

$$\Delta(1620) \frac{1}{2}^-$$

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

Older and obsolete values are listed and referenced in the 2014 edition, *Chinese Physics C* **38** 070001 (2014).

## $\Delta(1620)$ POLE POSITION

### REAL PART

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>1590 to 1610 (<math>\approx</math> 1600) OUR ESTIMATE</b>			
1597 $\pm$ 5	SOKHOYAN	15A	DPWA Multichannel
1603 $\pm$ 7 $\pm$ 2	<sup>1</sup> SVARC	14	L+P $\pi N \rightarrow \pi N$
1595	ARNDT	06	DPWA $\pi N \rightarrow \pi N, \eta N$
1608	HOEHLER	93	SPED $\pi N \rightarrow \pi N$
1600 $\pm$ 15	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
1597 $\pm$ 4	ANISOVICH	12A	DPWA Multichannel
1587	SHRESTHA	12A	DPWA Multichannel
1607	VRANA	00	DPWA Multichannel

### −2×IMAGINARY PART

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>120 to 140 (<math>\approx</math> 130) OUR ESTIMATE</b>			
134 $\pm$ 8	SOKHOYAN	15A	DPWA Multichannel
114 $\pm$ 12 $\pm$ 4	<sup>1</sup> SVARC	14	L+P $\pi N \rightarrow \pi N$
135	ARNDT	06	DPWA $\pi N \rightarrow \pi N, \eta N$
116	HOEHLER	93	SPED $\pi N \rightarrow \pi N$
120 $\pm$ 20	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
130 $\pm$ 9	ANISOVICH	12A	DPWA Multichannel
107	SHRESTHA	12A	DPWA Multichannel
148	VRANA	00	DPWA Multichannel

## $\Delta(1620)$ ELASTIC POLE RESIDUE

### MODULUS $|r|$

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>15 to 20 (<math>\approx</math> 17) OUR ESTIMATE</b>			
20 $\pm$ 3	SOKHOYAN	15A	DPWA Multichannel
17 $\pm$ 2 $\pm$ 1	<sup>1</sup> SVARC	14	L+P $\pi N \rightarrow \pi N$
15	ARNDT	06	DPWA $\pi N \rightarrow \pi N, \eta N$
19	HOEHLER	93	SPED $\pi N \rightarrow \pi N$
15 $\pm$ 2	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
18 $\pm$ 2	ANISOVICH	12A	DPWA Multichannel

**PHASE  $\theta$** 

<u>VALUE (<math>^\circ</math>)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>– 90 to –110 (<math>\approx</math> –100) OUR ESTIMATE</b>			
– 90 $\pm$ 15	SOKHOYAN	15A	DPWA Multichannel
– 106 $\pm$ 10 $\pm$ 4	<sup>1</sup> SVARC	14	L+P $\pi N \rightarrow \pi N$
– 92	ARNDT	06	DPWA $\pi N \rightarrow \pi N, \eta N$
– 95	HOEHLER	93	SPED $\pi N \rightarrow \pi N$
– 110 $\pm$ 20	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
– 100 $\pm$ 5	ANISOVICH	12A	DPWA Multichannel

 **$\Delta(1620)$  INELASTIC POLE RESIDUE**

The “normalized residue” is the residue divided by  $\Gamma_{pole}/2$ .

**Normalized residue in  $N\pi \rightarrow \Delta(1620) \rightarrow \Delta\pi, D$ -wave**

<u>MODULUS</u>	<u>PHASE (<math>^\circ</math>)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
0.42 $\pm$ 0.06	– 90 $\pm$ 20	SOKHOYAN	15A	DPWA Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.38 $\pm$ 0.09	– 85 $\pm$ 30	ANISOVICH	12A	DPWA Multichannel

**Normalized residue in  $N\pi \rightarrow \Delta(1620) \rightarrow N(1440)\pi$** 

<u>MODULUS</u>	<u>PHASE (<math>^\circ</math>)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
0.10 $\pm$ 0.06	– 65 $\pm$ 30	SOKHOYAN	15A	DPWA Multichannel

 **$\Delta(1620)$  BREIT-WIGNER MASS**

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>1600 to 1660 (<math>\approx</math> 1630) OUR ESTIMATE</b>			
1595 $\pm$ 8	SOKHOYAN	15A	DPWA Multichannel
1615.2 $\pm$ 0.4	ARNDT	06	DPWA $\pi N \rightarrow \pi N, \eta N$
1620 $\pm$ 20	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
1610 $\pm$ 7	HOEHLER	79	IPWA $\pi N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
1600 $\pm$ 8	ANISOVICH	12A	DPWA Multichannel
1600 $\pm$ 1	SHRESTHA	12A	DPWA Multichannel
1612 $\pm$ 2	PENNER	02C	DPWA Multichannel
1617 $\pm$ 15	VRANA	00	DPWA Multichannel

 **$\Delta(1620)$  BREIT-WIGNER WIDTH**

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>130 to 150 (<math>\approx</math> 140) OUR ESTIMATE</b>			
135 $\pm$ 9	SOKHOYAN	15A	DPWA Multichannel
146.9 $\pm$ 1.9	ARNDT	06	DPWA $\pi N \rightarrow \pi N, \eta N$
140 $\pm$ 20	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
139 $\pm$ 18	HOEHLER	79	IPWA $\pi N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
130 $\pm$ 11	ANISOVICH	12A	DPWA Multichannel
112 $\pm$ 2	SHRESTHA	12A	DPWA Multichannel
202 $\pm$ 7	PENNER	02C	DPWA Multichannel
143 $\pm$ 42	VRANA	00	DPWA Multichannel

**$\Delta(1620)$  DECAY MODES**

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

Mode	Fraction ( $\Gamma_i/\Gamma$ )
$\Gamma_1$ $N\pi$	20–30 %
$\Gamma_2$ $N\pi\pi$	55–80 %
$\Gamma_3$ $\Delta(1232)\pi$	
$\Gamma_4$ $\Delta(1232)\pi$ , <i>D</i> -wave	52–72 %
$\Gamma_5$ $N\rho$	
$\Gamma_6$ $N\rho$ , $S=1/2$ , <i>S</i> -wave	seen
$\Gamma_7$ $N\rho$ , $S=3/2$ , <i>D</i> -wave	seen
$\Gamma_8$ $N(1440)\pi$	3–9 %
$\Gamma_9$ $N\gamma$ , helicity=1/2	0.03–0.10 %

 **$\Delta(1620)$  BRANCHING RATIOS**

$\Gamma(N\pi)/\Gamma_{\text{total}}$					$\Gamma_1/\Gamma$
VALUE (%)	DOCUMENT ID	TECN	COMMENT		
<b>20 to 30 OUR ESTIMATE</b>					
28 $\pm$ 3	SOKHOYAN	15A	DPWA	Multichannel	
31.5 $\pm$ 0.1	ARNDT	06	DPWA	$\pi N \rightarrow \pi N, \eta N$	
25 $\pm$ 3	CUTKOSKY	80	IPWA	$\pi N \rightarrow \pi N$	
35 $\pm$ 6	HOEHLER	79	IPWA	$\pi N \rightarrow \pi N$	
• • • We do not use the following data for averages, fits, limits, etc. • • •					
28 $\pm$ 3	ANISOVICH	12A	DPWA	Multichannel	
33 $\pm$ 2	SHRESTHA	12A	DPWA	Multichannel	
34 $\pm$ 1	PENNER	02C	DPWA	Multichannel	
45 $\pm$ 5	VRANA	00	DPWA	Multichannel	

$\Gamma(\Delta(1232)\pi, D\text{-wave})/\Gamma_{\text{total}}$					$\Gamma_4/\Gamma$
VALUE (%)	DOCUMENT ID	TECN	COMMENT		
62 $\pm$ 10	SOKHOYAN	15A	DPWA	Multichannel	
• • • We do not use the following data for averages, fits, limits, etc. • • •					
60 $\pm$ 17	ANISOVICH	12A	DPWA	Multichannel	
32 $\pm$ 2	SHRESTHA	12A	DPWA	Multichannel	
39 $\pm$ 2	VRANA	00	DPWA	Multichannel	

$\Gamma(N\rho, S=1/2, S\text{-wave})/\Gamma_{\text{total}}$					$\Gamma_6/\Gamma$
VALUE (%)	DOCUMENT ID	TECN	COMMENT		
• • • We do not use the following data for averages, fits, limits, etc. • • •					
26 $\pm$ 2	SHRESTHA	12A	DPWA	Multichannel	
14 $\pm$ 3	VRANA	00	DPWA	Multichannel	

$\Gamma(N\rho, S=3/2, D\text{-wave})/\Gamma_{\text{total}}$					$\Gamma_7/\Gamma$
VALUE (%)	DOCUMENT ID	TECN	COMMENT		
• • • We do not use the following data for averages, fits, limits, etc. • • •					
2 $\pm$ 1	VRANA	00	DPWA	Multichannel	

$\Gamma(N(1440)\pi)/\Gamma_{\text{total}}$	$\Gamma_8/\Gamma$			
VALUE (%)	DOCUMENT ID	TECN	COMMENT	
$6 \pm 3$	SOKHOYAN	15A	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
$9 \pm 1$	SHRESTHA	12A	DPWA	Multichannel
$0 \pm 1$	VRANA	00	DPWA	Multichannel

### $\Delta(1620)$ PHOTON DECAY AMPLITUDES AT THE POLE

#### $\Delta(1620) \rightarrow N\gamma$ , helicity-1/2 amplitude $A_{1/2}$

MODULUS ( $\text{GeV}^{-1/2}$ )	PHASE ( $^\circ$ )	DOCUMENT ID	TECN	COMMENT
$0.054 \pm 0.007$	$-6 \pm 7$	SOKHOYAN	15A	DPWA Multichannel

### $\Delta(1620)$ BREIT-WIGNER PHOTON DECAY AMPLITUDES

#### $\Delta(1620) \rightarrow N\gamma$ , helicity-1/2 amplitude $A_{1/2}$

VALUE ( $\text{GeV}^{-1/2}$ )	DOCUMENT ID	TECN	COMMENT	
<b>+0.040 ± 0.015 OUR ESTIMATE</b>				
$0.055 \pm 0.007$	SOKHOYAN	15A	DPWA	Multichannel
$0.029 \pm 0.003$	WORKMAN	12A	DPWA	$\gamma N \rightarrow N\pi$
$0.050 \pm 0.002$	DUGGER	07	DPWA	$\gamma N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
$0.052 \pm 0.005$	ANISOVICH	12A	DPWA	Multichannel
$-0.003 \pm 0.003$	SHRESTHA	12A	DPWA	Multichannel
0.066	DRECHSEL	07	DPWA	$\gamma N \rightarrow \pi N$
-0.050	PENNER	02D	DPWA	Multichannel

### $\Delta(1620)$ FOOTNOTES

<sup>1</sup> Fit to the amplitudes of HOEHLER 79.

### $\Delta(1620)$ REFERENCES

For early references, see *Physics Letters* **111B** 1 (1982).

SOKHOYAN	15A	EPJ A51 95	V. Sokhoyan <i>et al.</i>	(CBELSA/TAPS Collab.)
PDG	14	CPC 38 070001	K. Olive <i>et al.</i>	(PDG Collab.)
SVARC	14	PR C89 045205	A. Svarc <i>et al.</i>	
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)
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)
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	$\pi N$ 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