42 781		(VPI)
TANABE	89	PR C39 741	+Kohn, Bennhold	(MANZ)
Also	89	NC 102A 193	Kohn, Tanabe, Bennhold	(MANZ)
BELL	83	NP B222 389	+Blissett, Broome, Daley, Hart, Lintern+	(RL) IJP
CRAWFORD	83	NP B211 1	+Morton	(GLAS)
PDG	82	PL 111B	Roos, Porter, Aguilar-Benitez+	(HELS, CIT, CERN)
AWAJI	81	Bonn Conf. 352	+Kajikawa	(NAGO)
Also	82	NP B197 365	Fujii, Hayashii, Iwata, Kajikawa+	(NAGO)
ARAI	80	Toronto Conf. 93		(INUS)
Also	82	NP B194 251	Arai, Fujii	(INUS)
CRAWFORD	80	Toronto Conf. 107		(GLAS)
CUTKOSKY	80	Toronto Conf. 19	+Forsyth, Babcock, Kelly, Hendrick	(CMU, LBL) IJP
Also	79	PR D20 2839	Cutkosky, Forsyth, Hendrick, Kelly	(CMU, LBL) IJP
SAXON	80	NP B162 522	+Baker, Bell, Blissett, Bloodworth+	(RHEL, BRIS) IJP
BAKER	79	NP B156 93	+Brown, Clark, Davies, Depagter, Evans+	(RHEL) IJP
HOEHLER	79	PDAT 12-1	+Kaiser, Koch, Pietarinen	(KARLT) IJP
Also	80	Toronto Conf. 3	Koch	(KARLT) IJP
BAKER	78	NP B141 29	+Blissett, Bloodworth, Broome+	(RL, CAVE) IJP
BARBOUR	78	NP B141 253	+Crawford, Parsons	(GLAS)
LONGACRE	78	PR D17 1795	+Lasinski, Rosenfeld, Smadja+	(LBL, SLAC)
BAKER	77	NP B126 365	+Blissett, Bloodworth, Broome, Hart+	(RHEL) IJP
LONGACRE	77	NP B122 493	+Dolbeau	(SACL) IJP
Also	76	NP B108 365	Dolbeau, Triantis, Neveu, Cadiet	(SACL) IJP
WINNIK	77	NP B128 66	+Toaff, Revel, Goldberg, Berny	(HAIF) I
DEANS	75	NP B96 90	+Mitchell, Montgomery+	(SFLA, ALAH) IJP
KNASEL	75	PR D11 1	+Lindquist, Nelson+	(CHIC, WUSL, OSU, ANL) IJP
LONGACRE	75	PL 55B 415	+Rosenfeld, Lasinski, Smadja+	(LBL, SLAC) IJP