

ρ(770)

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

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ρ(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 |
|---|-------|-------------------|------|---|
| 775.49 ± 0.34 OUR AVERAGE | | | | |
| 775.97 ± 0.46 ± 0.70 | 900k | 1 AKHMETSHIN 07 | | e ⁺ e ⁻ → π ⁺ π ⁻ |
| 774.6 ± 0.4 ± 0.5 | 800k | 2,3 ACHASOV 06 | SND | e ⁺ e ⁻ → π ⁺ π ⁻ |
| 775.65 ± 0.64 ± 0.50 | 114k | 4,5 AKHMETSHIN 04 | CMD2 | e ⁺ e ⁻ → π ⁺ π ⁻ |
| 775.9 ± 0.5 ± 0.5 | 1.98M | 6 ALOISIO 03 | KLOE | 1.02 e ⁺ e ⁻ → π ⁺ π ⁻ π ⁰ |
| 775.8 ± 0.9 ± 2.0 | 500k | 6 ACHASOV 02 | SND | 1.02 e ⁺ e ⁻ → π ⁺ π ⁻ π ⁰ |
| 775.9 ± 1.1 | | 7 BARKOV 85 | OLYA | e ⁺ e ⁻ → π ⁺ π ⁻ |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● | | | | |
| 775.8 ± 0.5 ± 0.3 | 1.98M | 8 ALOISIO 03 | KLOE | 1.02 e ⁺ e ⁻ → π ⁺ π ⁻ π ⁰ |
| 775.9 ± 0.6 ± 0.5 | 1.98M | 9 ALOISIO 03 | KLOE | 1.02 e ⁺ e ⁻ → π ⁺ π ⁻ π ⁰ |
| 775.0 ± 0.6 ± 1.1 | 500k | 10 ACHASOV 02 | SND | 1.02 e ⁺ e ⁻ → π ⁺ π ⁻ π ⁰ |
| 775.1 ± 0.7 ± 5.3 | | 11 BENAYOUN 98 | RVUE | e ⁺ e ⁻ → π ⁺ π ⁻ , μ ⁺ μ ⁻ |
| 770.5 ± 1.9 ± 5.1 | | 12 GARDNER 98 | RVUE | 0.28–0.92 e ⁺ e ⁻ → π ⁺ π ⁻ |
| 764.1 ± 0.7 | | 13 O'CONNELL 97 | RVUE | e ⁺ e ⁻ → π ⁺ π ⁻ |
| 757.5 ± 1.5 | | 14 BERNICHA 94 | RVUE | e ⁺ e ⁻ → π ⁺ π ⁻ |
| 768 ± 1 | | 15 GESHKEN... 89 | RVUE | e ⁺ e ⁻ → π ⁺ π ⁻ |

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 | 16,17 FUJIKAWA 08 | BELL | ± | τ ⁻ → π ⁻ π ⁰ ν _τ |
| 775.5 ± 0.7 | | 17,18 SCHAEEL 05c | ALEP | | τ ⁻ → π ⁻ π ⁰ ν _τ |
| 775.5 ± 0.5 ± 0.4 | 1.98M | 6 ALOISIO 03 | KLOE | | 1.02 e ⁺ e ⁻ → π ⁺ π ⁻ π ⁰ |
| 775.1 ± 1.1 ± 0.5 | 87k | 19,20 ANDERSON 00A | CLE2 | | τ ⁻ → π ⁻ π ⁰ ν _τ |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● | | | | | |
| 774.8 ± 0.6 ± 0.4 | 1.98M | 9 ALOISIO 03 | KLOE | - | 1.02 e ⁺ e ⁻ → π ⁺ π ⁻ π ⁰ |
| 776.3 ± 0.6 ± 0.7 | 1.98M | 9 ALOISIO 03 | KLOE | + | 1.02 e ⁺ e ⁻ → π ⁺ π ⁻ π ⁰ |
| 773.9 ± 2.0 ^{+0.3} / _{-1.0} | | 21 SANZ-CILLERO03 | RVUE | | τ ⁻ → π ⁻ π ⁰ ν _τ |
| 774.5 ± 0.7 ± 1.5 | 500k | 6 ACHASOV 02 | SND | ± | 1.02 e ⁺ e ⁻ → π ⁺ π ⁻ π ⁰ |
| 775.1 ± 0.5 | | 22 PICH 01 | RVUE | | τ ⁻ → π ⁻ π ⁰ ν _τ |

MIXED CHARGES, OTHER REACTIONS

| <u>VALUE (MeV)</u> | <u>EVTS</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>CHG</u> | <u>COMMENT</u> | |
|----------------------|-------------|---------------------|-------------|------------|----------------|--|
| 763.0±0.3±1.2 | 600k | ²³ ABELE | 99E | CBAR | 0± | 0.0 $\bar{p}p \rightarrow \pi^+\pi^-\pi^0$ |

CHARGED ONLY, HADROPRODUCED

| <u>VALUE (MeV)</u> | <u>EVTS</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>CHG</u> | <u>COMMENT</u> | |
|------------------------------|-------------|-----------------------|-------------|------------|--|---|
| 766.5±1.1 OUR AVERAGE | | | | | | |
| 763.7±3.2 | | ABELE | 97 | CBAR | $\bar{p}n \rightarrow \pi^-\pi^0\pi^0$ | |
| 768 ±9 | | AGUILAR-... | 91 | EHS | 400 pp | |
| 767 ±3 | 2935 | ²⁴ CAPRARO | 87 | SPEC | - | 200 $\pi^-\pi^0\text{Cu} \rightarrow \pi^-\pi^0\text{Cu}$ |
| 761 ±5 | 967 | ²⁴ CAPRARO | 87 | SPEC | - | 200 $\pi^-\pi^0\text{Pb} \rightarrow \pi^-\pi^0\text{Pb}$ |
| 771 ±4 | | HUSTON | 86 | SPEC | + | 202 $\pi^+\pi^0\text{A} \rightarrow \pi^+\pi^0\text{A}$ |
| 766 ±7 | 6500 | ²⁵ BYERLY | 73 | OSPK | - | 5 π^-p |
| 766.8±1.5 | 9650 | ²⁶ PISUT | 68 | RVUE | - | 1.7-3.2 $\pi^-p, t < 10$ |
| 767 ±6 | 900 | ²⁴ EISNER | 67 | HBC | - | 4.2 $\pi^-p, t < 10$ |

NEUTRAL ONLY, PHOTOPRODUCED

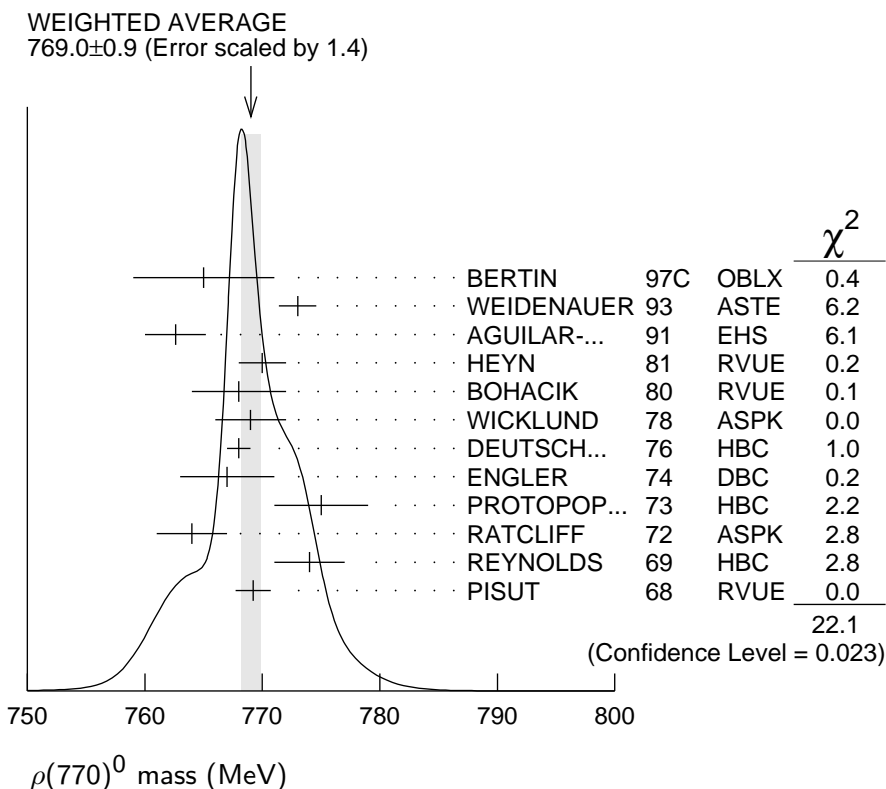
| <u>VALUE (MeV)</u> | <u>EVTS</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>CHG</u> | <u>COMMENT</u> | |
|---|-------------|------------------------|-------------|------------|----------------|--|
| 768.5± 1.1 OUR AVERAGE | | | | | | |
| 770 ± 2 ±1 | 79k | ²⁷ BREITWEG | 98B | ZEUS | 0 | 50-100 γp |
| 767.6± 2.7 | | BARTALUCCI | 78 | CNTR | 0 | $\gamma p \rightarrow e^+e^-p$ |
| 775 ± 5 | | GLADDING | 73 | CNTR | 0 | 2.9-4.7 γp |
| 767 ± 4 | 1930 | BALLAM | 72 | HBC | 0 | 2.8 γp |
| 770 ± 4 | 2430 | BALLAM | 72 | HBC | 0 | 4.7 γp |
| 765 ±10 | | ALVENSLEB... | 70 | CNTR | 0 | $\gamma\text{A}, t < 0.01$ |
| 767.7± 1.9 | 140k | BIGGS | 70 | CNTR | 0 | <4.1 $\gamma\text{C} \rightarrow \pi^+\pi^-\text{C}$ |
| 765 ± 5 | 4000 | ASBURY | 67B | CNTR | 0 | $\gamma + \text{Pb}$ |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● | | | | | | |
| 771 ± 2 | 79k | ²⁸ BREITWEG | 98B | ZEUS | 0 | 50-100 γp |

NEUTRAL ONLY, OTHER REACTIONS

| <u>VALUE (MeV)</u> | <u>EVTS</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>CHG</u> | <u>COMMENT</u> | |
|--|-------------|---------------------------|-------------|------------|----------------|--|
| 769.0±0.9 OUR AVERAGE Error includes scale factor of 1.4. See the ideogram below. | | | | | | |
| 765 ±6 | | BERTIN | 97C | OBLX | | 0.0 $\bar{p}p \rightarrow \pi^+\pi^-\pi^0$ |
| 773 ±1.6 | | WEIDENAUER | 93 | ASTE | | $\bar{p}p \rightarrow \pi^+\pi^-\omega$ |
| 762.6±2.6 | | AGUILAR-... | 91 | EHS | | 400 pp |
| 770 ±2 | | ²⁹ HEYN | 81 | RVUE | | Pion form factor |
| 768 ±4 | | ^{30,31} BOHACIK | 80 | RVUE | 0 | |
| 769 ±3 | | ²⁵ WICKLUND | 78 | ASPK | 0 | 3,4,6 $\pi^\pm N$ |
| 768 ±1 | 76000 | DEUTSCH... | 76 | HBC | 0 | 16 π^+p |
| 767 ±4 | 4100 | ENGLER | 74 | DBC | 0 | 6 $\pi^+n \rightarrow \pi^+\pi^-p$ |
| 775 ±4 | 32000 | ³⁰ 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 π^-p |
| 769.2±1.5 | 13300 | ³² 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±2.5 | | 33 COLANGELO | 01 | RVUE | | $\pi\pi \rightarrow \pi\pi$ |
| 762.3±0.5±1.2 | 600k | 34 ABELE | 99E | CBAR | 0 | 0.0 $\bar{p}p \rightarrow \pi^+\pi^-\pi^0$ |
| 777 ±2 | 4943 | 35 ADAMS | 97 | E665 | | 470 $\mu p \rightarrow \mu XB$ |
| 770 ±2 | | 36 BOGOLYUB... | 97 | MIRA | | 32 $\bar{p}p \rightarrow \pi^+\pi^-\chi$ |
| 768 ±8 | | 36 BOGOLYUB... | 97 | MIRA | | 32 $pp \rightarrow \pi^+\pi^-\chi$ |
| 761.1±2.9 | | DUBNICKA | 89 | RVUE | | π form factor |
| 777.4±2.0 | | 37 CHABAUD | 83 | ASPK | 0 | 17 $\pi^- p$ polarized |
| 769.5±0.7 | | 30,31 LANG | 79 | RVUE | 0 | |
| 770 ±9 | | 31 ESTABROOKS | 74 | RVUE | 0 | 17 $\pi^- p \rightarrow \pi^+\pi^- n$ |
| 773.5±1.7 | 11200 | 24 JACOBS | 72 | HBC | 0 | 2.8 $\pi^- p$ |
| 775 ±3 | 2250 | HYAMS | 68 | OSPK | 0 | 11.2 $\pi^- p$ |



¹ A combined fit of AKHMETSHIN 07, AULCHENKO 06, and AULCHENKO 05.

² Supersedes ACHASOV 05A.

³ 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.

⁴ Using the GOUNARIS 68 parametrization with the complex phase of the ρ - ω interference.

⁵ Update of AKHMETSHIN 02.

⁶ Assuming $m_{\rho^+} = m_{\rho^-}$, $\Gamma_{\rho^+} = \Gamma_{\rho^-}$.

⁷ From the GOUNARIS 68 parametrization of the pion form factor.

⁸ Assuming $m_{\rho^+} = m_{\rho^-} = m_{\rho^0}$, $\Gamma_{\rho^+} = \Gamma_{\rho^-} = \Gamma_{\rho^0}$.

⁹ Without limitations on masses and widths.

¹⁰ Assuming $m_{\rho^0} = m_{\rho^\pm}$, $g_{\rho^0\pi\pi} = g_{\rho^\pm\pi\pi}$.

¹¹ Using the data of BARKOV 85 in the hidden local symmetry model.

- 12 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.
- 13 A fit of BARKOV 85 data assuming the direct $\omega\pi\pi$ coupling.
- 14 Applying the S-matrix formalism to the BARKOV 85 data.
- 15 Includes BARKOV 85 data. Model-dependent width definition.
- 16 $|F_\pi(0)|^2$ fixed to 1.
- 17 From the GOUNARIS 68 parametrization of the pion form factor.
- 18 The error combines statistical and systematic uncertainties. Supersedes BARATE 97M.
- 19 $\rho(1700)$ mass and width fixed at 1700 MeV and 235 MeV respectively.
- 20 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.
- 21 Using the data of BARATE 97M and the effective chiral Lagrangian.
- 22 From a fit of the model-independent parameterization of the pion form factor to the data of BARATE 97M.
- 23 Assuming the equality of ρ^+ and ρ^- masses and widths.
- 24 Mass errors enlarged by us to Γ/\sqrt{N} ; see the note with the $K^*(892)$ mass.
- 25 Phase shift analysis. Systematic errors added corresponding to spread of different fits.
- 26 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.
- 27 From the parametrization according to SOEDING 66.
- 28 From the parametrization according to ROSS 66.
- 29 HEYN 81 includes all spacelike and timelike F_π values until 1978.
- 30 From pole extrapolation.
- 31 From phase shift analysis of GRAYER 74 data.
- 32 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.
- 33 Breit-Wigner mass from a phase-shift analysis of HYAMS 73 and PROTOPOPESCU 73 data.
- 34 Using relativistic Breit-Wigner and taking into account ρ - ω interference.
- 35 Systematic errors not evaluated.
- 36 Systematic effects not studied.
- 37 From fit of 3-parameter relativistic Breit-Wigner to helicity-zero part of P -wave intensity. CHABAUD 83 includes data of GRAYER 74.

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

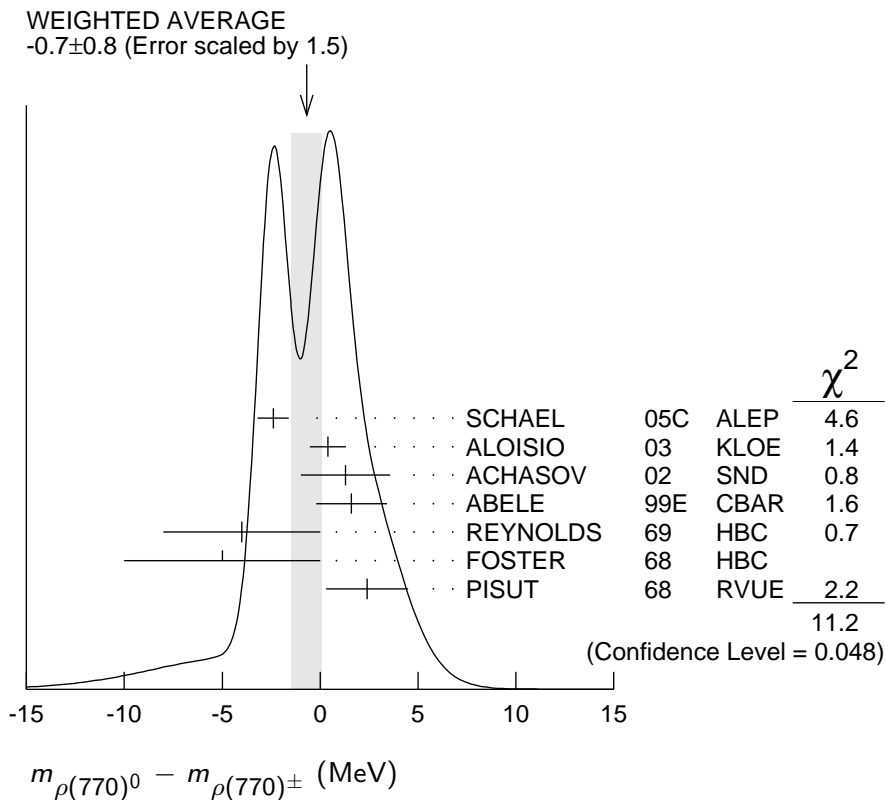
| <u>VALUE (MeV)</u> | <u>EVTS</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>CHG</u> | <u>COMMENT</u> |
|--|-------------|---|-------------|------------|---|
| -0.7 ± 0.8 OUR AVERAGE | | Error includes scale factor of 1.5. See the ideogram below. | | | |
| -2.4 ± 0.8 | | 38 SCHAEL | 05C | ALEP | $\tau^- \rightarrow \pi^- \pi^0 \nu_\tau$ |
| $0.4 \pm 0.7 \pm 0.6$ | 1.98M | 39 ALOISIO | 03 | KLOE | $1.02 e^+ e^- \rightarrow \pi^+ \pi^- \pi^0$ |
| $1.3 \pm 1.1 \pm 2.0$ | 500k | 39 ACHASOV | 02 | SND | $1.02 e^+ e^- \rightarrow \pi^+ \pi^- \pi^0$ |
| $1.6 \pm 0.6 \pm 1.7$ | 600k | ABELE | 99E | CBAR | $0.0 \bar{p} p \rightarrow \pi^+ \pi^- \pi^0$ |
| -4 ± 4 | 3000 | 40 REYNOLDS | 69 | HBC | -0 $2.26 \pi^- \rho$ |
| -5 ± 5 | 3600 | 40 FOSTER | 68 | HBC | ± 0 $0.0 \bar{p} p$ |
| 2.4 ± 2.1 | 22950 | 41 PISUT | 68 | RVUE | $\pi N \rightarrow \rho N$ |

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

39 Assuming $m_{\rho^+} = m_{\rho^-}$, $\Gamma_{\rho^+} = \Gamma_{\rho^-}$.

40 From quoted masses of charged and neutral modes.

41 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, GOLDBERGER 64, ABOLINS 63.



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

VALUE (MeV) EVTS DOCUMENT ID TECN COMMENT

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

$1.5 \pm 0.8 \pm 0.7$ 1.98M 42 ALOISIO 03 KLOE 1.02 $e^+e^- \rightarrow \pi^+\pi^-\pi^0$

42 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, $q = q_r$.

| <u>VALUE (GeV⁻¹)</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>CHG</u> | <u>COMMENT</u> | |
|--|--------------------|-------------|------------|----------------|------------------------|
| 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, $e^+ e^-$

| <u>VALUE (MeV)</u> | <u>EVTS</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>CHG</u> | <u>COMMENT</u> |
|---|-------------|-------------------------------------|-------------|------------|--|
| 146.2 ± 0.7 OUR AVERAGE | | Error includes scale factor of 1.1. | | | |
| 145.98 ± 0.75 ± 0.50 | 900k | 43 AKHMETSHIN 07 | | | $e^+ e^- \rightarrow \pi^+ \pi^-$ |
| 146.1 ± 0.8 ± 1.5 | 800k | 44,45 ACHASOV 06 | SND | | $e^+ e^- \rightarrow \pi^+ \pi^-$ |
| 143.85 ± 1.33 ± 0.80 | 114k | 46,47 AKHMETSHIN 04 | CMD2 | | $e^+ e^- \rightarrow \pi^+ \pi^-$ |
| 147.3 ± 1.5 ± 0.7 | 1.98M | 48 ALOISIO 03 | KLOE | | $1.02 e^+ e^- \rightarrow \pi^+ \pi^- \pi^0$ |
| 151.1 ± 2.6 ± 3.0 | 500k | 48 ACHASOV 02 | SND | 0 | $1.02 e^+ e^- \rightarrow \pi^+ \pi^- \pi^0$ |
| 150.5 ± 3.0 | | 49 BARKOV 85 | OLYA | 0 | $e^+ e^- \rightarrow \pi^+ \pi^-$ |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● | | | | | |
| 143.9 ± 1.3 ± 1.1 | 1.98M | 50 ALOISIO 03 | KLOE | | $1.02 e^+ e^- \rightarrow \pi^+ \pi^- \pi^0$ |
| 147.4 ± 1.5 ± 0.7 | 1.98M | 51 ALOISIO 03 | KLOE | | $1.02 e^+ e^- \rightarrow \pi^+ \pi^- \pi^0$ |
| 149.8 ± 2.2 ± 2.0 | 500k | 52 ACHASOV 02 | SND | | $1.02 e^+ e^- \rightarrow \pi^+ \pi^- \pi^0$ |
| 147.9 ± 1.5 ± 7.5 | | 53 BENAYOUN 98 | RVUE | | $e^+ e^- \rightarrow \pi^+ \pi^-, \mu^+ \mu^-$ |
| 153.5 ± 1.3 ± 4.6 | | 54 GARDNER 98 | RVUE | | $0.28-0.92 e^+ e^- \rightarrow \pi^+ \pi^-$ |
| 145.0 ± 1.7 | | 55 O'CONNELL 97 | RVUE | | $e^+ e^- \rightarrow \pi^+ \pi^-$ |
| 142.5 ± 3.5 | | 56 BERNICHA 94 | RVUE | | $e^+ e^- \rightarrow \pi^+ \pi^-$ |
| 138 ± 1 | | 57 GESHKEN... 89 | RVUE | | $e^+ e^- \rightarrow \pi^+ \pi^-$ |

CHARGED ONLY, τ DECAYS and $e^+ e^-$

| <u>VALUE (MeV)</u> | <u>EVTS</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>CHG</u> | <u>COMMENT</u> |
|--------------------------------|-------------|--------------------|-------------|------------|--|
| 149.1 ± 0.8 OUR FIT | | | | | |
| 149.1 ± 0.8 OUR AVERAGE | | | | | |
| 148.1 ± 0.4 ± 1.7 | 5.4M | 58,59 FUJIKAWA 08 | BELL | ± | $\tau^- \rightarrow \pi^- \pi^0 \nu_\tau$ |
| 149.0 ± 1.2 | | 59,60 SCHAELE 05C | ALEP | | $\tau^- \rightarrow \pi^- \pi^0 \nu_\tau$ |
| 149.9 ± 2.3 ± 2.0 | 500k | 48 ACHASOV 02 | SND | ± | $1.02 e^+ e^- \rightarrow \pi^+ \pi^- \pi^0$ |
| 150.4 ± 1.4 ± 1.4 | 87k | 61,62 ANDERSON 00A | CLE2 | | $\tau^- \rightarrow \pi^- \pi^0 \nu_\tau$ |

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

| | | | | | | | |
|---|-------|----|----------------|----|------|---|---|
| 143.7±1.3±1.2 | 1.98M | 48 | ALOISIO | 03 | KLOE | ± | 1.02 $e^+e^- \rightarrow \pi^+\pi^-\pi^0$ |
| 142.9±1.3±1.4 | 1.98M | 51 | ALOISIO | 03 | KLOE | - | 1.02 $e^+e^- \rightarrow \pi^+\pi^-\pi^0$ |
| 144.7±1.4±1.2 | 1.98M | 51 | ALOISIO | 03 | KLOE | + | 1.02 $e^+e^- \rightarrow \pi^+\pi^-\pi^0$ |
| 150.2±2.0 ^{+0.7} _{-1.6} | | 63 | SANZ-CILLERO03 | | RVUE | | $\tau^- \rightarrow \pi^-\pi^0\nu_\tau$ |
| 150.9±2.2±2.0 | 500k | 52 | ACHASOV | 02 | SND | | 1.02 $e^+e^- \rightarrow \pi^+\pi^-\pi^0$ |

MIXED CHARGES, OTHER REACTIONS

| VALUE (MeV) | EVTS | DOCUMENT ID | TECN | CHG | COMMENT |
|------------------|------|-------------|------|------|---|
| 149.5±1.3 | 600k | 64 ABELE | 99E | CBAR | 0± 0.0 $\bar{p}p \rightarrow \pi^+\pi^-\pi^0$ |

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 | $\bar{p}n \rightarrow \pi^-\pi^0\pi^0$ |
| 155 ±11 | 2935 | 65 CAPRARO | 87 | SPEC | - 200 $\pi^-\text{Cu} \rightarrow \pi^-\pi^0\text{Cu}$ |
| 154 ±20 | 967 | 65 CAPRARO | 87 | SPEC | - 200 $\pi^-\text{Pb} \rightarrow \pi^-\pi^0\text{Pb}$ |
| 150 ± 5 | | HUSTON | 86 | SPEC | + 202 $\pi^+\text{A} \rightarrow \pi^+\pi^0\text{A}$ |
| 146 ±12 | 6500 | 66 BYERLY | 73 | OSPK | - 5 π^-p |
| 148.2± 4.1 | 9650 | 67 PISUT | 68 | RVUE | - 1.7-3.2 $\pi^-p, t < 10$ |
| 146 ±13 | 900 | EISNER | 67 | HBC | - 4.2 $\pi^-p, t < 10$ |

NEUTRAL ONLY, PHOTOPRODUCED

| VALUE (MeV) | EVTS | DOCUMENT ID | TECN | CHG | COMMENT |
|---|------|--------------|------|------|---|
| 150.7± 2.9 OUR AVERAGE | | | | | |
| 146 ± 3 ±13 | 79k | 68 BREITWEG | 98B | ZEUS | 0 50-100 γp |
| 150.9± 3.0 | | BARTALUCCI | 78 | CNTR | 0 $\gamma p \rightarrow e^+e^-p$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | |
| 138 ± 3 | 79k | 69 BREITWEG | 98B | ZEUS | 0 50-100 γp |
| 147 ±11 | | GLADDING | 73 | CNTR | 0 2.9-4.7 γp |
| 155 ±12 | 2430 | BALLAM | 72 | HBC | 0 4.7 γp |
| 145 ±13 | 1930 | BALLAM | 72 | HBC | 0 2.8 γp |
| 140 ± 5 | | ALVENSLEB... | 70 | CNTR | 0 $\gamma A, t < 0.01$ |
| 146.1± 2.9 | 140k | BIGGS | 70 | CNTR | 0 <4.1 $\gamma C \rightarrow \pi^+\pi^-C$ |
| 160 ±10 | | LANZEROTTI | 68 | CNTR | 0 γp |
| 130 ± 5 | 4000 | ASBURY | 67B | CNTR | 0 $\gamma + \text{Pb}$ |

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 $\bar{p}p \rightarrow \pi^+\pi^-\pi^0$ |
| 145.7± 5.3 | | WEIDENAUER | 93 | ASTE | $\bar{p}p \rightarrow \pi^+\pi^-\omega$ |
| 144.9± 3.7 | | DUBNICKA | 89 | RVUE | π form factor |
| 148 ± 6 | 70,71 | BOHACIK | 80 | RVUE | 0 |

| | | | | | | |
|---|-------|---------------------------|-----|------|---|---|
| 152 ± 9 | | ⁶⁶ WICKLUND | 78 | ASPK | 0 | 3,4,6 $\pi^\pm p N$ |
| 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 | ⁷² ABELE | 99E | CBAR | 0 | 0.0 $\bar{p} p \rightarrow \pi^+ \pi^- \pi^0$ |
| 146 ± 3 | 4943 | ⁷³ ADAMS | 97 | E665 | | 470 $\mu p \rightarrow \mu X B$ |
| 160.0 ⁺ 4.1 - 4.0 | | ⁷⁴ CHABAUD | 83 | ASPK | 0 | 17 $\pi^- p$ polarized |
| 155 ± 1 | | ⁷⁵ HEYN | 81 | RVUE | 0 | π form factor |
| 148.0 ± 1.3 | | ^{70,71} LANG | 79 | RVUE | 0 | |
| 146 ± 14 | 4100 | ENGLER | 74 | DBC | 0 | 6 $\pi^+ n \rightarrow \pi^+ \pi^- p$ |
| 143 ± 13 | | ⁷¹ ESTABROOKS | 74 | RVUE | 0 | 17 $\pi^- p \rightarrow \pi^+ \pi^- n$ |
| 160 ± 10 | 32000 | ⁷⁰ PROTOPOP... | 73 | HBC | 0 | 7.1 $\pi^+ p, t < 0.4$ |
| 145 ± 12 | 2250 | ⁶⁵ HYAMS | 68 | OSPK | 0 | 11.2 $\pi^- p$ |
| 163 ± 15 | 13300 | ⁷⁶ PISUT | 68 | RVUE | 0 | 1.7–3.2 $\pi^- p, t < 10$ |

⁴³ A combined fit of AKHMETSHIN 07, AULCHENKO 06, and AULCHENKO 05.

⁴⁴ Supersedes ACHASOV 05A.

⁴⁵ 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.

⁴⁶ Using the GOUNARIS 68 parametrization with the complex phase of the ρ - ω interference.

⁴⁷ From a fit in the energy range 0.61 to 0.96 GeV. Update of AKHMETSHIN 02.

⁴⁸ Assuming $m_{\rho^+} = m_{\rho^-}$, $\Gamma_{\rho^+} = \Gamma_{\rho^-}$.

⁴⁹ From the GOUNARIS 68 parametrization of the pion form factor.

⁵⁰ Assuming $m_{\rho^+} = m_{\rho^-} = m_{\rho^0}$, $\Gamma_{\rho^+} = \Gamma_{\rho^-} = \Gamma_{\rho^0}$.

⁵¹ Without limitations on masses and widths.

⁵² Assuming $m_{\rho^0} = m_{\rho^\pm}$, $g_{\rho^0 \pi \pi} = g_{\rho^\pm \pi \pi}$.

⁵³ Using the data of BARKOV 85 in the hidden local symmetry model.

⁵⁴ 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.

⁵⁵ A fit of BARKOV 85 data assuming the direct $\omega \pi \pi$ coupling.

⁵⁶ Applying the S-matrix formalism to the BARKOV 85 data.

⁵⁷ Includes BARKOV 85 data. Model-dependent width definition.

⁵⁸ $|F_\pi(0)|^2$ fixed to 1.

⁵⁹ From the GOUNARIS 68 parametrization of the pion form factor.

⁶⁰ The error combines statistical and systematic uncertainties. Supersedes BARATE 97M.

⁶¹ $\rho(1700)$ mass and width fixed at 1700 MeV and 235 MeV respectively.

⁶² 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.

⁶³ Using the data of BARATE 97M and the effective chiral Lagrangian.

⁶⁴ Assuming the equality of ρ^+ and ρ^- masses and widths.

⁶⁵ Width errors enlarged by us to $4\Gamma/\sqrt{N}$; see the note with the $K^*(892)$ mass.

⁶⁶ Phase shift analysis. Systematic errors added corresponding to spread of different fits.

⁶⁷ 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.

⁶⁸ From the parametrization according to SOEDING 66.

⁶⁹ From the parametrization according to ROSS 66.

⁷⁰ From pole extrapolation.

⁷¹ From phase shift analysis of GRAYER 74 data.

- 72 Using relativistic Breit-Wigner and taking into account ρ - ω interference.
 73 Systematic errors not evaluated.
 74 From fit of 3-parameter relativistic Breit-Wigner to helicity-zero part of P -wave intensity. CHABAUD 83 includes data of GRAYER 74.
 75 HEYN 81 includes all spacelike and timelike F_π values until 1978.
 76 Includes MALAMUD 69, ARMENISE 68, BACON 67, HUWE 67, MILLER 67B, ALFF-STEINBERGER 66, HAGOPIAN 66, HAGOPIAN 66B, JACOBS 66B, JAMES 66, WEST 66, GOLDBABER 64, ABOLINS 63.

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

| VALUE | EVTS | DOCUMENT ID | TECN | COMMENT |
|----------------------------|-------|-------------------------------------|----------|--|
| 0.3±1.3 OUR AVERAGE | | Error includes scale factor of 1.4. | | |
| -0.2±1.0 | | ⁷⁷ SCHAEL | 05C ALEP | $\tau^- \rightarrow \pi^- \pi^0 \nu_\tau$ |
| 3.6±1.8±1.7 | 1.98M | ⁷⁸ ALOISIO | 03 KLOE | $1.02 e^+ e^- \rightarrow \pi^+ \pi^- \pi^0$ |

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

| VALUE | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------|-------|-----------------------|---------|--|
| 1.8±2.0±0.5 | 1.98M | ⁷⁹ ALOISIO | 03 KLOE | $1.02 e^+ e^- \rightarrow \pi^+ \pi^- \pi^0$ |

⁷⁷ 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.

⁷⁸ Assuming $m_{\rho^+} = m_{\rho^-}$, $\Gamma_{\rho^+} = \Gamma_{\rho^-}$.

⁷⁹ Without limitations on masses and widths.

$\rho(770)$ DECAY MODES

| Mode | Fraction (Γ_i/Γ) | Scale factor/ Confidence level |
|--------------------------|--------------------------------|-----------------------------------|
| $\Gamma_1 \quad \pi \pi$ | ~ 100 | % |

$\rho(770)^\pm$ decays

| | | |
|--|---------------|-------------------------|
| $\Gamma_2 \quad \pi^\pm \pi^0$ | ~ 100 | % |
| $\Gamma_3 \quad \pi^\pm \gamma$ | (4.5 ± 0.5) | $\times 10^{-4}$ S=2.2 |
| $\Gamma_4 \quad \pi^\pm \eta$ | < 6 | $\times 10^{-3}$ CL=84% |
| $\Gamma_5 \quad \pi^\pm \pi^+ \pi^- \pi^0$ | < 2.0 | $\times 10^{-3}$ CL=84% |

$\rho(770)^0$ decays

| | | |
|--|---------------------|------------------|
| $\Gamma_6 \quad \pi^+ \pi^-$ | ~ 100 | % |
| $\Gamma_7 \quad \pi^+ \pi^- \gamma$ | (9.9 ± 1.6) | $\times 10^{-3}$ |
| $\Gamma_8 \quad \pi^0 \gamma$ | (6.0 ± 0.8) | $\times 10^{-4}$ |
| $\Gamma_9 \quad \eta \gamma$ | (3.00 ± 0.20) | $\times 10^{-4}$ |
| $\Gamma_{10} \quad \pi^0 \pi^0 \gamma$ | (4.5 ± 0.8) | $\times 10^{-5}$ |
| $\Gamma_{11} \quad \mu^+ \mu^-$ | [a] (4.55 ± 0.28) | $\times 10^{-5}$ |

| | | | | |
|---------------|---------------------------|-----|-----------------------------------|-------------------------|
| Γ_{12} | $e^+ e^-$ | [a] | (4.72 ± 0.05) | $\times 10^{-5}$ |
| Γ_{13} | $\pi^+ \pi^- \pi^0$ | | $(1.01^{+0.54}_{-0.36} \pm 0.34)$ | $\times 10^{-4}$ |
| Γ_{14} | $\pi^+ \pi^- \pi^+ \pi^-$ | | (1.8 ± 0.9) | $\times 10^{-5}$ |
| Γ_{15} | $\pi^+ \pi^- \pi^0 \pi^0$ | | < 4 | $\times 10^{-5}$ CL=90% |
| Γ_{16} | $\pi^0 e^+ e^-$ | | < 1.2 | $\times 10^{-5}$ CL=90% |
| Γ_{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 $\langle \delta p_i \delta p_j \rangle / (\delta p_i \cdot \delta p_j)$, in percent, from the fit to parameters p_i , including the branching fractions, $x_i \equiv \Gamma_i / \Gamma_{\text{total}}$. The fit constrains the x_i whose labels appear in this array to sum to one.

$$\begin{array}{c}
 x_3 \\
 \Gamma
 \end{array}
 \begin{array}{|c}
 -100 \\
 \hline
 15 \quad -15 \\
 \hline
 x_2 \quad x_3
 \end{array}$$

| | 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 21 measurements and one constraint to determine 9 parameters. The overall fit has a $\chi^2 = 6.0$ for 13 degrees of freedom.

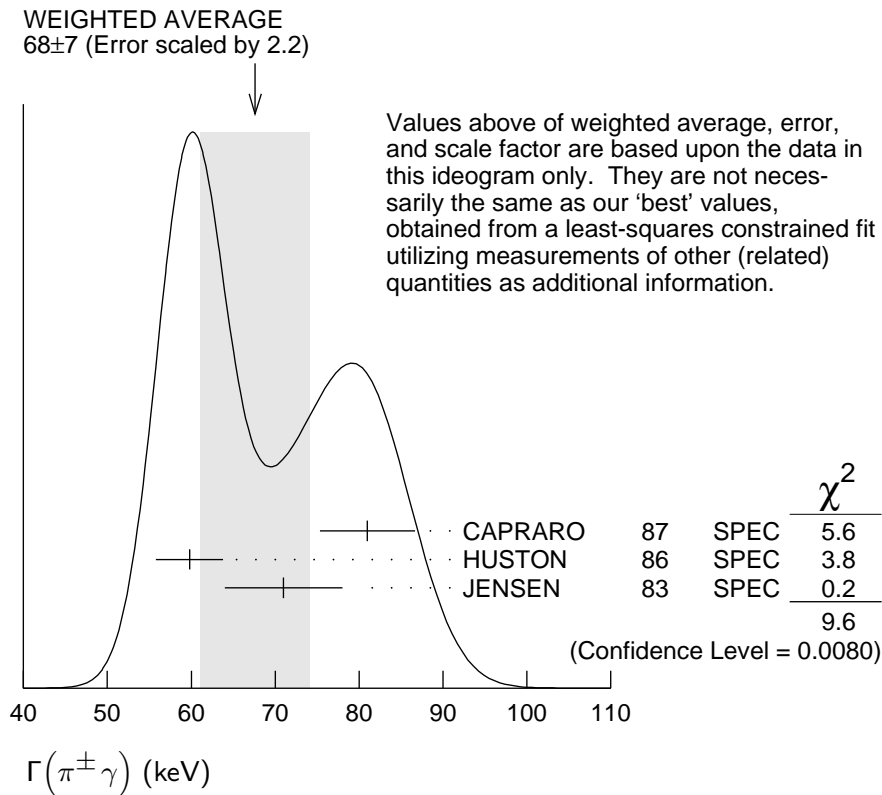
The following *off-diagonal* array elements are the correlation coefficients $\langle \delta p_i \delta p_j \rangle / (\delta p_i \cdot \delta p_j)$, in percent, from the fit to parameters p_i , including the branching fractions, $x_i \equiv \Gamma_i / \Gamma_{\text{total}}$. The fit constrains the x_i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

| | | | | | | | | |
|----------|-------|-------|-------|-------|----------|----------|----------|----------|
| x_7 | -100 | | | | | | | |
| x_8 | -5 | 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) |
|---------------------------------------|---------------------------|
| $\Gamma_6 \pi^+ \pi^-$ | 147.5 \pm 0.9 |
| $\Gamma_7 \pi^+ \pi^- \gamma$ | 1.48 \pm 0.24 |
| $\Gamma_8 \pi^0 \gamma$ | 0.089 \pm 0.012 |
| $\Gamma_9 \eta \gamma$ | 0.0447 \pm 0.0031 |
| $\Gamma_{10} \pi^0 \pi^0 \gamma$ | 0.0066 \pm 0.0012 |
| $\Gamma_{11} \mu^+ \mu^-$ | [a] 0.0068 \pm 0.0004 |
| $\Gamma_{12} e^+ e^-$ | [a] 0.00704 \pm 0.00006 |
| $\Gamma_{14} \pi^+ \pi^- \pi^+ \pi^-$ | 0.0027 \pm 0.0014 |

$\rho(770)$ PARTIAL WIDTHS

| $\Gamma(\pi^\pm \gamma)$ | | | | | | Γ_3 |
|--|---|------|------|---------|---|------------|
| VALUE (keV) | DOCUMENT ID | TECN | CHG | COMMENT | | |
| 68 \pm 7 OUR FIT | Error includes scale factor of 2.3. | | | | | |
| 68 \pm 7 OUR AVERAGE | Error includes scale factor of 2.2. See the ideogram below. | | | | | |
| 81 \pm 4 \pm 4 | CAPRARO | 87 | SPEC | - | 200 $\pi^- A \rightarrow \pi^- \pi^0 A$ | |
| 59.8 \pm 4.0 | HUSTON | 86 | SPEC | + | 202 $\pi^+ A \rightarrow \pi^+ \pi^0 A$ | |
| 71 \pm 7 | JENSEN | 83 | SPEC | - | 156-260 $\pi^- A \rightarrow \pi^- \pi^0 A$ | |



$\Gamma(e^+e^-)$

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 | ⁸⁰ AKHMETSHIN 07 | | $e^+e^- \rightarrow \pi^+\pi^-$ |
| 7.06 ±0.11 ±0.05 | 114k | ^{81,82} AKHMETSHIN 04 | CMD2 | $e^+e^- \rightarrow \pi^+\pi^-$ |
| 6.77 ±0.10 ±0.30 | | BARKOV 85 | OLYA | $e^+e^- \rightarrow \pi^+\pi^-$ |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● | | | | |
| 7.12 ±0.02 ±0.11 | 800k | ⁸³ ACHASOV 06 | SND | $e^+e^- \rightarrow \pi^+\pi^-$ |
| 6.3 ±0.1 | | ⁸⁴ BENAYOUN 98 | RVUE | $e^+e^- \rightarrow \pi^+\pi^-, \mu^+\mu^-$ |

$\Gamma(\pi^0\gamma)$

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 | ⁸⁵ ACHASOV 03 | SND | 0.60–0.97 $e^+e^- \rightarrow \pi^0\gamma$ |
| 121±31 | | DOLINSKY 89 | ND | $e^+e^- \rightarrow \pi^0\gamma$ |

$\Gamma(\eta\gamma)$

Γ_9

| VALUE (keV) | DOCUMENT ID | TECN | COMMENT |
|---|---------------------------|------|---------------------------------|
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● | | | |
| 62±17 | ⁸⁶ DOLINSKY 89 | ND | $e^+e^- \rightarrow \eta\gamma$ |

$\Gamma(\pi^+\pi^-\pi^+\pi^-)$ Γ_{14}

| VALUE (keV) | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------------|------|-------------|------|---------|
|-------------|------|-------------|------|---------|

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

| | | | | |
|-----------------------|-----|---------------|------|--|
| $2.8 \pm 1.4 \pm 0.5$ | 153 | AKHMETSHIN 00 | CMD2 | $0.6-0.97 e^+e^- \rightarrow \pi^+\pi^-\pi^+\pi^-$ |
|-----------------------|-----|---------------|------|--|

- ⁸⁰ A combined fit of AKHMETSHIN 07, AULCHENKO 06, and AULCHENKO 05.
⁸¹ Using the GOUNARIS 68 parametrization with the complex phase of the ρ - ω interference.
⁸² From a fit in the energy range 0.61 to 0.96 GeV. Update of AKHMETSHIN 02.
⁸³ Supersedes ACHASOV 05A.
⁸⁴ Using the data of BARKOV 85 in the hidden local symmetry model.
⁸⁵ Using $\Gamma_{\text{total}} = 147.9 \pm 1.3$ MeV and $B(\rho \rightarrow \pi^0\gamma)$ from ACHASOV 03.
⁸⁶ Solution corresponding to constructive ω - ρ interference.

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

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

| VALUE (units 10^{-5}) | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

| | | | | |
|---|------|--------------------------|----|-------------------------------------|
| $4.876 \pm 0.023 \pm 0.064$ | 800k | ^{87,88} ACHASOV | 06 | SND $e^+e^- \rightarrow \pi^+\pi^-$ |
|---|------|--------------------------|----|-------------------------------------|

- ⁸⁷ Supersedes ACHASOV 05A.
⁸⁸ 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.

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

| VALUE (units 10^{-8}) | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

1.42 ± 0.10 OUR FIT

1.45 ± 0.12 OUR AVERAGE

| | | | | |
|--------------------------|-------|-----------------------------|-----|--|
| $1.32 \pm 0.14 \pm 0.08$ | 33k | ⁸⁹ ACHASOV | 07B | SND $0.6-1.38 e^+e^- \rightarrow \eta\gamma$ |
| $1.50 \pm 0.65 \pm 0.09$ | 17.4k | ⁹⁰ AKHMETSHIN | 05 | CMD2 $0.60-1.38 e^+e^- \rightarrow \eta\gamma$ |
| $1.61 \pm 0.20 \pm 0.11$ | 23k | ^{91,92} AKHMETSHIN | 01B | CMD2 $e^+e^- \rightarrow \eta\gamma$ |
| 1.85 ± 0.49 | | ⁹³ DOLINSKY | 89 | ND $e^+e^- \rightarrow \eta\gamma$ |

- ⁸⁹ From a combined fit of $\sigma(e^+e^- \rightarrow \eta\gamma)$ with $\eta \rightarrow 3\pi^0$ and $\eta \rightarrow \pi^+\pi^-\pi^0$, and fixing $B(\eta \rightarrow 3\pi^0) / B(\eta \rightarrow \pi^+\pi^-\pi^0) = 1.44 \pm 0.04$. Recalculated by us from the cross section at the peak. Supersedes ACHASOV 00D and ACHASOV 06A.
⁹⁰ From the $\eta \rightarrow 2\gamma$ decay and using $B(\eta \rightarrow \gamma\gamma) = 39.43 \pm 0.26\%$.
⁹¹ From the $\eta \rightarrow 3\pi^0$ decay and using $B(\eta \rightarrow 3\pi^0) = (32.24 \pm 0.29) \times 10^{-2}$.
⁹² 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).
⁹³ Recalculated by us from the cross section in the peak.

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

| VALUE (units 10^{-8}) | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

2.8 ± 0.4 OUR FIT

2.8 ± 0.4 OUR AVERAGE

| | | | | |
|---------------------------------|-------|------------------------|----|---|
| $2.90^{+0.60}_{-0.55} \pm 0.18$ | 18680 | AKHMETSHIN | 05 | CMD2 $0.60-1.38 e^+e^- \rightarrow \pi^0\gamma$ |
| $2.37 \pm 0.53 \pm 0.33$ | 36500 | ⁹⁴ ACHASOV | 03 | SND $0.60-0.97 e^+e^- \rightarrow \pi^0\gamma$ |
| $3.61 \pm 0.74 \pm 0.49$ | 10625 | ⁹⁵ DOLINSKY | 89 | ND $e^+e^- \rightarrow \pi^0\gamma$ |

- ⁹⁴ Using $\sigma_{\phi \rightarrow \pi^0\gamma}$ from ACHASOV 00 and $m_\rho = 775.97$ MeV in the model with the energy-independent phase of ρ - ω interference equal to $(-10.2 \pm 7.0)^\circ$.
⁹⁵ Recalculated by us from the cross section in the peak.

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

VALUE (units 10^{-9}) EVTS DOCUMENT ID TECN COMMENT

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

4.58^{+2.46}_{-1.64} ± 1.56 1.2M ⁹⁶ACHASOV 03D RVUE 0.44–2.00 $e^+e^- \rightarrow \pi^+\pi^-\pi^0$

⁹⁶Statistical significance in less than 3 σ .

$\rho(770)$ BRANCHING RATIOS

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

VALUE (units 10^{-4}) CL% DOCUMENT ID TECN CHG COMMENT

<60 84 FERBEL 66 HBC ± $\pi^\pm p$ above 2.5

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

VALUE (units 10^{-4}) CL% DOCUMENT ID TECN CHG COMMENT

<20 84 FERBEL 66 HBC ± $\pi^\pm p$ above 2.5

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

35 ± 40 JAMES 66 HBC + 2.1 $\pi^+ p$

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

VALUE (units 10^{-5}) DOCUMENT ID TECN COMMENT

4.60 ± 0.28 OUR FIT

4.6 ± 0.2 ± 0.2 ANTIPOV 89 SIGM $\pi^- \text{Cu} \rightarrow \mu^+ \mu^- \pi^- \text{Cu}$

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

8.2^{+1.6}_{-3.6} ⁹⁷ROTHWELL 69 CNTR Photoproduction

5.6 ± 1.5 ⁹⁸WEHMANN 69 OSPK 12 $\pi^- \text{C, Fe}$

9.7^{+3.1}_{-3.3} ⁹⁹HYAMS 67 OSPK 11 $\pi^- \text{Li, H}$

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

VALUE (units 10^{-4}) DOCUMENT ID TECN COMMENT

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

0.40 ± 0.05 ¹⁰⁰BENAKSAS 72 OSPK $e^+e^- \rightarrow \pi^+\pi^-$

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

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 ¹⁰¹ACHASOV 07B SND 0.6–1.38 $e^+e^- \rightarrow \eta\gamma$

3.6 ± 0.9 ¹⁰²ANDREWS 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^{103,104} AKHMETSHIN 05 CMD2 0.60–1.38 $e^+e^- \rightarrow \eta\gamma$

3.39 ± 0.42 ± 0.23 ^{102,105,106} AKHMETSHIN 01B CMD2 $e^+e^- \rightarrow \eta\gamma$

1.9^{+0.6}_{-0.8} ¹⁰⁷BENAYOUN 96 RVUE 0.54–1.04 $e^+e^- \rightarrow \eta\gamma$

4.0 ± 1.1 ^{102,104}DOLINSKY 89 ND $e^+e^- \rightarrow \eta\gamma$

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

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

$\Gamma(\pi^+\pi^-\pi^+\pi^-)/\Gamma(\pi\pi)$ 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 $\pi^+ p$ |

$\Gamma(\pi^+\pi^-\pi^0)/\Gamma_{\text{total}}$ 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. • • • | | | | | |
| $1.01^{+0.54}_{-0.36} \pm 0.34$ | | 1.2M | 108 ACHASOV | 03D RVUE | 0.44-2.00 $e^+e^- \rightarrow \pi^+\pi^-\pi^0$ |
| <1.2 | 90 | | VASSERMAN 88B | ND | $e^+e^- \rightarrow \pi^+\pi^-\pi^0$ |

$\Gamma(\pi^+\pi^-\pi^0)/\Gamma(\pi\pi)$ 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 | $J/\psi \rightarrow \omega\pi^0$ |
| <0.01 | 84 | 109 ABRAMS 71 | HBC | 0 | 3.7 $\pi^+ p$ |

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

| VALUE (units 10^{-4}) | CL% | DOCUMENT ID | TECN | CHG | COMMENT |
|---|-----|---------------|------|-----|---|
| <0.4 | 90 | AULCHENKO 87C | ND | 0 | $e^+e^- \rightarrow \pi^+\pi^-\pi^0\pi^0$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | |
| <2 | 90 | KURDADZE 86 | OLYA | 0 | $e^+e^- \rightarrow \pi^+\pi^-\pi^0\pi^0$ |

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

| VALUE | CL% | DOCUMENT ID | TECN | COMMENT |
|---|-----|------------------|------|---------------------------------------|
| 0.0099 ± 0.0016 OUR FIT | | | | |
| 0.0099 ± 0.0016 | | 110 DOLINSKY 91 | ND | $e^+e^- \rightarrow \pi^+\pi^-\gamma$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 0.0111 ± 0.0014 | | 111 VASSERMAN 88 | ND | $e^+e^- \rightarrow \pi^+\pi^-\gamma$ |
| <0.005 | 90 | 112 VASSERMAN 88 | ND | $e^+e^- \rightarrow \pi^+\pi^-\gamma$ |

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

| <u>VALUE (units 10^{-4})</u> | <u>EVTS</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|---|--------------------------|--------------------|-------------|--|
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● | | | | |
| $6.21^{+1.28}_{-1.18} \pm 0.39$ | 18680 ^{113,114} | AKHMETSHIN 05 | CMD2 | $0.60-1.38 e^+ e^- \rightarrow \pi^0 \gamma$ |
| $5.22 \pm 1.17 \pm 0.75$ | 36500 ^{114,115} | ACHASOV 03 | SND | $0.60-0.97 e^+ e^- \rightarrow \pi^0 \gamma$ |
| 6.8 ± 1.7 | 116 | BENAYOUN 96 | RVUE | $0.54-1.04 e^+ e^- \rightarrow \pi^0 \gamma$ |
| 7.9 ± 2.0 | 114 | DOLINSKY 89 | ND | $e^+ e^- \rightarrow \pi^0 \gamma$ |

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

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

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

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

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

| <u>VALUE (units 10^{-5})</u> | <u>EVTS</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|---|-------------|--------------------|-------------|--|
| 4.5 ± 0.8 OUR FIT | | | | |
| 4.5^{+0.9}_{-0.8} OUR AVERAGE | | | | |
| $5.2^{+1.5}_{-1.3} \pm 0.6$ | 190 | 117 AKHMETSHIN 04B | CMD2 | $0.6-0.97 e^+ e^- \rightarrow \pi^0 \pi^0 \gamma$ |
| $4.1^{+1.0}_{-0.9} \pm 0.3$ | 295 | 118 ACHASOV 02F | SND | $0.36-0.97 e^+ e^- \rightarrow \pi^0 \pi^0 \gamma$ |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● | | | | |
| $4.8^{+3.4}_{-1.8} \pm 0.5$ | 63 | 119 ACHASOV 00G | SND | $e^+ e^- \rightarrow \pi^0 \pi^0 \gamma$ |

⁹⁷ Possibly large ρ - ω interference leads us to increase the minus error.
⁹⁸ Result contains $11 \pm 11\%$ 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 $\omega \rightarrow \mu^+ \mu^-$ from this experiment.
⁹⁹ HYAMS 67's mass resolution is 20 MeV. The ω region was excluded.
¹⁰⁰ The ρ' contribution is not taken into account.
¹⁰¹ ACHASOV 07B reports $[\Gamma(\rho(770) \rightarrow \eta\gamma)/\Gamma_{\text{total}}] \times [\text{B}(\rho(770) \rightarrow e^+ e^-)] = (1.32 \pm 0.14 \pm 0.08) \times 10^{-8}$. We divide by our best value $\text{B}(\rho(770) \rightarrow e^+ e^-) = (4.72 \pm 0.05) \times 10^{-5}$. 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.
¹⁰² Solution corresponding to constructive ω - ρ interference.
¹⁰³ Using $\text{B}(\rho \rightarrow e^+ e^-) = (4.67 \pm 0.09) \times 10^{-5}$ and $\text{B}(\eta \rightarrow \gamma\gamma) = 39.43 \pm 0.26\%$.
¹⁰⁴ Not independent of the corresponding $\Gamma(e^+ e^-) \times \Gamma(\eta\gamma)/\Gamma_{\text{total}}^2$.

- 105 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).
- 106 Using $B(\rho \rightarrow e^+ e^-) = (4.75 \pm 0.10) \times 10^{-5}$ from AKHMETSHIN 02 and $B(\eta \rightarrow 3\pi^0) = (32.24 \pm 0.29) \times 10^{-2}$.
- 107 Reanalysis of DRUZHININ 84, DOLINSKY 89, and DOLINSKY 91 taking into account a triangle anomaly contribution. Constructive ρ - ω interference solution.
- 108 Statistical significance is less than 3σ .
- 109 Model dependent, assumes $l = 1, 2, \text{ or } 3$ for the 3π system.
- 110 Bremsstrahlung from a decay pion and for photon energy above 50 MeV.
- 111 Superseded by DOLINSKY 91.
- 112 Structure radiation due to quark rearrangement in the decay.
- 113 Using $B(\rho \rightarrow e^+ e^-) = (4.67 \pm 0.09) \times 10^{-5}$.
- 114 Not independent of the corresponding $\Gamma(e^+ e^-) \times \Gamma(\pi^0 \gamma) / \Gamma_{\text{total}}^2$.
- 115 Using $B(\rho \rightarrow e^+ e^-) = (4.54 \pm 0.10) \times 10^{-5}$.
- 116 Reanalysis of DRUZHININ 84, DOLINSKY 89, and DOLINSKY 91 taking into account a triangle anomaly contribution.
- 117 This branching ratio includes the conventional VMD mechanism $\rho \rightarrow \omega \pi^0$, $\omega \rightarrow \pi^0 \gamma$, and the new decay mode $\rho \rightarrow f_0(600) \gamma$, $f_0(600) \rightarrow \pi^0 \pi^0$ with a branching ratio $(2.0^{+1.1}_{-0.9} \pm 0.3) \times 10^{-5}$ differing from zero by 2.0 standard deviations.
- 118 This branching ratio includes the conventional VMD mechanism $\rho \rightarrow \omega \pi^0$, $\omega \rightarrow \pi^0 \gamma$ and the new decay mode $\rho \rightarrow f_0(600) \gamma$, $f_0(600) \rightarrow \pi^0 \pi^0$ 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.
- 119 Superseded by ACHASOV 02F.

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| MARCO | 99 | PL B470 20 | E. Marco <i>et al.</i> | |
| ROOS | 99 | APS 49 N2 vii | M. Roos | |
| ALEMANY | 98 | EPJ C2 123 | R. Alemany <i>et al.</i> | |
| ABELE | 97B | PL B402 195 | A. Abele <i>et al.</i> | (Crystal Barrel Collab.) |
| ABELE | 97F | PL B411 354 | A. Abele <i>et al.</i> | (Crystal Barrel Collab.) |
| BIJNENS | 96 | PL B374 210 | J. Bijnens <i>et al.</i> | (NORD, BERN, WIEN+) |
| BENAYOUN | 93 | ZPHY C58 31 | M. Benayoun <i>et al.</i> | (CDEF, CERN, BARI) |
| LAFFERTY | 93 | ZPHY C60 659 | G.D. Lafferty | (MCHS) |
| KAMAL | 92 | PL B284 421 | A.N. Kamal, Q.P. Xu | (ALBE) |
| KUHN | 90 | ZPHY C48 445 | J.H. Kuhn <i>et al.</i> | (MPIM) |

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|----------|----|-------------------------------|---------------------------------------|--------------------|
| ERKAL | 85 | ZPHY C29 485 | C. Erkal, M.G. Olsson | (WISC) |
| RYBICKI | 85 | ZPHY C28 65 | K. Rybicki, I. Sakrejda | (CRAC) |
| KURDADZE | 83 | JETPL 37 733 | L.M. Kurdadze <i>et al.</i> | (NOVO) |
| ALEKSEEV | 82 | Translated from JETP 55 591 | E.A. Alekseeva <i>et al.</i> | (KIAE) |
| KENNEY | 62 | Translated from ZETFP 37 613. | | |
| SAMIOS | 62 | PR 126 736 | V.P. Kenney, W.D. Shephard, C.D. Gall | (KNTY) |
| XUONG | 62 | PRL 9 139 | N.P. Samios <i>et al.</i> | (BNL, CUNY, COLU+) |
| ANDERSON | 61 | PR 128 1849 | H. Nguyen Ngoc, G.R. Lynch | (LRL) |
| ERWIN | 61 | PRL 6 365 | J.A. Anderson <i>et al.</i> | (LRL) |
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