# $\rho(770)$

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

**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 | $e^+e^- \to \pi^+\pi^-$ |

[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 $\rho$-$\omega$ 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.

## CHARGED ONLY, $\tau$ 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 | [1,2] FUJIKAWA | 08 | BELL | ± | $\tau^- \rightarrow \pi^-\pi^0\nu_\tau$ |
| 775.5 ±0.7 | | [2,3] SCHAEL | 05C | ALEP | | $\tau^- \rightarrow \pi^-\pi^0\nu_\tau$ |
| 775.5 ±0.5 ±0.4 | 1.98M | [4] ALOISIO | 03 | KLOE | | 1.02 $e^+e^- \rightarrow \pi^+\pi^-\pi^0$ |
| 775.1 ±1.1 ±0.5 | 87k | [5,6] ANDERSON | 00A | CLE2 | | $\tau^- \rightarrow \pi^-\pi^0\nu_\tau$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | | |
| 761.60±0.95 | | [7] BARTOS | 17A | RVUE | | $\tau^- \rightarrow \pi^-\pi^0\nu_\tau$ |
| 774.8 ±0.6 ±0.4 | 1.98M | [8] ALOISIO | 03 | KLOE | − | 1.02 $e^+e^- \rightarrow \pi^+\pi^-\pi^0$ |
| 776.3 ±0.6 ±0.7 | 1.98M | [8] ALOISIO | 03 | KLOE | + | 1.02 $e^+e^- \rightarrow \pi^+\pi^-\pi^0$ |
| 773.9 ±2.0 $^{+0.3}_{-1.0}$ | | [9] SANZ-CILLERO | 03 | RVUE | | $\tau^- \rightarrow \pi^-\pi^0\nu_\tau$ |
| 774.5 ±0.7 ±1.5 | 500k | [4] ACHASOV | 02 | SND | ± | 1.02 $e^+e^- \rightarrow \pi^+\pi^-\pi^0$ |
| 775.1 ±0.5 | | [10] PICH | 01 | RVUE | | $\tau^- \rightarrow \pi^-\pi^0\nu_\tau$ |

[1] $|F_\pi(0)|^2$ fixed to 1.
[2] From the GOUNARIS 68 parametrization of the pion form factor.
[3] The error combines statistical and systematic uncertainties. Supersedes BARATE 97M.
[4] Assuming $m_{\rho^+} = m_{\rho^-}$, $\Gamma_{\rho^+} = \Gamma_{\rho^-}$.
[5] $\rho(1700)$ mass and width fixed at 1700 MeV and 235 MeV respectively.
[6] 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.
[7] Applies the Unitary & Analytic Model of the pion electromagnetic form factor of DUBNICKA 10 to analyze the data of FUJIKAWA 08.
[8] Without limitations on masses and widths.
[9] Using the data of BARATE 97M and the effective chiral Lagrangian.
[10] From a fit of the model-independent parameterization of the pion form factor to the data of BARATE 97M.

## MIXED CHARGES, OTHER REACTIONS

| VALUE (MeV) | EVTS | DOCUMENT ID | | TECN | CHG | COMMENT |
|---|---|---|---|---|---|---|
| **763.0±0.3±1.2** | 600k | [1] ABELE | 99E | CBAR | 0± | 0.0 $\overline{p}p \rightarrow \pi^+\pi^-\pi^0$ |

[1] Assuming the equality of $\rho^+$ and $\rho^-$ masses and widths.

## 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 $pp$ |
| 767 ±3 | 2935 | [1] CAPRARO | 87 | SPEC | − | 200 $\pi^-$ Cu $\to \pi^-\pi^0$ Cu |
| 761 ±5 | 967 | [1] CAPRARO | 87 | SPEC | − | 200 $\pi^-$ Pb $\to \pi^-\pi^0$ Pb |
| 771 ±4 | | HUSTON | 86 | SPEC | + | 202 $\pi^+$ A $\to \pi^+\pi^0$ A |
| 766 ±7 | 6500 | [2] BYERLY | 73 | OSPK | − | 5 $\pi^- p$ |
| 766.8±1.5 | 9650 | [3] PISUT | 68 | RVUE | − | 1.7–3.2 $\pi^- p$, $t$ <10 |
| 767 ±6 | 900 | [1] EISNER | 67 | HBC | − | 4.2 $\pi^- p$, $t$ <10 |

[1] Mass errors enlarged by us to $\Gamma/\sqrt{N}$; see the note with the $K^*(892)$ mass.
[2] Phase shift analysis. Systematic errors added corresponding to spread of different fits.
[3] 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.

## NEUTRAL ONLY, PHOTOPRODUCED

| VALUE (MeV) | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **769.0± 1.0 OUR AVERAGE** | | | | | |
| 771 ± 2 $^{+2}_{-1}$ | 63.5k | [1] ABRAMOWICZ | 12 | ZEUS | $ep \to e\pi^+\pi^- p$ |
| 770 ± 2 ±1 | 79k | [2] BREITWEG | 98B | ZEUS | 50–100 $\gamma p$ |
| 767.6± 2.7 | | BARTALUCCI | 78 | CNTR | $\gamma p \to e^+e^- p$ |
| 775 ± 5 | | GLADDING | 73 | CNTR | 2.9–4.7 $\gamma p$ |
| 767 ± 4 | 1930 | BALLAM | 72 | HBC | 2.8 $\gamma p$ |
| 770 ± 4 | 2430 | BALLAM | 72 | HBC | 4.7 $\gamma p$ |
| 765 ±10 | | ALVENSLEB... | 70 | CNTR | $\gamma$A, $t$ <0.01 |
| 767.7± 1.9 | 140k | BIGGS | 70 | CNTR | <4.1 $\gamma$C $\to \pi^+\pi^-$ C |
| 765 ± 5 | 4000 | ASBURY | 67B | CNTR | $\gamma +$ Pb |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | |
| 771 ± 2 | 79k | [3] BREITWEG | 98B | ZEUS | 50–100 $\gamma p$ |

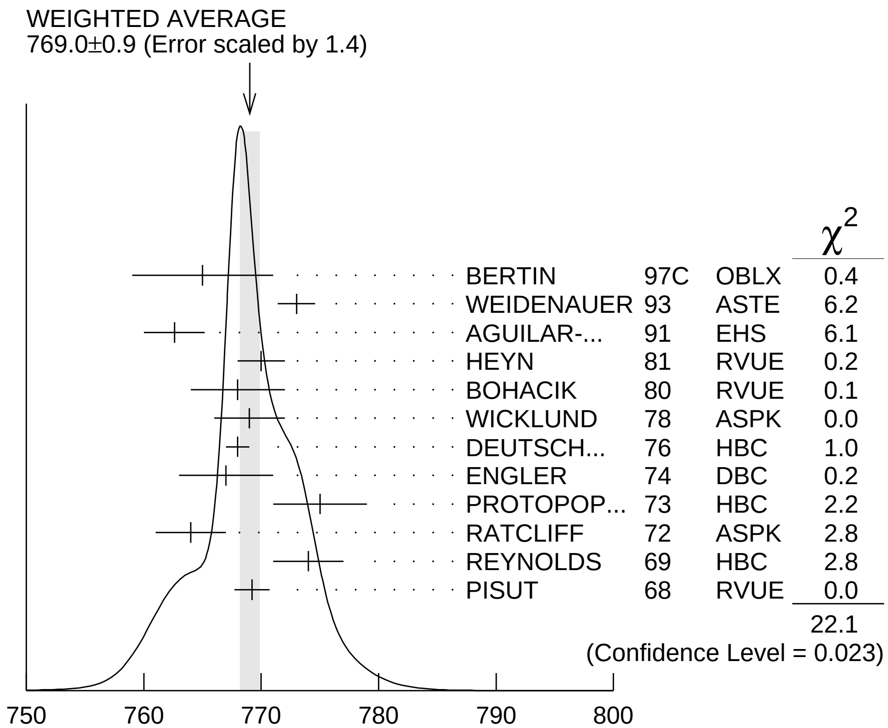
[1] Using the KUHN 90 parametrization of the pion form factor, neglecting $\rho-\omega$ interference.
[2] From the parametrization according to SOEDING 66.
[3] From the parametrization according to ROSS 66.

## NEUTRAL ONLY, OTHER REACTIONS

| VALUE (MeV) | EVTS | DOCUMENT ID | | TECN | 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 $pp$ |
| 770 ±2 | | [1] HEYN | 81 | RVUE | Pion form factor |
| 768 ±4 | | [2,3] BOHACIK | 80 | RVUE | |
| 769 ±3 | | [4] WICKLUND | 78 | ASPK | 3,4,6 $\pi^\pm N$ |
| 768 ±1 | 76k | DEUTSCH... | 76 | HBC | 16 $\pi^+ p$ |
| 767 ±4 | 4100 | ENGLER | 74 | DBC | 6 $\pi^+ n \to \pi^+\pi^- p$ |
| 775 ±4 | 32k | [2] PROTOPOP... | 73 | HBC | 7.1 $\pi^+ p$, $t$ <0.4 |
| 764 ±3 | 6.8k | [5] RATCLIFF | 72 | ASPK | 15 $\pi^- p$, $t$ <0.3 |
| 774 ±3 | 1.7k | REYNOLDS | 69 | HBC | 2.26 $\pi^- p$ |
| 769.2 ±1.5 | 13.3k | [6] PISUT | 68 | RVUE | 1.7–3.2 $\pi^- p$, $t$ <10 |

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

| | | | | | |
|---|---|---|---|---|---|
| 774.34 ± 0.18 ± 0.35 | 970k | [7] ABLIKIM | 18C | BES3 | $\eta'(958) \to \gamma\pi^+\pi^-$ |
| 772.93 ± 0.18 ± 0.34 | 970k | [8] ABLIKIM | 18C | BES3 | $\eta'(958) \to \gamma\pi^+\pi^-$ |
| 773.5 ± 2.5 | | [9] COLANGELO | 01 | RVUE | $\pi\pi \to \pi\pi$ |
| 762.3 ± 0.5 ± 1.2 | 600k | [10] ABELE | 99E | CBAR | 0.0 $\overline{p}p \to \pi^+\pi^-\pi^0$ |
| 777 ± 2 | 4.9k | [11] ADAMS | 97 | E665 | 470 $\mu p \to \mu X B$ |
| 770 ± 2 | | [12] BOGOLYUB... | 97 | MIRA | 32 $\overline{p}p \to \pi^+\pi^- X$ |
| 768 ± 8 | | [12] BOGOLYUB... | 97 | MIRA | 32 $pp \to \pi^+\pi^- X$ |
| 761.1 ± 2.9 | | DUBNICKA | 89 | RVUE | $\pi$ form factor |
| 777.4 ± 2.0 | | [13] CHABAUD | 83 | ASPK | 17 $\pi^- p$ polarized |
| 769.5 ± 0.7 | | [2,3] LANG | 79 | RVUE | |
| 770 ± 9 | | [3] ESTABROOKS | 74 | RVUE | 17 $\pi^- p \to \pi^+\pi^- n$ |
| 773.5 ± 1.7 | 11.2k | [14] JACOBS | 72 | HBC | 2.8 $\pi^- p$ |
| 775 ± 3 | 2.2k | [15] HYAMS | 68 | OSPK | 11.2 $\pi^- p$ |




$\rho(770)^0$ mass (MeV)

[1] HEYN 81 includes all spacelike and timelike $F_\pi$ values until 1978.

[2] From pole extrapolation.

[3] From phase shift analysis of GRAYER 74 data.

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

[5] Published values contain misprints. Corrected by private communication RATCLIFF 74.

[6] 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.

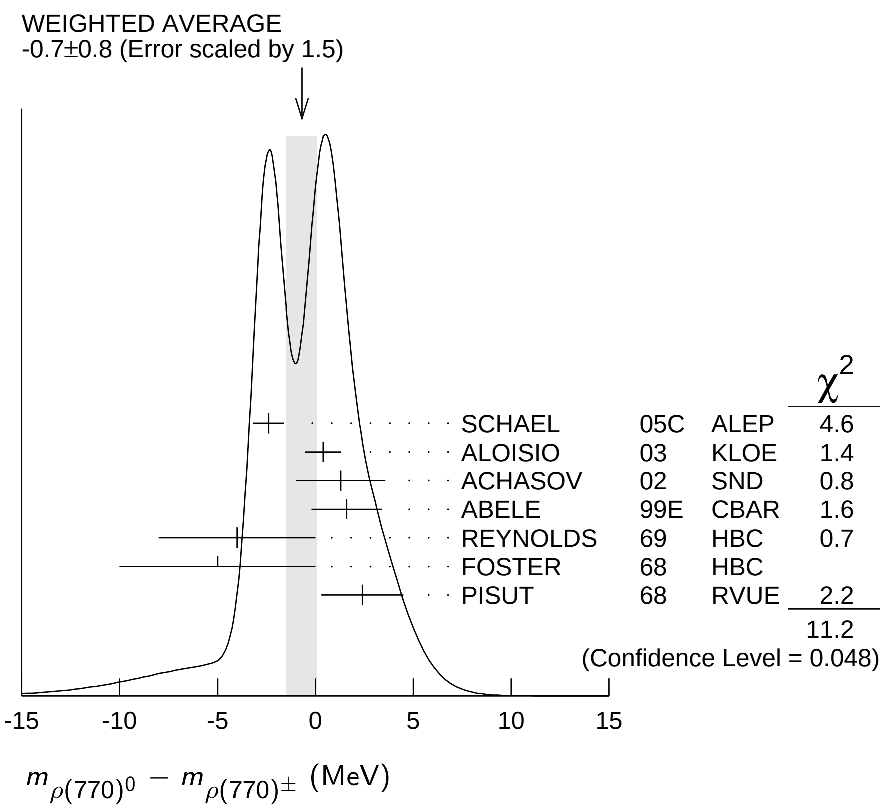
[7] From a fit to $\pi^+\pi^-$ mass using $\rho(770)$ (parametrized with the Gounaris-Sakurai approach), $\omega(782)$, and box anomaly components.

[8] From a fit to $\pi^+\pi^-$ mass using $\rho(770)$ (parametrized with the Gounaris-Sakurai approach), $\omega(782)$, and $\rho(1450)$ components.

[9] Breit-Wigner mass from a phase-shift analysis of HYAMS 73 and PROTOPOPESCU 73 data.
[10] Using relativistic Breit-Wigner and taking into account $\rho$-$\omega$ interference.
[11] Systematic errors not evaluated.
[12] Systematic effects not studied.
[13] From fit of 3-parameter relativistic Breit-Wigner to helicity-zero part of P-wave intensity. CHABAUD 83 includes data of GRAYER 74.
[14] Mass errors enlarged by us to $\Gamma/\sqrt{N}$; see the note with the $K^*(892)$ mass.
[15] Of HYAMS 68 six parametrizations, this is theoretically soundest. MR

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

| 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 | | $e^+ e^- \to \pi^+ \pi^-$, $\tau^- \to \pi^- \pi^0 \nu_\tau$ |



[1] From the combined fit of the $\tau^-$ 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 $e^+ e^- \rightarrow \pi^+ \pi^- \pi^0$ |

[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 |
|---|---|---|---|---|---|
| **$5.3^{+0.9}_{-0.7}$** | [1] CHABAUD | 83 | ASPK | 0 | 17 $\pi^- p$ polarized |

[1] The old PISUT 68 value, properly corrected, was 3.2 ± 0.6.

## $\rho(770)$ WIDTH

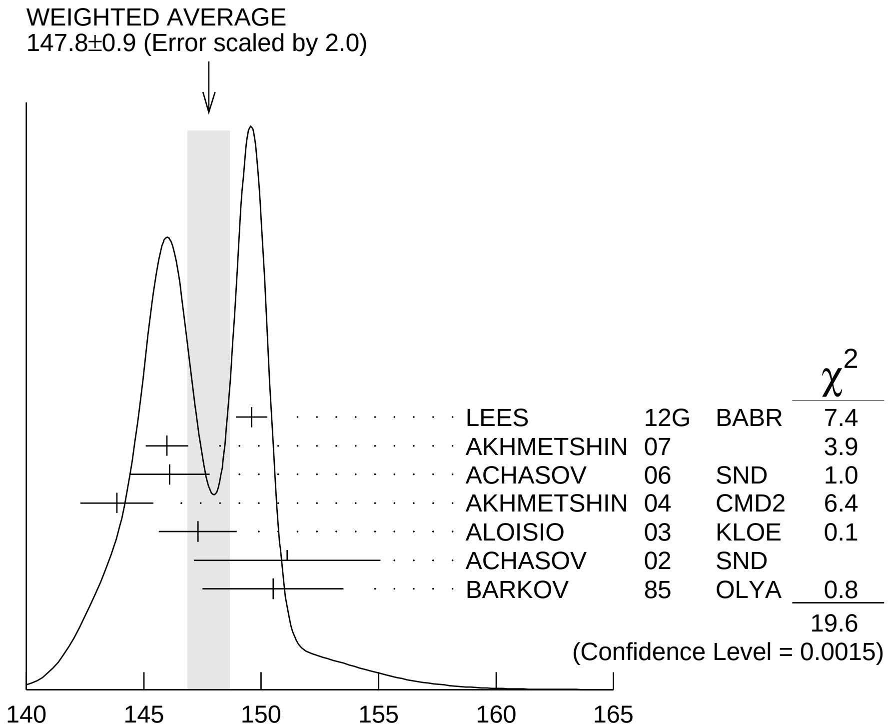
We no longer list $S$-wave Breit-Wigner fits, or data with high combinatorial background.

### NEUTRAL ONLY, $e^+ e^-$

| VALUE (MeV) | EVTS | DOCUMENT ID | | TECN | 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 | $e^+ e^- \rightarrow \pi^+ \pi^- \gamma$ |
| 145.98±0.75±0.50 | 900k | [2] AKHMETSHIN | 07 | | $e^+ e^- \rightarrow \pi^+ \pi^-$ |
| 146.1 ±0.8 ±1.5 | 800k | [3,4] ACHASOV | 06 | SND | $e^+ e^- \rightarrow \pi^+ \pi^-$ |
| 143.85±1.33±0.80 | 114k | [5,6] AKHMETSHIN | 04 | CMD2 | $e^+ e^- \rightarrow \pi^+ \pi^-$ |
| 147.3 ±1.5 ±0.7 | 1.98M | [7] ALOISIO | 03 | KLOE | 1.02 $e^+ e^- \rightarrow \pi^+ \pi^- \pi^0$ |
| 151.1 ±2.6 ±3.0 | 500k | [7] ACHASOV | 02 | SND | 1.02 $e^+ e^- \rightarrow \pi^+ \pi^- \pi^0$ |
| 150.5 ±3.0 | | [8] BARKOV | 85 | OLYA | $e^+ e^- \rightarrow \pi^+ \pi^-$ |

• • • 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, $e^+e^-$ (MeV)

[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 $\rho$-$\omega$ 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.

## CHARGED ONLY, $\tau$ 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 | [1,2] FUJIKAWA | 08 | BELL | ± | $\tau^- \rightarrow \pi^- \pi^0 \nu_\tau$ |
| 149.0 ±1.2 | | [2,3] SCHAEL | 05C | ALEP | | $\tau^- \rightarrow \pi^- \pi^0 \nu_\tau$ |
| 149.9 ±2.3 ±2.0 | 500k | [4] ACHASOV | 02 | SND | ± | 1.02 $e^+ e^- \rightarrow \pi^+ \pi^- \pi^0$ |
| 150.4 ±1.4 ±1.4 | 87k | [5,6] ANDERSON | 00A | CLE2 | | $\tau^- \rightarrow \pi^- \pi^0 \nu_\tau$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | | |
| 139.90±0.46 | | [7] BARTOS | 17A | RVUE | | $\tau^- \rightarrow \pi^- \pi^0 \nu_\tau$ |
| 143.7 ±1.3 ±1.2 | 1.98M | [4] ALOISIO | 03 | KLOE | ± | 1.02 $e^+ e^- \rightarrow \pi^+ \pi^- \pi^0$ |
| 142.9 ±1.3 ±1.4 | 1.98M | [8] ALOISIO | 03 | KLOE | − | 1.02 $e^+ e^- \rightarrow \pi^+ \pi^- \pi^0$ |
| 144.7 ±1.4 ±1.2 | 1.98M | [8] ALOISIO | 03 | KLOE | + | 1.02 $e^+ e^- \rightarrow \pi^+ \pi^- \pi^0$ |
| 150.2 ±2.0 $^{+0.7}_{-1.6}$ | | [9] SANZ-CILLERO | 03 | RVUE | | $\tau^- \rightarrow \pi^- \pi^0 \nu_\tau$ |
| 150.9 ±2.2 ±2.0 | 500k | [10] ACHASOV | 02 | SND | | 1.02 $e^+ e^- \rightarrow \pi^+ \pi^- \pi^0$ |

[1] $|F_\pi(0)|^2$ fixed to 1.
[2] From the GOUNARIS 68 parametrization of the pion form factor.
[3] The error combines statistical and systematic uncertainties. Supersedes BARATE 97M.
[4] Assuming $m_{\rho^+} = m_{\rho^-}$, $\Gamma_{\rho^+} = \Gamma_{\rho^-}$.
[5] $\rho(1700)$ mass and width fixed at 1700 MeV and 235 MeV respectively.
[6] 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.
[7] Applies the Unitary & Analytic Model of the pion electromagnetic form factor of DUBNICKA 10 to analyze the data of FUJIKAWA 08.
[8] Without limitations on masses and widths.
[9] Using the data of BARATE 97M and the effective chiral Lagrangian.
[10] Assuming $m_{\rho^0} = m_{\rho^\pm}$, $g_{\rho^0 \pi\pi} = g_{\rho^\pm \pi\pi}$.

## MIXED CHARGES, OTHER REACTIONS

| VALUE (MeV) | EVTS | DOCUMENT ID | | TECN | CHG | COMMENT |
|---|---|---|---|---|---|---|
| **149.5±1.3** | 600k | [1] ABELE | 99E | CBAR | 0± | 0.0 $\overline{p} p \rightarrow \pi^+ \pi^- \pi^0$ |

[1] Assuming the equality of $\rho^+$ and $\rho^-$ masses and widths.

## 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 | | $\overline{p}n \rightarrow \pi^- \pi^0 \pi^0$ |
| 155 ±11 | 2.9k | [1] CAPRARO | 87 | SPEC | − | 200 $\pi^-$ Cu $\rightarrow \pi^- \pi^0$ Cu |
| 154 ±20 | 967 | [1] CAPRARO | 87 | SPEC | − | 200 $\pi^-$ Pb $\rightarrow \pi^- \pi^0$ Pb |
| 150 ± 5 | | HUSTON | 86 | SPEC | + | 202 $\pi^+$ A $\rightarrow \pi^+ \pi^0$ A |
| 146 ±12 | 6.5k | [2] BYERLY | 73 | OSPK | − | 5 $\pi^- p$ |
| 148.2± 4.1 | 9.6k | [3] 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 | | [4] ABLIKIM | 17 | BES3 | | $J/\psi \rightarrow \gamma 3\pi$ |

[1] Width errors enlarged by us to $4\Gamma/\sqrt{N}$; see the note with the $K^*(892)$ mass.
[2] Phase shift analysis. Systematic errors added corresponding to spread of different fits.
[3] 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.
[4] S-matrix pole at a fixed $\rho$ meson mass of 775.49 MeV.

## NEUTRAL ONLY, PHOTOPRODUCED

| VALUE (MeV) | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **151.7± 2.6 OUR AVERAGE** | | | | | |
| 155 ± 5 ± 2 | 63.5k | [1] ABRAMOWICZ | 12 | ZEUS | $e p \rightarrow e \pi^+ \pi^- p$ |
| 146 ± 3 ±13 | 79k | [2] BREITWEG | 98B | ZEUS | 50–100 $\gamma p$ |
| 150.9± 3.0 | | BARTALUCCI | 78 | CNTR | $\gamma p \rightarrow e^+ e^- p$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | |
| 138 ± 3 | 79k | [3] BREITWEG | 98B | ZEUS | 50–100 $\gamma p$ |
| 147 ±11 | | GLADDING | 73 | CNTR | 2.9–4.7 $\gamma p$ |
| 155 ±12 | 2430 | BALLAM | 72 | HBC | 4.7 $\gamma p$ |
| 145 ±13 | 1930 | BALLAM | 72 | HBC | 2.8 $\gamma p$ |
| 140 ± 5 | | ALVENSLEB... | 70 | CNTR | $\gamma$A, $t$ <0.01 |
| 146.1± 2.9 | 140k | BIGGS | 70 | CNTR | <4.1 $\gamma$C $\rightarrow \pi^+ \pi^-$ C |
| 160 ±10 | | LANZEROTTI | 68 | CNTR | $\gamma p$ |
| 130 ± 5 | 4000 | ASBURY | 67B | CNTR | $\gamma$ + Pb |

[1] Using the KUHN 90 parametrization of the pion form factor, neglecting $\rho$−$\omega$ interference.
[2] From the parametrization according to SOEDING 66.
[3] From the parametrization according to ROSS 66.

## NEUTRAL ONLY, OTHER REACTIONS

| VALUE (MeV) | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **150.9 ± 1.7 OUR AVERAGE** Error includes scale factor of 1.1. | | | | | |
| 122 ±20 | | BERTIN | 97C | OBLX | 0.0 $\overline{p}p \rightarrow \pi^+ \pi^- \pi^0$ |
| 145.7 ± 5.3 | | WEIDENAUER | 93 | ASTE | $\overline{p}p \rightarrow \pi^+ \pi^- \omega$ |
| 144.9 ± 3.7 | | DUBNICKA | 89 | RVUE | $\pi$ form factor |
| 148 ± 6 | | [1,2] BOHACIK | 80 | RVUE | |
| 152 ± 9 | | [3] WICKLUND | 78 | ASPK | 3,4,6 $\pi^\pm p N$ |
| 154 ± 2 | 76k | DEUTSCH... | 76 | HBC | 16 $\pi^+ p$ |
| 157 ± 8 | 6.8k | [4] RATCLIFF | 72 | ASPK | 15 $\pi^- p$, $t$ <0.3 |
| 143 ± 8 | 1.7k | REYNOLDS | 69 | HBC | 2.26 $\pi^- p$ |

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

| | | | | | |
|---|---|---|---|---|---|
| 150.85 ± 0.55 ± 0.67 | 970k | [5] ABLIKIM | 18C | BES3 | $\eta'(958) \to \gamma\pi^+\pi^-$ |
| 150.18 ± 0.55 ± 0.65 | 970k | [6] ABLIKIM | 18C | BES3 | $\eta'(958) \to \gamma\pi^+\pi^-$ |
| 147.0 ± 2.5 | 600k | [7] ABELE | 99E | CBAR | 0.0 $\overline{p}p \to \pi^+\pi^-\pi^0$ |
| 146 ± 3 | 4.9k | [8] ADAMS | 97 | E665 | 470 $\mu p \to \mu XB$ |
| 160.0 $^{+4.1}_{-4.0}$ | | [9] CHABAUD | 83 | ASPK | 17 $\pi^- p$ polarized |
| 155 ± 1 | | [10] HEYN | 81 | RVUE | $\pi$ form factor |
| 148.0 ± 1.3 | | [1,2] LANG | 79 | RVUE | |
| 146 ±14 | 4.1k | ENGLER | 74 | DBC | 6 $\pi^+ n \to \pi^+\pi^- p$ |
| 143 ±13 | | [2] ESTABROOKS | 74 | RVUE | 17 $\pi^- p \to \pi^+\pi^- n$ |
| 160 ±10 | 32k | [1] PROTOPOP... | 73 | HBC | 7.1 $\pi^+ p$, $t <0.4$ |
| 145 ±12 | 2.2k | [3,11] HYAMS | 68 | OSPK | 11.2 $\pi^- p$ |
| 163 ±15 | 13.3k | [12] PISUT | 68 | RVUE | 1.7–3.2 $\pi^- p$, $t <10$ |

[1] From pole extrapolation.
[2] From phase shift analysis of GRAYER 74 data.
[3] Width errors enlarged by us to $4\Gamma/\sqrt{N}$; see the note with the $K^*(892)$ mass.
[4] Published values contain misprints. Corrected by private communication RATCLIFF 74.
[5] From a fit to $\pi^+\pi^-$ mass using $\rho(770)$ (parametrized with the Gounaris-Sakurai approach), $\omega(782)$, and box anomaly components.
[6] From a fit to $\pi^+\pi^-$ mass using $\rho(770)$ (parametrized with the Gounaris-Sakurai approach), $\omega(782)$, and $\rho(1450)$ components.
[7] Using relativistic Breit-Wigner and taking into account $\rho$-$\omega$ interference.
[8] Systematic errors not evaluated.
[9] From fit of 3-parameter relativistic Breit-Wigner to helicity-zero part of $P$-wave intensity. CHABAUD 83 includes data of GRAYER 74.
[10] HEYN 81 includes all spacelike and timelike $F_\pi$ values until 1978.
[11] Of HYAMS 68 six parametrizations this is theoretically soundest. MR
[12] 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 | $e^+e^- \to \pi^+\pi^-$, $\tau^- \to \pi^-\pi^0\nu_\tau$ |

[1] From the combined fit of the $\tau^-$ 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.

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

| VALUE | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **1.8±2.0±0.5** | 1.98M | [1] ALOISIO | 03 | KLOE | 1.02 $e^+ e^- \rightarrow \pi^+ \pi^- \pi^0$ |

[1] Without limitations on masses and widths.

## $\rho$(770) DECAY MODES

| | Mode | | Fraction ($\Gamma_i/\Gamma$) | Scale factor/ Confidence level |
|---|---|---|---|---|
| $\Gamma_1$ | $\pi\pi$ | | $\sim$ 100 % | |
| | **$\rho(770)^{\pm}$ decays** | | | |
| $\Gamma_2$ | $\pi^{\pm}\pi^0$ | | $\sim$ 100 % | |
| $\Gamma_3$ | $\pi^{\pm}\gamma$ | | $(4.5 \pm 0.5) \times 10^{-4}$ | S=2.2 |
| $\Gamma_4$ | $\pi^{\pm}\eta$ | | $< 6 \times 10^{-3}$ | CL=84% |
| $\Gamma_5$ | $\pi^{\pm}\pi^+\pi^-\pi^0$ | | $< 2.0 \times 10^{-3}$ | CL=84% |
| | **$\rho(770)^0$ decays** | | | |
| $\Gamma_6$ | $\pi^+\pi^-$ | | $\sim$ 100 % | |
| $\Gamma_7$ | $\pi^+\pi^-\gamma$ | | $(9.9 \pm 1.6) \times 10^{-3}$ | |
| $\Gamma_8$ | $\pi^0\gamma$ | | $(4.7 \pm 0.6) \times 10^{-4}$ | S=1.4 |
| $\Gamma_9$ | $\eta\gamma$ | | $(3.00 \pm 0.21) \times 10^{-4}$ | |
| $\Gamma_{10}$ | $\pi^0\pi^0\gamma$ | | $(4.5 \pm 0.8) \times 10^{-5}$ | |
| $\Gamma_{11}$ | $\mu^+\mu^-$ | [a] | $(4.55 \pm 0.28) \times 10^{-5}$ | |
| $\Gamma_{12}$ | $e^+e^-$ | [a] | $(4.72 \pm 0.05) \times 10^{-5}$ | |
| $\Gamma_{13}$ | $\pi^+\pi^-\pi^0$ | | $(1.01^{+0.54}_{-0.36} \pm 0.34) \times 10^{-4}$ | |
| $\Gamma_{14}$ | $\pi^+\pi^-\pi^+\pi^-$ | | $(1.8 \pm 0.9) \times 10^{-5}$ | |
| $\Gamma_{15}$ | $\pi^+\pi^-\pi^0\pi^0$ | | $(1.6 \pm 0.8) \times 10^{-5}$ | |
| $\Gamma_{16}$ | $\pi^0 e^+ e^-$ | | $< 1.2 \times 10^{-5}$ | CL=90% |
| $\Gamma_{17}$ | $\eta e^+ e^-$ | | | |

[a] The $\omega\rho$ interference is then due to $\omega\rho$ mixing only, and is expected to be small. If $e\mu$ universality holds, $\Gamma(\rho^0 \rightarrow \mu^+\mu^-) = \Gamma(\rho^0 \rightarrow e^+e^-) \times 0.99785$.

## 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 $\left\langle\delta p_i \delta p_j\right\rangle/(\delta p_i{\cdot}\delta p_j)$, in percent, from the fit to parameters $p_i$, including the branching fractions, $x_i \equiv \Gamma_i/\Gamma_{\rm total}$. The fit constrains the $x_i$ whose labels appear in this array to sum to one.

| | | |
|---|---|---|
| $x_3$ | −100 | |
| $\Gamma$ | 15 | −15 |
| | $x_2$ | $x_3$ |

| | Mode | Rate (MeV) | Scale factor |
|---|---|---|---|
| $\Gamma_2$ | $\pi^\pm\pi^0$ | 150.2 ±2.4 | |
| $\Gamma_3$ | $\pi^\pm\gamma$ | 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, $x_i \equiv \Gamma_i/\Gamma_{\rm total}$. The fit constrains the $x_i$ whose labels appear in this array to sum to one.

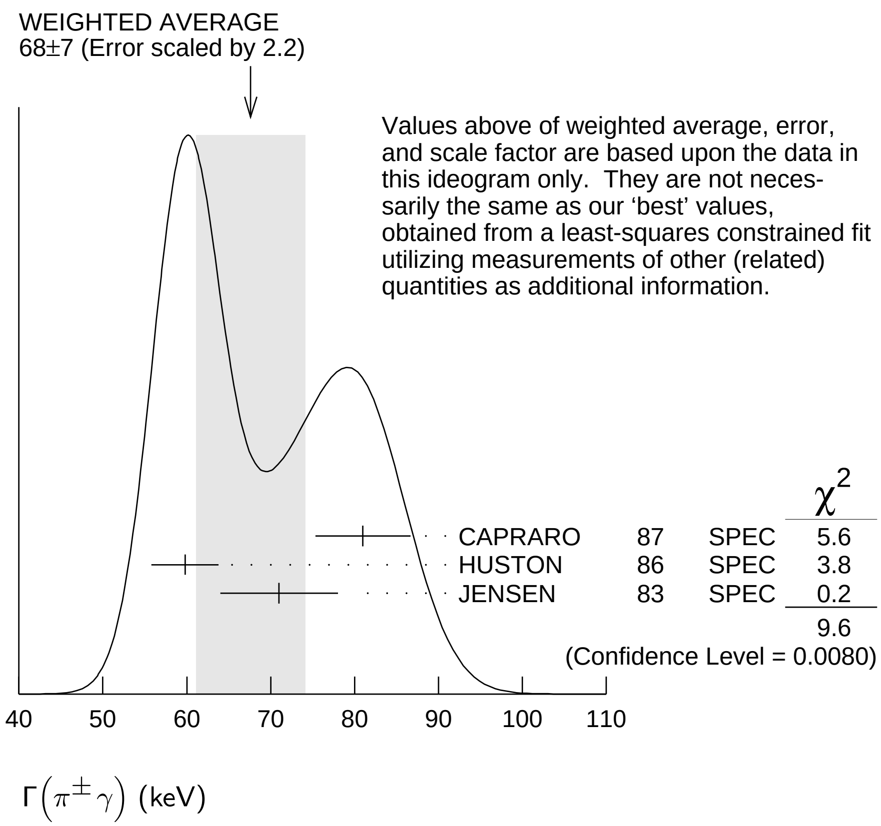
| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $x_7$ | −100 | | | | | | | |
| $x_8$ | −4 | 0 | | | | | | |
| $x_9$ | −1 | 0 | 1 | | | | | |
| $x_{10}$ | −1 | 0 | 0 | 0 | | | | |
| $x_{11}$ | 2 | −3 | 0 | 0 | 0 | | | |
| $x_{12}$ | 0 | 0 | −8 | −9 | 0 | 0 | | |
| $x_{14}$ | −1 | 0 | 0 | 0 | 0 | 0 | 0 | |
| $\Gamma$ | 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 |
|---|---|---|---|---|
| $\Gamma_6$ | $\pi^+\pi^-$ | | 147.5 ±0.9 | |
| $\Gamma_7$ | $\pi^+\pi^-\gamma$ | | 1.48 ±0.24 | |
| $\Gamma_8$ | $\pi^0\gamma$ | | 0.070 ±0.009 | 1.4 |
| $\Gamma_9$ | $\eta\gamma$ | | 0.0447 ±0.0032 | |
| $\Gamma_{10}$ | $\pi^0\pi^0\gamma$ | | 0.0066 ±0.0012 | |
| $\Gamma_{11}$ | $\mu^+\mu^-$ | [a] | 0.0068 ±0.0004 | |
| $\Gamma_{12}$ | $e^+e^-$ | [a] | 0.00704±0.00006 | |
| $\Gamma_{14}$ | $\pi^+\pi^-\pi^+\pi^-$ | | 0.0027 ±0.0014 | |

# $\rho(770)$ PARTIAL WIDTHS

## $\Gamma(\pi^{\pm}\gamma)$ — $\Gamma_3$

| 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 $\pi^- A \to \pi^- \pi^0 A$ |
| 59.8±4.0 | HUSTON | 86 | SPEC | + | 202 $\pi^+ A \to \pi^+ \pi^0 A$ |
| 71 ±7 | JENSEN | 83 | SPEC | − | 156–260 $\pi^- A \to \pi^- \pi^0 A$ |




## $\Gamma(\pi^0\gamma)$ — $\Gamma_8$

| VALUE (keV) | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | |
| 77±17±11 | 36500 | [1] ACHASOV | 03 | SND | 0.60–0.97 $e^+ e^- \to \pi^0 \gamma$ |
| 121±31 | | DOLINSKY | 89 | ND | $e^+ e^- \to \pi^0 \gamma$ |

[1] Using $\Gamma_{total}$= 147.9 ± 1.3 MeV and B($\rho \to \pi^0 \gamma$) from ACHASOV 03.

## $\Gamma(\eta\gamma)$ — $\Gamma_9$

| VALUE (keV) | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 62±17 | [1] DOLINSKY | 89 | ND | $e^+ e^- \to \eta \gamma$ |

[1] Solution corresponding to constructive $\omega$-$\rho$ interference.

### $\Gamma(e^+e^-)$ $\Gamma_{12}$

| 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 | $e^+e^- \to \pi^+\pi^-$, $\mu^+\mu^-$ |

[1] A combined fit of AKHMETSHIN 07, AULCHENKO 06, and AULCHENKO 05.
[2] Using the GOUNARIS 68 parametrization with the complex phase of the $\rho$-$\omega$ 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.

### $\Gamma(\pi^+\pi^-\pi^+\pi^-)$ $\Gamma_{14}$

| VALUE (keV) | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | |
| 2.8±1.4±0.5 | 153 | AKHMETSHIN | 00 | CMD2 | 0.6–0.97 $e^+e^- \to \pi^+\pi^-\pi^+\pi^-$ |

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

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

| 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.

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

| VALUE (units $10^{-8}$) | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **1.42±0.10 OUR FIT** | | | | | |
| **1.45±0.12 OUR AVERAGE** | | | | | |
| 1.32±0.14±0.08 | 33k | [1] ACHASOV | 07B | SND | 0.6–1.38 $e^+e^- \to \eta\gamma$ |
| 1.50±0.65±0.09 | 17.4k | [2] AKHMETSHIN | 05 | CMD2 | 0.60-1.38 $e^+e^- \to \eta\gamma$ |
| 1.61±0.20±0.11 | 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 $e^+e^-$ |

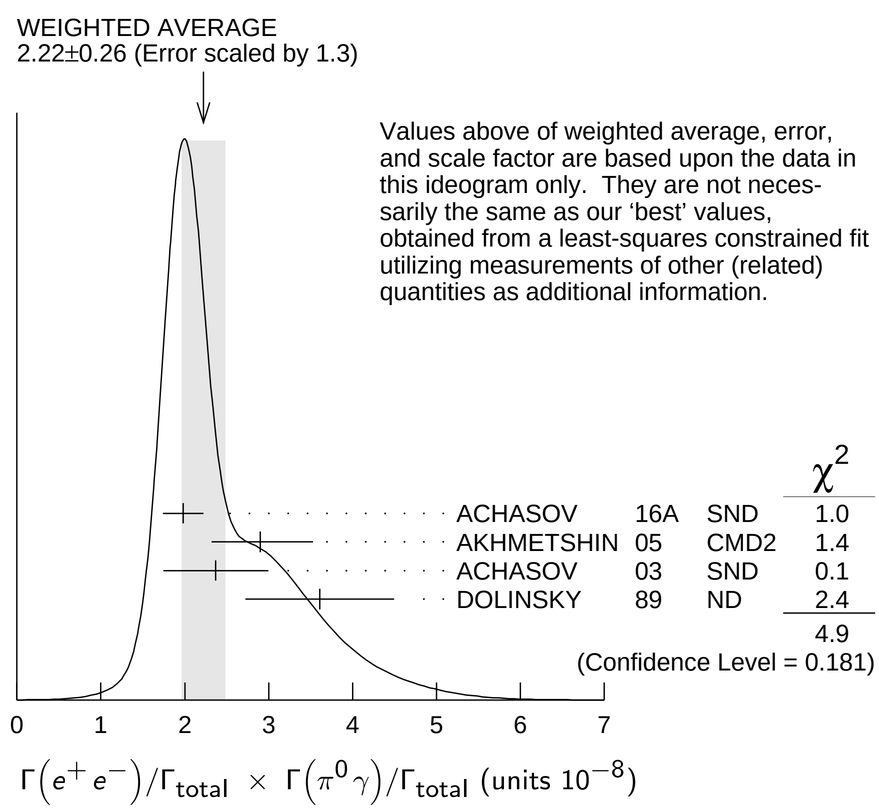
[1] From a combined fit of $\sigma(e^+e^- \to \eta\gamma)$ with $\eta \to 3\pi^0$ and $\eta \to \pi^+\pi^-\pi^0$, and fixing B($\eta \to 3\pi^0$) / B($\eta \to \pi^+\pi^-\pi^0$) = 1.44 ± 0.04. Recalculated by us from the cross section at the peak. Supersedes ACHASOV 00D and ACHASOV 06A.

[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 $e^+e^- \to \pi^0\gamma$ |
| 2.90 $^{+0.60}_{-0.55}$ ±0.18 | 18k | AKHMETSHIN | 05 | CMD2 | 0.60-1.38 $e^+e^- \to \pi^0\gamma$ |
| 2.37 ±0.53 ±0.33 | 36k | [2] ACHASOV | 03 | SND | 0.60–0.97 $e^+e^- \to \pi^0\gamma$ |
| 3.61 ±0.74 ±0.49 | 10k | [3] DOLINSKY | 89 | ND | $e^+e^- \to \pi^0\gamma$ |
| • • • 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 $\sigma_{\phi \to \pi^0\gamma}$ from ACHASOV 00 and $m_\rho$= 775.97 MeV in the model with the energy-independent phase of $\rho$-$\omega$ 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 $e^+e^- \to \pi^+\pi^-$, $\pi^+\pi^-\pi^0$, $\pi^0\gamma$, $\eta\gamma$ data.



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

| *VALUE* (units $10^{-9}$) | *EVTS* | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|---|
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | |
| $0.903\pm0.076$ | | [1] BENAYOUN | 10 | RVUE | 0.4–1.05 $e^+e^-$ |
| $4.58\ ^{+2.46}_{-1.64}\ \pm1.56$ | 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 $3\,\sigma$.

## $\rho(770)$ BRANCHING RATIOS

### $\Gamma(\pi^\pm\eta)/\Gamma(\pi\pi)$ — $\Gamma_4/\Gamma_1$

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

### $\Gamma(\pi^\pm\pi^+\pi^-\pi^0)/\Gamma(\pi\pi)$ — $\Gamma_5/\Gamma_1$

| *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. • • • | | | | | | |
| $35\pm40$ | | JAMES | 66 | HBC | + | 2.1 $\pi^+ p$ |

### $\Gamma(\pi^+\pi^-\gamma)/\Gamma_{\text{total}}$ — $\Gamma_7/\Gamma$

| *VALUE* | *CL%* | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|---|
| **0.0099±0.0016 OUR FIT** | | | | | |
| **0.0099±0.0016** | | [1] DOLINSKY | 91 | ND | $e^+e^- \rightarrow \pi^+\pi^-\gamma$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | |
| $0.0111\pm0.0014$ | | [2] VASSERMAN | 88 | ND | $e^+e^- \rightarrow \pi^+\pi^-\gamma$ |
| $<0.005$ | 90 | [3] VASSERMAN | 88 | ND | $e^+e^- \rightarrow \pi^+\pi^-\gamma$ |

[1] Bremsstrahlung from a decay pion and for photon energy above 50 MeV.
[2] Superseded by DOLINSKY 91.
[3] Structure radiation due to quark rearrangement in the decay.

### $\Gamma(\pi^0\gamma)/\Gamma_{\text{total}}$ — $\Gamma_8/\Gamma$

| *VALUE* (units $10^{-4}$) | *EVTS* | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|---|
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | |
| $4.20\pm0.52$ | | [1] ACHASOV | 16A | SND | 0.60–1.38 $e^+e^- \rightarrow \pi^0\gamma$ |
| $6.21\,^{+1.28}_{-1.18}\pm0.39$ | 18k | [2,3] AKHMETSHIN | 05 | CMD2 | 0.60-1.38 $e^+e^- \rightarrow \pi^0\gamma$ |
| $5.22\pm1.17\pm0.75$ | 36k | [3,4] ACHASOV | 03 | SND | 0.60–0.97 $e^+e^- \rightarrow \pi^0\gamma$ |
| $6.8\ \pm1.7$ | | [5] BENAYOUN | 96 | RVUE | 0.54-1.04 $e^+e^- \rightarrow \pi^0\gamma$ |
| $7.9\ \pm2.0$ | | [3] DOLINSKY | 89 | ND | $e^+e^- \rightarrow \pi^0\gamma$ |

[1] Using B($\rho \rightarrow e^+e^-$) from PDG 15. Supersedes ACHASOV 03.
[2] Using B($\rho \rightarrow e^+e^-$) = $(4.67 \pm 0.09) \times 10^{-5}$.
[3] Not independent of the corresponding $\Gamma(e^+e^-) \times \Gamma(\pi^0\gamma)/\Gamma^2_{\text{total}}$.
[4] Using B($\rho \rightarrow e^+e^-$) = $(4.54 \pm 0.10) \times 10^{-5}$.
[5] Reanalysis of DRUZHININ 84, DOLINSKY 89, and DOLINSKY 91 taking into account a triangle anomaly contribution.

## $\Gamma(\eta\gamma)/\Gamma_{total}$ $\Gamma_9/\Gamma$

| 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 | [1] ACHASOV | 07B | SND | | 0.6–1.38 $e^+e^- \to \eta\gamma$ |
| 3.6 ±0.9 | | [2] ANDREWS | 77 | CNTR | 0 | 6.7–10 $\gamma$Cu |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | | |
| 3.21±1.39±0.20 | 17.4k | [3,4] AKHMETSHIN | 05 | CMD2 | | 0.60-1.38 $e^+e^- \to \eta\gamma$ |
| 3.39±0.42±0.23 | | [2,5,6] AKHMETSHIN | 01B | CMD2 | | $e^+e^- \to \eta\gamma$ |
| 1.9 $^{+0.6}_{-0.8}$ | | [7] BENAYOUN | 96 | RVUE | | 0.54-1.04 $e^+e^- \to \eta\gamma$ |
| 4.0 ±1.1 | | [2,4] DOLINSKY | 89 | ND | | $e^+e^- \to \eta\gamma$ |

[1] ACHASOV 07B reports $[\Gamma(\rho(770) \to \eta\gamma)/\Gamma_{total}] \times [B(\rho(770) \to e^+e^-)] = (1.32 \pm 0.14 \pm 0.08) \times 10^{-8}$ which we divide by our best value $B(\rho(770) \to e^+e^-) = (4.72 \pm 0.05) \times 10^{-5}$. 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.

[2] Solution corresponding to constructive $\omega$-$\rho$ interference.

[3] Using $B(\rho \to e^+e^-) = (4.67 \pm 0.09) \times 10^{-5}$ and $B(\eta \to \gamma\gamma) = 39.43 \pm 0.26\%$.

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

[5] 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).

[6] Using $B(\rho \to e^+e^-) = (4.75 \pm 0.10) \times 10^{-5}$ from AKHMETSHIN 02 and $B(\eta \to 3\pi^0) = (32.24 \pm 0.29) \times 10^{-2}$.

[7] Reanalysis of DRUZHININ 84, DOLINSKY 89, and DOLINSKY 91 taking into account a triangle anomaly contribution. Constructive $\rho$-$\omega$ interference solution.

## $\Gamma(\pi^0\pi^0\gamma)/\Gamma_{total}$ $\Gamma_{10}/\Gamma$

| 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$^{+1.5}_{-1.3}$±0.6 | 190 | [1] AKHMETSHIN | 04B | CMD2 | 0.6–0.97 $e^+e^- \to \pi^0\pi^0\gamma$ |
| 4.1$^{+1.0}_{-0.9}$±0.3 | 295 | [2] 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$^{+3.4}_{-1.8}$±0.5 | 63 | [3] ACHASOV | 00G | SND | $e^+e^- \to \pi^0\pi^0\gamma$ |

[1] 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.

[2] 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.

[3] Superseded by ACHASOV 02F.

## $\Gamma(\mu^+\mu^-)/\Gamma(\pi^+\pi^-)$ — $\Gamma_{11}/\Gamma_6$

| VALUE (units $10^{-5}$) | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| **4.60±0.28 OUR FIT** | | | | |
| **4.6 ±0.2 ±0.2** | ANTIPOV | 89 | SIGM | $\pi^- \text{Cu} \to \mu^+\mu^-\pi^- \text{Cu}$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| $8.2\ ^{+1.6}_{-3.6}$ | [1] ROTHWELL | 69 | CNTR | Photoproduction |
| $5.6\ \pm1.5$ | [2] WEHMANN | 69 | OSPK | 12 $\pi^-$ C, Fe |
| $9.7\ ^{+3.1}_{-3.3}$ | [3,4] HYAMS | 67 | OSPK | 11 $\pi^-$ Li, H |

[1] Possibly large $\rho$-$\omega$ 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 $\rho$-$\omega$ interference and the upper limit agrees with the upper limit of $\omega \to \mu^+\mu^-$ from this experiment.
[3] But he even enlarges his error to take residual $\omega$ contamination into account. Since his value is high, seems the other experiments also can't have too many $\omega$'s. But maybe Hyams has additional $\mu$'s from $\rho \to \pi\pi$, decaying $\pi$'s.
[4] HYAMS 67's mass resolution is 20 MeV. The $\omega$ region was excluded.

## $\Gamma(e^+e^-)/\Gamma(\pi\pi)$ — $\Gamma_{12}/\Gamma_1$

| VALUE (units $10^{-4}$) | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 0.40±0.05 | [1,2] BENAKSAS | 72 | OSPK | $e^+e^- \to \pi^+\pi^-$ |

[1] The $\rho'$ contribution is not taken into account.
[2] Barkov excludes Auslender and Benaksas for large statistical and systematic errors.

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

| 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 | [1] ACHASOV | 03D | RVUE | 0.44–2.00 $e^+e^- \to \pi^+\pi^-\pi^0$ |
| <1.2 | 90 | | VASSERMAN | 88B | ND | $e^+e^- \to \pi^+\pi^-\pi^0$ |

[1] Statistical significance is less than $3\sigma$.

## $\Gamma(\pi^+\pi^-\pi^0)/\Gamma(\pi\pi)$ — $\Gamma_{13}/\Gamma_1$

| 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 | [1] ABRAMS | 71 | HBC | 0 | 3.7 $\pi^+ p$ |

[1] Model dependent, assumes $I$ = 1, 2, or 3 for the $3\pi$ system.

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

| 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 | $e^+e^- \to \pi^+\pi^-\pi^+\pi^-$ |

### $\Gamma(\pi^+\pi^-\pi^+\pi^-)/\Gamma(\pi\pi)$ $\Gamma_{14}/\Gamma_1$

| 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 $\gamma p$ |
| $<20$ | | 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 $\pi^+ p$ |

### $\Gamma(\pi^+\pi^-\pi^0\pi^0)/\Gamma_{\text{total}}$ $\Gamma_{15}/\Gamma$

| VALUE (units $10^{-5}$) | CL% | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **1.60±0.74±0.18** | | [1] 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 | $e^+e^- \to \pi^+\pi^-\pi^0\pi^0$ |

[1] Assuming no interference between the $\rho$ and $\omega$ contributions.

### $\Gamma(\pi^0 e^+e^-)/\Gamma_{\text{total}}$ $\Gamma_{16}/\Gamma$

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

### $\Gamma(\eta e^+e^-)/\Gamma_{\text{total}}$ $\Gamma_{17}/\Gamma$

| 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 $e^+e^-$ |

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| ERBE | 69 | PR 188 2060 | R. Erbe *et al.* | (German Bubble Chamber Collab.) |
| MALAMUD | 69 | Argonne Conf. 93 | E.I. Malamud, P.E. Schlein | (UCLA) |
| REYNOLDS | 69 | PR 184 1424 | B.G. Reynolds *et al.* | (FSU) |
| ROTHWELL | 69 | PRL 23 1521 | P.L. Rothwell *et al.* | (NEAS) |
| WEHMANN | 69 | PR 178 2095 | A.A. Wehmann *et al.* | (HARV, CASE, SLAC+) |
| ARMENISE | 68 | NC 54A 999 | N. Armenise *et al.* | (BARI, BGNA, FIRZ+) |
| BATON | 68 | PR 176 1574 | J.P. Baton, G. Laurens | (SACL) |
| CHUNG | 68 | PR 165 1491 | S.U. Chung *et al.* | (LRL) |
| FOSTER | 68 | NP B6 107 | M. Foster *et al.* | (CERN, CDEF) |
| GOUNARIS | 68 | PRL 21 244 | G.J. Gounaris, J.J. Sakurai | |
| HUSON | 68 | PL 28B 208 | R. Huson *et al.* | (ORSAY, MILA, UCLA) |
| HYAMS | 68 | NP B7 1 | B.D. Hyams *et al.* | (CERN, MPIM) |
| LANZEROTTI | 68 | PR 166 1365 | L.J. Lanzerotti *et al.* | (HARV) |
| PISUT | 68 | NP B6 325 | J. Pisut, M. Roos | (CERN) |
| ASBURY | 67B | PRL 19 865 | J.G. Asbury *et al.* | (DESY, COLU) |
| BACON | 67 | PR 157 1263 | T.C. Bacon *et al.* | (BNL) |
| EISNER | 67 | PR 164 1699 | R.L. Eisner *et al.* | (PURD) |
| HUWE | 67 | PL 24B 252 | D.O. Huwe *et al.* | (COLU) |
| HYAMS | 67 | PL 24B 634 | B.D. Hyams *et al.* | (CERN, MPIM) |
| MILLER | 67B | PR 153 1423 | D.H. Miller *et al.* | (PURD) |
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| HAGOPIAN | 66B | PR 152 1183 | V. Hagopian, Y.L. Pan | (PENN, LRL) |
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| JAMES | 66 | PR 142 896 | F.E. James, H.L. Kraybill | (YALE, BNL) |
| ROSS | 66 | PR 149 1172 | M. Ross, L. Stodolsky | |
| SOEDING | 66 | PL B19 702 | P. Soeding | |
| WEST | 66 | PR 149 1089 | E. West *et al.* | (WISC) |
| BLIEDEN | 65 | PL 19 444 | H.R. Blieden *et al.* | (CERN MMS Collab.) |
| CARMONY | 64 | PRL 12 254 | D.D. Carmony *et al.* | (UCB) |
| GOLDHABER | 64 | PRL 12 336 | G. Goldhaber *et al.* | (LRL, UCB) |
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