

$\Delta(1232) P_{33}$

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

$\Delta(1232)$ BREIT-WIGNER MASSES

MIXED CHARGES

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
1231 to 1233 (≈ 1232) OUR ESTIMATE			
1232.9 \pm 1.2	ARNDT	04	DPWA $\pi N \rightarrow \pi N, \eta N$
1231 \pm 1	MANLEY	92	IPWA $\pi N \rightarrow \pi N \& N\pi\pi$
1232 \pm 3	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
1233 \pm 2	HOEHLER	79	IPWA $\pi N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
1228 \pm 1	PENNER	02C	DPWA Multichannel
1234 \pm 5	VRANA	00	DPWA Multichannel
1233	ARNDT	95	DPWA $\pi N \rightarrow N\pi$

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

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
• • • We do not use the following data for averages, fits, limits, etc. • • •			
1231.88 \pm 0.29	BERNICHIA	96	Fit to PEDRONI 78
1230.5 \pm 0.2	ABAEV	95	IPWA $\pi N \rightarrow \pi N$
1230.9 \pm 0.3	KOCH	80B	IPWA $\pi N \rightarrow \pi N$
1231.1 \pm 0.2	PEDRONI	78	$\pi N \rightarrow \pi N$ 70–370 MeV

$\Delta(1232)^+$ MASS

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
• • • We do not use the following data for averages, fits, limits, etc. • • •			
1231.6	CRAWFORD	80	DPWA $\gamma N \rightarrow \pi N$
1234.9 \pm 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

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
• • • We do not use the following data for averages, fits, limits, etc. • • •			
1234.35 \pm 0.75	BERNICHIA	96	Fit to PEDRONI 78
1233.1 \pm 0.3	ABAEV	95	IPWA $\pi N \rightarrow \pi N$
1233.6 \pm 0.5	KOCH	80B	IPWA $\pi N \rightarrow \pi N$
1233.8 \pm 0.2	PEDRONI	78	$\pi N \rightarrow \pi N$ 70–370 MeV

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

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
● ● ● 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	³ PEDRONI	78	See the masses

$\Delta(1232)$ BREIT-WIGNER WIDTHS

MIXED CHARGES

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
116 to 120 (≈ 118) OUR ESTIMATE			
118.0 ± 2.2	ARNDT	04	DPWA $\pi N \rightarrow \pi N, \eta N$
118 ± 4	MANLEY	92	IPWA $\pi N \rightarrow \pi N \& N\pi\pi$
120 ± 5	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
116 ± 5	HOEHLER	79	IPWA $\pi N \rightarrow \pi N$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
106 ± 1	PENNER	02C	DPWA Multichannel
112 ± 18	VRANA	00	DPWA Multichannel
114	ARNDT	95	DPWA $\pi N \rightarrow N\pi$

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

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
109.07 ± 0.48	BERNICHA	96	Fit to PEDRONI 78
111.0 ± 1.0	KOCH	80B	IPWA $\pi N \rightarrow \pi N$
111.3 ± 0.5	PEDRONI	78	$\pi N \rightarrow \pi N$ 70–370 MeV

$\Delta(1232)^+$ WIDTH

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

$\Delta(1232)^0$ WIDTH

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
117.58 ± 1.16	BERNICHA	96	Fit to PEDRONI 78
113.0 ± 1.5	KOCH	80B	IPWA $\pi N \rightarrow \pi N$
117.9 ± 0.9	PEDRONI	78	$\pi N \rightarrow \pi N$ 70–370 MeV

Δ^0 - Δ^{++} WIDTH DIFFERENCE

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

$\Delta(1232)$ POLE POSITIONS

REAL PART, MIXED CHARGES

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
1209 to 1211 (≈ 1210) OUR ESTIMATE			
1210	ARNDT	04	DPWA $\pi N \rightarrow \pi N, \eta N$
1209	⁴ HOEHLER	93	ARGD $\pi N \rightarrow \pi N$
1210 ± 1	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
1217	VRANA	00	DPWA Multichannel
1211	ARNDT	95	DPWA $\pi N \rightarrow N\pi$
1210	ARNDT	91	DPWA $\pi N \rightarrow \pi N$ Soln SM90

–2×IMAGINARY PART, MIXED CHARGES

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
98 to 102 (≈ 100) OUR ESTIMATE			
100	ARNDT	04	DPWA $\pi N \rightarrow \pi N, \eta N$
100	⁴ HOEHLER	93	ARGD $\pi N \rightarrow \pi N$
100 ± 2	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
96	VRANA	00	DPWA Multichannel
100	ARNDT	95	DPWA $\pi N \rightarrow N\pi$
100	ARNDT	91	DPWA $\pi N \rightarrow \pi N$ Soln SM90

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

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>COMMENT</u>
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●		
1212.50 ± 0.24	BERNICH A	96 Fit to PEDRONI 78
1209.6 ± 0.5	⁵ VASAN	76B Fit to CARTER 73
1210.5 to 1210.8	⁶ VASAN	76B Fit to CARTER 73

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

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>COMMENT</u>
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●		
97.37 ± 0.42	BERNICH A	96 Fit to PEDRONI 78
100.8 ± 1.0	⁵ VASAN	76B Fit to CARTER 73
99.8 to 100	⁶ VASAN	76B Fit to CARTER 73

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

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

–2×IMAGINARY PART, $\Delta(1232)^+$

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
102 ± 2 to 99 ± 2	¹ HANSTEIN	96	DPWA $\gamma N \rightarrow \pi N$
111.2 ± 2.0 to 116.6 ± 2.2	MIROSHNIC...	79	Fit photoproduction
106 ± 4	CAMPBELL	76	Fit photoproduction

¹ The second (lower) value of HANSTEIN 96 here goes with the second (higher) value of the real part in the preceding data block.

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

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>COMMENT</u>
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●		
1213.20 ± 0.66	BERNICHIA	96 Fit to PEDRONI 78
1210.75 ± 0.6	⁵ VASAN	76B Fit to CARTER 73
1210.2	⁶ VASAN	76B Fit to CARTER 73

–2×IMAGINARY PART, $\Delta(1232)^0$

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>COMMENT</u>
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●		
104.10 ± 1.01	BERNICHIA	96 Fit to PEDRONI 78
105.6 ± 1.2	⁵ VASAN	76B Fit to CARTER 73
105.8 to 106.2	⁶ VASAN	76B Fit to CARTER 73

$\Delta(1232)$ ELASTIC POLE RESIDUES

ABSOLUTE VALUE, MIXED CHARGES

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
53	ARNDT	04	DPWA $\pi N \rightarrow \pi N, \eta N$
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. ● ● ●			
38	⁷ ARNDT	95	DPWA $\pi N \rightarrow N\pi$
52	ARNDT	91	DPWA $\pi N \rightarrow \pi N$ Soln SM90

PHASE, MIXED CHARGES

<u>VALUE (°)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
–47	ARNDT	04	DPWA $\pi N \rightarrow \pi N, \eta N$
–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. ● ● ●			
–22	⁷ ARNDT	95	DPWA $\pi N \rightarrow N\pi$
–31	ARNDT	91	DPWA $\pi N \rightarrow \pi N$ Soln SM90

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

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>COMMENT</u>
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●		
52.4 to 53.2	⁵ VASAN	76B Fit to CARTER 73
52.1 to 52.4	⁶ VASAN	76B Fit to CARTER 73

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

<u>VALUE (rad)</u>	<u>DOCUMENT ID</u>	<u>COMMENT</u>
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●		
-0.822 to -0.833	⁵ VASAN	76B Fit to CARTER 73
-0.823 to -0.830	⁶ VASAN	76B Fit to CARTER 73

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

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>COMMENT</u>
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●		
54.8 to 55.0	⁵ VASAN	76B Fit to CARTER 73
55.2 to 55.3	⁶ VASAN	76B Fit to CARTER 73

PHASE, $\Delta(1232)^0$

<u>VALUE (rad)</u>	<u>DOCUMENT ID</u>	<u>COMMENT</u>
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●		
-0.840 to -0.847	⁵ VASAN	76B Fit to CARTER 73
-0.848 to -0.856	⁶ 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 $N\pi$	100 %
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

$\Gamma(N\pi)/\Gamma_{\text{total}}$	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>	Γ_1/Γ
1.0 OUR ESTIMATE				
1.000	ARNDT	04	DPWA $\pi N \rightarrow \pi N, \eta N$	
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. ● ● ●				
1.00	PENNER	02C	DPWA Multichannel	
1.00 ± 0.01	VRANA	00	DPWA Multichannel	
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 ($\text{GeV}^{-1/2}$)	DOCUMENT ID	TECN	COMMENT
-0.135 ± 0.006	OUR ESTIMATE		
-0.137 ± 0.005	AHRENS	04A	DPWA $\vec{\gamma}\vec{p} \rightarrow N\pi$
-0.129 ± 0.001	ARNDT	02	DPWA $\gamma p \rightarrow N\pi$
-0.1357 ± 0.0013 ± 0.0037	BLANPIED	01	LEGS $\gamma p \rightarrow p\gamma, p\pi^0, n\pi^+$
-0.131 ± 0.001	BECK	00	IPWA $\vec{\gamma}p \rightarrow p\pi^0, n\pi^+$
-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. ● ● ●			
-0.128	PENNER	02D	DPWA Multichannel
-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	⁸ 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 ($\text{GeV}^{-1/2}$)	DOCUMENT ID	TECN	COMMENT
-0.250 ± 0.008	OUR ESTIMATE		
-0.256 ± 0.003	AHRENS	04A	DPWA $\vec{\gamma}\vec{p} \rightarrow N\pi$
-0.243 ± 0.001	ARNDT	02	DPWA $\gamma p \rightarrow N\pi$
-0.2669 ± 0.0016 ± 0.0078	BLANPIED	01	LEGS $\gamma p \rightarrow p\gamma, p\pi^0, n\pi^+$
-0.251 ± 0.001	BECK	00	IPWA $\vec{\gamma}p \rightarrow p\pi^0, n\pi^+$
-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. • • •

-0.247	PENNER	02D	DPWA	Multichannel
-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	⁸ 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

<u>VALUE</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
-0.025 ± 0.005 OUR ESTIMATE			
-0.0274 ± 0.0003 ± 0.0030	AHRENS	04A	DPWA $\vec{\gamma}\vec{p} \rightarrow N\pi$
-0.020 ± 0.002	ARNDT	02	DPWA $\gamma p \rightarrow N\pi$
-0.0307 ± 0.0026 ± 0.0024	BLANPIED	01	LEGS $\gamma p \rightarrow p\gamma, p\pi^0, n\pi^+$
-0.016 ± 0.004 ± 0.002	GALLER	01	DPWA $\gamma p \rightarrow \gamma p$
-0.025 ± 0.001 ± 0.002	BECK	00	IPWA $\vec{\gamma}p \rightarrow p\pi^0, n\pi^+$
-0.0254 ± 0.0010	HANSTEIN	98	DPWA $\gamma N \rightarrow \pi N$
-0.015 ± 0.005	⁹ ARNDT	97	IPWA $\gamma N \rightarrow \pi N$
-0.0319 ± 0.0024	DAVIDSON	97	DPWA $\gamma N \rightarrow \pi N$

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

-0.026	PENNER	02D	DPWA	Multichannel
-0.0233 ± 0.0017	HANSTEIN	98	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	$\gamma N \rightarrow \pi N, \gamma N$
-0.027 ± 0.003 ± 0.001	KHANDAKER	95	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	$\gamma N \rightarrow \pi N$
-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

<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. • • •			
0.065 ± 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

<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. • • •			
-122 ± 5	ARNDT	97	DPWA $\gamma N \rightarrow \pi N$
-127.2	HANSTEIN	96	DPWA $\gamma N \rightarrow \pi N$

$\Delta(1232)$ MAGNETIC MOMENTS

$\Delta(1232)^{++}$ 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	TECN	COMMENT
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3.7 to 7.5 OUR ESTIMATE

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

6.14 ± 0.51	LOPEZCAST... 01	DPWA	$\pi^+ p \rightarrow \pi^+ p \gamma$
4.52 ± 0.50 ± 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)

$\Delta(1232)^+$ MAGNETIC MOMENT

VALUE (μ_N)	DOCUMENT ID	COMMENT
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• • • We do not use the following data for averages, fits, limits, etc. • • •

2.7 ^{+1.0} _{-1.3} ± 1.5 ± 3	² KOTULLA	02 $\gamma p \rightarrow p \pi^0 \gamma'$
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² The second error is systematic, the third is an estimate of theoretical uncertainties.

$\Delta(1232)$ FOOTNOTES

³ Using $\pi^\pm d$ as well, PEDRONI 78 determine $(M^- - M^{++}) + (M^0 - M^+)/3 = 4.6 \pm 0.2$ MeV.

⁴ 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.

⁵ This VASAN 76B value is from fits to the coulomb-barrier-corrected CARTER 73 phase shift.

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

⁷ This ARNDT 95 value is in error, as pointed out by HOHLER 01. The corrected value is in line with the ARNDT 91 value (R.A. Arndt, private communication).

⁸ Converted to our conventions using $M = 1232$ MeV, $\Gamma = 110$ MeV from NOELLE 78.

⁹ 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).

AHRENS	04A	EPJ A21 323	J. Ahrens <i>et al.</i>	(Mainz GDH, A2 Collab.)
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VRANA	00	PRPL 328 181	T.P. Vrana, S.A. Dytman., T.-S.H. Lee (PITT+)
HANSTEIN	98	NP A632 561	O. Hanstein, D. Drechsel, L. Tiator
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BECK	97	PRL 78 606	R. Beck <i>et al.</i> (MANZ, SACL, PAVI, GLAS)
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MANLEY	92	PR D45 4002	D.M. Manley, E.M. Saleski (KENT) IJP
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KOCH	80B	NP A336 331	R. Koch, E. Pietarinen (KARLT) IJP
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NEFKENS	78	PR D18 3911	B.M.K. Nefkens <i>et al.</i> (UCLA, CATH) IJP
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FELLER	76	NP B104 219	P. Feller <i>et al.</i> (NAGO, OSAK) IJP
VASAN	76B	NP B106 535	S.S. Vasan (CMU) IJP
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BERENDS	75	NP B84 342	F.A. Berends, A. Donnachie (LEID, MCHS)
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