$\rho(770)$

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

See the related review(s):
$\rho(770)$

$\rho(770)$ MASS

We no longer list *S*-wave Breit-Wigner fits, or data with high combinatorial background.

NEUTRAL ONLY, e^+e^-

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	COMMENT
775.26±0.25 OUR AVERAGE					
775.02±0.35		[1] LEES	12G	BABR	$e^+e^- \to \pi^+\pi^-\gamma$
775.97±0.46±0.70	900k	[2] AKHMETSHIN	07		$e^+e^- \to \pi^+\pi^-$
774.6 ±0.4 ±0.5	800k	[3,4] ACHASOV	06	SND	$e^+e^- \to \pi^+\pi^-$
775.65±0.64±0.50	114k	[5,6] AKHMETSHIN	04	CMD2	$e^+e^- \to \pi^+\pi^-$
775.9 ±0.5 ±0.5	1.98M	[7] ALOISIO	03	KLOE	1.02 $e^+e^- \to \pi^+\pi^-\pi^0$
775.8 ±0.9 ±2.0	500k	[7] ACHASOV	02	SND	1.02 $e^+e^- \to \pi^+\pi^-\pi^0$
775.9 ±1.1		[8] BARKOV	85	OLYA	$e^+e^- \to \pi^+\pi^-$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
763.49±0.53		[9] BARTOS	17	RVUE	$e^+e^- \to \pi^+\pi^-$
758.23±0.46		[10] BARTOS	17A	RVUE	$e^+e^- \to \pi^+\pi^-$
775.8 ±0.5 ±0.3	1.98M	[11] ALOISIO	03	KLOE	1.02 $e^+e^- \to \pi^+\pi^-\pi^0$
775.9 ±0.6 ±0.5	1.98M	[12] ALOISIO	03	KLOE	1.02 $e^+e^- \to \pi^+\pi^-\pi^0$
775.0 ±0.6 ±1.1	500k	[13] ACHASOV	02	SND	1.02 $e^+e^- \to \pi^+\pi^-\pi^0$
775.1 ±0.7 ±5.3		[14] BENAYOUN	98	RVUE	$e^+e^- \to \pi^+\pi^-$, $\mu^+\mu^-$
770.5 ±1.9 ±5.1		[15] GARDNER	98	RVUE	0.28–0.92 $e^+e^- \to \pi^+\pi^-$
764.1 ±0.7		[16] O'CONNELL	97	RVUE	$e^+e^- \to \pi^+\pi^-$
757.5 ±1.5		[17] BERNICHA	94	RVUE	$e^+e^- \to \pi^+\pi^-$
768 ±1		[18] GESHKEN...	89	RVUE	$e^+e^- \to \pi^+\pi^-$

CHARGED ONLY, τ DECAYS and e^+e^-

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	CHG	COMMENT
775.11±0.34 OUR AVERAGE						
774.6 ±0.2 ±0.5	5.4M	[19,20] FUJIKAWA	08	BELL	±	$\tau^- \to \pi^-\pi^0\nu_\tau$
775.5 ±0.7		[20,21] SCHAEL	05C	ALEP		$\tau^- \to \pi^-\pi^0\nu_\tau$
775.5 ±0.5 ±0.4	1.98M	[7] ALOISIO	03	KLOE		1.02 $e^+e^- \to \pi^+\pi^-\pi^0$
775.1 ±1.1 ±0.5	87k	[22,23] ANDERSON	00A	CLE2		$\tau^- \to \pi^-\pi^0\nu_\tau$
• • • We do not use the following data for averages, fits, limits, etc. • • •						
761.60±0.95		[24] BARTOS	17A	RVUE		$\tau^- \to \pi^-\pi^0\nu_\tau$
774.8 ±0.6 ±0.4	1.98M	[12] ALOISIO	03	KLOE	−	1.02 $e^+e^- \to \pi^+\pi^-\pi^0$
776.3 ±0.6 ±0.7	1.98M	[12] ALOISIO	03	KLOE	+	1.02 $e^+e^- \to \pi^+\pi^-\pi^0$

773.9 ± 2.0 $^{+0.3}_{-1.0}$		[25] SANZ-CILLERO	03	RVUE		$\tau^- \to \pi^- \pi^0 \nu_\tau$
774.5 ± 0.7 ± 1.5	500k	[7] ACHASOV	02	SND	$\pm$	1.02 $e^+ e^- \to \pi^+ \pi^- \pi^0$
775.1 ± 0.5		[26] PICH	01	RVUE		$\tau^- \to \pi^- \pi^0 \nu_\tau$

MIXED CHARGES, OTHER REACTIONS

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	CHG	COMMENT
763.0±0.3±1.2	600k	[27] ABELE	99E	CBAR	$0\pm$	0.0 $\overline{p} p \to \pi^+ \pi^- \pi^0$

CHARGED ONLY, HADROPRODUCED

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	CHG	COMMENT
766.5±1.1 OUR AVERAGE						
763.7 ± 3.2		ABELE	97	CBAR		$\overline{p} n \to \pi^- \pi^0 \pi^0$
768 ± 9		AGUILAR-...	91	EHS		400 $p p$
767 ± 3	2935	[28] CAPRARO	87	SPEC	$-$	200 π^- Cu $\to \pi^- \pi^0$ Cu
761 ± 5	967	[28] CAPRARO	87	SPEC	$-$	200 π^- Pb $\to \pi^- \pi^0$ Pb
771 ± 4		HUSTON	86	SPEC	$+$	202 π^+ A $\to \pi^+ \pi^0$ A
766 ± 7	6500	[29] BYERLY	73	OSPK	$-$	5 $\pi^- p$
766.8 ± 1.5	9650	[30] PISUT	68	RVUE	$-$	1.7–3.2 $\pi^- p$, $t < 10$
767 ± 6	900	[28] EISNER	67	HBC	$-$	4.2 $\pi^- p$, $t < 10$

NEUTRAL ONLY, PHOTOPRODUCED

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	COMMENT
769.0± 1.0 OUR AVERAGE					
771 $\pm$ 2 $^{+2}_{-1}$	63.5k	[31] ABRAMOWICZ	12	ZEUS	$e p \to e \pi^+ \pi^- p$
770 $\pm$ 2 ± 1	79k	[32] BREITWEG	98B	ZEUS	50–100 γp
767.6 $\pm$ 2.7		BARTALUCCI	78	CNTR	$\gamma p \to e^+ e^- p$
775 $\pm$ 5		GLADDING	73	CNTR	2.9–4.7 γp
767 $\pm$ 4	1930	BALLAM	72	HBC	2.8 γp
770 $\pm$ 4	2430	BALLAM	72	HBC	4.7 γp
765 ± 10		ALVENSLEB...	70	CNTR	γA, $t < 0.01$
767.7 $\pm$ 1.9	140k	BIGGS	70	CNTR	< 4.1 γC $\to \pi^+ \pi^-$ C
765 $\pm$ 5	4000	ASBURY	67B	CNTR	$\gamma +$ Pb
• • • We do not use the following data for averages, fits, limits, etc. • • •					
771 $\pm$ 2	79k	[33] BREITWEG	98B	ZEUS	50–100 γp

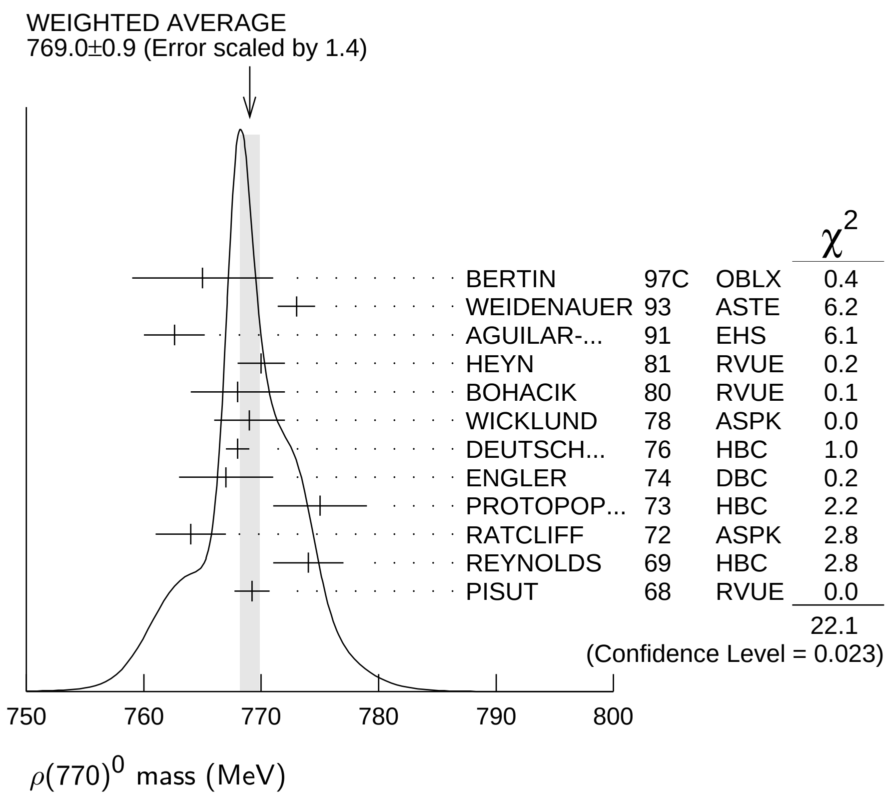
NEUTRAL ONLY, OTHER REACTIONS

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	CHG	COMMENT
769.0±0.9 OUR AVERAGE	Error includes scale factor of 1.4. See the ideogram below.					
765 ± 6		BERTIN	97C	OBLX		0.0 $\overline{p} p \to \pi^+ \pi^- \pi^0$
773 ± 1.6		WEIDENAUER	93	ASTE		$\overline{p} p \to \pi^+ \pi^- \omega$
762.6 ± 2.6		AGUILAR-...	91	EHS		400 $p p$
770 ± 2		[34] HEYN	81	RVUE		Pion form factor
768 ± 4		[35,36] BOHACIK	80	RVUE	0	
769 ± 3		[29] WICKLUND	78	ASPK	0	3,4,6 $\pi^\pm N$

768 ±1	76000	DEUTSCH...	76	HBC	0	16 $\pi^+ p$
767 ±4	4100	ENGLER	74	DBC	0	6 $\pi^+ n \rightarrow \pi^+\pi^- p$
775 ±4	32000	[35] PROTOPOP...	73	HBC	0	7.1 $\pi^+ p$, t <0.4
764 ±3	6800	RATCLIFF	72	ASPK	0	15 $\pi^- p$, t <0.3
774 ±3	1700	REYNOLDS	69	HBC	0	2.26 $\pi^- p$
769.2$\pm$1.5	13300	[37] PISUT	68	RVUE	0	1.7–3.2 $\pi^- p$, t <10

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

773.5$\pm$2.5		[38] COLANGELO	01	RVUE		$\pi\pi \rightarrow \pi\pi$
762.3$\pm$0.5$\pm$1.2	600k	[39] ABELE	99E	CBAR	0	0.0 $\overline{p}p \rightarrow \pi^+\pi^-\pi^0$
777 ±2	4943	[40] ADAMS	97	E665		470 $\mu p \rightarrow \mu XB$
770 ±2		[41] BOGOLYUB...	97	MIRA		32 $\overline{p}p \rightarrow \pi^+\pi^- X$
768 ±8		[41] BOGOLYUB...	97	MIRA		32 $pp \rightarrow \pi^+\pi^- X$
761.1$\pm$2.9		DUBNICKA	89	RVUE		π form factor
777.4$\pm$2.0		[42] CHABAUD	83	ASPK	0	17 $\pi^- p$ polarized
769.5$\pm$0.7		[35,36] LANG	79	RVUE	0	
770 ±9		[36] ESTABROOKS	74	RVUE	0	17 $\pi^- p \rightarrow \pi^+\pi^- n$
773.5$\pm$1.7	11200	[28] JACOBS	72	HBC	0	2.8 $\pi^- p$
775 ±3	2250	HYAMS	68	OSPK	0	11.2 $\pi^- p$



[1] Using the GOUNARIS 68 parametrization with the complex phase of the $\rho-\omega$ interference and leaving the masses and widths of the $\rho(1450)$, $\rho(1700)$, and $\rho(2150)$ resonances as free parameters of the fit.

[2] A combined fit of AKHMETSHIN 07, AULCHENKO 06, and AULCHENKO 05.

[3] Supersedes ACHASOV 05A.

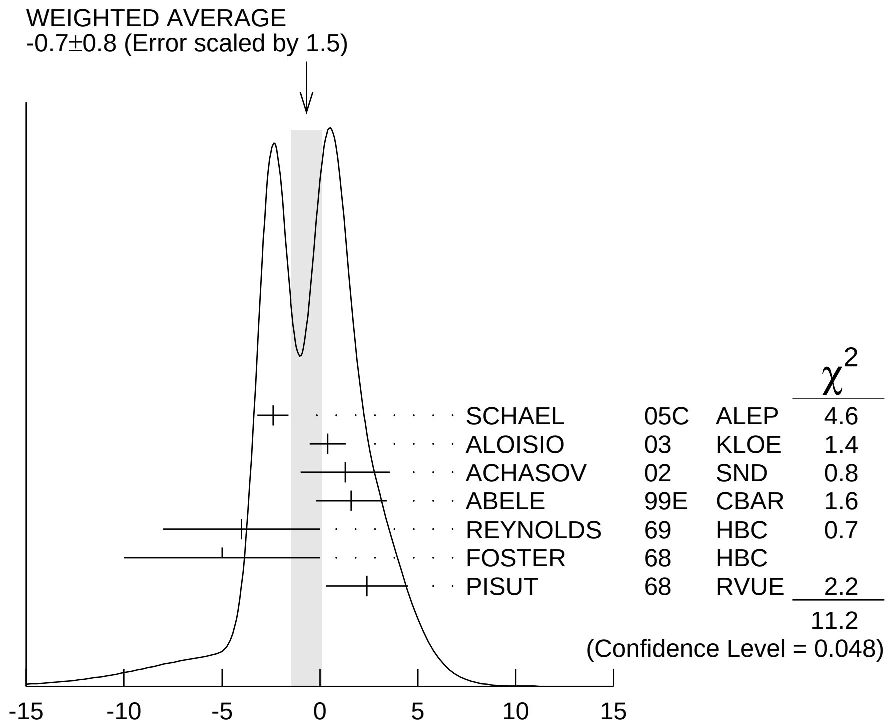
[4] A fit of the SND data from 400 to 1000 MeV using parameters of the $\rho(1450)$ and $\rho(1700)$ from a fit of the data of BARKOV 85, BISELLO 89 and ANDERSON 00A.

[5] Using the GOUNARIS 68 parametrization with the complex phase of the ρ-ω interference.

[6] Update of AKHMETSHIN 02.
[7] Assuming $m_{\rho^+} = m_{\rho^-}$, $\Gamma_{\rho^+} = \Gamma_{\rho^-}$.
[8] From the GOUNARIS 68 parametrization of the pion form factor.
[9] Applies the Unitary & Analytic Model of the pion electromagnetic form factor of DUBNICKA 10 to analyze the data of LEES 12G and ABLIKIM 16C.
[10] Applies the Unitary & Analytic Model of the pion electromagnetic form factor of DUBNICKA 10 to analyze the data of ACHASOV 06, AKHMETSHIN 07, AUBERT 09AS, and AMBROSINO 11A.
[11] Assuming $m_{\rho^+} = m_{\rho^-} = m_{\rho^0}$, $\Gamma_{\rho^+} = \Gamma_{\rho^-} = \Gamma_{\rho^0}$.
[12] Without limitations on masses and widths.
[13] Assuming $m_{\rho^0} = m_{\rho^\pm}$, $g_{\rho^0 \pi\pi} = g_{\rho^\pm \pi\pi}$.
[14] Using the data of BARKOV 85 in the hidden local symmetry model.
[15] From the fit to $e^+ e^- \rightarrow \pi^+ \pi^-$ data from the compilations of HEYN 81 and BARKOV 85, including the GOUNARIS 68 parametrization of the pion form factor.
[16] A fit of BARKOV 85 data assuming the direct $\omega\pi\pi$ coupling.
[17] Applying the S-matrix formalism to the BARKOV 85 data.
[18] Includes BARKOV 85 data. Model-dependent width definition.
[19] $|F_\pi(0)|^2$ fixed to 1.
[20] From the GOUNARIS 68 parametrization of the pion form factor.
[21] The error combines statistical and systematic uncertainties. Supersedes BARATE 97M.
[22] $\rho(1700)$ mass and width fixed at 1700 MeV and 235 MeV respectively.
[23] From the GOUNARIS 68 parametrization of the pion form factor. The second error is a model error taking into account different parametrizations of the pion form factor.
[24] Applies the Unitary & Analytic Model of the pion electromagnetic form factor of DUBNICKA 10 to analyze the data of FUJIKAWA 08.
[25] Using the data of BARATE 97M and the effective chiral Lagrangian.
[26] From a fit of the model-independent parameterization of the pion form factor to the data of BARATE 97M.
[27] Assuming the equality of ρ^+ and ρ^- masses and widths.
[28] Mass errors enlarged by us to $\Gamma/\sqrt{N}$; see the note with the $K^*(892)$ mass.
[29] Phase shift analysis. Systematic errors added corresponding to spread of different fits.
[30] From fit of 3-parameter relativistic P-wave Breit-Wigner to total mass distribution. Includes BATON 68, MILLER 67B, ALFF-STEINBERGER 66, HAGOPIAN 66, HAGOPIAN 66B, JACOBS 66B, JAMES 66, WEST 66, BLIEDEN 65 and CARMONY 64.
[31] Using the KUHN 90 parametrization of the pion form factor, neglecting ρ–ω interference.
[32] From the parametrization according to SOEDING 66.
[33] From the parametrization according to ROSS 66.
[34] HEYN 81 includes all spacelike and timelike F_π values until 1978.
[35] From pole extrapolation.
[36] From phase shift analysis of GRAYER 74 data.
[37] Includes MALAMUD 69, ARMENISE 68, BACON 67, HUWE 67, MILLER 67B, ALFF-STEINBERGER 66, HAGOPIAN 66, HAGOPIAN 66B, JACOBS 66B, JAMES 66, WEST 66, GOLDHABER 64, ABOLINS 63.
[38] Breit-Wigner mass from a phase-shift analysis of HYAMS 73 and PROTOPOPESCU 73 data.
[39] Using relativistic Breit-Wigner and taking into account ρ-ω interference.
[40] Systematic errors not evaluated.
[41] Systematic effects not studied.
[42] From fit of 3-parameter relativistic Breit-Wigner to helicity-zero part of P-wave intensity. CHABAUD 83 includes data of GRAYER 74.

$m_{\rho(770)^0} - m_{\rho(770)^\pm}$

VALUE (MeV)	EVTS	DOCUMENT ID	TECN	CHG	COMMENT
−0.7 ±0.8 OUR AVERAGE	Error includes scale factor of 1.5. See the ideogram below.				
−2.4 ±0.8		[1] SCHAEL 05C	ALEP		$\tau^- \to \pi^- \pi^0 \nu_\tau$
0.4 ±0.7 ±0.6	1.98M	[2] ALOISIO 03	KLOE		$1.02\ e^+ e^- \to \pi^+ \pi^- \pi^0$
1.3 ±1.1 ±2.0	500k	[2] ACHASOV 02	SND		$1.02\ e^+ e^- \to \pi^+ \pi^- \pi^0$
1.6 ±0.6 ±1.7	600k	ABELE 99E	CBAR	±0	$0.0\ \overline{p} p \to \pi^+ \pi^- \pi^0$
−4 ±4	3000	[3] REYNOLDS 69	HBC	−0	$2.26\ \pi^- p$
−5 ±5	3600	[3] FOSTER 68	HBC	±0	$0.0\ \overline{p} p$
2.4 ±2.1	22950	[4] PISUT 68	RVUE		$\pi N \to \rho N$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
−3.37±1.06		[5] BARTOS 17A	RVUE		$e^+ e^- \to \pi^+ \pi^-$, $\tau^- \to \pi^- \pi^0 \nu_\tau$



$m_{\rho(770)^0} - m_{\rho(770)^\pm}$ (MeV)

[1] From the combined fit of the τ^- data from ANDERSON 00A and SCHAEL 05C and $e^+ e^-$ data from the compilation of BARKOV 85, AKHMETSHIN 04, and ALOISIO 05. Supersedes BARATE 97M.

[2] Assuming $m_{\rho^+} = m_{\rho^-}$, $\Gamma_{\rho^+} = \Gamma_{\rho^-}$.

[3] From quoted masses of charged and neutral modes.

[4] Includes MALAMUD 69, ARMENISE 68, BATON 68, BACON 67, HUWE 67, MILLER 67B, ALFF-STEINBERGER 66, HAGOPIAN 66, HAGOPIAN 66B, JACOBS 66B, JAMES 66, WEST 66, BLIEDEN 65, CARMONY 64, GOLDHABER 64, ABOLINS 63.

[5] Applies the Unitary & Analytic Model of the pion electromagnetic form factor of DUBNICKA 10 to analyze the data of ACHASOV 06, AKHMETSHIN 07, AUBERT 09AS, AMBROSINO 11A, and FUJIKAWA 08.

$m_{\rho(770)^+} - m_{\rho(770)^-}$

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
1.5±0.8±0.7	1.98M	[1] ALOISIO	03	KLOE	1.02 $e^+e^- \to \pi^+\pi^-\pi^0$

[1] Without limitations on masses and widths.

$\rho(770)$ RANGE PARAMETER

The range parameter R enters an energy-dependent correction to the width, of the form $(1 + q_r^2\ R^2)\ /\ (1 + q^2\ R^2)$, where q is the momentum of one of the pions in the $\pi\pi$ rest system. At resonance, $q = q_r$.

VALUE (GeV^{-1})	DOCUMENT ID		TECN	CHG	COMMENT
$5.3^{+0.9}_{-0.7}$	CHABAUD	83	ASPK	0	17 $\pi^- p$ polarized

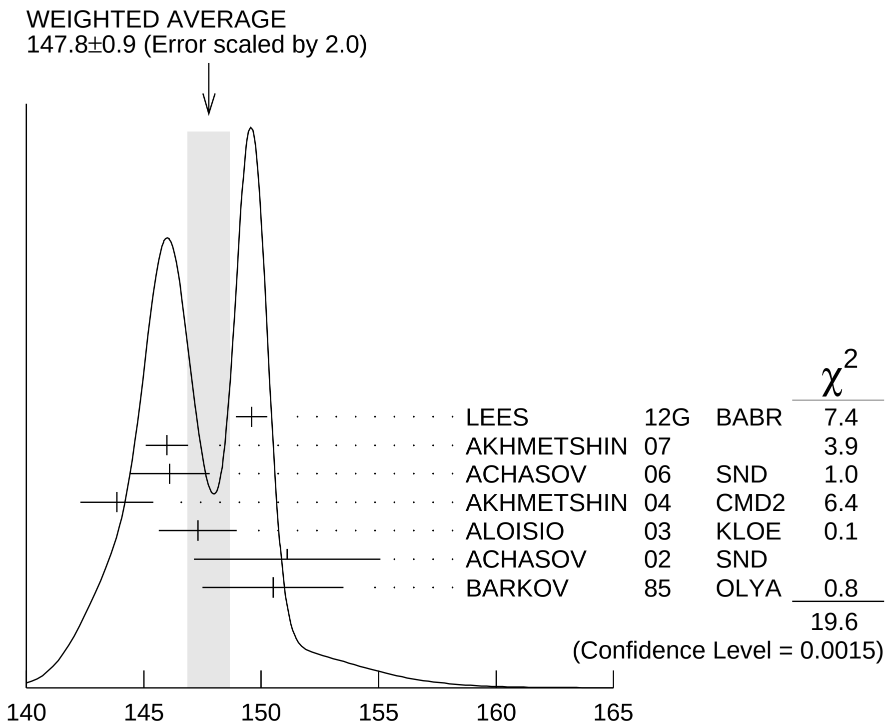
$\rho(770)$ WIDTH

We no longer list S-wave Breit-Wigner fits, or data with high combinatorial background.

NEUTRAL ONLY, e^+e^-

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	CHG	COMMENT
147.8 ±0.9 OUR AVERAGE		Error includes scale factor of 2.0. See the ideogram below.				
149.59±0.67		[1] LEES	12G	BABR		$e^+e^- \to \pi^+\pi^-\gamma$
145.98±0.75±0.50	900k	[2] AKHMETSHIN	07			$e^+e^- \to \pi^+\pi^-$
146.1 ±0.8 ±1.5	800k	[3,4] ACHASOV	06	SND		$e^+e^- \to \pi^+\pi^-$
143.85±1.33±0.80	114k	[5,6] AKHMETSHIN	04	CMD2		$e^+e^- \to \pi^+\pi^-$
147.3 ±1.5 ±0.7	1.98M	[7] ALOISIO	03	KLOE		1.02 $e^+e^- \to \pi^+\pi^-\pi^0$
151.1 ±2.6 ±3.0	500k	[7] ACHASOV	02	SND	0	1.02 $e^+e^- \to \pi^+\pi^-\pi^0$
150.5 ±3.0		[8] BARKOV	85	OLYA	0	$e^+e^- \to \pi^+\pi^-$
• • • We do not use the following data for averages, fits, limits, etc. • • •						
144.06±0.85		[9] BARTOS	17	RVUE		$e^+e^- \to \pi^+\pi^-$
144.56±0.80		[10] BARTOS	17A	RVUE		$e^+e^- \to \pi^+\pi^-$
143.9 ±1.3 ±1.1	1.98M	[11] ALOISIO	03	KLOE		1.02 $e^+e^- \to \pi^+\pi^-\pi^0$
147.4 ±1.5 ±0.7	1.98M	[12] ALOISIO	03	KLOE		1.02 $e^+e^- \to \pi^+\pi^-\pi^0$
149.8 ±2.2 ±2.0	500k	[13] ACHASOV	02	SND		1.02 $e^+e^- \to \pi^+\pi^-\pi^0$

147.9 ±1.5 ±7.5	[14] BENAYOUN	98	RVUE	$e^+e^- \to \pi^+\pi^-$, $\mu^+\mu^-$
153.5 ±1.3 ±4.6	[15] GARDNER	98	RVUE	0.28–0.92 $e^+e^- \to \pi^+\pi^-$
145.0 ±1.7	[16] O'CONNELL	97	RVUE	$e^+e^- \to \pi^+\pi^-$
142.5 ±3.5	[17] BERNICHA	94	RVUE	$e^+e^- \to \pi^+\pi^-$
138 ±1	[18] GESHKEN...	89	RVUE	$e^+e^- \to \pi^+\pi^-$



Neutral only, e^+e^-

CHARGED ONLY, τ DECAYS and e^+e^-

VALUE (MeV)	EVTS	DOCUMENT ID	TECN	CHG	COMMENT
149.1 ±0.8 OUR FIT					
149.1 ±0.8 OUR AVERAGE					
148.1 ±0.4 ±1.7	5.4M	[19,20] FUJIKAWA	08 BELL	±	$\tau^- \to \pi^-\pi^0\nu_\tau$
149.0 ±1.2		[20,21] SCHAEL	05C ALEP		$\tau^- \to \pi^-\pi^0\nu_\tau$
149.9 ±2.3 ±2.0	500k	[7] ACHASOV	02 SND	±	1.02 $e^+e^- \to \pi^+\pi^-\pi^0$
150.4 ±1.4 ±1.4	87k	[22,23] ANDERSON	00A CLE2		$\tau^- \to \pi^-\pi^0\nu_\tau$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
139.90±0.46		[24] BARTOS	17A RVUE		$\tau^- \to \pi^-\pi^0\nu_\tau$
143.7 ±1.3 ±1.2	1.98M	[7] ALOISIO	03 KLOE	±	1.02 $e^+e^- \to \pi^+\pi^-\pi^0$
142.9 ±1.3 ±1.4	1.98M	[12] ALOISIO	03 KLOE	−	1.02 $e^+e^- \to \pi^+\pi^-\pi^0$
144.7 ±1.4 ±1.2	1.98M	[12] ALOISIO	03 KLOE	+	1.02 $e^+e^- \to \pi^+\pi^-\pi^0$
150.2 ±2.0 $^{+0.7}_{-1.6}$		[25] SANZ-CILLERO	03 RVUE		$\tau^- \to \pi^-\pi^0\nu_\tau$
150.9 ±2.2 ±2.0	500k	[13] ACHASOV	02 SND		1.02 $e^+e^- \to \pi^+\pi^-\pi^0$

MIXED CHARGES, OTHER REACTIONS

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	CHG	COMMENT
149.5±1.3	600k	[26] ABELE	99E	CBAR	0±	0.0 $\overline{p}p \to \pi^+\pi^-\pi^0$

CHARGED ONLY, HADROPRODUCED

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	CHG	COMMENT
150.2± 2.4 OUR FIT						
150.2± 2.4 OUR AVERAGE						
152.8± 4.3		ABELE	97	CBAR		$\overline{p}n \to \pi^-\pi^0\pi^0$
155 ±11	2.9k	[27] CAPRARO	87	SPEC	−	200 π^- Cu $\to \pi^-\pi^0$ Cu
154 ±20	967	[27] CAPRARO	87	SPEC	−	200 π^- Pb $\to \pi^-\pi^0$ Pb
150 ± 5		HUSTON	86	SPEC	+	202 π^+ A $\to \pi^+\pi^0$ A
146 ±12	6.5k	[28] BYERLY	73	OSPK	−	5 $\pi^- p$
148.2± 4.1	9.6k	[29] PISUT	68	RVUE	−	1.7–3.2 $\pi^- p$, t <10
146 ±13	900	EISNER	67	HBC	−	4.2 $\pi^- p$, t <10
• • • We do not use the following data for averages, fits, limits, etc. • • •						
137.0± 0.4		[30] ABLIKIM	17	BES3		$J/\psi \to \gamma 3\pi$

NEUTRAL ONLY, PHOTOPRODUCED

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	COMMENT
151.7± 2.6 OUR AVERAGE					
155 ± 5 ± 2	63.5k	[31] ABRAMOWICZ	12	ZEUS	$e p \to e\pi^+\pi^- p$
146 ± 3 ±13	79k	[32] BREITWEG	98B	ZEUS	50–100 γp
150.9± 3.0		BARTALUCCI	78	CNTR	$\gamma p \to e^+e^- p$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
138 ± 3	79k	[33] BREITWEG	98B	ZEUS	50–100 γp
147 ±11		GLADDING	73	CNTR	2.9–4.7 γp
155 ±12	2430	BALLAM	72	HBC	4.7 γp
145 ±13	1930	BALLAM	72	HBC	2.8 γp
140 ± 5		ALVENSLEB...	70	CNTR	γA, t <0.01
146.1± 2.9	140k	BIGGS	70	CNTR	<4.1 γC $\to \pi^+\pi^-$ C
160 ±10		LANZEROTTI	68	CNTR	γp
130 ± 5	4000	ASBURY	67B	CNTR	$\gamma +$ Pb

NEUTRAL ONLY, OTHER REACTIONS

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	CHG	COMMENT
150.9± 1.7 OUR AVERAGE	Error includes scale factor of 1.1.					
122 ±20		BERTIN	97C	OBLX		0.0 $\overline{p}p \to \pi^+\pi^-\pi^0$
145.7± 5.3		WEIDENAUER	93	ASTE		$\overline{p}p \to \pi^+\pi^-\omega$
144.9± 3.7		DUBNICKA	89	RVUE		π form factor
148 ± 6		[34,35] BOHACIK	80	RVUE	0	
152 ± 9		[28] WICKLUND	78	ASPK	0	3,4,6 $\pi^\pm pN$
154 ± 2	76000	DEUTSCH...	76	HBC	0	16 $\pi^+ p$
157 ± 8	6800	RATCLIFF	72	ASPK	0	15 $\pi^- p$, t <0.3
143 ± 8	1700	REYNOLDS	69	HBC	0	2.26 $\pi^- p$
• • • We do not use the following data for averages, fits, limits, etc. • • •						
147.0± 2.5	600k	[36] ABELE	99E	CBAR	0	0.0 $\overline{p}p \to \pi^+\pi^-\pi^0$
146 ± 3	4943	[37] ADAMS	97	E665		470 $\mu p \to \mu XB$
$160.0^{+4.1}_{-4.0}$		[38] CHABAUD	83	ASPK	0	17 $\pi^- p$ polarized

155 $\pm$ 1		[39] HEYN	81	RVUE	0	π form factor
148.0 $\pm$ 1.3		[34,35] LANG	79	RVUE	0	
146 $\pm$14	4100	ENGLER	74	DBC	0	6 $\pi^+ n \rightarrow \pi^+\pi^- p$
143 $\pm$13		[35] ESTABROOKS	74	RVUE	0	17 $\pi^- p \rightarrow \pi^+\pi^- n$
160 $\pm$10	32000	[34] PROTOPOP...	73	HBC	0	7.1 $\pi^+ p$, $t <$0.4
145 $\pm$12	2250	[27] HYAMS	68	OSPK	0	11.2 $\pi^- p$
163 $\pm$15	13300	[40] PISUT	68	RVUE	0	1.7–3.2 $\pi^- p$, $t <$10

[1] Using the GOUNARIS 68 parametrization with the complex phase of the $\rho-\omega$ interference and leaving the masses and widths of the $\rho(1450)$, $\rho(1700)$, and $\rho(2150)$ resonances as free parameters of the fit.

[2] A combined fit of AKHMETSHIN 07, AULCHENKO 06, and AULCHENKO 05.

[3] Supersedes ACHASOV 05A.

[4] A fit of the SND data from 400 to 1000 MeV using parameters of the $\rho(1450)$ and $\rho(1700)$ from a fit of the data of BARKOV 85, BISELLO 89 and ANDERSON 00A.

[5] Using the GOUNARIS 68 parametrization with the complex phase of the ρ-ω interference.

[6] From a fit in the energy range 0.61 to 0.96 GeV. Update of AKHMETSHIN 02.

[7] Assuming $m_{\rho^+} = m_{\rho^-}$, $\Gamma_{\rho^+} = \Gamma_{\rho^-}$.

[8] From the GOUNARIS 68 parametrization of the pion form factor.

[9] Applies the Unitary & Analytic Model of the pion electromagnetic form factor of DUBNICKA 10 to analyze the data of LEES 12G and ABLIKIM 16C.

[10] Applies the Unitary & Analytic Model of the pion electromagnetic form factor of DUBNICKA 10 to analyze the data of ACHASOV 06, AKHMETSHIN 07, AUBERT 09AS, and AMBROSINO 11A.

[11] Assuming $m_{\rho^+} = m_{\rho^-} = m_{\rho^0}$, $\Gamma_{\rho^+} = \Gamma_{\rho^-} = \Gamma_{\rho^0}$.

[12] Without limitations on masses and widths.

[13] Assuming $m_{\rho^0} = m_{\rho^\pm}$, $g_{\rho^0 \pi\pi} = g_{\rho^\pm \pi\pi}$.

[14] Using the data of BARKOV 85 in the hidden local symmetry model.

[15] From the fit to $e^+ e^- \rightarrow \pi^+\pi^-$ data from the compilations of HEYN 81 and BARKOV 85, including the GOUNARIS 68 parametrization of the pion form factor.

[16] A fit of BARKOV 85 data assuming the direct $\omega\pi\pi$ coupling.

[17] Applying the S-matrix formalism to the BARKOV 85 data.

[18] Includes BARKOV 85 data. Model-dependent width definition.

[19] $|F_\pi(0)|^2$ fixed to 1.

[20] From the GOUNARIS 68 parametrization of the pion form factor.

[21] The error combines statistical and systematic uncertainties. Supersedes BARATE 97M.

[22] $\rho(1700)$ mass and width fixed at 1700 MeV and 235 MeV respectively.

[23] From the GOUNARIS 68 parametrization of the pion form factor. The second error is a model error taking into account different parametrizations of the pion form factor.

[24] Applies the Unitary & Analytic Model of the pion electromagnetic form factor of DUBNICKA 10 to analyze the data of FUJIKAWA 08.

[25] Using the data of BARATE 97M and the effective chiral Lagrangian.

[26] Assuming the equality of ρ^+ and ρ^- masses and widths.

[27] Width errors enlarged by us to $4\Gamma/\sqrt{N}$; see the note with the $K^*(892)$ mass.

[28] Phase shift analysis. Systematic errors added corresponding to spread of different fits.

[29] From fit of 3-parameter relativistic P-wave Breit-Wigner to total mass distribution. Includes BATON 68, MILLER 67B, ALFF-STEINBERGER 66, HAGOPIAN 66, HAGOPIAN 66B, JACOBS 66B, JAMES 66, WEST 66, BLIEDEN 65 and CARMONY 64.

[30] S-matrix pole at a fixed ρ meson mass of 775.49 MeV.

[31] Using the KUHN 90 parametrization of the pion form factor, neglecting $\rho-\omega$ interference.

[32] From the parametrization according to SOEDING 66.

[33] From the parametrization according to ROSS 66.

[34] From pole extrapolation.
[35] From phase shift analysis of GRAYER 74 data.
[36] Using relativistic Breit-Wigner and taking into account ρ-ω interference.
[37] Systematic errors not evaluated.
[38] From fit of 3-parameter relativistic Breit-Wigner to helicity-zero part of P-wave intensity. CHABAUD 83 includes data of GRAYER 74.
[39] HEYN 81 includes all spacelike and timelike F_π values until 1978.
[40] Includes MALAMUD 69, ARMENISE 68, BACON 67, HUWE 67, MILLER 67B, ALFF-STEINBERGER 66, HAGOPIAN 66, HAGOPIAN 66B, JACOBS 66B, JAMES 66, WEST 66, GOLDHABER 64, ABOLINS 63.

$\Gamma_{\rho(770)^0} - \Gamma_{\rho(770)^\pm}$

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	COMMENT
0.3 ±1.3 OUR AVERAGE		Error includes scale factor of 1.4.			
−0.2 ±1.0		[1] SCHAEL	05C	ALEP	$\tau^- \to \pi^- \pi^0 \nu_\tau$
3.6 ±1.8 ±1.7	1.98M	[2] ALOISIO	03	KLOE	1.02 $e^+ e^- \to \pi^+ \pi^- \pi^0$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
4.66±0.85		[3] BARTOS	17A	RVUE	$e^+ e^- \to \pi^+ \pi^-$, $\tau^- \to \pi^- \pi^0 \nu_\tau$

$\Gamma_{\rho(770)^+} - \Gamma_{\rho(770)^-}$

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
1.8±2.0±0.5	1.98M	[4] ALOISIO	03	KLOE	1.02 $e^+ e^- \to \pi^+ \pi^- \pi^0$

[1] From the combined fit of the τ^- data from ANDERSON 00A and SCHAEL 05C and $e^+ e^-$ data from the compilation of BARKOV 85, AKHMETSHIN 04, and ALOISIO 05. Supersedes BARATE 97M.
[2] Assuming $m_{\rho^+} = m_{\rho^-}$, $\Gamma_{\rho^+} = \Gamma_{\rho^-}$.
[3] Applies the Unitary & Analytic Model of the pion electromagnetic form factor of DUBNICKA 10 to analyze the data of ACHASOV 06, AKHMETSHIN 07, AUBERT 09AS, AMBROSINO 11A, and FUJIKAWA 08.
[4] Without limitations on masses and widths.

$\rho(770)$ DECAY MODES

	Mode	Fraction (Γ_i/Γ)	Scale factor/ Confidence level
Γ_1	$\pi\pi$	$\sim$ 100 %	
	$\rho(770)^\pm$ decays		
Γ_2	$\pi^\pm \pi^0$	$\sim$ 100 %	
Γ_3	$\pi^\pm \gamma$	(4.5 ±0.5) $\times 10^{-4}$	S=2.2
Γ_4	$\pi^\pm \eta$	< 6 $\times 10^{-3}$	CL=84%
Γ_5	$\pi^\pm \pi^+ \pi^- \pi^0$	< 2.0 $\times 10^{-3}$	CL=84%
	$\rho(770)^0$ decays		
Γ_6	$\pi^+ \pi^-$	$\sim$ 100 %	
Γ_7	$\pi^+ \pi^- \gamma$	(9.9 ±1.6) $\times 10^{-3}$	
Γ_8	$\pi^0 \gamma$	(4.7 ±0.6) $\times 10^{-4}$	S=1.4

Γ_9	$\eta\gamma$		$(3.00\pm0.21)\times10^{-4}$	
Γ_{10}	$\pi^0\pi^0\gamma$		$(4.5\pm0.8)\times10^{-5}$	
Γ_{11}	$\mu^+\mu^-$	[a]	$(4.55\pm0.28)\times10^{-5}$	
Γ_{12}	e^+e^-	[a]	$(4.72\pm0.05)\times10^{-5}$	
Γ_{13}	$\pi^+\pi^-\pi^0$		$(1.01^{+0.54}_{-0.36}\pm0.34)\times10^{-4}$	
Γ_{14}	$\pi^+\pi^-\pi^+\pi^-$		$(1.8\pm0.9)\times10^{-5}$	
Γ_{15}	$\pi^+\pi^-\pi^0\pi^0$		$(1.6\pm0.8)\times10^{-5}$	
Γ_{16}	$\pi^0e^+e^-$		$<1.2\times10^{-5}$	CL=90%
Γ_{17}	ηe^+e^-			

[a] The $\omega\rho$ interference is then due to $\omega\rho$ mixing only, and is expected to be small. If $e\mu$ universality holds, $\Gamma(\rho^0\to\mu^+\mu^-)=\Gamma(\rho^0\to e^+e^-)\times0.99785$.

CONSTRAINED FIT INFORMATION

An overall fit to the total width and a partial width uses 10 measurements and one constraint to determine 3 parameters. The overall fit has a $\chi^2=10.7$ for 8 degrees of freedom.

The following *off-diagonal* array elements are the correlation coefficients $\langle\delta p_i\delta p_j\rangle/(\delta p_i\cdot\delta p_j)$, in percent, from the fit to parameters p_i, including the branching fractions, $x_i\equiv\Gamma_i/\Gamma_{total}$. The fit constrains the x_i whose labels appear in this array to sum to one.

x_3	−100	
Γ	15	−15
	x_2	x_3

	Mode	Rate (MeV)	Scale factor
Γ_2	$\pi^\pm\pi^0$	150.2 ± 2.4	
Γ_3	$\pi^\pm\gamma$	0.068 ± 0.007	2.3

CONSTRAINED FIT INFORMATION

An overall fit to the total width, a partial width, and 7 branching ratios uses 22 measurements and one constraint to determine 9 parameters. The overall fit has a $\chi^2 = 9.5$ for 14 degrees of freedom.

The following *off-diagonal* array elements are the correlation coefficients $\left\langle\delta p_i \delta p_j\right\rangle/(\delta p_i \cdot \delta p_j)$, in percent, from the fit to parameters p_i, including the branching fractions, $x_i \equiv \Gamma_i/\Gamma_{total}$. The fit constrains the x_i whose labels appear in this array to sum to one.

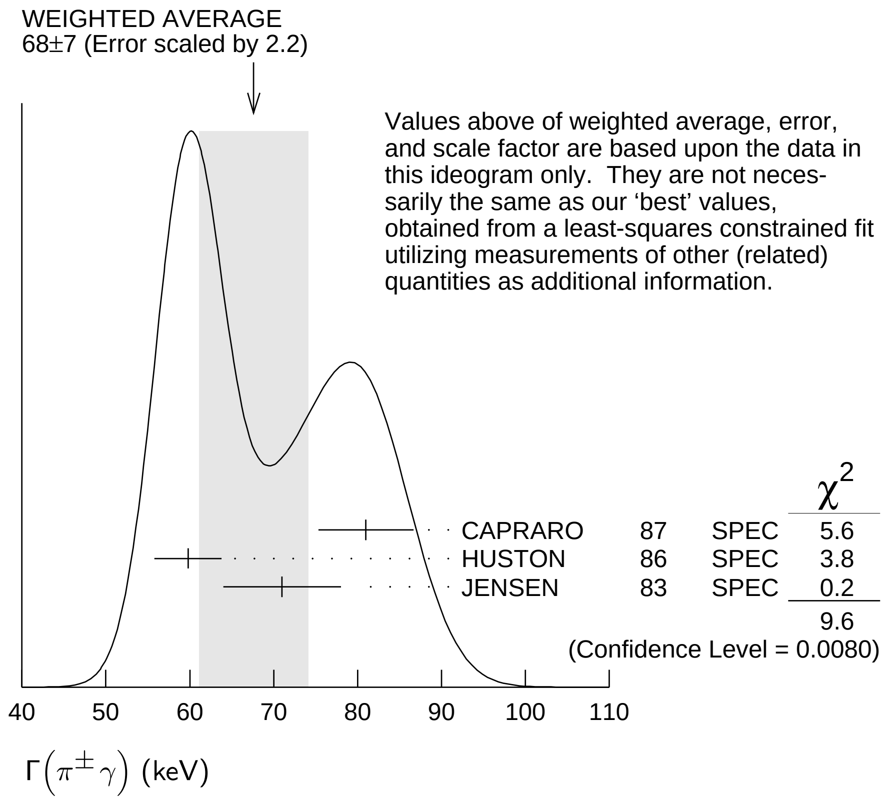
x_7	−100							
x_8	−4	0						
x_9	−1	0	1					
x_{10}	−1	0	0	0				
x_{11}	2	−3	0	0	0			
x_{12}	0	0	−8	−9	0	0		
x_{14}	−1	0	0	0	0	0	0	
Γ	0	0	4	5	0	0	−54	0
	x_6	x_7	x_8	x_9	x_{10}	x_{11}	x_{12}	x_{14}

	Mode		Rate (MeV)	Scale factor
Γ_6	$\pi^+\pi^-$		147.5 ±0.9	
Γ_7	$\pi^+\pi^-\gamma$		1.48 ±0.24	
Γ_8	$\pi^0\gamma$		0.070 ±0.009	1.4
Γ_9	$\eta\gamma$		0.0447 ±0.0032	
Γ_{10}	$\pi^0\pi^0\gamma$		0.0066 ±0.0012	
Γ_{11}	$\mu^+\mu^-$	[a]	0.0068 ±0.0004	
Γ_{12}	e^+e^-	[a]	0.00704±0.00006	
Γ_{14}	$\pi^+\pi^-\pi^+\pi^-$		0.0027 ±0.0014	

ρ(770) PARTIAL WIDTHS

$\Gamma(\pi^\pm\gamma)$ Γ_3

VALUE (keV)	*DOCUMENT ID*		*TECN*	*CHG*	*COMMENT*
68 ±7 OUR FIT Error includes scale factor of 2.3.					
68 ±7 OUR AVERAGE Error includes scale factor of 2.2. See the ideogram below.					
81 ±4 ±4	CAPRARO	87	SPEC	−	200 π^- A → $\pi^-\pi^0$ A
59.8±4.0	HUSTON	86	SPEC	+	202 π^+ A → $\pi^+\pi^0$ A
71 ±7	JENSEN	83	SPEC	−	156–260 π^- A → $\pi^-\pi^0$ A



$\Gamma(e^+e^-)$ Γ_{12}

VALUE (keV)	EVTS	DOCUMENT ID		TECN	COMMENT
7.04 ±0.06 OUR FIT					
7.04 ±0.06 OUR AVERAGE					
7.048±0.057±0.050	900k	[1] AKHMETSHIN	07		$e^+e^- \to \pi^+\pi^-$
7.06 ±0.11 ±0.05	114k	[2,3] AKHMETSHIN	04	CMD2	$e^+e^- \to \pi^+\pi^-$
6.77 ±0.10 ±0.30		BARKOV	85	OLYA	$e^+e^- \to \pi^+\pi^-$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
7.12 ±0.02 ±0.11	800k	[4] ACHASOV	06	SND	$e^+e^- \to \pi^+\pi^-$
6.3 ±0.1		[5] BENAYOUN	98	RVUE	$e^+e^- \to \pi^+\pi^-$, $\mu^+\mu^-$

$\Gamma(\pi^0\gamma)$ Γ_8

VALUE (keV)	EVTS	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
77±17±11	36500	[6] ACHASOV	03	SND	0.60–0.97 $e^+e^- \to \pi^0\gamma$
121±31		DOLINSKY	89	ND	$e^+e^- \to \pi^0\gamma$

$\Gamma(\eta\gamma)$ Γ_9

VALUE (keV)	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
62±17	[7] DOLINSKY	89	ND	$e^+e^- \to \eta\gamma$

$\Gamma(\pi^+\pi^-\pi^+\pi^-)$ Γ_{14}

VALUE (keV)	EVTS	DOCUMENT ID	TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
$2.8\pm1.4\pm0.5$	153	AKHMETSHIN 00	CMD2	0.6–0.97 $e^+e^- \to \pi^+\pi^-\pi^+\pi^-$

[1] A combined fit of AKHMETSHIN 07, AULCHENKO 06, and AULCHENKO 05.
[2] Using the GOUNARIS 68 parametrization with the complex phase of the ρ-ω interference.
[3] From a fit in the energy range 0.61 to 0.96 GeV. Update of AKHMETSHIN 02.
[4] Supersedes ACHASOV 05A.
[5] Using the data of BARKOV 85 in the hidden local symmetry model.
[6] Using Γ_{total}= 147.9 ± 1.3 MeV and B($\rho \to \pi^0\gamma$) from ACHASOV 03.
[7] Solution corresponding to constructive ω-ρ interference.

$\rho(770)$ $\Gamma(e^+e^-)\Gamma(i)/\Gamma^2(\text{total})$

$\Gamma(e^+e^-)/\Gamma_{total} \times \Gamma(\pi^+\pi^-)/\Gamma_{total}$ $\Gamma_{12}/\Gamma \times \Gamma_6/\Gamma$

VALUE (units 10^{-5})	EVTS	DOCUMENT ID	TECN	COMMENT
4.876±0.023±0.064	800k	[1,2] ACHASOV 06	SND	$e^+e^- \to \pi^+\pi^-$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
4.72 ± 0.02		[3] BENAYOUN 10	RVUE	0.4–1.05 e^+e^-

[1] Supersedes ACHASOV 05A.
[2] A fit of the SND data from 400 to 1000 MeV using parameters of the $\rho(1450)$ and $\rho(1700)$ from a fit of the data of BARKOV 85, BISELLO 89 and ANDERSON 00A.
[3] A simultaneous fit of $e^+e^- \to \pi^+\pi^-$, $\pi^+\pi^-\pi^0$, $\pi^0\gamma$, $\eta\gamma$ data.

$\Gamma(e^+e^-)/\Gamma_{total} \times \Gamma(\eta\gamma)/\Gamma_{total}$ $\Gamma_{12}/\Gamma \times \Gamma_9/\Gamma$

VALUE (units 10^{-8})	EVTS	DOCUMENT ID	TECN	COMMENT
1.42±0.10 OUR FIT				
1.45±0.12 OUR AVERAGE				
$1.32\pm0.14\pm0.08$	33k	[1] ACHASOV 07B	SND	0.6–1.38 $e^+e^- \to \eta\gamma$
$1.50\pm0.65\pm0.09$	17.4k	[2] AKHMETSHIN 05	CMD2	0.60-1.38 $e^+e^- \to \eta\gamma$
$1.61\pm0.20\pm0.11$	23k	[3,4] AKHMETSHIN 01B	CMD2	$e^+e^- \to \eta\gamma$
1.85 ± 0.49		[5] DOLINSKY 89	ND	$e^+e^- \to \eta\gamma$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
1.05 ± 0.02		[6] BENAYOUN 10	RVUE	0.4–1.05 e^+e^-

[1] From a combined fit of $\sigma(e^+e^- \to \eta\gamma)$ with $\eta \to 3\pi^0$ and $\eta \to \pi^+\pi^-\pi^0$, and fixing B($\eta \to 3\pi^0$) / B($\eta \to \pi^+\pi^-\pi^0$) = 1.44 ± 0.04. Recalculated by us from the cross section at the peak. Supersedes ACHASOV 00D and ACHASOV 06A.
[2] From the $\eta \to 2\gamma$ decay and using B($\eta \to \gamma\gamma$)= 39.43 ± 0.26%.
[3] From the $\eta \to 3\pi^0$ decay and using B($\eta \to 3\pi^0$)= (32.24 ± 0.29) × 10^{-2}.
[4] The combined fit from 600 to 1380 MeV taking into account $\rho(770)$, $\omega(782)$, $\phi(1020)$, and $\rho(1450)$ (mass and width fixed at 1450 MeV and 310 MeV respectively).
[5] Recalculated by us from the cross section in the peak.
[6] A simultaneous fit of $e^+e^- \to \pi^+\pi^-$, $\pi^+\pi^-\pi^0$, $\pi^0\gamma$, $\eta\gamma$ data.

$\Gamma(e^+e^-)/\Gamma_{total} \times \Gamma(\pi^0\gamma)/\Gamma_{total}$ — $\Gamma_{12}/\Gamma \times \Gamma_8/\Gamma$

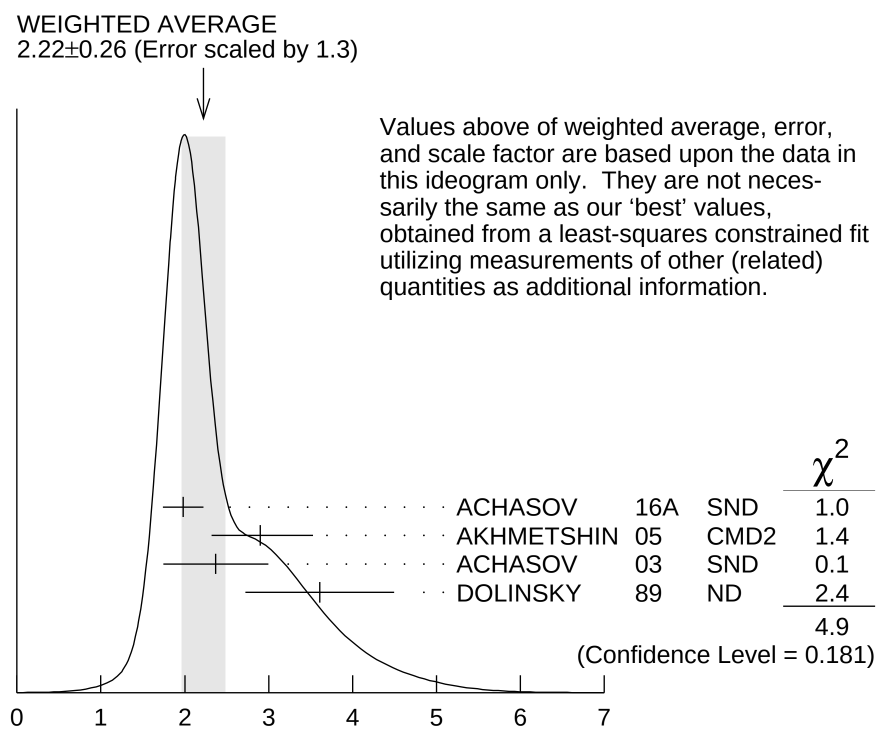
VALUE (units 10^{-8})	EVTS	DOCUMENT ID		TECN	COMMENT
2.22 ±0.29 OUR FIT Error includes scale factor of 1.4.					
2.22 ±0.26 OUR AVERAGE Error includes scale factor of 1.3. See the ideogram below.					
1.98 ±0.22 ±0.10		[1] ACHASOV	16A	SND	0.60-1.38 $e^+e^- \rightarrow \pi^0\gamma$
2.90 $^{+0.60}_{-0.55}$ ±0.18	18k	AKHMETSHIN	05	CMD2	0.60-1.38 $e^+e^- \rightarrow \pi^0\gamma$
2.37 ±0.53 ±0.33	36k	[2] ACHASOV	03	SND	0.60–0.97 $e^+e^- \rightarrow \pi^0\gamma$
3.61 ±0.74 ±0.49	10k	[3] DOLINSKY	89	ND	$e^+e^- \rightarrow \pi^0\gamma$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
1.875±0.026		[4] BENAYOUN	10	RVUE	0.4–1.05 e^+e^-

[1] From the VMD model with the prho(770), $\omega(782)$, $\phi(1020)$ resonances, and an additional resonance describing the total contribution of the $\rho(1450)$ and $\omega(1420)$ states. Supersedes ACHASOV 03.

[2] Using $\sigma_{\phi \rightarrow \pi^0\gamma}$ from ACHASOV 00 and m_ρ= 775.97 MeV in the model with the energy-independent phase of ρ-ω interference equal to $(-10.2 \pm 7.0)^\circ$.

[3] Recalculated by us from the cross section in the peak.

[4] A simultaneous fit of $e^+e^- \rightarrow \pi^+\pi^-$, $\pi^+\pi^-\pi^0$, $\pi^0\gamma$, $\eta\gamma$ data.



$\Gamma(e^+e^-)/\Gamma_{total} \times \Gamma(\pi^0\gamma)/\Gamma_{total}$ (units 10^{-8})

$\Gamma(e^+e^-)/\Gamma_{total} \times \Gamma(\pi^+\pi^-\pi^0)/\Gamma_{total}$ — $\Gamma_{12}/\Gamma \times \Gamma_{13}/\Gamma$

VALUE (units 10^{-9})	EVTS	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.903±0.076		[1] BENAYOUN	10	RVUE	0.4–1.05 e^+e^-
4.58 $^{+2.46}_{-1.64}$ ±1.56	1.2M	[2] ACHASOV	03D	RVUE	0.44–2.00 $e^+e^- \rightarrow \pi^+\pi^-\pi^0$

[1] A simultaneous fit of $e^+e^- \rightarrow \pi^+\pi^-$, $\pi^+\pi^-\pi^0$, $\pi^0\gamma$, $\eta\gamma$ data.
[2] Statistical significance is less than $3\,\sigma$.

ρ(770) BRANCHING RATIOS

$\Gamma(\pi^\pm\eta)/\Gamma(\pi\pi)$ — Γ_4/Γ_1

VALUE (units 10^{-4})	CL%	DOCUMENT ID		TECN	CHG	COMMENT
<60	84	FERBEL	66	HBC	$\pm$	$\pi^\pm p$ above 2.5

$\Gamma(\pi^\pm\pi^+\pi^-\pi^0)/\Gamma(\pi\pi)$ — Γ_5/Γ_1

VALUE (units 10^{-4})	CL%	DOCUMENT ID		TECN	CHG	COMMENT
<20	84	FERBEL	66	HBC	$\pm$	$\pi^\pm p$ above 2.5
• • • We do not use the following data for averages, fits, limits, etc. • • •						
35±40		JAMES	66	HBC	+	2.1 $\pi^+ p$

$\Gamma(\mu^+\mu^-)/\Gamma(\pi^+\pi^-)$ — Γ_{11}/Γ_6

VALUE (units 10^{-5})	DOCUMENT ID		TECN	COMMENT
4.60±0.28 OUR FIT				
4.6 ±0.2 ±0.2	ANTIPOV	89	SIGM	π^- Cu $\rightarrow \mu^+\mu^-\pi^-$ Cu
• • • We do not use the following data for averages, fits, limits, etc. • • •				
$8.2\ ^{+1.6}_{-3.6}$	[1] ROTHWELL	69	CNTR	Photoproduction
5.6 ±1.5	[2] WEHMANN	69	OSPK	12 π^- C, Fe
$9.7\ ^{+3.1}_{-3.3}$	[3] HYAMS	67	OSPK	11 π^- Li, H

$\Gamma(e^+e^-)/\Gamma(\pi\pi)$ — Γ_{12}/Γ_1

VALUE (units 10^{-4})	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.40±0.05	[4] BENAKSAS	72	OSPK	$e^+e^- \rightarrow \pi^+\pi^-$

$\Gamma(\eta\gamma)/\Gamma_{total}$ — Γ_9/Γ

VALUE (units 10^{-4})	EVTS	DOCUMENT ID		TECN	CHG	COMMENT
3.00±0.21 OUR FIT						
2.90±0.32 OUR AVERAGE						
2.79±0.34±0.03	33k	[5] ACHASOV	07B	SND		0.6–1.38 $e^+e^- \rightarrow \eta\gamma$
3.6 ±0.9		[6] ANDREWS	77	CNTR	0	6.7–10 γCu
• • • We do not use the following data for averages, fits, limits, etc. • • •						
3.21±1.39±0.20	17.4k	[7,8] AKHMETSHIN	05	CMD2		0.60-1.38 $e^+e^- \rightarrow \eta\gamma$
3.39±0.42±0.23		[6,9,10] AKHMETSHIN	01B	CMD2		$e^+e^- \rightarrow \eta\gamma$
$1.9\ ^{+0.6}_{-0.8}$		[11] BENAYOUN	96	RVUE		0.54-1.04 $e^+e^- \rightarrow \eta\gamma$
4.0 ±1.1		[6,8] DOLINSKY	89	ND		$e^+e^- \rightarrow \eta\gamma$

$\Gamma(\pi^+\pi^-\pi^+\pi^-)/\Gamma_{total}$ — Γ_{14}/Γ

VALUE (units 10^{-5})	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
1.8±0.9 OUR FIT						
1.8±0.9±0.3		153	AKHMETSHIN	00	CMD2	0.6–0.97 $e^+e^- \to \pi^+\pi^-\pi^+\pi^-$
• • • We do not use the following data for averages, fits, limits, etc. • • •						
<20	90		KURDADZE	88	OLYA	$e^+e^- \to \pi^+\pi^-\pi^+\pi^-$

$\Gamma(\pi^+\pi^-\pi^+\pi^-)/\Gamma(\pi\pi)$ — Γ_{14}/Γ_1

VALUE (units 10^{-4})	CL%	DOCUMENT ID		TECN	CHG	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •						
<15	90	ERBE	69	HBC	0	2.5–5.8 γp
<20		CHUNG	68	HBC	0	3.2,4.2 $\pi^- p$
<20	90	HUSON	68	HLBC	0	16.0 $\pi^- p$
<80		JAMES	66	HBC	0	2.1 $\pi^+ p$

$\Gamma(\pi^+\pi^-\pi^0)/\Gamma_{total}$ — Γ_{13}/Γ

VALUE (units 10^{-4})	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •						
$1.01^{+0.54}_{-0.36}\pm0.34$		1.2M	[12] ACHASOV	03D	RVUE	0.44–2.00 $e^+e^- \to \pi^+\pi^-\pi^0$
<1.2	90		VASSERMAN	88B	ND	$e^+e^- \to \pi^+\pi^-\pi^0$

$\Gamma(\pi^+\pi^-\pi^0)/\Gamma(\pi\pi)$ — Γ_{13}/Γ_1

VALUE	CL%	DOCUMENT ID		TECN	CHG	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •						
∼ 0.01		BRAMON	86	RVUE	0	$J/\psi \to \omega\pi^0$
<0.01	84	[13] ABRAMS	71	HBC	0	3.7 $\pi^+ p$

$\Gamma(\pi^+\pi^-\pi^0\pi^0)/\Gamma_{total}$ — Γ_{15}/Γ

VALUE (units 10^{-5})	CL%	DOCUMENT ID		TECN	COMMENT
1.60±0.74±0.18		[14] ACHASOV	09A	SND	$e^+e^- \to \pi^+\pi^-\pi^0\pi^0$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
< 4	90	AULCHENKO	87C	ND	$e^+e^- \to \pi^+\pi^-\pi^0\pi^0$
<20	90	KURDADZE	86	OLYA	$e^+e^- \to \pi^+\pi^-\pi^0\pi^0$

$\Gamma(\pi^+\pi^-\gamma)/\Gamma_{total}$ — Γ_7/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
0.0099±0.0016 OUR FIT					
0.0099±0.0016		[15] DOLINSKY	91	ND	$e^+e^- \to \pi^+\pi^-\gamma$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.0111±0.0014		[16] VASSERMAN	88	ND	$e^+e^- \to \pi^+\pi^-\gamma$
<0.005	90	[17] VASSERMAN	88	ND	$e^+e^- \to \pi^+\pi^-\gamma$

$\Gamma(\pi^0\gamma)/\Gamma_{total}$ — Γ_8/Γ

VALUE (units 10^{-4})	EVTS	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
4.20 ± 0.52		[18] ACHASOV	16A	SND	0.60–1.38 $e^+e^-\to\pi^0\gamma$
$6.21^{+1.28}_{-1.18}\pm0.39$	18k	[19,20] AKHMETSHIN	05	CMD2	0.60-1.38 $e^+e^-\to\pi^0\gamma$
$5.22\pm1.17\pm0.75$	36k	[20,21] ACHASOV	03	SND	0.60–0.97 $e^+e^-\to\pi^0\gamma$
6.8 ± 1.7		[22] BENAYOUN	96	RVUE	0.54-1.04 $e^+e^-\to\pi^0\gamma$
7.9 ± 2.0		[20] DOLINSKY	89	ND	$e^+e^-\to\pi^0\gamma$

$\Gamma(\pi^0e^+e^-)/\Gamma_{total}$ — Γ_{16}/Γ

VALUE (units 10^{-5})	CL%	DOCUMENT ID		TECN	COMMENT
<1.2	90	ACHASOV	08	SND	0.36–0.97 $e^+e^-\to\pi^0e^+e^-$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<1.6		AKHMETSHIN	05A	CMD2	0.72-0.84 e^+e^-

$\Gamma(\eta e^+e^-)/\Gamma_{total}$ — Γ_{17}/Γ

VALUE (units 10^{-5})	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
<0.7	AKHMETSHIN	05A	CMD2	0.72-0.84 e^+e^-

$\Gamma(\pi^0\pi^0\gamma)/\Gamma_{total}$ — Γ_{10}/Γ

VALUE (units 10^{-5})	EVTS	DOCUMENT ID		TECN	COMMENT
4.5±0.8 OUR FIT					
$4.5^{+0.9}_{-0.8}$ OUR AVERAGE					
$5.2^{+1.5}_{-1.3}\pm0.6$	190	[23] AKHMETSHIN	04B	CMD2	0.6–0.97 $e^+e^-\to\pi^0\pi^0\gamma$
$4.1^{+1.0}_{-0.9}\pm0.3$	295	[24] ACHASOV	02F	SND	0.36–0.97 $e^+e^-\to\pi^0\pi^0\gamma$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$4.8^{+3.4}_{-1.8}\pm0.5$	63	[25] ACHASOV	00G	SND	$e^+e^-\to\pi^0\pi^0\gamma$

[1] Possibly large ρ-ω interference leads us to increase the minus error.

[2] Result contains 11 ± 11% correction using SU(3) for central value. The error on the correction takes account of possible ρ-ω interference and the upper limit agrees with the upper limit of $\omega\to\mu^+\mu^-$ from this experiment.

[3] HYAMS 67's mass resolution is 20 MeV. The ω region was excluded.

[4] The ρ' contribution is not taken into account.

[5] ACHASOV 07B reports $[\Gamma(\rho(770)\to\eta\gamma)/\Gamma_{total}]\times[B(\rho(770)\to e^+e^-)] = (1.32\pm0.14\pm0.08)\times10^{-8}$ which we divide by our best value $B(\rho(770)\to e^+e^-) = (4.72\pm0.05)\times10^{-5}$. Our first error is their experiment's error and our second error is the systematic error from using our best value. Supersedes ACHASOV 00D and ACHASOV 06A.

[6] Solution corresponding to constructive ω-ρ interference.

[7] Using $B(\rho\to e^+e^-) = (4.67\pm0.09)\times10^{-5}$ and $B(\eta\to\gamma\gamma) = 39.43\pm0.26\%$.

[8] Not independent of the corresponding $\Gamma(e^+e^-)\times\Gamma(\eta\gamma)/\Gamma^2_{total}$.

[9] The combined fit from 600 to 1380 MeV taking into account $\rho(770)$, $\omega(782)$, $\phi(1020)$, and $\rho(1450)$ (mass and width fixed at 1450 MeV and 310 MeV respectively).
[10] Using B($\rho \to e^+e^-$) = $(4.75 \pm 0.10) \times 10^{-5}$ from AKHMETSHIN 02 and B($\eta \to 3\pi^0$) = $(32.24 \pm 0.29) \times 10^{-2}$.
[11] Reanalysis of DRUZHININ 84, DOLINSKY 89, and DOLINSKY 91 taking into account a triangle anomaly contribution. Constructive ρ-ω interference solution.
[12] Statistical significance is less than 3σ.
[13] Model dependent, assumes I = 1, 2, or 3 for the 3π system.
[14] Assuming no interference between the ρ and ω contributions.
[15] Bremsstrahlung from a decay pion and for photon energy above 50 MeV.
[16] Superseded by DOLINSKY 91.
[17] Structure radiation due to quark rearrangement in the decay.
[18] Using B($\rho \to e^+e^-$) from PDG 15. Supersedes ACHASOV 03.
[19] Using B($\rho \to e^+e^-$) = $(4.67 \pm 0.09) \times 10^{-5}$.
[20] Not independent of the corresponding $\Gamma(e^+e^-) \times \Gamma(\pi^0\gamma)/\Gamma^2_{\text{total}}$.
[21] Using B($\rho \to e^+e^-$) = $(4.54 \pm 0.10) \times 10^{-5}$.
[22] Reanalysis of DRUZHININ 84, DOLINSKY 89, and DOLINSKY 91 taking into account a triangle anomaly contribution.
[23] This branching ratio includes the conventional VMD mechanism $\rho \to \omega\pi^0$, $\omega \to \pi^0\gamma$, and the new decay mode $\rho \to f_0(500)\gamma$, $f_0(500) \to \pi^0\pi^0$ with a branching ratio $(2.0^{+1.1}_{-0.9} \pm 0.3) \times 10^{-5}$ differing from zero by 2.0 standard deviations.
[24] This branching ratio includes the conventional VMD mechanism $\rho \to \omega\pi^0$, $\omega \to \pi^0\gamma$ and the new decay mode $\rho \to f_0(500)\gamma$, $f_0(500) \to \pi^0\pi^0$ with a branching ratio $(1.9^{+0.9}_{-0.8} \pm 0.4) \times 10^{-5}$ differing from zero by 2.4 standard deviations. Supersedes ACHASOV 00G.
[25] Superseded by ACHASOV 02F.

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