$\Delta(1232)$ P_{33}

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

Most of the results published before 1977 are now obsolete and have been omitted. They may be found in our 1982 edition, Physics Letters **111B** (1982).

Δ(1232) BREIT-WIGNER MASSES

MIXED CHARGES

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
1230 to 1234 (≈ 1232) OUR ESTIMATE				
1231±1	MANLEY	92	IPWA	$\pi N \rightarrow \pi N$ & $N\pi\pi$
1232±3	CUTKOSKY	80	IPWA	$\pi N \rightarrow \pi N$
1233±2	HOEHLER	79	IPWA	$\pi N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
1233	ARNDT	95	DPWA	$\pi N \rightarrow N\pi$

$\Delta(1232)^{++}$ MASS

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
1230.5±0.2	ABAEV	95	IPWA	$\pi N \rightarrow \pi N$
1230.9±0.3	KOCH	80B	IPWA	$\pi N \rightarrow \pi N$
1231.1±0.2	PEDRONI	78		$\pi N \rightarrow \pi N$ 70–370 MeV

$\Delta(1232)^{+}$ MASS

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
• • • We do not use the following data for averages, fits, limits, etc. • • •				
1231.6	CRAWFORD	80	DPWA	$\gamma N \rightarrow \pi N$
1234.9±1.4	MIROSHNIC...	79		Fit photoproduction
1231.2	BARBOUR	78	DPWA	$\gamma N \rightarrow \pi N$
1231.8	BERENDS	75	IPWA	$\gamma p \rightarrow \pi N$

$\Delta(1232)^{0}$ MASS

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
1233.1±0.3	ABAEV	95	IPWA	$\pi N \rightarrow \pi N$
1233.6±0.5	KOCH	80B	IPWA	$\pi N \rightarrow \pi N$
1233.8±0.2	PEDRONI	78		$\pi N \rightarrow \pi N$ 70–370 MeV

$m_{\Delta^0} - m_{\Delta^{++}}$

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
• • • We do not use the following data for averages, fits, limits, etc. • • •				
2.25±0.68	BERNICHA	96		Fit to PEDRONI 78
2.6 ±0.4	ABAEV	95	IPWA	$\pi N \rightarrow \pi N$
2.7 ±0.3	[1] PEDRONI	78		See the masses

$\Delta(1232)$ BREIT-WIGNER WIDTHS

MIXED CHARGES

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
115 to 125 (≈ 120) OUR ESTIMATE				
118±4	MANLEY	92	IPWA	$\pi N \to \pi N$ & $N\pi\pi$
120±5	CUTKOSKY	80	IPWA	$\pi N \to \pi N$
116±5	HOEHLER	79	IPWA	$\pi N \to \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
114	ARNDT	95	DPWA	$\pi N \to N\pi$

$\Delta(1232)^{++}$ WIDTH

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
111.0±1.0	KOCH	80B	IPWA	$\pi N \to \pi N$
111.3±0.5	PEDRONI	78		$\pi N \to \pi N$ 70–370 MeV

$\Delta(1232)^{+}$ WIDTH

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
111.2	CRAWFORD	80	DPWA	$\gamma N \to \pi N$
131.1±2.4	MIROSHNIC...	79		Fit photoproduction
111.0	BARBOUR	78	DPWA	$\gamma N \to \pi N$

$\Delta(1232)^{0}$ WIDTH

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
113.0±1.5	KOCH	80B	IPWA	$\pi N \to \pi N$
117.9±0.9	PEDRONI	78		$\pi N \to \pi N$ 70–370 MeV

Δ^0-Δ^{++} WIDTH DIFFERENCE

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
8.45±1.11	BERNICHA	96		Fit to PEDRONI 78
5.1 ±1.0	ABAEV	95	IPWA	$\pi N \to \pi N$
6.6 ±1.0	PEDRONI	78		See the widths

$\Delta(1232)$ POLE POSITIONS

REAL PART, MIXED CHARGES

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
1209 to 1211 (≈ 1210) OUR ESTIMATE				
1211	ARNDT	95	DPWA	$\pi N \to N\pi$
1209	[2] HOEHLER	93	ARGD	$\pi N \to \pi N$
1210±1	CUTKOSKY	80	IPWA	$\pi N \to \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
1210	ARNDT	91	DPWA	$\pi N \to \pi N$ Soln SM90

−2×IMAGINARY PART, MIXED CHARGES

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
98 to 102 (≈ 100) OUR ESTIMATE				
100	ARNDT	95	DPWA	$\pi N \to N\pi$
100	[2] HOEHLER	93	ARGD	$\pi N \to \pi N$
100±2	CUTKOSKY	80	IPWA	$\pi N \to \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
100	ARNDT	91	DPWA	$\pi N \to \pi N$ Soln SM90

REAL PART, $\Delta(1232)^{++}$

VALUE (MeV)	DOCUMENT ID		COMMENT
1209.6±0.5	[3] VASAN	76B	Fit to CARTER 73
• • • We do not use the following data for averages, fits, limits, etc. • • •			
1210.5 to 1210.8	[4] VASAN	76B	Fit to CARTER 73

−2×IMAGINARY PART, $\Delta(1232)^{++}$

VALUE (MeV)	DOCUMENT ID		COMMENT
100.8±1.0	[3] VASAN	76B	Fit to CARTER 73
• • • We do not use the following data for averages, fits, limits, etc. • • •			
99.8 to 100	[4] VASAN	76B	Fit to CARTER 73

REAL PART, $\Delta(1232)^{+}$

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
1208.0±2.0	CAMPBELL	76		Fit photoproduction
• • • We do not use the following data for averages, fits, limits, etc. • • •				
1211 ±1 to 1212 ± 1	HANSTEIN	96	DPWA	$\gamma N \to \pi N$
1206.9±0.9 to 1210.5 ± 1.8	MIROSHNIC...	79		Fit photoproduction

−2×IMAGINARY PART, $\Delta(1232)^{+}$

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
106 ±4	CAMPBELL	76		Fit photoproduction
• • • We do not use the following data for averages, fits, limits, etc. • • •				
102 ±2 to 99 ± 2	HANSTEIN	96	DPWA	$\gamma N \to \pi N$
111.2±2.0 to 116.6 ± 2.2	MIROSHNIC...	79		Fit photoproduction

REAL PART, $\Delta(1232)^{0}$

VALUE (MeV)	DOCUMENT ID		COMMENT
1210.75±0.6	[3] VASAN	76B	Fit to CARTER 73
• • • We do not use the following data for averages, fits, limits, etc. • • •			
1210.2	[4] VASAN	76B	Fit to CARTER 73

−2×IMAGINARY PART, $\Delta(1232)^{0}$

VALUE (MeV)	DOCUMENT ID		COMMENT
105.6±1.2	[3] VASAN	76B	Fit to CARTER 73
• • • We do not use the following data for averages, fits, limits, etc. • • •			
105.8 to 106.2	[4] VASAN	76B	Fit to CARTER 73

$\Delta(1232)$ ELASTIC POLE RESIDUES

ABSOLUTE VALUE, MIXED CHARGES

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
38	ARNDT	95	DPWA	$\pi N \rightarrow N\pi$
50	HOEHLER	93	ARGD	$\pi N \rightarrow \pi N$
53±2	CUTKOSKY	80	IPWA	$\pi N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
52	ARNDT	91	DPWA	$\pi N \rightarrow \pi N$ Soln SM90

PHASE, MIXED CHARGES

VALUE (°)	DOCUMENT ID		TECN	COMMENT
−22	ARNDT	95	DPWA	$\pi N \rightarrow N\pi$
−48	HOEHLER	93	ARGD	$\pi N \rightarrow \pi N$
−47±1	CUTKOSKY	80	IPWA	$\pi N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
−31	ARNDT	91	DPWA	$\pi N \rightarrow \pi N$ Soln SM90

ABSOLUTE VALUE, $\Delta(1232)^{++}$

VALUE (MeV)	DOCUMENT ID		COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •			
52.4 to 53.2	[3] VASAN	76B	Fit to CARTER 73
52.1 to 52.4	[4] VASAN	76B	Fit to CARTER 73

PHASE, $\Delta(1232)^{++}$

VALUE (rad)	DOCUMENT ID		COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •			
−0.822 to −0.833	[3] VASAN	76B	Fit to CARTER 73
−0.823 to −0.830	[4] VASAN	76B	Fit to CARTER 73

ABSOLUTE VALUE, $\Delta(1232)^{0}$

VALUE (MeV)	DOCUMENT ID		COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •			
54.8 to 55.0	[3] VASAN	76B	Fit to CARTER 73
55.2 to 55.3	[4] VASAN	76B	Fit to CARTER 73

PHASE, $\Delta(1232)^{0}$

VALUE (rad)	DOCUMENT ID		COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •			
−0.840 to −0.847	[3] VASAN	76B	Fit to CARTER 73
−0.848 to −0.856	[4] VASAN	76B	Fit to CARTER 73

$\Delta(1232)$ DECAY MODES

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

	Mode	Fraction (Γ_i/Γ)
Γ_1	$N\pi$	>99 %
Γ_2	$N\gamma$	0.52–0.60 %
Γ_3	$N\gamma$, helicity=1/2	0.11–0.13 %
Γ_4	$N\gamma$, helicity=3/2	0.41–0.47 %

$\Delta(1232)$ BRANCHING RATIOS

$\Gamma(N\pi)/\Gamma_{total}$ — Γ_1/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
0.993 to 0.995 OUR ESTIMATE				
1.0	MANLEY	92	IPWA	$\pi N \rightarrow \pi N$ & $N\pi\pi$
1.0	CUTKOSKY	80	IPWA	$\pi N \rightarrow \pi N$
1.0	HOEHLER	79	IPWA	$\pi N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
1.0	ARNDT	95	DPWA	$\pi N \rightarrow N\pi$

$\Delta(1232)$ PHOTON DECAY AMPLITUDES

$\Delta(1232) \rightarrow N\gamma$, helicity-1/2 amplitude $A_{1/2}$

VALUE (GeV$^{-1/2}$)	DOCUMENT ID		TECN	COMMENT
$-$0.135 $\pm$0.006 OUR ESTIMATE				
-0.1294 ± 0.0013	HANSTEIN	98	IPWA	$\gamma N \rightarrow \pi N$
-0.135 ± 0.005	ARNDT	97	IPWA	$\gamma N \rightarrow \pi N$
-0.1278 ± 0.0012	DAVIDSON	97	DPWA	$\gamma N \rightarrow \pi N$
-0.141 ± 0.005	ARNDT	96	IPWA	$\gamma N \rightarrow \pi N$
-0.135 ± 0.016	DAVIDSON	91B	FIT	$\gamma N \rightarrow \pi N$
-0.145 ± 0.015	CRAWFORD	83	IPWA	$\gamma N \rightarrow \pi N$
-0.138 ± 0.004	AWAJI	81	DPWA	$\gamma N \rightarrow \pi N$
-0.147 ± 0.001	ARAI	80	DPWA	$\gamma N \rightarrow \pi N$ (fit 1)
-0.145 ± 0.001	ARAI	80	DPWA	$\gamma N \rightarrow \pi N$ (fit 2)
-0.136 ± 0.006	CRAWFORD	80	DPWA	$\gamma N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
-0.1312	HANSTEIN	98	DPWA	$\gamma N \rightarrow \pi N$
-0.143 ± 0.004	LI	93	IPWA	$\gamma N \rightarrow \pi N$
-0.140 ± 0.007	DAVIDSON	90	FIT	See DAVIDSON 91B
-0.142 ± 0.007	BARBOUR	78	DPWA	$\gamma N \rightarrow \pi N$
-0.140	[5] NOELLE	78		$\gamma N \rightarrow \pi N$
-0.141 ± 0.004	FELLER	76	DPWA	$\gamma N \rightarrow \pi N$

$\Delta(1232) \rightarrow N\gamma$, helicity-3/2 amplitude $A_{3/2}$

VALUE ($GeV^{-1/2}$)	DOCUMENT ID		TECN	COMMENT
−0.255 ±0.008 OUR ESTIMATE				
−0.2466±0.0013	HANSTEIN	98	IPWA	$\gamma N \rightarrow \pi N$
−0.250 ±0.008	ARNDT	97	IPWA	$\gamma N \rightarrow \pi N$
−0.2524±0.0013	DAVIDSON	97	DPWA	$\gamma N \rightarrow \pi N$
−0.261 ±0.005	ARNDT	96	IPWA	$\gamma N \rightarrow \pi N$
−0.251 ±0.033	DAVIDSON	91B	FIT	$\gamma N \rightarrow \pi N$
−0.263 ±0.026	CRAWFORD	83	IPWA	$\gamma N \rightarrow \pi N$
−0.259 ±0.006	AWAJI	81	DPWA	$\gamma N \rightarrow \pi N$
−0.264 ±0.002	ARAI	80	DPWA	$\gamma N \rightarrow \pi N$ (fit 1)
−0.261 ±0.002	ARAI	80	DPWA	$\gamma N \rightarrow \pi N$ (fit 2)
−0.247 ±0.010	CRAWFORD	80	DPWA	$\gamma N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
−0.2522	HANSTEIN	98	DPWA	$\gamma N \rightarrow \pi N$
−0.262 ±0.004	LI	93	IPWA	$\gamma N \rightarrow \pi N$
−0.254 ±0.011	DAVIDSON	90	FIT	See DAVIDSON 91B
−0.271 ±0.010	BARBOUR	78	DPWA	$\gamma N \rightarrow \pi N$
−0.247	[5] NOELLE	78		$\gamma N \rightarrow \pi N$
−0.256 ±0.003	FELLER	76	DPWA	$\gamma N \rightarrow \pi N$

$\Delta(1232) \rightarrow N\gamma$, E_2/M_1 ratio

VALUE	DOCUMENT ID		TECN	COMMENT
−0.025 ±0.005 OUR ESTIMATE				
−0.0254±0.0010	HANSTEIN	98	DPWA	$\gamma N \rightarrow \pi N$
−0.015 ±0.005	[6] ARNDT	97	IPWA	$\gamma N \rightarrow \pi N$
−0.025 ±0.002 ±0.002	BECK	97	IPWA	$\gamma N \rightarrow \pi N$
−0.030 ±0.003 ±0.002	BLANPIED	97	DPWA	$\gamma N \rightarrow \pi N, \gamma N$
−0.0319±0.0024	DAVIDSON	97	DPWA	$\gamma N \rightarrow \pi N$
−0.015 ±0.005	WORKMAN	92	IPWA	$\gamma N \rightarrow \pi N$
−0.0157±0.0072	DAVIDSON	91B	FIT	$\gamma N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
−0.0233±0.0017	HANSTEIN	98	IPWA	$\gamma N \rightarrow \pi N$
−0.027 ±0.003 ±0.001	KHANDAKER	95	DPWA	$\gamma N \rightarrow \pi N$
−0.0107±0.0037	DAVIDSON	90	FIT	$\gamma N \rightarrow \pi N$
−0.015 ±0.002	DAVIDSON	86	FIT	$\gamma N \rightarrow \pi N$
+0.037 ±0.004	TANABE	85	FIT	$\gamma N \rightarrow \pi N$

$\Delta(1232) \rightarrow N\gamma$, absolute value of E_2/M_1 ratio at pole

VALUE	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.065±0.007	ARNDT	97	DPWA	$\gamma N \rightarrow \pi N$
0.058	HANSTEIN	96	DPWA	$\gamma N \rightarrow \pi N$

$\Delta(1232) \rightarrow N\gamma$, phase of E_2/M_1 ratio at pole

VALUE	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
−122 ±5	ARNDT	97	DPWA	$\gamma N \rightarrow \pi N$
−127.2	HANSTEIN	96	DPWA	$\gamma N \rightarrow \pi N$

$\Delta(1232)^{++}$ MAGNETIC MOMENT

The values are extracted from UCLA and SIN data on $\pi^+ p$ bremsstrahlung using a variety of different theoretical approximations and methods. Our estimate is *only* a rough guess of the range we expect the moment to lie within.

VALUE (μ_N)	*DOCUMENT ID*		*COMMENT*
3.7 to 7.5 OUR ESTIMATE			
• • • We do not use the following data for averages, fits, limits, etc. • • •			
$4.52 \pm 0.50 \pm 0.45$	BOSSHARD	91	$\pi^+ p \rightarrow \pi^+ p \gamma$ (SIN data)
3.7 to 4.2	LIN	91B	$\pi^+ p \rightarrow \pi^+ p \gamma$ (from UCLA data)
4.6 to 4.9	LIN	91B	$\pi^+ p \rightarrow \pi^+ p \gamma$ (from SIN data)
5.6 to 7.5	WITTMAN	88	$\pi^+ p \rightarrow \pi^+ p \gamma$ (from UCLA data)
6.9 to 9.8	HELLER	87	$\pi^+ p \rightarrow \pi^+ p \gamma$ (from UCLA data)
4.7 to 6.7	NEFKENS	78	$\pi^+ p \rightarrow \pi^+ p \gamma$ (UCLA data)

$\Delta(1232)$ FOOTNOTES

[1] Using $\pi^\pm d$ as well, PEDRONI 78 determine $(\mathrm{M}^- - \mathrm{M}^{++}) + (\mathrm{M}^0 - \mathrm{M}^+)/3 = 4.6 \pm 0.2$ MeV.
[2] 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.
[3] This VASAN 76B value is from fits to the coulomb-barrier-corrected CARTER 73 phase shift.
[4] This VASAN 76B value is from fits to the CARTER 73 nuclear phase shift without coulomb barrier corrections.
[5] Converted to our conventions using $M = 1232$ MeV, $\Gamma = 110$ MeV from NOELLE 78.
[6] This ARNDT 97 value is very sensitive to the database being fitted. The result is from a fit to the full pion photoproduction database, apart from the BLANPIED 97 cross-section measurements.

$\Delta(1232)$ REFERENCES

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

HANSTEIN	98	NP A632 561	O. Hanstein, D. Drechsel, L. Tiator	
ARNDT	97	PR C56 577	+Strakovsky, Workman	(VPI)
BECK	97	PRL 78 606	+Krahn+	(MANZ, SACL, PAVI, GLAS)
Also	97B	PRL 79 4510	Beck, Krahn	(MANZ)
Also	97C	PRL 79 4512	Beck, Krahn	(MANZ)
Also	97D	PRL 79 4515 (erratum)	Beck, Krahn+	(MANZ, SACL, PAVI, GLAS)
BLANPIED	97	PRL 79 4337	+Blecher, Caracappa+	(LEGS Collab.)
DAVIDSON	97	PRL 79 4509	+Mukhopadhyay	(RPI)
ARNDT	96	PR C53 430	+Strakovsky, Workman	(VPI)
BERNICHA	96	NP A597 623	+Lopez Castro, Pestieau	(LOUV, CINV)
HANSTEIN	96	PL B385 45	+Drechsel, Tiator	(MANZ)
ABAEV	95	ZPHY A352 85	+Kruglov	(PNPI)
ARNDT	95	PR C52 2120	+Strakovsky, Workman, Pavan	(VPI, BRCO)
KHANDAKER	95	PR D51 3966	+Sandorfi	(BNL, VPI)
HOEHLER	93	πN 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)
WORKMAN	92	PR C46 1546	+Arndt, Li	(VPI)
ARNDT	91	PR D43 2131	+Li, Roper, Workman, Ford	(VPI, TELE) IJP
BOSSHARD	91	PR D44 1962	+Amsler+	(ZURI, LBL, VILL, LAUS, UCLA, CATH)
Also	90	PRL 64 2619	Bosshard+	(CATH, LAUS, LBL, VILL, UCLA, ZURI)
DAVIDSON	91B	PR D43 71	+Mukhopadhyay, Wittman	(RPI)

LIN	91B	PR C44 1819	+Liou, Ding	(CUNY, CSOK)
Also	91	PR C43 R930	Lin, Liou	(CUNY)
DAVIDSON	90	PR D42 20	+Mukhopadhyay	(RPI)
WITTMAN	88	PR C37 2075		(TRIU)
HELLER	87	PR C35 718	+Kumano, Martinez, Moniz	(LANL, MIT, ILL)
DAVIDSON	86	PRL 56 804	+Mukhopadhyay, Wittman	(RPI)
TANABE	85	PR C31 1876	+Ohta	(KOMAB)
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)
KOCH	80B	NP A336 331	+Pietarinen	(KARLT) IJP
HOEHLER	79	PDAT 12-1	+Kaiser, Koch, Pietarinen	(KARLT) IJP
Also	80	Toronto Conf. 3	Koch	(KARLT) IJP
MIROSHNIC...	79	SJNP 29 94	Miroshnichenko, Nikiforov, Sanin+	(KFTI) IJP
		Translated from YAF 29 188.		
BARBOUR	78	NP B141 253	+Crawford, Parsons	(GLAS)
NEFKENS	78	PR D18 3911	+Arman, Ballagh, Glodis, Haddock+	(UCLA, CATH) IJP
NOELLE	78	PTP 60 778		(NAGO)
PEDRONI	78	NP A300 321	+Gabathuler, Domingo, Hirt+	(SIN, ISNG, KARLE+) IJP
CAMPBELL	76	PR D14 2431	+Shaw, Ball	(BOIS, UCI, UTAH) IJP
FELLER	76	NP B104 219	+Fukushima, Horikawa, Kajikawa+	(NAGO, OSAK) IJP
VASAN	76B	NP B106 535		(CMU) IJP
Also	76	NP B106 526	Vasan	(CMU) IJP
BERENDS	75	NP B84 342	+Donnachie	(LEID, MCHS)
CARTER	73	NP B58 378	+Bugg, Carter	(CAVE, LOQM) IJP