

$\omega(1420)$ 

$$I^G(J^{PC}) = 0^-(1^{--})$$

See also the  $\omega(1650)$  particle listing. **$\omega(1420)$  MASS**

VALUE (MeV)	EVTS	DOCUMENT ID	TECN	COMMENT
<b>1410 ± 60 OUR ESTIMATE</b>				
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
1350 ± 43		1 DIMOVA 25	SND	$e^+e^- \rightarrow \pi^+\pi^-\pi^0$
1350 ± 43		2 ACHASOV 24A	SND	$e^+e^- \rightarrow \pi^+\pi^-\pi^0$
1418 ± 30 ± 10	824	3 AKHMETSHIN 17A	CMD3	1.4–2.0 $e^+e^- \rightarrow \omega\eta$
1470 ± 50	13.1k	4 AULCHENKO 15A	SND	1.05–1.80 $e^+e^- \rightarrow \pi^+\pi^-\pi^0$
1382 ± 23 ± 70		AUBERT 07AU	BABR	10.6 $e^+e^- \rightarrow \omega\pi^+\pi^-\gamma$
1350 ± 20 ± 20		AUBERT,B 04N	BABR	10.6 $e^+e^- \rightarrow \pi^+\pi^-\pi^0\gamma$
1400 ± 50 ± 130	1.2M	5 ACHASOV 03D	RVUE	0.44–2.00 $e^+e^- \rightarrow \pi^+\pi^-\pi^0$
1450 ± 10		6 HENNER 02	RVUE	1.2–2.0 $e^+e^- \rightarrow \rho\pi, \omega\pi\pi$
1373 ± 70	177	7 AKHMETSHIN 00D	CMD2	1.2–1.38 $e^+e^- \rightarrow \omega\pi^+\pi^-$
1370 ± 25	5095	ANISOVICH 00H	SPEC	0.0 $\rho\bar{p} \rightarrow \omega\pi^0\pi^0\pi^0$
1400 <sup>+100</sup> <sub>-200</sub>		8 ACHASOV 98H	RVUE	$e^+e^- \rightarrow \pi^+\pi^-\pi^0$
~ 1400		9 ACHASOV 98H	RVUE	$e^+e^- \rightarrow \omega\pi^+\pi^-$
~ 1460		10 ACHASOV 98H	RVUE	$e^+e^- \rightarrow K^+K^-$
1440 ± 70		11 CLEGG 94	RVUE	
1419 ± 31	315	12 ANTONELLI 92	DM2	1.34–2.4 $e^+e^- \rightarrow \rho\pi$

<sup>1</sup> From a fit to the cross section with contributions from  $\omega(782)$ ,  $\phi(1020)$ ,  $\omega(1420)$ , and  $\omega(1650)$ . An alternative fit which also includes  $\phi(1680)$  gives  $1374 \pm 27$  MeV with a worse  $\chi^2$ . Supersedes ACHASOV 24A.

<sup>2</sup> From a fit to the cross section including contribution from  $\omega(782)$ ,  $\phi(1020)$ ,  $\omega(1420)$ , and  $\omega(1650)$ . Supersedes ACHASOV 20A.

<sup>3</sup> From a fit of the interfering  $\omega(1420)$  and  $\omega(1650)$  with a relative phase of  $\pi$  and other parameters floating.

<sup>4</sup> From a fit with contributions from  $\omega(782)$ ,  $\phi(1020)$ ,  $\omega(1420)$ , and  $\omega(1650)$ . See ACHASOV 20A for a further analysis of the  $\pi^+\pi^-\pi^0$  data.

<sup>5</sup> From the combined fit of ANTONELLI 92, ACHASOV 01E, ACHASOV 02E, and ACHASOV 03D data on the  $\pi^+\pi^-\pi^0$  and ANTONELLI 92 on the  $\omega\pi^+\pi^-$  final states. Supersedes ACHASOV 99E and ACHASOV 02E.

<sup>6</sup> Using results of CORDIER 81 and preliminary data of DOLINSKY 91 and ANTONELLI 92.

<sup>7</sup> Using the data of AKHMETSHIN 00D and ANTONELLI 92. The  $\rho\pi$  dominance for the energy dependence of the  $\omega(1420)$  and  $\omega(1650)$  width assumed.

<sup>8</sup> Using data from BARKOV 87, DOLINSKY 91, and ANTONELLI 92.

<sup>9</sup> Using the data from ANTONELLI 92.

<sup>10</sup> Using the data from IVANOV 81 and BISELLO 88B.

<sup>11</sup> From a fit to two Breit-Wigner functions and using the data of DOLINSKY 91 and ANTONELLI 92.

<sup>12</sup> From a fit to two Breit-Wigner functions interfering between them and with the  $\omega, \phi$  tails with fixed (+, -, +) phases.

**$\omega(1420)$  WIDTH**

<u>VALUE (MeV)</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>290±190 OUR ESTIMATE</b>				
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
590± 90		1 DIMOVA 25	SND	$e^+e^- \rightarrow \pi^+\pi^-\pi^0$
590± 90		2 ACHASOV 24A	SND	$e^+e^- \rightarrow \pi^+\pi^-\pi^0$
440±125	267	3 ACHASOV 20B	SND	$e^+e^- \rightarrow \omega\eta \rightarrow \eta\pi^0\gamma$
104± 35± 10	824	4 AKHMETSHIN 17A	CMD3	1.4–2.0 $e^+e^- \rightarrow \omega\eta$
880±170	13.1k	5 AULCHENKO 15A	SND	1.05–1.80 $e^+e^- \rightarrow \pi^+\pi^-\pi^0$
480±180		6 ACHASOV 10D	SND	1.075–2.0 $e^+e^- \rightarrow \pi^0\gamma$
130± 50±100		AUBERT 07AU	BABR	10.6 $e^+e^- \rightarrow \omega\pi^+\pi^-\gamma$
450± 70± 70		AUBERT,B 04N	BABR	10.6 $e^+e^- \rightarrow \pi^+\pi^-\pi^0\gamma$
870 <sup>+500</sup> <sub>-300</sub> ±450	1.2M	7 ACHASOV 03D	RVUE	0.44–2.00 $e^+e^- \rightarrow \pi^+\pi^-\pi^0$
199± 15		8 HENNER 02	RVUE	1.2–2.0 $e^+e^- \rightarrow \rho\pi, \omega\pi\pi$
188± 45	177	9 AKHMETSHIN 00D	CMD2	1.2–1.38 $e^+e^- \rightarrow \omega\pi^+\pi^-$
360 <sup>+100</sup> <sub>-60</sub>	5095	ANISOVICH 00H	SPEC	0.0 $\rho\bar{p} \rightarrow \omega\pi^0\pi^0\pi^0$
240± 70		10 CLEGG 94	RVUE	
174± 59	315	11 ANTONELLI 92	DM2	1.34–2.4 $e^+e^- \rightarrow \rho\pi$

<sup>1</sup> From a fit to the cross section with contributions from  $\omega(782)$ ,  $\phi(1020)$ ,  $\omega(1420)$ , and  $\omega(1650)$ . An alternative fit which also includes  $\phi(1680)$  gives  $720 \pm 98$  MeV with a worse  $\chi^2$ . Supersedes ACHASOV 24A.

<sup>2</sup> From a fit to the cross section including contribution from  $\omega(782)$ ,  $\phi(1020)$ ,  $\omega(1420)$ , and  $\omega(1650)$ . Supersedes ACHASOV 20A.

<sup>3</sup> From a fit with contributions from  $\omega(1420)$ ,  $\omega(1650)$ , and  $\phi(1680)$ . The mass of  $\omega(1420)$  is fixed to the PDG 18 value of 1420 MeV.

<sup>4</sup> From a fit of the interfering  $\omega(1420)$  and  $\omega(1650)$  with a relative phase of  $\pi$  and other parameters floating.

<sup>5</sup> From a fit with contributions from  $\omega(782)$ ,  $\phi(1020)$ ,  $\omega(1420)$ , and  $\omega(1650)$ . See ACHASOV 20A for a further analysis of the  $\pi^+\pi^-\pi^0$  data.

<sup>6</sup> From a fit of a VMD model with two effective resonances with masses of 1450 MeV and 1700 MeV to describe the excited vector states  $\omega(1420)$ ,  $\rho(1450)$ ,  $\omega(1650)$ , and  $\rho(1700)$ . Systematic errors not evaluated.

<sup>7</sup> From the combined fit of ANTONELLI 92, ACHASOV 01E, ACHASOV 02E, and ACHASOV 03D data on the  $\pi^+\pi^-\pi^0$  and ANTONELLI 92 on the  $\omega\pi^+\pi^-$  final states. Supersedes ACHASOV 99E and ACHASOV 02E.

<sup>8</sup> Using results of CORDIER 81 and preliminary data of DOLINSKY 91 and ANTONELLI 92.

<sup>9</sup> Using the data of AKHMETSHIN 00D and ANTONELLI 92. The  $\rho\pi$  dominance for the energy dependence of the  $\omega(1420)$  and  $\omega(1650)$  width assumed.

<sup>10</sup> From a fit to two Breit-Wigner functions and using the data of DOLINSKY 91 and ANTONELLI 92.

<sup>11</sup> From a fit to two Breit-Wigner functions interfering between them and with the  $\omega, \phi$  tails with fixed (+, -, +) phases.

**$\omega(1420)$  DECAY MODES**

Mode	Fraction ( $\Gamma_i/\Gamma$ )
$\Gamma_1$ $\rho\pi$	seen
$\Gamma_2$ $\rho(1450)\pi$	possibly seen
$\Gamma_3$ $\omega\pi\pi$	seen
$\Gamma_4$ $\omega\eta$	possibly seen
$\Gamma_5$ $b_1(1235)\pi$	seen
$\Gamma_6$ $e^+e^-$	seen
$\Gamma_7$ $\pi^0\gamma$	

 **$\omega(1420) \Gamma(i)\Gamma(e^+e^-)/\Gamma^2(\text{total})$** 

**$\Gamma(\rho\pi)/\Gamma_{\text{total}} \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$   $\Gamma_1/\Gamma \times \Gamma_6/\Gamma$**

<u>VALUE (units <math>10^{-6}</math>)</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
$0.73 \pm 0.08$	13.1k	<sup>1</sup> AULCHENKO	15A SND	$1.05\text{--}1.80 e^+e^- \rightarrow \pi^+\pi^-\pi^0$
$0.82 \pm 0.05 \pm 0.06$		AUBERT,B	04N BABR	$10.6 e^+e^- \rightarrow \pi^+\pi^-\pi^0\gamma$
$0.65 \pm 0.13 \pm 0.21$	1.2M	<sup>2,3</sup> ACHASOV	03D RVUE	$0.44\text{--}2.00 e^+e^- \rightarrow \pi^+\pi^-\pi^0$
$0.625 \pm 0.160$		<sup>4,5</sup> CLEGG	94 RVUE	
$0.466 \pm 0.178$		<sup>6,7</sup> ANTONELLI	92 DM2	$1.34\text{--}2.4 e^+e^- \rightarrow \rho\pi$

<sup>1</sup> From a fit with contributions from  $\omega(782)$ ,  $\phi(1020)$ ,  $\omega(1420)$ , and  $\omega(1650)$ . See ACHASOV 20A for a further analysis of the  $\pi^+\pi^-\pi^0$  data.

<sup>2</sup> Calculated by us from the cross section at the peak.

<sup>3</sup> From the combined fit of ANTONELLI 92, ACHASOV 01E, ACHASOV 02E, and ACHASOV 03D data on the  $\pi^+\pi^-\pi^0$  and ANTONELLI 92 on the  $\omega\pi^+\pi^-$  final states. Supersedes ACHASOV 99E and ACHASOV 02E.

<sup>4</sup> From a fit to two Breit-Wigner functions and using the data of DOLINSKY 91 and ANTONELLI 92.

<sup>5</sup> From the partial and leptonic width given by the authors.

<sup>6</sup> From a fit to two Breit-Wigner functions interfering between them and with the  $\omega, \phi$  tails with fixed (+, -, +) phases.

<sup>7</sup> From the product of the leptonic width and partial branching ratio given by the authors.

**$\Gamma(\omega\pi\pi)/\Gamma_{\text{total}} \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$   $\Gamma_3/\Gamma \times \Gamma_6/\Gamma$**

<u>VALUE (units <math>10^{-8}</math>)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
$19.7 \pm 5.7$	AUBERT	07AU BABR	$10.6 e^+e^- \rightarrow \omega\pi^+\pi^-\gamma$
$1.9 \pm 1.9$	<sup>1</sup> AKHMETSHIN	00D CMD2	$1.2\text{--}2.4 e^+e^- \rightarrow \omega\pi^+\pi^-$

<sup>1</sup> Using the data of AKHMETSHIN 00D and ANTONELLI 92. The  $\rho\pi$  dominance for the energy dependence of the  $\omega(1420)$  and  $\omega(1650)$  width assumed.

$\Gamma(\omega\eta)/\Gamma_{\text{total}} \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$   $\Gamma_4/\Gamma \times \Gamma_6/\Gamma$

<u>VALUE (units <math>10^{-8}</math>)</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
$2.5 \pm 0.6$	267	<sup>1</sup> ACHASOV	20B SND	$e^+e^- \rightarrow \omega\eta \rightarrow \eta\pi^0\gamma$
$2.1^{+1.0}_{-0.8}$		ACHASOV	19 SND	$e^+e^- \rightarrow \pi^+\pi^-\pi^0\eta$
$5.0 \pm 2.6 \pm 0.3$	824	<sup>2</sup> AKHMETSHIN 17A	CMD3	$1.4\text{--}2.0 e^+e^- \rightarrow \omega\eta$
$1.6^{+0.9}_{-0.7}$	898	<sup>3</sup> ACHASOV	16B SND	$1.34\text{--}2.00 e^+e^- \rightarrow \omega\eta$

<sup>1</sup> From a fit with contributions from  $\omega(1420)$ ,  $\omega(1650)$ , and  $\phi(1680)$ . The mass of  $\omega(1420)$  is fixed to the PDG 18 value of 1420 MeV. Fixing also the width of  $\omega(1420)$  to the PDG 18 value of 220 MeV results in  $(3.0 \pm 1.6) \times 10^{-8}$  measurement.

<sup>2</sup> From a fit of the interfering  $\omega(1420)$  and  $\omega(1650)$  with a relative phase of  $\pi$  and other parameters floating. From an alternative fit  $\Gamma(\omega(1420) \rightarrow \omega\eta)/\Gamma_{\text{total}} \times \Gamma(\omega(1420) \rightarrow e^+e^-) = 5.3 \pm 1.6$  eV.

<sup>3</sup> From a fit with contributions from  $\omega(1420)$ ,  $\omega(1650)$ , and  $\phi(1680)$ . The mass and the width of  $\omega(1420)$  are fixed to the 2014 edition (PDG 14) of this review.

$\Gamma(\pi^0\gamma)/\Gamma_{\text{total}} \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$   $\Gamma_7/\Gamma \times \Gamma_6/\Gamma$

<u>VALUE (units <math>10^{-8}</math>)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
$0.23 \pm 0.14$	<sup>1</sup> ACHASOV	10D SND	$1.075\text{--}2.0 e^+e^- \rightarrow \pi^0\gamma$
$2.03^{+0.70}_{-0.75}$	<sup>2</sup> AKHMETSHIN 05	CMD2	$0.60\text{--}1.38 e^+e^- \rightarrow \pi^0\gamma$

<sup>1</sup> From a fit of a VMD model with two effective resonances with masses of 1450 MeV and 1700 MeV to describe the excited vector states  $\omega(1420)$ ,  $\rho(1450)$ ,  $\omega(1650)$ , and  $\rho(1700)$ . Systematic errors not evaluated.

<sup>2</sup> Using 1420 MeV and 220 MeV for the  $\omega(1420)$  mass and width.

**$\omega(1420)$  BRANCHING RATIOS**

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

<u>VALUE</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>seen</b>	<sup>1</sup> DIMOVA	25 SND	$e^+e^- \rightarrow \pi^+\pi^-\pi^0$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
seen	ACHASOV	20A SND	$1.15\text{--}2.00 e^+e^- \rightarrow \pi^+\pi^-\pi^0$
$0.699 \pm 0.029$	<sup>2</sup> HENNER	02 RVUE	$1.2\text{--}2.0 e^+e^- \rightarrow \rho\pi, \omega\pi\pi$

<sup>1</sup> From a fit to the cross section with contributions from  $\omega(782)$ ,  $\phi(1020)$ ,  $\omega(1420)$ , and  $\omega(1650)$ .

<sup>2</sup> Assuming that the  $\omega(1420)$  decays into  $\rho\pi$  and  $\omega\pi\pi$  only.

$\Gamma(\rho(1450)\pi)/\Gamma_{\text{total}}$   $\Gamma_2/\Gamma$

<u>VALUE</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>possibly seen</b>	<sup>1</sup> DIMOVA	25 SND	$e^+e^- \rightarrow \pi^+\pi^-\pi^0$

<sup>1</sup> From a fit to the cross section with contributions from  $\omega(782)$ ,  $\phi(1020)$ ,  $\omega(1420)$ , and  $\omega(1650)$ .

$\Gamma(\omega\pi\pi)/\Gamma_{\text{total}}$   $\Gamma_3/\Gamma$ 

VALUE	DOCUMENT ID	TECN	COMMENT
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● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●

0.301±0.029	<sup>1</sup> HENNER	02	RVUE 1.2–2.0 $e^+e^- \rightarrow \rho\pi, \omega\pi\pi$
possibly seen	AKHMETSHIN	00D	CMD2 $e^+e^- \rightarrow \omega\pi^+\pi^-$

<sup>1</sup> Assuming that the  $\omega(1420)$  decays into  $\rho\pi$  and  $\omega\pi\pi$  only. $\Gamma(\omega\pi\pi)/\Gamma(b_1(1235)\pi)$   $\Gamma_3/\Gamma_5$ 

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
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● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●

0.60±0.16	5095	ANISOVICH	00H	SPEC 0.0 $\rho\bar{p} \rightarrow \omega\pi^0\pi^0\pi^0$
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 $\Gamma(e^+e^-)/\Gamma_{\text{total}}$   $\Gamma_6/\Gamma$ 

VALUE (units $10^{-7}$ )	EVTS	DOCUMENT ID	TECN	COMMENT
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● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●

~ 6.6	1.2M	<sup>1,2</sup> ACHASOV	03D	RVUE 0.44–2.00 $e^+e^- \rightarrow \pi^+\pi^-\pi^0$
23 ± 1		<sup>3</sup> HENNER	02	RVUE 1.2–2.0 $e^+e^- \rightarrow \rho\pi, \omega\pi\pi$

<sup>1</sup> Assuming that the  $\omega(1420)$  decays into  $\rho\pi$  only.<sup>2</sup> Calculated by us from the cross section at the peak.<sup>3</sup> Assuming that the  $\omega(1420)$  decays into  $\rho\pi$  and  $\omega\pi\pi$  only. **$\omega(1420)$  REFERENCES**

DIMOVA	25	PPN 56 820	T.V. Dimova <i>et al.</i>	(SND Collab.)
ACHASOV	24A	PAN 87 747	M.N. Achasov <i>et al.</i>	(SND Collab.)
ACHASOV	20A	EPJ C80 993	M.N. Achasov <i>et al.</i>	(SND Collab.)
ACHASOV	20B	EPJ C80 1008	M.N. Achasov <i>et al.</i>	(SND Collab.)
ACHASOV	19	PR D99 112004	M.N. Achasov <i>et al.</i>	(SND Collab.)
PDG	18	PR D98 030001	M. Tanabashi <i>et al.</i>	(PDG Collab.)
AKHMETSHIN	17A	PL B773 150	R.R. Akhmetshin <i>et al.</i>	(CMD-3 Collab.)
ACHASOV	16B	PR D94 092002	M.N. Achasov <i>et al.</i>	(SND Collab.)
AULCHENKO	15A	JETP 121 27	V.M. Aulchenko <i>et al.</i>	(SND Collab.)
		Translated from ZETF 148 34.		
PDG	14	CP C38 070001	K. Olive <i>et al.</i>	(PDG Collab.)
ACHASOV	10D	PR D98 112001	M.N. Achasov <i>et al.</i>	(SND Collab.)
AUBERT	07AU	PR D76 092005	B. Aubert <i>et al.</i>	(BABAR Collab.)
AKHMETSHIN	05	PL B605 26	R.R. Akhmetshin <i>et al.</i>	(Novosibirsk CMD-2 Collab.)
AUBERT,B	04N	PR D70 072004	B. Aubert <i>et al.</i>	(BABAR Collab.)
ACHASOV	03D	PR D68 052006	M.N. Achasov <i>et al.</i>	(Novosibirsk SND Collab.)
ACHASOV	02E	PR D66 032001	M.N. Achasov <i>et al.</i>	(Novosibirsk SND Collab.)
HENNER	02	EPJ C26 3	V.K. Henner <i>et al.</i>	
ACHASOV	01E	PR D63 072002	M.N. Achasov <i>et al.</i>	(Novosibirsk SND Collab.)
AKHMETSHIN	00D	PL B489 125	R.R. Akhmetshin <i>et al.</i>	(Novosibirsk CMD-2 Collab.)
ANISOVICH	00H	PL B485 341	A.V. Anisovich <i>et al.</i>	
ACHASOV	99E	PL B462 365	M.N. Achasov <i>et al.</i>	(Novosibirsk SND Collab.)
ACHASOV	98H	PR D57 4334	N.N. Achasov, A.A. Kozhevnikov	
CLEGG	94	ZPHY C62 455	A.B. Clegg, A. Donnachie	(LANC, MCHS)
ANTONELLI	92	ZPHY C56 15	A. Antonelli <i>et al.</i>	(DM2 Collab.)
DOLINSKY	91	PRPL 202 99	S.I. Dolinsky <i>et al.</i>	(NOVO)
BISELLO	88B	ZPHY C39 13	D. Bisello <i>et al.</i>	(PADO, CLER, FRAS+)
BARKOV	87	JETPL 46 164	L.M. Barkov <i>et al.</i>	(NOVO)
		Translated from ZETFP 46 132.		
CORDIER	81	PL 106B 155	A. Cordier <i>et al.</i>	(ORSAY)
IVANOV	81	PL 107B 297	P.M. Ivanov <i>et al.</i>	(NOVO)