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

VALUE (GeV$^{-1/2}$)	DOCUMENT ID		TECN	COMMENT
$-$0.257$\pm$0.008 OUR ESTIMATE				
$-$0.262$\pm$0.004	LI	93	IPWA	$\gamma N \rightarrow \pi N$
$-$0.251$\pm$0.033	DAVIDSON	91B	FIT	$\gamma N \rightarrow \pi N$
$-$0.263$\pm$0.026	CRAWFORD	83	IPWA	$\gamma N \rightarrow \pi N$
$-$0.259$\pm$0.006	AWAJI	81	DPWA	$\gamma N \rightarrow \pi N$
$-$0.264$\pm$0.002	ARAI	80	DPWA	$\gamma N \rightarrow \pi N$ (fit 1)
$-$0.261$\pm$0.002	ARAI	80	DPWA	$\gamma N \rightarrow \pi N$ (fit 2)
$-$0.247$\pm$0.010	CRAWFORD	80	DPWA	$\gamma N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
$-$0.244$\pm$0.008	ARNDT	90B	IPWA	See LI 93
$-$0.246	ARNDT	90B	FIT	See LI 93
$-$0.254$\pm$0.011	DAVIDSON	90	FIT	See DAVIDSON 91B
$-$0.271$\pm$0.010	BARBOUR	78	DPWA	$\gamma N \rightarrow \pi N$
$-$0.247	[7] NOELLE	78		$\gamma N \rightarrow \pi N$
$-$0.256$\pm$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
$-$0.015 $\pm$0.004 OUR AVERAGE				
$-$0.015 $\pm$0.005	WORKMAN	92	IPWA	$\gamma N \rightarrow \pi N$
$-$0.0157$\pm$0.0072	DAVIDSON	91B	FIT	$\gamma N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
$-$0.0107$\pm$0.0037	DAVIDSON	90	FIT	$\gamma N \rightarrow \pi N$
$-$0.015 $\pm$0.002	DAVIDSON	86	FIT	$\gamma N \rightarrow \pi N$
+0.037 $\pm$0.004	TANABE	85	FIT	$\gamma N \rightarrow \pi N$

$\Delta(1232)$ PHASE OF M1+(3/2) PHOTOPRODUCTION MULTIPOLE AMPLITUDE POLE RESIDUE

Information on the phase (and magnitude) of the M1+(3/2) multipole amplitude pole residue is contained implicitly in the paper of MIROSHNICHENKO 79. They find that the phase is consistent with being equal to that of the elastic pole residue.

$\Delta(1232)^{++}$ 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 $(M^- - M^{++}) + (M^0 - M^+)/3$ = 4.6 $\pm$ 0.2 MeV.

[2] See HOEHLER 93 and HOEHLER 94 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] The accuracy claimed by ZIDELL 80 on the real part is considerably better than is allowed by uncertainties in the beam momentum.

[4] This VASAN 76B value is from fits to the coulomb-barrier-corrected CARTER 73 phase shift.

[5] ZIDELL 78 fits the nuclear phase shift without coulomb barrier corrections.

[6] This VASAN 76B value is from fits to the CARTER 73 nuclear phase shift without coulomb barrier corrections.

[7] Converted to our conventions using $M = 1232$ MeV, $\Gamma = 110$ MeV from NOELLE 78.

$\Delta(1232)$ REFERENCES

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

HOEHLER	94	πN Newsletter 10 (to be pub.)		(KARL)
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)
ARNDT	90B	PR C42 1864	+Workman, Li, Roper	(VPI)
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)
ARNDT	85	PR D32 1085	+Ford, Roper	(VPI)
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
ZIDELL	80	PR D21 1255	+Arndt, Roper	(VPI) IJP
HOEHLER	79	PDAT 12-1	+Kaiser, Koch, Pietarinen	(KARLT) IJP
Also	80	Toronto Conf. 3	Koch	(KARLT) IJP
MIROSHNIC...	79	SJNP 29 94 Translated from YAF 29 188.	Miroshnichenko, Nikiforov, Sanin+	(KFTI) IJP
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
ZIDELL	78	LNC 21 140	+Arndt, Roper	(VPI) 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

$\Delta(1600)$ P_{33}

$I(J^P) = \frac{3}{2}(\frac{3}{2}^+)$ 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).

The various analyses are not in good agreement.

$\Delta(1600)$ MASS

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
1550 to 1700 ($\approx$ 1600) OUR ESTIMATE				
1706$\pm$10	MANLEY	92	IPWA	$\pi N \rightarrow \pi N$ & $N\pi\pi$
1600$\pm$50	CUTKOSKY	80	IPWA	$\pi N \rightarrow \pi N$
1522$\pm$13	HOEHLER	79	IPWA	$\pi N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
1706	LI	93	IPWA	$\gamma N \rightarrow \pi N$
1690	BARNHAM	80	IPWA	$\pi N \rightarrow N\pi\pi$
1560	[1] LONGACRE	77	IPWA	$\pi N \rightarrow N\pi\pi$
1640	[2] LONGACRE	75	IPWA	$\pi N \rightarrow N\pi\pi$

$\Delta(1600)$ WIDTH

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
250 to 450 ($\approx$ 350) OUR ESTIMATE				
430$\pm$ 73	MANLEY	92	IPWA	$\pi N \rightarrow \pi N$ & $N\pi\pi$
300$\pm$100	CUTKOSKY	80	IPWA	$\pi N \rightarrow \pi N$
220$\pm$ 40	HOEHLER	79	IPWA	$\pi N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
215	LI	93	IPWA	$\gamma N \rightarrow \pi N$
250	BARNHAM	80	IPWA	$\pi N \rightarrow N\pi\pi$
180	[1] LONGACRE	77	IPWA	$\pi N \rightarrow N\pi\pi$
300	[2] LONGACRE	75	IPWA	$\pi N \rightarrow N\pi\pi$

$\Delta(1600)$ POLE POSITION

REAL PART

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
1550	[3] HOEHLER	93	SPED	$\pi N \rightarrow \pi N$
1612	ARNDT	91	DPWA	$\pi N \rightarrow \pi N$ Soln SM90
1550$\pm$40	CUTKOSKY	80	IPWA	$\pi N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
1581	ARNDT	85	DPWA	See ARNDT 91
1609 or 1610	[4] LONGACRE	78	IPWA	$\pi N \rightarrow N\pi\pi$
1541 or 1542	[1] LONGACRE	77	IPWA	$\pi N \rightarrow N\pi\pi$

$-2\times$IMAGINARY PART

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
230	ARNDT	91	DPWA	$\pi N \rightarrow \pi N$ Soln SM90
200$\pm$60	CUTKOSKY	80	IPWA	$\pi N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
300	ARNDT	85	DPWA	See ARNDT 91
323 or 325	[4] LONGACRE	78	IPWA	$\pi N \rightarrow N\pi\pi$
178 or 178	[1] LONGACRE	77	IPWA	$\pi N \rightarrow N\pi\pi$

$\Delta(1600)$ ELASTIC POLE RESIDUE

MODULUS $|r|$

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
16	ARNDT	91	DPWA	$\pi N \rightarrow \pi N$ Soln SM90
17$\pm$4	CUTKOSKY	80	IPWA	$\pi N \rightarrow \pi N$

PHASE θ

VALUE ($^\circ$)	DOCUMENT ID		TECN	COMMENT
$-$ 73	ARNDT	91	DPWA	$\pi N \rightarrow \pi N$ Soln SM90
$-$150$\pm$30	CUTKOSKY	80	IPWA	$\pi N \rightarrow \pi N$