

$\phi(1020)$

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

$\phi(1020)$ MASS

| VALUE (MeV) | EVTS | DOCUMENT ID | TECN | COMMENT |
|---|-------|-------------------------------------|------|---|
| 1019.461 ± 0.019 OUR AVERAGE | | Error includes scale factor of 1.1. | | |
| 1019.51 ± 0.02 ± 0.05 | | ¹ LEES 13Q | BABR | $e^+e^- \rightarrow K^+K^-\gamma$ |
| 1019.30 ± 0.02 ± 0.10 | 105k | AKHMETSHIN 06 | CMD2 | 0.98–1.06 $e^+e^- \rightarrow \pi^+\pi^-\pi^0$ |
| 1019.52 ± 0.05 ± 0.05 | 17.4k | AKHMETSHIN 05 | CMD2 | 0.60–1.38 $e^+e^- \rightarrow \pi^+\pi^-\pi^0$ |
| 1019.483 ± 0.011 ± 0.025 | 272k | ² AKHMETSHIN 04 | CMD2 | $e^+e^- \rightarrow K_L^0 K_S^0$ |
| 1019.42 ± 0.05 | 1900k | ³ ACHASOV 01E | SND | $e^+e^- \rightarrow K^+K^-$, $K_S^0 K_L^0$, $\pi^+\pi^-\pi^0$ |
| 1019.40 ± 0.04 ± 0.05 | 23k | AKHMETSHIN 01B | CMD2 | $e^+e^- \rightarrow \eta\gamma$ |
| 1019.36 ± 0.12 | | ⁴ ACHASOV 00B | SND | $e^+e^- \rightarrow \eta\gamma$ |
| 1019.38 ± 0.07 ± 0.08 | 2200 | ⁵ AKHMETSHIN 99F | CMD2 | $e^+e^- \rightarrow \pi^+\pi^- \geq 2\gamma$ |
| 1019.51 ± 0.07 ± 0.10 | 11169 | AKHMETSHIN 98 | CMD2 | $e^+e^- \rightarrow \pi^+\pi^-\pi^0$ |
| 1019.5 ± 0.4 | | BARBERIS 98 | OMEG | 450 $pp \rightarrow pp2K^+2K^-$ |
| 1019.42 ± 0.06 | 55600 | AKHMETSHIN 95 | CMD2 | $e^+e^- \rightarrow$ hadrons |
| 1019.7 ± 0.3 | 2012 | DAVENPORT 86 | MPSF | 400 $pA \rightarrow 4KX$ |
| 1019.7 ± 0.1 ± 0.1 | 5079 | ALBRECHT 85D | ARG | 10 $e^+e^- \rightarrow K^+K^-X$ |
| 1019.3 ± 0.1 | 1500 | ARENTON 82 | AEMS | 11.8 polar. $pp \rightarrow KK$ |
| 1019.67 ± 0.17 | 25080 | ⁶ PELLINEN 82 | RVUE | |
| 1019.52 ± 0.13 | 3681 | BUKIN 78C | OLYA | $e^+e^- \rightarrow$ hadrons |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● | | | | |
| 1019.48 ± 0.01 | | LEES 13F | BABR | $D^+ \rightarrow K^+K^-\pi^+$ |
| 1019.441 ± 0.008 ± 0.080 | 542k | ⁷ AKHMETSHIN 08 | CMD2 | 1.02 $e^+e^- \rightarrow K^+K^-$ |
| 1019.63 ± 0.07 | 12540 | ⁸ AUBERT,B 05J | BABR | $D^0 \rightarrow \bar{K}^0 K^+K^-$ |
| 1019.8 ± 0.7 | | ARMSTRONG 86 | OMEG | 85 $\pi^+/pp \rightarrow \pi^+/p4Kp$ |
| 1020.1 ± 0.11 | 5526 | ⁸ ATKINSON 86 | OMEG | 20–70 γp |
| 1019.7 ± 1.0 | | BEBEK 86 | CLEO | $e^+e^- \rightarrow \Upsilon(4S)$ |
| 1019.411 ± 0.008 | 642k | ⁹ DIJKSTRA 86 | SPEC | 100–200 $\pi^\pm, \bar{p}, p, K^\pm$, on Be |
| 1020.9 ± 0.2 | | ⁸ FRAME 86 | OMEG | 13 $K^+p \rightarrow \phi K^+p$ |
| 1021.0 ± 0.2 | | ⁸ ARMSTRONG 83B | OMEG | 18.5 $K^-p \rightarrow K^-K^+\Lambda$ |
| 1020.0 ± 0.5 | | ⁸ ARMSTRONG 83B | OMEG | 18.5 $K^-p \rightarrow K^-K^+\Lambda$ |
| 1019.7 ± 0.3 | | ⁸ BARATE 83 | GOLI | 190 $\pi^-Be \rightarrow 2\mu X$ |
| 1019.8 ± 0.2 ± 0.5 | 766 | IVANOV 81 | OLYA | 1–1.4 $e^+e^- \rightarrow K^+K^-$ |
| 1019.4 ± 0.5 | 337 | COOPER 78B | HBC | 0.7–0.8 $\bar{p}p \rightarrow K_S^0 K_L^0 \pi^+ \pi^-$ |

| | | | | | | |
|--------|-----------|-----|---------------------------|-----|------|--|
| 1020 | ± 1 | 383 | ⁸ BALDI | 77 | CNTR | 10 $\pi^- p \rightarrow \pi^- \phi p$ |
| 1018.9 | ± 0.6 | 800 | COHEN | 77 | ASPK | 6 $\pi^\pm N \rightarrow K^+ K^- N$ |
| 1019.7 | ± 0.5 | 454 | KALBFLEISCH | 76 | HBC | 2.18 $K^- p \rightarrow \Lambda K \bar{K}$ |
| 1019.4 | ± 0.8 | 984 | BESCH | 74 | CNTR | 2 $\gamma p \rightarrow p K^+ K^-$ |
| 1020.3 | ± 0.4 | 100 | BALLAM | 73 | HBC | 2.8–9.3 γp |
| 1019.4 | ± 0.7 | | BINNIE | 73B | CNTR | $\pi^- p \rightarrow \phi n$ |
| 1019.6 | ± 0.5 | 120 | ¹⁰ AGUILAR-... | 72B | HBC | 3.9,4.6 $K^- p \rightarrow \Lambda K^+ K^-$ |
| 1019.9 | ± 0.5 | 100 | ¹⁰ AGUILAR-... | 72B | HBC | 3.9,4.6 $K^- p \rightarrow K^- p K^+ K^-$ |
| 1020.4 | ± 0.5 | 131 | COLLEY | 72 | HBC | 10 $K^+ p \rightarrow K^+ p \phi$ |
| 1019.9 | ± 0.3 | 410 | STOTTLE... | 71 | HBC | 2.9 $K^- p \rightarrow \Sigma / \Lambda K \bar{K}$ |

¹ Using a phenomenological model based on KUHN 90 with a sum of Breit-Wigner resonances for $\rho(770)$, $\omega(782)$, $\phi(1020)$ and their higher mass excitations.

² Update of AKHMETSHIN 99D

³ From the combined fit assuming that the total $\phi(1020)$ production cross section is saturated by those of $K^+ K^-$, $K_S K_L$, $\pi^+ \pi^- \pi^0$, and $\eta \gamma$ decays modes and using ACHASOV 00B for the $\eta \gamma$ decay mode.

⁴ Using a total width of 4.43 ± 0.05 MeV. Systematic uncertainty included.

⁵ Using a total width of 4.43 ± 0.05 MeV.

⁶ PELLINEN 82 review includes AKERLOF 77, DAUM 81, BALDI 77, AYRES 74, DE-GROOT 74.

⁷ Strongly correlated with AKHMETSHIN 04.

⁸ Systematic errors not evaluated.

⁹ Weighted and scaled average of 12 measurements of DIJKSTRA 86.

¹⁰ Mass errors enlarged by us to Γ/\sqrt{N} ; see the note with the $K^*(892)$ mass.

$\phi(1020)$ WIDTH

| VALUE (MeV) | EVTS | DOCUMENT ID | TECN | COMMENT |
|----------------------------------|-------|-------------------------------------|----------|---|
| 4.266 ± 0.031 OUR AVERAGE | | Error includes scale factor of 1.2. | | |
| 4.29 ± 0.04 ± 0.07 | | ¹ LEES | 13Q BABR | $e^+ e^- \rightarrow K^+ K^- \gamma$ |
| 4.30 ± 0.06 ± 0.17 | 105k | AKHMETSHIN 06 | CMD2 | 0.98–1.06 $e^+ e^- \rightarrow \pi^+ \pi^- \pi^0$ |
| 4.280 ± 0.033 ± 0.025 | 272k | ² AKHMETSHIN 04 | CMD2 | $e^+ e^- \rightarrow K_L^0 K_S^0$ |
| 4.21 ± 0.04 | 1900k | ³ ACHASOV | 01E SND | $e^+ e^- \rightarrow K^+ K^-, K_S K_L, \pi^+ \pi^- \pi^0$ |
| 4.44 ± 0.09 | 55600 | AKHMETSHIN 95 | CMD2 | $e^+ e^- \rightarrow$ hadrons |
| 4.5 ± 0.7 | 1500 | ARENTON | 82 AEMS | 11.8 polar. $pp \rightarrow K K$ |
| 4.2 ± 0.6 | 766 | ⁴ IVANOV | 81 OLYA | 1–1.4 $e^+ e^- \rightarrow K^+ K^-$ |
| 4.3 ± 0.6 | | ⁴ CORDIER | 80 DM1 | $e^+ e^- \rightarrow \pi^+ \pi^- \pi^0$ |
| 4.36 ± 0.29 | 3681 | ⁴ BUKIN | 78C OLYA | $e^+ e^- \rightarrow$ hadrons |
| 4.4 ± 0.6 | 984 | ⁴ BESCH | 74 CNTR | 2 $\gamma p \rightarrow p K^+ K^-$ |
| 4.67 ± 0.72 | 681 | ⁴ BALAKIN | 71 OSPK | $e^+ e^- \rightarrow$ hadrons |
| 4.09 ± 0.29 | | BIZOT | 70 OSPK | $e^+ e^- \rightarrow$ hadrons |

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

| | | | | | |
|------------------|-------|-------------------------|-----|------|---|
| 4.37 ±0.02 | | LEES | 13F | BABR | $D^+ \rightarrow K^+ K^- \pi^+$ |
| 4.24 ±0.02 ±0.03 | 542k | ⁵ AKHMETSHIN | 08 | CMD2 | $1.02 e^+ e^- \rightarrow K^+ K^-$ |
| 4.28 ±0.13 | 12540 | ⁶ AUBERT,B | 05J | BABR | $D^0 \rightarrow \bar{K}^0 K^+ K^-$ |
| 4.45 ±0.06 | 271k | DIJKSTRA | 86 | SPEC | $100 \pi^- \text{Be}$ |
| 3.6 ±0.8 | 337 | ⁴ COOPER | 78B | HBC | $0.7\text{--}0.8 \bar{p} p \rightarrow$ $K_S^0 K_L^0 \pi^+ \pi^-$ |
| 4.5 ±0.50 | 1300 | ^{4,6} AKERLOF | 77 | SPEC | $400 p A \rightarrow K^+ K^- X$ |
| 4.5 ±0.8 | 500 | ^{4,6} AYRES | 74 | ASPK | $3\text{--}6 \pi^- p \rightarrow$ $K^+ K^- n, K^- p \rightarrow$ $K^+ K^- \Lambda / \Sigma^0$ |
| 3.81 ±0.37 | | COSME | 74B | OSPK | $e^+ e^- \rightarrow K_L^0 K_S^0$ |
| 3.8 ±0.7 | 454 | ⁴ BORENSTEIN | 72 | HBC | $2.18 K^- p \rightarrow K \bar{K} n$ |

¹Using a phenomenological model based on KUHN 90 with a sum of Breit-Wigner resonances for $\rho(770)$, $\omega(782)$, $\phi(1020)$ and their higher mass excitations.

²Update of AKHMETSHIN 99D

³From the combined fit assuming that the total $\phi(1020)$ production cross section is saturated by those of $K^+ K^-$, $K_S K_L$, $\pi^+ \pi^- \pi^0$, and $\eta\gamma$ decays modes and using ACHASOV 00B for the $\eta\gamma$ decay mode.

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

⁵Strongly correlated with AKHMETSHIN 04.

⁶Systematic errors not evaluated.

$\phi(1020)$ DECAY MODES

| Mode | Fraction (Γ_i/Γ) | Scale factor/ Confidence level |
|--|--|-----------------------------------|
| Γ_1 $K^+ K^-$ | (48.9 ±0.5) % | S=1.1 |
| Γ_2 $K_L^0 K_S^0$ | (34.2 ±0.4) % | S=1.1 |
| Γ_3 $\rho\pi + \pi^+ \pi^- \pi^0$ | (15.32 ±0.32) % | S=1.1 |
| Γ_4 $\rho\pi$ | | |
| Γ_5 $\pi^+ \pi^- \pi^0$ | | |
| Γ_6 $\eta\gamma$ | (1.309±0.024) % | S=1.2 |
| Γ_7 $\pi^0\gamma$ | (1.27 ±0.06) × 10 ⁻³ | |
| Γ_8 $\ell^+ \ell^-$ | — | |
| Γ_9 $e^+ e^-$ | (2.954±0.030) × 10 ⁻⁴ | S=1.1 |
| Γ_{10} $\mu^+ \mu^-$ | (2.87 ±0.19) × 10 ⁻⁴ | |
| Γ_{11} $\eta e^+ e^-$ | (1.15 ±0.10) × 10 ⁻⁴ | |
| Γ_{12} $\pi^+ \pi^-$ | (7.4 ±1.3) × 10 ⁻⁵ | |
| Γ_{13} $\omega\pi^0$ | (4.7 ±0.5) × 10 ⁻⁵ | |
| Γ_{14} $\omega\gamma$ | < 5 % | CL=84% |
| Γ_{15} $\rho\gamma$ | < 1.2 × 10 ⁻⁵ | CL=90% |
| Γ_{16} $\pi^+ \pi^- \gamma$ | (4.1 ±1.3) × 10 ⁻⁵ | |
| Γ_{17} $f_0(980)\gamma$ | (3.22 ±0.19) × 10 ⁻⁴ | S=1.1 |
| Γ_{18} $\pi^0\pi^0\gamma$ | (1.13 ±0.06) × 10 ⁻⁴ | |
| Γ_{19} $\pi^+ \pi^- \pi^+ \pi^-$ | (4.0 ^{+2.8} _{-2.2}) × 10 ⁻⁶ | |

| | | | | |
|---------------|-----------------------------------|---------------------|------------------|--------|
| Γ_{20} | $\pi^+\pi^+\pi^-\pi^-\pi^0$ | < 4.6 | $\times 10^{-6}$ | CL=90% |
| Γ_{21} | $\pi^0 e^+ e^-$ | (1.12 ± 0.28) | $\times 10^{-5}$ | |
| Γ_{22} | $\pi^0 \eta \gamma$ | (7.27 ± 0.30) | $\times 10^{-5}$ | S=1.5 |
| Γ_{23} | $a_0(980) \gamma$ | (7.6 ± 0.6) | $\times 10^{-5}$ | |
| Γ_{24} | $K^0 \bar{K}^0 \gamma$ | < 1.9 | $\times 10^{-8}$ | CL=90% |
| Γ_{25} | $\eta'(958) \gamma$ | (6.25 ± 0.21) | $\times 10^{-5}$ | |
| Γ_{26} | $\eta \pi^0 \pi^0 \gamma$ | < 2 | $\times 10^{-5}$ | CL=90% |
| Γ_{27} | $\mu^+ \mu^- \gamma$ | (1.4 ± 0.5) | $\times 10^{-5}$ | |
| Γ_{28} | $\rho \gamma \gamma$ | < 1.2 | $\times 10^{-4}$ | CL=90% |
| Γ_{29} | $\eta \pi^+ \pi^-$ | < 1.8 | $\times 10^{-5}$ | CL=90% |
| Γ_{30} | $\eta \mu^+ \mu^-$ | < 9.4 | $\times 10^{-6}$ | CL=90% |
| Γ_{31} | $\eta U \rightarrow \eta e^+ e^-$ | < 1 | $\times 10^{-6}$ | CL=90% |

Lepton Family number (LF) violating modes

| | | | | | |
|---------------|-----------------|------|-------|------------------|--------|
| Γ_{32} | $e^\pm \mu^\mp$ | LF | < 2 | $\times 10^{-6}$ | CL=90% |
|---------------|-----------------|------|-------|------------------|--------|

CONSTRAINED FIT INFORMATION

An overall fit to 30 branching ratios uses 79 measurements and one constraint to determine 14 parameters. The overall fit has a $\chi^2 = 57.4$ for 66 degrees of freedom.

The following *off-diagonal* array elements are the correlation coefficients $\langle \delta x_i \delta x_j \rangle / (\delta x_i \delta x_j)$, in percent, from the fit to 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_2 | -72 | | | | | | | | | |
| x_3 | -53 | -21 | | | | | | | | |
| x_6 | -13 | 7 | 2 | | | | | | | |
| x_7 | -5 | 3 | 1 | 5 | | | | | | |
| x_9 | 30 | -25 | -10 | -32 | -15 | | | | | |
| x_{10} | -4 | 3 | 1 | 3 | 2 | -11 | | | | |
| x_{12} | -2 | 1 | 0 | 2 | 1 | -5 | 1 | | | |
| x_{13} | -2 | 2 | 1 | 2 | 1 | -7 | 1 | 0 | | |
| x_{17} | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| x_{18} | -6 | 4 | 2 | 17 | 3 | -17 | 2 | 1 | 1 | 0 |
| x_{19} | 0 | 0 | 0 | 0 | 0 | -1 | 0 | 0 | 0 | 0 |
| x_{23} | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| x_{25} | -4 | 2 | 1 | 32 | 2 | -10 | 1 | 1 | 1 | 0 |
| | x_1 | x_2 | x_3 | x_6 | x_7 | x_9 | x_{10} | x_{12} | x_{13} | x_{17} |

| | | | |
|----------|----------|----------|----------|
| x_{19} | 0 | | |
| x_{23} | 0 | 0 | |
| x_{25} | 5 | 0 | 0 |
| | x_{18} | x_{19} | x_{23} |

$\phi(1020)$ PARTIAL WIDTHS

$\Gamma(\eta\gamma)$ Γ_6

| VALUE (keV) | DOCUMENT ID | TECN | COMMENT |
|---|-------------|------|-------------------------------------|
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● | | | |
| $58.9 \pm 0.5 \pm 2.4$ | ACHASOV | 00 | SND $e^+e^- \rightarrow \eta\gamma$ |

$\Gamma(\pi^0\gamma)$ Γ_7

| VALUE (keV) | DOCUMENT ID | TECN | COMMENT |
|---|-------------|------|--------------------------------------|
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● | | | |
| $5.40 \pm 0.16^{+0.43}_{-0.40}$ | ACHASOV | 00 | SND $e^+e^- \rightarrow \pi^0\gamma$ |

$\Gamma(\ell^+\ell^-)$ Γ_8

| VALUE (keV) | DOCUMENT ID | TECN | COMMENT |
|---|------------------------|------|---|
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● | | | |
| $1.320 \pm 0.017 \pm 0.015$ | ¹ AMBROSINO | 05 | KLOE $1.02 e^+e^- \rightarrow \mu^+\mu^-$ |

$\Gamma(e^+e^-)$ Γ_9

| VALUE (keV) | DOCUMENT ID | TECN | COMMENT |
|--|-------------------------|------|---------------------------------------|
| 1.27 ± 0.04 OUR EVALUATION | | | |
| 1.251 ± 0.021 OUR AVERAGE Error includes scale factor of 1.1. | | | |
| $1.235 \pm 0.006 \pm 0.022$ | ² AKHMETSHIN | 11 | CMD2 $1.02 e^+e^- \rightarrow \phi$ |
| $1.32 \pm 0.05 \pm 0.03$ | ³ AMBROSINO | 05 | KLOE $1.02 e^+e^- \rightarrow e^+e^-$ |
| 1.28 ± 0.05 | AKHMETSHIN | 95 | CMD2 $1.02 e^+e^- \rightarrow \phi$ |

$(\Gamma(e^+e^-) \times \Gamma(\mu^+\mu^-))^{1/2}$ $(\Gamma_9\Gamma_{10})^{1/2}$

| VALUE (keV) | DOCUMENT ID | TECN | COMMENT |
|------------------------------|-------------|------|---|
| 1.320 ± 0.018 ± 0.017 | AMBROSINO | 05 | KLOE $1.02 e^+e^- \rightarrow \mu^+\mu^-$ |

¹ Weighted average of Γ_{ee} and $\sqrt{\Gamma_{ee}\Gamma_{\mu\mu}}$ from AMBROSINO 05 assuming lepton universality.

² Combined analysis of the CMD-2 data on $\phi \rightarrow K^+K^-, K_S^0 K_L^0, \pi^+\pi^-\pi^0, \eta\gamma$ assuming that the sum of their branching fractions is 0.99741 ± 0.00007 .

³ From forward-backward asymmetry and using $\Gamma_{\text{total}} = 4.26 \pm 0.05$ MeV from the 2004 edition of this Review.

$\phi(1020) \Gamma(i)\Gamma(e^+e^-)/\Gamma(\text{total})$

$\Gamma(K^+K^-) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \qquad \Gamma_1\Gamma_9/\Gamma$

| VALUE (keV) | DOCUMENT ID | TECN | COMMENT |
|-----------------------------|-------------------|----------|-----------------------------------|
| 0.6340±0.0070±0.0039 | ¹ LEES | 13Q BABR | $e^+e^- \rightarrow K^+K^-\gamma$ |

¹ Using a phenomenological model based on KUHN 90 with a sum of Breit-Wigner resonances for $\rho(770)$, $\omega(782)$, $\phi(1020)$ and their higher mass excitations. The first error combines statistical and systematic uncertainties. The second one is due to the parametrization of the charged kaon form factor and mass calibration.

$\phi(1020) \Gamma(i)\Gamma(e^+e^-)/\Gamma^2(\text{total})$

$\Gamma(K^+K^-)/\Gamma_{\text{total}} \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \qquad \Gamma_1/\Gamma \times \Gamma_9/\Gamma$

| VALUE (units 10^{-5}) | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------------------------------|-------|----------------------|---------|---|
| 14.46±0.23 OUR FIT | | | | Error includes scale factor of 1.1. |
| 14.24±0.30 OUR AVERAGE | | | | |
| 14.27±0.05±0.31 | 542k | AKHMETSHIN 08 | CMD2 | 1.02 $e^+e^- \rightarrow K^+K^-$ |
| 13.93±0.14±0.99 | 1000k | ¹ ACHASOV | 01E SND | $e^+e^- \rightarrow K^+K^-$, $K_S K_L, \pi^+\pi^-\pi^0$ |

$\Gamma(K_L^0 K_S^0)/\Gamma_{\text{total}} \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \qquad \Gamma_2/\Gamma \times \Gamma_9/\Gamma$

| VALUE (units 10^{-5}) | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------------------------------|------|----------------------------|---------|---|
| 10.10±0.13 OUR FIT | | | | |
| 10.06±0.16 OUR AVERAGE | | | | |
| 10.01±0.04±0.17 | 272k | ² AKHMETSHIN 04 | CMD2 | $e^+e^- \rightarrow K_L^0 K_S^0$ |
| 10.27±0.07±0.34 | 500k | ¹ ACHASOV | 01E SND | $e^+e^- \rightarrow K^+K^-$, $K_S K_L, \pi^+\pi^-\pi^0$ |

$[\Gamma(\rho\pi) + \Gamma(\pi^+\pi^-\pi^0)]/\Gamma_{\text{total}} \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \qquad \Gamma_3/\Gamma \times \Gamma_9/\Gamma$

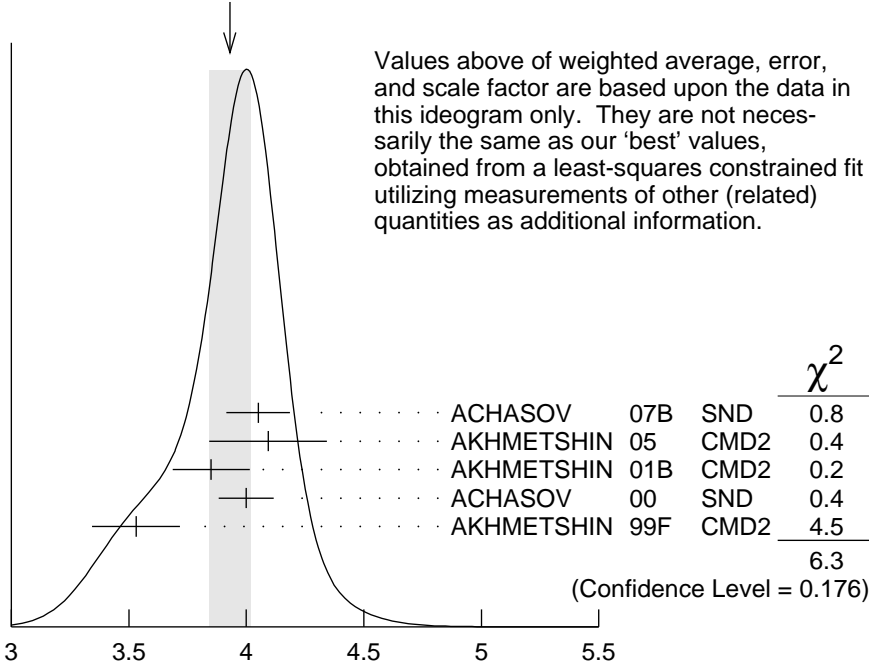
| VALUE (units 10^{-5}) | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------------------------------|-------|----------------------------|----------|---|
| 4.53 ±0.10 OUR FIT | | | | Error includes scale factor of 1.1. |
| 4.46 ±0.12 OUR AVERAGE | | | | |
| 4.51 ±0.16 ±0.11 | 105k | AKHMETSHIN 06 | CMD2 | 0.98–1.06 $e^+e^- \rightarrow$ $\pi^+\pi^-\pi^0$ |
| 4.30 ±0.08 ±0.21 | | AUBERT,B | 04N BABR | 10.6 $e^+e^- \rightarrow$ $\pi^+\pi^-\pi^0\gamma$ |
| 4.665±0.042±0.261 | 400k | ¹ ACHASOV | 01E SND | $e^+e^- \rightarrow K^+K^-$, $K_S K_L, \pi^+\pi^-\pi^0$ |
| 4.35 ±0.27 ±0.08 | 11169 | ³ AKHMETSHIN 98 | CMD2 | $e^+e^- \rightarrow \pi^+\pi^-\pi^0$ |
| 4.38 ±0.12 | | BENAYOUN | 10 RVUE | 0.4–1.05 e^+e^- |

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

$\Gamma(\eta\gamma)/\Gamma_{\text{total}} \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$ $\Gamma_6/\Gamma \times \Gamma_9/\Gamma$

| VALUE (units 10^{-6}) | EVTS | DOCUMENT ID | TECN | COMMENT |
|---|-------|--------------------------------|------|---|
| 3.87 ± 0.07 OUR FIT | | | | Error includes scale factor of 1.2. |
| 3.93 ± 0.09 OUR AVERAGE | | | | Error includes scale factor of 1.3. See the ideogram below. |
| 4.050 ± 0.067 ± 0.118 | 33k | ⁴ ACHASOV 07B | SND | 0.6–1.38 $e^+e^- \rightarrow \eta\gamma$ |
| 4.093 ^{+0.040} _{-0.043} ± 0.247 | 17.4k | ⁵ AKHMETSHIN 05 | CMD2 | 0.60–1.38 $e^+e^- \rightarrow \eta\gamma$ |
| 3.850 ± 0.041 ± 0.159 | 23k | ^{6,7} AKHMETSHIN 01B | CMD2 | $e^+e^- \rightarrow \eta\gamma$ |
| 4.00 ± 0.04 ± 0.11 | | ⁸ ACHASOV 00 | SND | $e^+e^- \rightarrow \eta\gamma$ |
| 3.53 ± 0.08 ± 0.17 | 2200 | ^{9,10} AKHMETSHIN 99F | CMD2 | $e^+e^- \rightarrow \eta\gamma$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 4.19 ± 0.06 | | ¹¹ BENAYOUN 10 | RVUE | 0.4–1.05 e^+e^- |

WEIGHTED AVERAGE
3.93±0.09 (Error scaled by 1.3)



$\Gamma(\eta\gamma)/\Gamma_{\text{total}} \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$ $\Gamma_6/\Gamma \times \Gamma_9/\Gamma$

$\Gamma(\pi^0\gamma)/\Gamma_{\text{total}} \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$ $\Gamma_7/\Gamma \times \Gamma_9/\Gamma$

| VALUE (units 10^{-7}) | EVTS | DOCUMENT ID | TECN | COMMENT |
|---|-------|---------------------------|------|--|
| 3.74 ± 0.18 OUR FIT | | | | |
| 3.71 ± 0.21 OUR AVERAGE | | | | |
| 3.75 ± 0.11 ± 0.29 | 18680 | AKHMETSHIN 05 | CMD2 | 0.60–1.38 $e^+e^- \rightarrow \pi^0\gamma$ |
| 3.67 ± 0.10 ^{+0.27} _{-0.25} | | ¹² ACHASOV 00 | SND | $e^+e^- \rightarrow \pi^0\gamma$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 4.29 ± 0.11 | | ¹¹ BENAYOUN 10 | RVUE | 0.4–1.05 e^+e^- |

$\Gamma(\mu^+ \mu^-)/\Gamma_{\text{total}} \times \Gamma(e^+ e^-)/\Gamma_{\text{total}}$ $\Gamma_{10}/\Gamma \times \Gamma_9/\Gamma$

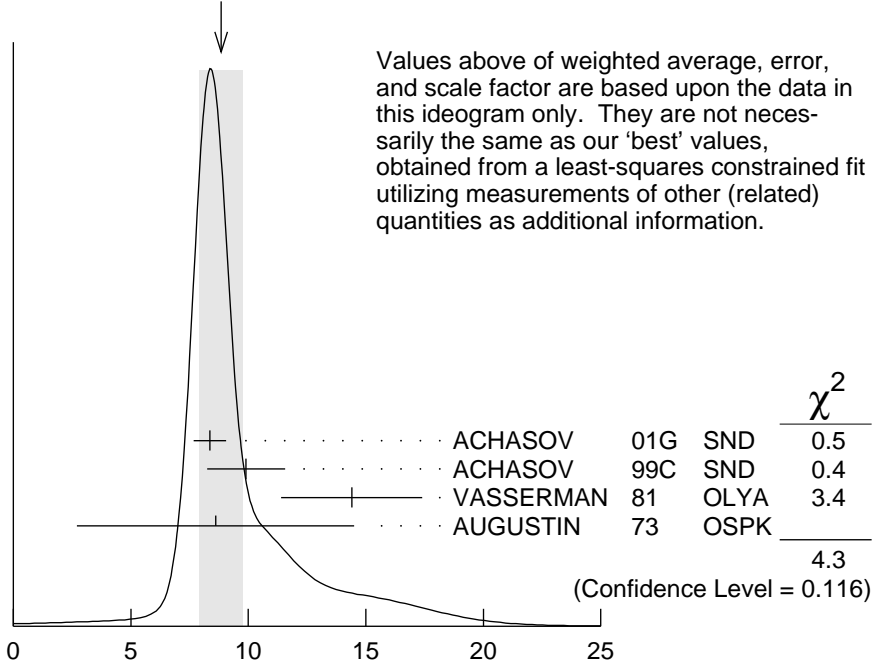
VALUE (units 10^{-8}) DOCUMENT ID TECN COMMENT

8.5 $^{+0.5}_{-0.6}$ OUR FIT

8.8 ± 0.9 OUR AVERAGE Error includes scale factor of 1.5. See the ideogram below.

| | | | | |
|--------------------------|------------------------|-----|------|-----------------------------------|
| 8.36 $\pm 0.59 \pm 0.37$ | ACHASOV | 01G | SND | $e^+ e^- \rightarrow \mu^+ \mu^-$ |
| 9.9 $\pm 1.4 \pm 0.9$ | ⁹ ACHASOV | 99C | SND | $e^+ e^- \rightarrow \mu^+ \mu^-$ |
| 14.4 ± 3.0 | ³ VASSERMAN | 81 | OLYA | $e^+ e^- \rightarrow \mu^+ \mu^-$ |
| 8.6 ± 5.9 | ³ AUGUSTIN | 73 | OSPK | $e^+ e^- \rightarrow \mu^+ \mu^-$ |

WEIGHTED AVERAGE
8.8 ± 0.9 (Error scaled by 1.5)



$\Gamma(\mu^+ \mu^-)/\Gamma_{\text{total}} \times \Gamma(e^+ e^-)/\Gamma_{\text{total}}$ $\Gamma_{10}/\Gamma \times \Gamma_9/\Gamma$

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

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

2.2 ± 0.4 OUR FIT

2.2 ± 0.4 OUR AVERAGE

| | | | | |
|-------------------------|------------------------|-----|------|-----------------------------------|
| 2.1 $\pm 0.3 \pm 0.3$ | ⁹ ACHASOV | 00C | SND | $e^+ e^- \rightarrow \pi^+ \pi^-$ |
| 1.95 $^{+1.15}_{-0.87}$ | ³ GOLUBEV | 86 | ND | $e^+ e^- \rightarrow \pi^+ \pi^-$ |
| 6.01 $^{+3.19}_{-2.51}$ | ³ VASSERMAN | 81 | OLYA | $e^+ e^- \rightarrow \pi^+ \pi^-$ |

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

| | | | | |
|-----------------|------------------------|----|------|--------------------|
| 3.31 ± 0.99 | ¹³ BENAYOUN | 13 | RVUE | 0.4–1.05 $e^+ e^-$ |
|-----------------|------------------------|----|------|--------------------|

$\Gamma(\omega \pi^0)/\Gamma_{\text{total}} \times \Gamma(e^+ e^-)/\Gamma_{\text{total}}$ $\Gamma_{13}/\Gamma \times \Gamma_9/\Gamma$

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

1.40 ± 0.15 OUR FIT

| | | | | |
|--|----------------------------|-----|------|---|
| 1.37 $\pm 0.17 \pm 0.01$ | ^{14,15} AMBROSINO | 08G | KLOE | $e^+ e^- \rightarrow \pi^+ \pi^- 2\pi^0, 2\pi^0 \gamma$ |
|--|----------------------------|-----|------|---|

$$\Gamma(\pi^0\pi^0\gamma)/\Gamma_{\text{total}} \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \qquad \Gamma_{18}/\Gamma \times \Gamma_9/\Gamma$$

| VALUE (units 10^{-8}) | DOCUMENT ID | TECN | COMMENT |
|---|----------------------------|------|---------------------------------------|
| 3.34±0.17 OUR FIT | | | |
| 3.33^{+0.04+0.19}_{-0.09-0.20} | ¹⁶ AMBROSINO 07 | KLOE | $e^+e^- \rightarrow \pi^0\pi^0\gamma$ |

$$\Gamma(\pi^+\pi^-\pi^+\pi^-)/\Gamma_{\text{total}} \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \qquad \Gamma_{19}/\Gamma \times \Gamma_9/\Gamma$$

| VALUE (units 10^{-9}) | EVTS | DOCUMENT ID | TECN | COMMENT |
|--|------|-----------------------------|------|---|
| 1.2^{+0.8}_{-0.7} OUR FIT | | | | |
| 1.17±0.52±0.64 | 3285 | ⁹ AKHMETSHIN 00E | CMD2 | $e^+e^- \rightarrow \pi^+\pi^-\pi^+\pi^-$ |

¹ From the combined fit assuming that the total $\phi(1020)$ production cross section is saturated by those of K^+K^- , $K_S K_L$, $\pi^+\pi^-\pi^0$, and $\eta\gamma$ decays modes and using ACHASOV 00B for the $\eta\gamma$ decay mode.

² Update of AKHMETSHIN 99D

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

⁴ 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.

⁵ From the $\eta \rightarrow 2\gamma$ decay and using $B(\eta \rightarrow \gamma\gamma) = 39.43 \pm 0.26\%$.

⁶ From the $\eta \rightarrow 3\pi^0$ decay and using $B(\eta \rightarrow 3\pi^0) = (32.24 \pm 0.29) \times 10^{-2}$.

⁷ 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).

⁸ From the $\eta \rightarrow 2\gamma$ decay and using $B(\eta \rightarrow 2\gamma) = (39.21 \pm 0.34) \times 10^{-2}$.

⁹ Recalculated by the authors from the cross section in the peak.

¹⁰ From the $\eta \rightarrow \pi^+\pi^-\pi^0$ decay and using $B(\eta \rightarrow \pi^+\pi^-\pi^0) = (23.1 \pm 0.5) \times 10^{-2}$.

¹¹ A simultaneous fit of $e^+e^- \rightarrow \pi^+\pi^-$, $\pi^+\pi^-\pi^0$, $\pi^0\gamma$, $\eta\gamma$ data.

¹² From the $\pi^0 \rightarrow 2\gamma$ decay and using $B(\pi^0 \rightarrow 2\gamma) = (98.798 \pm 0.032) \times 10^{-2}$.

¹³ A simultaneous fit to $e^+e^- \rightarrow \pi^+\pi^-$, $\pi^+\pi^-\pi^0$, $\pi^0\gamma$, $\eta\gamma$, $K\bar{K}$, and $\tau^- \rightarrow \pi^-\pi^0\nu_\tau$ data.

¹⁴ Recalculated by the authors from the cross section at the peak.

¹⁵ AMBROSINO 08G reports $[\Gamma(\phi(1020) \rightarrow \omega\pi^0)/\Gamma_{\text{total}} \times \Gamma(\phi(1020) \rightarrow e^+e^-)/\Gamma_{\text{total}}] \times [B(\omega(782) \rightarrow \pi^+\pi^-\pi^0)] = (1.22 \pm 0.13 \pm 0.08) \times 10^{-8}$ which we divide by our best value $B(\omega(782) \rightarrow \pi^+\pi^-\pi^0) = (89.2 \pm 0.7) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

¹⁶ Calculated by the authors from the cross section at the peak.

$\phi(1020)$ BRANCHING RATIOS

$$\Gamma(K^+K^-)/\Gamma_{\text{total}} \qquad \Gamma_1/\Gamma$$

| VALUE | EVTS | DOCUMENT ID | TECN | COMMENT |
|---|-------|----------------------------|------|---|
| 0.489±0.005 OUR FIT | | | | Error includes scale factor of 1.1. |
| 0.493±0.010 OUR AVERAGE | | | | |
| 0.492±0.012 | 2913 | AKHMETSHIN 95 | CMD2 | $e^+e^- \rightarrow K^+K^-$ |
| 0.44 ±0.05 | 321 | KALBFLEISCH 76 | HBC | 2.18 $K^-p \rightarrow \Lambda K^+K^-$ |
| 0.49 ±0.06 | 270 | DEGROOT 74 | HBC | 4.2 $K^-p \rightarrow \Lambda\phi$ |
| 0.540±0.034 | 565 | BALAKIN 71 | OSPK | $e^+e^- \rightarrow K^+K^-$ |
| 0.48 ±0.04 | 252 | LINDSEY 66 | HBC | 2.1–2.7 $K^-p \rightarrow \Lambda K^+K^-$ |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● | | | | |
| 0.493±0.003±0.007 | | ¹ AKHMETSHIN 11 | CMD2 | 1.02 $e^+e^- \rightarrow K^+K^-$ |
| 0.476±0.017 | 1000k | ² ACHASOV 01E | SND | $e^+e^- \rightarrow K^+K^-, K_S K_L, \pi^+\pi^-\pi^0$ |

$\Gamma(K_L^0 K_S^0)/\Gamma_{\text{total}}$ Γ_2/Γ

| VALUE | EVTS | DOCUMENT ID | TECN | COMMENT |
|---|-------|----------------------------|------|--|
| 0.342±0.004 OUR FIT | | | | Error includes scale factor of 1.1. |
| 0.331±0.009 OUR AVERAGE | | | | |
| 0.335±0.010 | 40644 | AKHMETSHIN 95 | CMD2 | $e^+e^- \rightarrow K_L^0 K_S^0$ |
| 0.326±0.035 | | DOLINSKY 91 | ND | $e^+e^- \rightarrow K_L^0 K_S^0$ |
| 0.310±0.024 | | DRUZHININ 84 | ND | $e^+e^- \rightarrow K_L^0 K_S^0$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 0.336±0.002±0.006 | | ¹ AKHMETSHIN 11 | CMD2 | 1.02 $e^+e^- \rightarrow K_S^0 K_L^0$ |
| 0.351±0.013 | 500k | ² ACHASOV 01E | SND | $e^+e^- \rightarrow K^+ K^-, K_S^0 K_L^0, \pi^+ \pi^- \pi^0$ |
| 0.27 ±0.03 | 133 | KALBFLEISCH 76 | HBC | 2.18 $K^- p \rightarrow \Lambda K_L^0 K_S^0$ |
| 0.257±0.030 | 95 | BALAKIN 71 | OSPK | $e^+e^- \rightarrow K_L^0 K_S^0$ |
| 0.40 ±0.04 | 167 | LINDSEY 66 | HBC | 2.1–2.7 $K^- p \rightarrow \Lambda K_L^0 K_S^0$ |

$\Gamma(K_L^0 K_S^0)/\Gamma(K^+ K^-)$ Γ_2/Γ_1

| VALUE | EVTS | DOCUMENT ID | TECN | COMMENT |
|---|------|----------------------------|---------|---|
| 0.698±0.014 OUR FIT | | | | Error includes scale factor of 1.1. |
| 0.740±0.031 OUR AVERAGE | | | | |
| 0.70 ±0.06 | 2732 | BUKIN 78c | OLYA | $e^+e^- \rightarrow K_L^0 K_S^0$ |
| 0.82 ±0.08 | | LOSTY 78 | HBC | 4.2 $K^- p \rightarrow \phi$ hyperon |
| 0.71 ±0.05 | | LAVEN 77 | HBC | 10 $K^- p \rightarrow K^+ K^- \Lambda$ |
| 0.71 ±0.08 | | LYONS 77 | HBC | 3–4 $K^- p \rightarrow \Lambda \phi$ |
| 0.89 ±0.10 | 144 | AGUILAR-... | 72B HBC | 3.9,4.6 $K^- p$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 0.68 ±0.03 | | ³ AKHMETSHIN 95 | CMD2 | $e^+e^- \rightarrow K_L^0 K_S^0, K^+ K^-$ |

$\Gamma(K_L^0 K_S^0)/\Gamma(K\bar{K})$ $\Gamma_2/(\Gamma_1+\Gamma_2)$

| VALUE | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------------------------------|------|-------------|------|---|
| 0.411±0.005 OUR FIT | | | | Error includes scale factor of 1.1. |
| 0.45 ±0.04 OUR AVERAGE | | | | |
| 0.44 ±0.07 | | LONDON 66 | HBC | 2.24 $K^- p \rightarrow \Lambda K\bar{K}$ |
| 0.48 ±0.07 | 52 | BADIER 65B | HBC | 3 $K^- p$ |
| 0.40 ±0.10 | 34 | SCHLEIN 63 | HBC | 1.95 $K^- p \rightarrow \Lambda K\bar{K}$ |

$[\Gamma(\rho\pi) + \Gamma(\pi^+ \pi^- \pi^0)]/\Gamma_{\text{total}}$ Γ_3/Γ

| VALUE | EVTS | DOCUMENT ID | TECN | COMMENT |
|---|-------|----------------------------|------|--|
| 0.1532±0.0032 OUR FIT | | | | Error includes scale factor of 1.1. |
| 0.151 ±0.009 OUR AVERAGE | | | | Error includes scale factor of 1.7. |
| 0.161 ±0.008 | 11761 | AKHMETSHIN 95 | CMD2 | $e^+e^- \rightarrow \pi^+ \pi^- \pi^0$ |
| 0.143 ±0.007 | | DOLINSKY 91 | ND | $e^+e^- \rightarrow \pi^+ \pi^- \pi^0$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 0.155 ±0.002 ±0.005 | | ¹ AKHMETSHIN 11 | CMD2 | 1.02 $e^+e^- \rightarrow \pi^+ \pi^- \pi^0$ |
| 0.159 ±0.008 | 400k | ² ACHASOV 01E | SND | $e^+e^- \rightarrow K^+ K^-, K_S^0 K_L^0, \pi^+ \pi^- \pi^0$ |
| 0.145 ±0.009 ±0.003 | 11169 | ⁴ AKHMETSHIN 98 | CMD2 | $e^+e^- \rightarrow \pi^+ \pi^- \pi^0$ |
| 0.139 ±0.007 | | ⁵ PARROUR 76B | OSPK | e^+e^- |

$[\Gamma(\rho\pi) + \Gamma(\pi^+\pi^-\pi^0)]/\Gamma(K^+K^-)$ Γ_3/Γ_1

| VALUE | EVTS | DOCUMENT ID | TECN | COMMENT |
|----------------------------|------|-------------|---------|-------------------------------------|
| 0.313±0.009 OUR FIT | | | | Error includes scale factor of 1.1. |
| 0.28 ±0.09 | 34 | AGUILAR-... | 72B HBC | 3.9,4.6 K^-p |

$[\Gamma(\rho\pi) + \Gamma(\pi^+\pi^-\pi^0)]/\Gamma(K\bar{K})$ $\Gamma_3/(\Gamma_1+\Gamma_2)$

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------------------------------|-------------|------|---|
| 0.184±0.005 OUR FIT | | | Error includes scale factor of 1.1. |
| 0.24 ±0.04 OUR AVERAGE | | | |
| 0.237±0.039 | CERRADA 77B | HBC | 4.2 $K^-p \rightarrow \Lambda 3\pi$ |
| 0.30 ±0.15 | LONDON 66 | HBC | 2.24 $K^-p \rightarrow \Lambda \pi^+\pi^-\pi^0$ |

$[\Gamma(\rho\pi) + \Gamma(\pi^+\pi^-\pi^0)]/\Gamma(K_L^0 K_S^0)$ Γ_3/Γ_2

| VALUE | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------------------------------|------|-------------|------|---|
| 0.448±0.012 OUR FIT | | | | Error includes scale factor of 1.1. |
| 0.51 ±0.05 OUR AVERAGE | | | | |
| 0.56 ±0.07 | 3681 | BUKIN 78C | OLYA | $e^+e^- \rightarrow K_L^0 K_S^0, \pi^+\pi^-\pi^0$ |
| 0.47 ±0.06 | 516 | COSME 74 | OSPK | $e^+e^- \rightarrow \pi^+\pi^-\pi^0$ |

$\Gamma(\pi^+\pi^-\pi^0)/\Gamma_{total}$ Γ_5/Γ

| VALUE | CL% | EVTS | DOCUMENT ID | TECN | COMMENT |
|---|-----|-------|---------------------------|------|---|
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● | | | | | |
| ≈ 0.0087 | | 1.98M | ^{6,7} ALOISIO 03 | KLOE | 1.02 $e^+e^- \rightarrow \pi^+\pi^-\pi^0$ |
| <0.0006 | 90 | | ⁸ ACHASOV 02 | SND | 1.02 $e^+e^- \rightarrow \pi^+\pi^-\pi^0$ |
| <0.23 | 90 | | ⁸ CORDIER 80 | DM1 | $e^+e^- \rightarrow \pi^+\pi^-\pi^0$ |
| <0.20 | 90 | | ⁸ PARROUR 76B | OSPK | $e^+e^- \rightarrow \pi^+\pi^-\pi^0$ |

$\Gamma(\eta\gamma)/\Gamma_{total}$ Γ_6/Γ

| VALUE (units 10 ⁻²) | EVTS | DOCUMENT ID | TECN | COMMENT |
|---|-------|---------------------------------|------|--|
| 1.309±0.024 OUR FIT | | | | Error includes scale factor of 1.2. |
| 1.26 ±0.04 OUR AVERAGE | | | | |
| 1.246±0.025±0.057 | 10k | ⁹ ACHASOV 98F | SND | $e^+e^- \rightarrow 7\gamma$ |
| 1.18 ±0.11 | 279 | ¹⁰ AKHMETSHIN 95 | CMD2 | $e^+e^- \rightarrow \pi^+\pi^-\pi^0 3\gamma$ |
| 1.30 ±0.06 | | ¹¹ DRUZHININ 84 | ND | $e^+e^- \rightarrow 3\gamma$ |
| 1.4 ±0.2 | | ¹² DRUZHININ 84 | ND | $e^+e^- \rightarrow 6\gamma$ |
| 0.88 ±0.20 | 290 | KURDADZE 83C | OLYA | $e^+e^- \rightarrow 3\gamma$ |
| 1.35 ±0.29 | | ANDREWS 77 | CNTR | 6.7–10 γ Cu |
| 1.5 ±0.4 | 54 | ¹¹ COSME 76 | OSPK | e^+e^- |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● | | | | |
| 1.38 ±0.02 ±0.02 | | ¹ AKHMETSHIN 11 | CMD2 | 1.02 $e^+e^- \rightarrow \eta\gamma$ |
| 1.37 ±0.05 ±0.01 | 33k | ¹³ ACHASOV 07B | SND | 0.6–1.38 $e^+e^- \rightarrow \eta\gamma$ |
| 1.373±0.014±0.085 | 17.4k | ^{14,15} AKHMETSHIN 05 | CMD2 | 0.60–1.38 $e^+e^- \rightarrow \eta\gamma$ |
| 1.287±0.013±0.063 | | ^{16,17} AKHMETSHIN 01B | CMD2 | $e^+e^- \rightarrow \eta\gamma$ |
| 1.338±0.012±0.052 | | ¹⁸ ACHASOV 00 | SND | $e^+e^- \rightarrow \eta\gamma$ |
| 1.18 ±0.03 ±0.06 | 2200 | ¹⁹ AKHMETSHIN 99F | CMD2 | $e^+e^- \rightarrow \eta\gamma$ |
| 1.21 ±0.07 | | ²⁰ BENAYOUN 96 | RVUE | 0.54–1.04 $e^+e^- \rightarrow \eta\gamma$ |

$\Gamma(\pi^0\gamma)/\Gamma_{\text{total}}$ Γ_7/Γ

| VALUE (units 10^{-3}) | EVTS | DOCUMENT ID | TECN | COMMENT |
|---|-------|--------------------------------|------|--|
| 1.27 ± 0.06 | | | | OUR FIT |
| 1.31 ± 0.13 | | | | OUR AVERAGE |
| 1.30 ± 0.13 | | DRUZHININ 84 | ND | $e^+e^- \rightarrow 3\gamma$ |
| 1.4 ± 0.5 | 32 | COSME 76 | OSPK | e^+e^- |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● | | | | |
| 1.258 ± 0.037 ± 0.077 | 18680 | ^{21,22} AKHMETSHIN 05 | CMD2 | 0.60-1.38 $e^+e^- \rightarrow \pi^0\gamma$ |
| 1.226 ± 0.036 ^{+0.096} _{-0.089} | | ²³ ACHASOV 00 | SND | $e^+e^- \rightarrow \pi^0\gamma$ |
| 1.26 ± 0.17 | | ²⁰ BENAYOUN 96 | RVUE | 0.54-1.04 $e^+e^- \rightarrow \pi^0\gamma$ |

$\Gamma(\eta\gamma)/\Gamma(\pi^0\gamma)$ Γ_6/Γ_7

| VALUE | DOCUMENT ID | TECN | COMMENT |
|---|-------------|------|--|
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● | | | |
| 10.9 ± 0.3 ^{+0.7} _{-0.8} | ACHASOV 00 | SND | $e^+e^- \rightarrow \eta\gamma, \pi^0\gamma$ |

$\Gamma(e^+e^-)/\Gamma_{\text{total}}$ Γ_9/Γ

| VALUE (units 10^{-4}) | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-------|---------------------------|------|--|
| 2.954 ± 0.030 | | | | OUR FIT Error includes scale factor of 1.1. |
| 2.98 ± 0.07 | | | | OUR AVERAGE Error includes scale factor of 1.1. |
| 2.93 ± 0.14 | 1900k | ²⁴ ACHASOV 01E | SND | $e^+e^- \rightarrow K^+K^-, K_S^0K_L^0, \pi^+\pi^-\pi^0$ |
| 2.88 ± 0.09 | 55600 | AKHMETSHIN 95 | CMD2 | $e^+e^- \rightarrow \text{hadrons}$ |
| 3.00 ± 0.21 | 3681 | BUKIN 78C | OLYA | $e^+e^- \rightarrow \text{hadrons}$ |
| 3.10 ± 0.14 | | ²⁵ PARROUR 76 | OSPK | e^+e^- |
| 3.3 ± 0.3 | | COSME 74 | OSPK | $e^+e^- \rightarrow \text{hadrons}$ |
| 2.81 ± 0.25 | 681 | BALAKIN 71 | OSPK | $e^+e^- \rightarrow \text{hadrons}$ |
| 3.50 ± 0.27 | | CHATELUS 71 | OSPK | e^+e^- |

$\Gamma(\mu^+\mu^-)/\Gamma_{\text{total}}$ Γ_{10}/Γ

| VALUE (units 10^{-4}) | DOCUMENT ID | TECN | COMMENT |
|---|----------------------------|------|--|
| 2.87 ± 0.19 | | | OUR FIT |
| 2.5 ± 0.4 | | | OUR AVERAGE |
| 2.69 ± 0.46 | ²⁶ HAYES 71 | CNTR | 8.3, 9.8 $\gamma C \rightarrow \mu^+\mu^- X$ |
| 2.17 ± 0.60 | ²⁶ EARLES 70 | CNTR | 6.0 $\gamma C \rightarrow \mu^+\mu^- X$ |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● | | | |
| 2.87 ± 0.20 ± 0.14 | ²⁷ ACHASOV 01G | SND | $e^+e^- \rightarrow \mu^+\mu^-$ |
| 3.30 ± 0.45 ± 0.32 | ⁴ ACHASOV 99C | SND | $e^+e^- \rightarrow \mu^+\mu^-$ |
| 4.83 ± 1.02 | ²⁸ VASSERMAN 81 | OLYA | $e^+e^- \rightarrow \mu^+\mu^-$ |
| 2.87 ± 1.98 | ²⁸ AUGUSTIN 73 | OSPK | $e^+e^- \rightarrow \mu^+\mu^-$ |

$\Gamma(\eta e^+e^-)/\Gamma_{\text{total}}$ Γ_{11}/Γ

| VALUE (units 10^{-4}) | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------------------------------------|------|-----------------------------|------|--|
| 1.15 ± 0.10 | | | | OUR AVERAGE |
| 1.19 ± 0.19 ± 0.12 | 213 | ²⁹ ACHASOV 01B | SND | $e^+e^- \rightarrow \gamma\gamma e^+e^-$ |
| 1.14 ± 0.10 ± 0.06 | 355 | ³⁰ AKHMETSHIN 01 | CMD2 | $e^+e^- \rightarrow \eta e^+e^-$ |
| 1.3 ^{+0.8} _{-0.6} | 7 | GOLUBEV 85 | ND | $e^+e^- \rightarrow \gamma\gamma e^+e^-$ |

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

| | | | | | |
|----------------|-----|----|---------------|------|----------------------------------|
| 1.13±0.14±0.07 | 183 | 31 | AKHMETSHIN 01 | CMD2 | $e^+e^- \rightarrow \eta e^+e^-$ |
| 1.21±0.14±0.09 | 130 | 32 | AKHMETSHIN 01 | CMD2 | $e^+e^- \rightarrow \eta e^+e^-$ |
| 1.04±0.20±0.08 | 42 | 33 | AKHMETSHIN 01 | CMD2 | $e^+e^- \rightarrow \eta e^+e^-$ |

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

Γ_{12}/Γ

| VALUE (units 10^{-4}) | CL% | DOCUMENT ID | TECN | COMMENT |
|---|-----|--------------|----------|--|
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 0.71±0.11±0.09 | | 4 ACHASOV | 00C SND | $e^+e^- \rightarrow \pi^+\pi^-$ |
| 0.65 ^{+0.38} _{-0.29} | | 4 GOLUBEV | 86 ND | $e^+e^- \rightarrow \pi^+\pi^-$ |
| 2.01 ^{+1.07} _{-0.84} | | 4 VASSERMAN | 81 OLYA | $e^+e^- \rightarrow \pi^+\pi^-$ |
| <6.6 | 95 | BUKIN | 78B OLYA | $e^+e^- \rightarrow \pi^+\pi^-$ |
| <2.7 | 95 | ALVENSLEB... | 72 CNTR | 6.7 $\gamma C \rightarrow C\pi^+\pi^-$ |

$\Gamma(\omega\pi^0)/\Gamma_{\text{total}}$

Γ_{13}/Γ

| VALUE (units 10^{-5}) | DOCUMENT ID | TECN | COMMENT |
|---|-----------------|----------|---|
| 4.7±0.5 OUR FIT | | | |
| 5.2 ^{+1.3} _{-1.1} | 34,35 AULCHENKO | 00A SND | $e^+e^- \rightarrow \pi^+\pi^-\pi^0\pi^0$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | |
| 4.4±0.6 | 36 AMBROSINO | 08G KLOE | $e^+e^- \rightarrow \pi^+\pi^-2\pi^0, 2\pi^0\gamma$ |
| ~ 5.4 | 37 ACHASOV | 00E SND | $e^+e^- \rightarrow \pi^0\pi^0\gamma$ |
| 5.5 ^{+1.6} _{-1.4} ±0.3 | 35,38 AULCHENKO | 00A SND | $e^+e^- \rightarrow \pi^+\pi^-\pi^0\pi^0$ |
| 4.8 ^{+1.9} _{-1.7} ±0.8 | 37 ACHASOV | 99 SND | $e^+e^- \rightarrow \pi^+\pi^-\pi^0\pi^0$ |

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

Γ_{14}/Γ

| VALUE | CL% | DOCUMENT ID | TECN | COMMENT |
|-------|-----|-------------|--------|---|
| <0.05 | 84 | LINDSEY | 66 HBC | 2.1–2.7 $K^-p \rightarrow \Lambda\pi^+\pi^-$ neutrals |

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

Γ_{15}/Γ

| VALUE (units 10^{-4}) | CL% | DOCUMENT ID | TECN | COMMENT |
|---|-----|-------------------|--------|---|
| < 0.12 | 90 | 39 AKHMETSHIN 99B | CMD2 | $e^+e^- \rightarrow \pi^+\pi^-\gamma$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| < 7 | 90 | AKHMETSHIN 97C | CMD2 | $e^+e^- \rightarrow \pi^+\pi^-\gamma$ |
| <200 | 84 | LINDSEY | 66 HBC | 2.1–2.7 $K^-p \rightarrow \Lambda\pi^+\pi^-$ neutrals |

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

Γ_{16}/Γ

| VALUE (units 10^{-4}) | CL% | EVTS | DOCUMENT ID | TECN | COMMENT |
|---|-----|-------|-------------------|---------|---|
| 0.41±0.12±0.04 | | 30175 | 40 AKHMETSHIN 99B | CMD2 | $e^+e^- \rightarrow \pi^+\pi^-\gamma$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | |
| < 0.3 | 90 | | 41 AKHMETSHIN 97C | CMD2 | $e^+e^- \rightarrow \pi^+\pi^-\gamma$ |
| <600 | 90 | | KALBFLEISCH 75 | HBC | 2.18 $K^-p \rightarrow \Lambda\pi^+\pi^-\gamma$ |
| < 70 | 90 | | COSME | 74 OSPK | $e^+e^- \rightarrow \pi^+\pi^-\gamma$ |
| <400 | 90 | | LINDSEY | 65 HBC | 2.1–2.7 $K^-p \rightarrow \Lambda\pi^+\pi^-$ neutrals |

$\Gamma(f_0(980)\gamma)/\Gamma_{\text{total}}$ **Γ_{17}/Γ**

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

3.22±0.19 OUR FIT Error includes scale factor of 1.1.

3.21±0.19 OUR AVERAGE

| | | | | | | |
|--|--|----|------------|-----|------|--|
| 3.21 ^{+0.03} _{-0.09} ±0.18 | | 42 | AMBROSINO | 07 | KLOE | $e^+e^- \rightarrow \pi^0\pi^0\gamma$ |
| 2.90±0.21±1.54 | | 43 | AKHMETSHIN | 99C | CMD2 | $e^+e^- \rightarrow \pi^+\pi^-\gamma,$ $\pi^0\pi^0\gamma$ |

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

| | | | | | | | |
|--|----|-------|-------|------------|-----|------|---------------------------------------|
| 4.47±0.21 | | 2438 | 44 | ALOISIO | 02D | KLOE | $e^+e^- \rightarrow \pi^0\pi^0\gamma$ |
| 3.5 ±0.3 ^{+1.3} _{-0.5} | | 419 | 45,46 | ACHASOV | 00H | SND | $e^+e^- \rightarrow \pi^0\pi^0\gamma$ |
| 1.93±0.46±0.50 | | 27188 | 47 | AKHMETSHIN | 99B | CMD2 | $e^+e^- \rightarrow \pi^+\pi^-\gamma$ |
| 3.05±0.25±0.72 | | 268 | 48 | AKHMETSHIN | 99C | CMD2 | $e^+e^- \rightarrow \pi^0\pi^0\gamma$ |
| 1.5 ±0.5 | | 268 | 49 | AKHMETSHIN | 99C | CMD2 | $e^+e^- \rightarrow \pi^0\pi^0\gamma$ |
| 3.42±0.30±0.36 | | 164 | 45 | ACHASOV | 98I | SND | $e^+e^- \rightarrow 5\gamma$ |
| < 1 | 90 | | 50 | AKHMETSHIN | 97C | CMD2 | $e^+e^- \rightarrow \pi^+\pi^-\gamma$ |
| < 7 | 90 | | 51 | AKHMETSHIN | 97C | CMD2 | $e^+e^- \rightarrow \pi^+\pi^-\gamma$ |
| < 20 | 90 | | | DRUZHININ | 87 | ND | $e^+e^- \rightarrow \pi^0\pi^0\gamma$ |

$\Gamma(f_0(980)\gamma)/\Gamma(\eta\gamma)$ **Γ_{17}/Γ_6**

VALUE (units 10^{-2}) EVTS DOCUMENT ID TECN COMMENT

2.46±0.15 OUR FIT Error includes scale factor of 1.1.

| | | | | | | | |
|--|--|-----|----|---------|-----|-----|---------------------------------------|
| 2.6 ±0.2 ^{+0.8} _{-0.3} | | 419 | 45 | ACHASOV | 00H | SND | $e^+e^- \rightarrow \pi^0\pi^0\gamma$ |
|--|--|-----|----|---------|-----|-----|---------------------------------------|

$\Gamma(\pi^0\pi^0\gamma)/\Gamma_{\text{total}}$ **Γ_{18}/Γ**

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

1.07 ±0.06 OUR AVERAGE

| | | | | | | | |
|--|--|-----|----|------------|-----|------|---------------------------------------|
| 1.07 ^{+0.01} _{-0.03} ^{+0.06} _{-0.06} | | | 52 | AMBROSINO | 07 | KLOE | $e^+e^- \rightarrow \pi^0\pi^0\gamma$ |
| 1.08 ±0.17 ±0.09 | | 268 | | AKHMETSHIN | 99C | CMD2 | $e^+e^- \rightarrow \pi^0\pi^0\gamma$ |

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

| | | | | | | | |
|-------------------|----|------|-------|-----------|-----|------|---------------------------------------|
| 1.09 ±0.03 ±0.05 | | 2438 | | ALOISIO | 02D | KLOE | $e^+e^- \rightarrow \pi^0\pi^0\gamma$ |
| 1.158±0.093±0.052 | | 419 | 46,53 | ACHASOV | 00H | SND | $e^+e^- \rightarrow \pi^0\pi^0\gamma$ |
| <10 | 90 | | | DRUZHININ | 87 | ND | $e^+e^- \rightarrow 5\gamma$ |

$\Gamma(\pi^0\pi^0\gamma)/\Gamma(\eta\gamma)$ **Γ_{18}/Γ_6**

VALUE (units 10^{-2}) EVTS DOCUMENT ID TECN COMMENT

0.86 ±0.04 OUR FIT

| | | | | | | | |
|-------------------|--|-----|----|---------|-----|-----|---------------------------------------|
| 0.865±0.070±0.017 | | 419 | 53 | ACHASOV | 00H | SND | $e^+e^- \rightarrow \pi^0\pi^0\gamma$ |
|-------------------|--|-----|----|---------|-----|-----|---------------------------------------|

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

| | | | | | | | |
|------------------|--|-----|--|---------|-----|-----|------------------------------|
| 0.90 ±0.08 ±0.07 | | 164 | | ACHASOV | 98I | SND | $e^+e^- \rightarrow 5\gamma$ |
|------------------|--|-----|--|---------|-----|-----|------------------------------|

$\Gamma(\pi^+\pi^-\pi^+\pi^-)/\Gamma_{\text{total}}$ **Γ_{19}/Γ**

VALUE (units 10^{-6}) CL% EVTS DOCUMENT ID TECN COMMENT

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

| | | | | | | | |
|----------------|----|------|--|------------|-----|------|---|
| 3.93±1.74±2.14 | | 3285 | | AKHMETSHIN | 00E | CMD2 | $e^+e^- \rightarrow \pi^+\pi^-\pi^+\pi^-$ |
| < 870 | 90 | | | CORDIER | 79 | WIRE | $e^+e^- \rightarrow \pi^+\pi^-\pi^+\pi^-$ |

$\Gamma(\pi^+\pi^+\pi^-\pi^-\pi^0)/\Gamma_{\text{total}}$ Γ_{20}/Γ

| VALUE (units 10^{-6}) | CL% | DOCUMENT ID | TECN | COMMENT |
|---|-----|----------------|------|--|
| < 4.6 | 90 | AKHMETSHIN 00E | CMD2 | $e^+e^- \rightarrow \pi^+\pi^-\pi^+\pi^-\pi^0$ |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● | | | | |
| <150 | 95 | BARKOV | 88 | CMD $e^+e^- \rightarrow \pi^+\pi^-\pi^+\pi^-\pi^0$ |

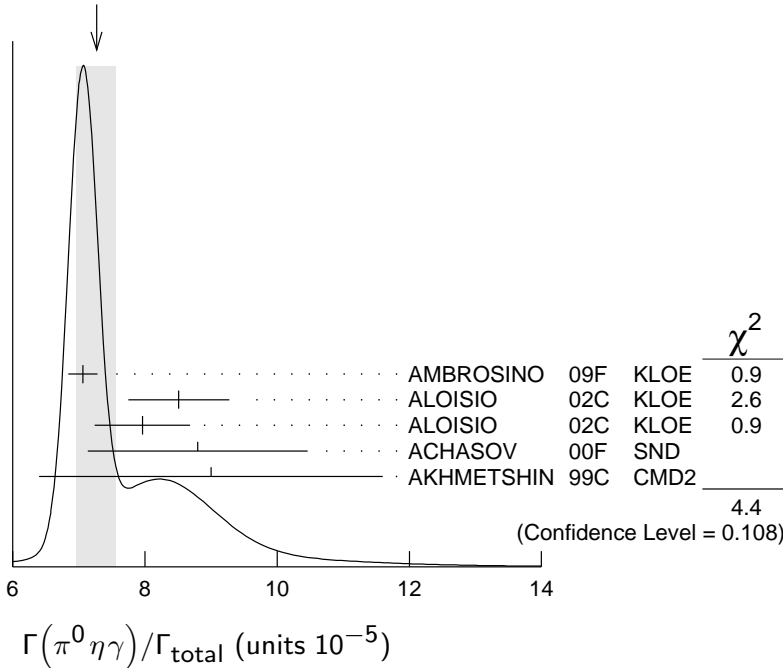
$\Gamma(\pi^0 e^+ e^-)/\Gamma_{\text{total}}$ Γ_{21}/Γ

| VALUE (units 10^{-5}) | CL% | EVTS | DOCUMENT ID | TECN | COMMENT |
|---|-----|------|-------------|----------------|---|
| 1.12±0.28 OUR AVERAGE | | | | | |
| 1.01±0.28±0.29 | | 52 | 54 | ACHASOV 02D | SND $e^+e^- \rightarrow \pi^0 e^+ e^-$ |
| 1.22±0.34±0.21 | | 46 | 55 | AKHMETSHIN 01C | CMD2 $e^+e^- \rightarrow \pi^0 e^+ e^-$ |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● | | | | | |
| <12 | 90 | | DOLINSKY | 88 | ND $e^+e^- \rightarrow \pi^0 e^+ e^-$ |

$\Gamma(\pi^0 \eta \gamma)/\Gamma_{\text{total}}$ Γ_{22}/Γ

| VALUE (units 10^{-5}) | CL% | EVTS | DOCUMENT ID | TECN | COMMENT |
|--|-----|-------|----------------|---------------|--|
| 7.27±0.30 OUR AVERAGE Error includes scale factor of 1.5. See the ideogram below. | | | | | |
| 7.06±0.22 | | 16.9k | 56 | AMBROSINO 09F | KLOE $1.02 e^+e^- \rightarrow \eta\pi^0\gamma$ |
| 8.51±0.51±0.57 | | 607 | 57 | ALOISIO 02C | KLOE $e^+e^- \rightarrow \eta\pi^0\gamma$ |
| 7.96±0.60±0.40 | | 197 | 58 | ALOISIO 02C | KLOE $e^+e^- \rightarrow \eta\pi^0\gamma$ |
| 8.8 ±1.4 ±0.9 | | 36 | 59 | ACHASOV 00F | SND $e^+e^- \rightarrow \eta\pi^0\gamma$ |
| 9.0 ±2.4 ±1.0 | | 80 | AKHMETSHIN 99C | CMD2 | $e^+e^- \rightarrow \eta\pi^0\gamma$ |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● | | | | | |
| 7.01±0.10±0.20 | | 13.3k | 57,60 | AMBROSINO 09F | KLOE $1.02 e^+e^- \rightarrow \eta\pi^0\gamma$ |
| 7.12±0.13±0.22 | | 3.6k | 58,61 | AMBROSINO 09F | KLOE $1.02 e^+e^- \rightarrow \eta\pi^0\gamma$ |
| 8.3 ±2.3 ±1.2 | | 20 | ACHASOV 98B | SND | $e^+e^- \rightarrow 5\gamma$ |
| <250 | 90 | | DOLINSKY 91 | ND | $e^+e^- \rightarrow \pi^0\eta\gamma$ |

WEIGHTED AVERAGE
7.27±0.30 (Error scaled by 1.5)



$\Gamma(a_0(980)\gamma)/\Gamma_{\text{total}}$ Γ_{23}/Γ

| VALUE (units 10^{-5}) | CL% | EVTS | DOCUMENT ID | TECN | COMMENT |
|---|-----|------|-------------|------|---|
| 7.6±0.6 OUR FIT | | | | | |
| 7.6±0.6 OUR AVERAGE | | | | | |
| 7.4±0.7 | | | 62 ALOISIO | 02C | KLOE $e^+e^- \rightarrow \eta\pi^0\gamma$ |
| 8.8±1.7 | | 36 | 63 ACHASOV | 00F | SND $e^+e^- \rightarrow \eta\pi^0\gamma$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | |
| 11 ±2 | | | 64 GOKALP | 02 | RVUE $e^+e^- \rightarrow \eta\pi^0\gamma$ |
| <500 | 90 | | DOLINSKY | 91 | ND $e^+e^- \rightarrow \pi^0\eta\gamma$ |

$\Gamma(f_0(980)\gamma)/\Gamma(a_0(980)\gamma)$ Γ_{17}/Γ_{23}

| VALUE | DOCUMENT ID | TECN | COMMENT |
|----------------|-------------|------|---|
| 6.1±0.6 | 65 ALOISIO | 02C | KLOE $e^+e^- \rightarrow \eta\pi^0\gamma$ |

$\Gamma(K^0\bar{K}^0\gamma)/\Gamma_{\text{total}}$ Γ_{24}/Γ

| VALUE | CL% | DOCUMENT ID | TECN | COMMENT |
|----------------------------------|-----|-------------|------|--|
| <1.9 × 10⁻⁸ | 90 | AMBROSINO | 09C | KLOE $e^+e^- \rightarrow K_S^0 K_S^0 \gamma$ |

$\Gamma(\eta'(958)\gamma)/\Gamma_{\text{total}}$ Γ_{25}/Γ

| VALUE (units 10^{-5}) | CL% | EVTS | DOCUMENT ID | TECN | COMMENT |
|---|-----|------|---------------|------|---|
| 6.25±0.21 OUR FIT | | | | | |
| 6.25±0.30 OUR AVERAGE | | | | | |
| 6.25±0.28±0.11 | | 3407 | 66 AMBROSINO | 07A | KLOE $1.02 e^+e^- \rightarrow \pi^+\pi^-7\gamma$ |
| 6.7 ^{+2.8} / _{-2.4} ±0.8 | | 12 | 67 AULCHENKO | 03B | SND $e^+e^- \rightarrow \eta'\gamma$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | |
| 6.7 ^{+5.0} / _{-4.2} ±1.5 | | 7 | AULCHENKO | 03B | SND $e^+e^- \rightarrow 7\gamma$ |
| 6.10±0.61±0.43 | | 120 | 68 ALOISIO | 02E | KLOE $1.02 e^+e^- \rightarrow \pi^+\pi^-3\gamma$ |
| 8.2 ^{+2.1} / _{-1.9} ±1.1 | | 21 | 69 AKHMETSHIN | 00B | CMD2 $e^+e^- \rightarrow \pi^+\pi^-3\gamma$ |
| 4.9 ^{+2.2} / _{-1.8} ±0.6 | | 9 | 70 AKHMETSHIN | 00F | CMD2 $e^+e^- \rightarrow \pi^+\pi^-\pi^+\pi^- \geq 2\gamma$ |
| 6.4 ±1.6 | | 30 | 71 AKHMETSHIN | 00F | CMD2 $e^+e^- \rightarrow \eta'(958)\gamma$ |
| 6.7 ^{+3.4} / _{-2.9} ±1.0 | | 5 | 72 AULCHENKO | 99 | SND $e^+e^- \rightarrow \pi^+\pi^-3\gamma$ |
| <11 | 90 | | AULCHENKO | 98 | SND $e^+e^- \rightarrow 7\gamma$ |
| 12 ⁺⁷ / ₋₅ ±2 | | 6 | 69 AKHMETSHIN | 97B | CMD2 $e^+e^- \rightarrow \pi^+\pi^-3\gamma$ |
| <41 | 90 | | DRUZHININ | 87 | ND $e^+e^- \rightarrow \gamma\eta\pi^+\pi^-$ |

$\Gamma(\eta'(958)\gamma)/\Gamma(K_L^0 K_S^0)$ Γ_{25}/Γ_2

| VALUE (units 10^{-4}) | EVTS | DOCUMENT ID | TECN | COMMENT |
|---|------|---------------|------|---|
| 1.83±0.06 OUR FIT | | | | |
| 1.46 ^{+0.64}/_{-0.54} ±0.18 | 9 | 73 AKHMETSHIN | 00F | CMD2 $e^+e^- \rightarrow \pi^+\pi^-\pi^+\pi^- \geq 2\gamma$ |

$\Gamma(\eta'(958)\gamma)/\Gamma(\eta\gamma)$ Γ_{25}/Γ_6

| <u>VALUE (units 10^{-3})</u> | <u>EVTS</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|---|-------------|--------------------|-------------|----------------|
|---|-------------|--------------------|-------------|----------------|

4.77±0.15 OUR FIT

4.78±0.20 OUR AVERAGE

| | | | | |
|--|------|---------------------------|------|---|
| 4.77±0.09±0.19 | 3407 | AMBROSINO 07A | KLOE | 1.02 $e^+e^- \rightarrow \pi^+\pi^-7\gamma$ |
| 4.70±0.47±0.31 | 120 | ⁷⁴ ALOISIO 02E | KLOE | 1.02 $e^+e^- \rightarrow \pi^+\pi^-3\gamma$ |
| 6.5 $\begin{smallmatrix} +1.7 \\ -1.5 \end{smallmatrix} \pm 0.8$ | 21 | AKHMETSHIN 00B | CMD2 | $e^+e^- \rightarrow \pi^+\pi^-3\gamma$ |

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

| | | | | |
|--|---|------------------------------|------|--|
| 9.5 $\begin{smallmatrix} +5.2 \\ -4.0 \end{smallmatrix} \pm 1.4$ | 6 | ⁷⁵ AKHMETSHIN 97B | CMD2 | $e^+e^- \rightarrow \pi^+\pi^-3\gamma$ |
|--|---|------------------------------|------|--|

$\Gamma(\eta\pi^0\pi^0\gamma)/\Gamma_{\text{total}}$ Γ_{26}/Γ

| <u>VALUE (units 10^{-5})</u> | <u>CL%</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|---|------------|--------------------|-------------|----------------|
|---|------------|--------------------|-------------|----------------|

| | | | | |
|----|----|--------------|-----|------------------------------|
| <2 | 90 | AULCHENKO 98 | SND | $e^+e^- \rightarrow 7\gamma$ |
|----|----|--------------|-----|------------------------------|

$\Gamma(\mu^+\mu^-\gamma)/\Gamma_{\text{total}}$ Γ_{27}/Γ

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

| | | | | |
|-----------------------|-------|------------------------------|------|---------------------------------------|
| 1.43±0.45±0.14 | 27188 | ⁴⁷ AKHMETSHIN 99B | CMD2 | $e^+e^- \rightarrow \mu^+\mu^-\gamma$ |
|-----------------------|-------|------------------------------|------|---------------------------------------|

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

| | | | | |
|----------|----------|------------------------------|------|---------------------------------------|
| 2.3 ±1.0 | 824 ± 33 | ⁷⁶ AKHMETSHIN 97C | CMD2 | $e^+e^- \rightarrow \mu^+\mu^-\gamma$ |
|----------|----------|------------------------------|------|---------------------------------------|

$\Gamma(\rho\gamma\gamma)/\Gamma_{\text{total}}$ Γ_{28}/Γ

| <u>VALUE (units 10^{-4})</u> | <u>CL%</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|---|------------|--------------------|-------------|----------------|
|---|------------|--------------------|-------------|----------------|

| | | | | |
|------|----|--------------|------|---|
| <1.2 | 90 | AULCHENKO 08 | CMD2 | $\phi \rightarrow \pi^+\pi^-\gamma\gamma$ |
|------|----|--------------|------|---|

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

| | | | | |
|----|----|---------------|------|---|
| <5 | 90 | AKHMETSHIN 98 | CMD2 | $e^+e^- \rightarrow \pi^+\pi^-\gamma\gamma$ |
|----|----|---------------|------|---|

$\Gamma(\eta\pi^+\pi^-)/\Gamma_{\text{total}}$ Γ_{29}/Γ

| <u>VALUE (units 10^{-5})</u> | <u>CL%</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|---|------------|--------------------|-------------|----------------|
|---|------------|--------------------|-------------|----------------|

| | | | | |
|-------|----|----------------|------|--|
| < 1.8 | 90 | AKHMETSHIN 00E | CMD2 | $e^+e^- \rightarrow \pi^+\pi^-\pi^+\pi^-\pi^0$ |
|-------|----|----------------|------|--|

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

| | | | | |
|-------|----|--------------|------|-----------------------------------|
| < 6.1 | 90 | AULCHENKO 08 | CMD2 | $\phi \rightarrow \eta\pi^+\pi^-$ |
|-------|----|--------------|------|-----------------------------------|

| | | | | |
|-----|----|---------------|------|---|
| <30 | 90 | AKHMETSHIN 98 | CMD2 | $e^+e^- \rightarrow \pi^+\pi^-\gamma\gamma$ |
|-----|----|---------------|------|---|

$\Gamma(\eta\mu^+\mu^-)/\Gamma_{\text{total}}$ Γ_{30}/Γ

| <u>VALUE (units 10^{-6})</u> | <u>CL%</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|---|------------|--------------------|-------------|----------------|
|---|------------|--------------------|-------------|----------------|

| | | | | |
|------|----|---------------|------|----------------------------------|
| <9.4 | 90 | AKHMETSHIN 01 | CMD2 | $e^+e^- \rightarrow \eta e^+e^-$ |
|------|----|---------------|------|----------------------------------|

$\Gamma(\eta U \rightarrow \eta e^+e^-)/\Gamma_{\text{total}}$ Γ_{31}/Γ

| <u>VALUE</u> | <u>CL%</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|--------------|------------|--------------------|-------------|----------------|
|--------------|------------|--------------------|-------------|----------------|

| | | | | |
|-----------------------|----|---------------------------|------|---------------------------------------|
| <1 × 10 ⁻⁶ | 90 | ⁷⁷ BABUSCI 13B | KLOE | 1.02 $e^+e^- \rightarrow \eta e^+e^-$ |
|-----------------------|----|---------------------------|------|---------------------------------------|

- 1 Combined analysis of the CMD-2 data on $\phi \rightarrow K^+ K^-, K_S^0 K_L^0, \pi^+ \pi^- \pi^0, \eta \gamma$ assuming that the sum of their branching fractions is 0.99741 ± 0.00007 .
- 2 Using $B(\phi \rightarrow e^+ e^-) = (2.93 \pm 0.14) \times 10^{-4}$.
- 3 Theoretical analysis of BRAMON 00 taking into account phase-space difference, electromagnetic radiative corrections, as well as isospin breaking, predicts 0.62. FLOREZ-BAEZ 08 predicts 0.63 considering also structure-dependent radiative corrections. FIS-CHBACH 02 calculates additional corrections caused by the close threshold and predicts 0.68. See also BENAYOUN 01 and DUBYNSKIY 07. BENAYOUN 12 obtains 0.71 ± 0.01 in the HLS model.
- 4 Using $B(\phi \rightarrow e^+ e^-) = (2.99 \pm 0.08) \times 10^{-4}$.
- 5 Using $\Gamma(\phi) = 4.1$ MeV. If interference between the $\rho\pi$ and 3π modes is neglected, the fraction of the $\rho\pi$ is more than 80% at the 90% confidence level.
- 6 From a fit without limitations on charged and neutral ρ masses and widths.
- 7 Adding the direct and $\omega\pi$ contributions and considering the interference between the $\rho\pi$ and $\pi^+ \pi^- \pi^0$.
- 8 Neglecting the interference between the $\rho\pi$ and $\pi^+ \pi^- \pi^0$.
- 9 Using $B(\phi \rightarrow e^+ e^-) = (2.99 \pm 0.08) \times 10^{-4}$ and $B(\eta \rightarrow 3\pi^0) = (32.2 \pm 0.4) \times 10^{-2}$.
- 10 From $\pi^+ \pi^- \pi^0$ decay mode of η .
- 11 From 2γ decay mode of η .
- 12 From $3\pi^0$ decay mode of η .
- 13 ACHASOV 07B reports $[\Gamma(\phi(1020) \rightarrow \eta\gamma)/\Gamma_{\text{total}}] \times [B(\phi(1020) \rightarrow e^+ e^-)] = (4.050 \pm 0.067 \pm 0.118) \times 10^{-6}$ which we divide by our best value $B(\phi(1020) \rightarrow e^+ e^-) = (2.954 \pm 0.030) \times 10^{-4}$. 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.
- 14 Using $B(\phi \rightarrow e^+ e^-) = (2.98 \pm 0.04) \times 10^{-4}$ and $B(\eta \rightarrow \gamma\gamma) = 39.43 \pm 0.26\%$.
- 15 Not independent of the corresponding $\Gamma(e^+ e^-) \times \Gamma(\eta\gamma)/\Gamma_{\text{total}}^2$.
- 16 Using $B(\phi \rightarrow e^+ e^-) = (2.99 \pm 0.08) \times 10^{-4}$ and $B(\eta \rightarrow 3\pi^0) = (32.24 \pm 0.29) \times 10^{-2}$.
- 17 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).
- 18 From the $\eta \rightarrow 2\gamma$ decay and using $B(\phi \rightarrow e^+ e^-) = (2.99 \pm 0.08) \times 10^{-4}$.
- 19 From $\pi^+ \pi^- \pi^0$ decay mode of η and using $B(\phi \rightarrow e^+ e^-) = (2.99 \pm 0.08) \times 10^{-4}$.
- 20 Reanalysis of DRUZHININ 84, DOLINSKY 89, and DOLINSKY 91 taking into account a triangle anomaly contribution.
- 21 Using $B(\phi \rightarrow e^+ e^-) = (2.98 \pm 0.04) \times 10^{-4}$.
- 22 Not independent of the corresponding $\Gamma(e^+ e^-) \times \Gamma(\pi^0\gamma)/\Gamma_{\text{total}}^2$.
- 23 From the $\pi^0 \rightarrow 2\gamma$ decay and using $B(\phi \rightarrow e^+ e^-) = (2.99 \pm 0.08) \times 10^{-4}$.
- 24 From the combined fit assuming that the total $\phi(1020)$ production cross section is saturated by those of $K^+ K^-, K_S^0 K_L^0, \pi^+ \pi^- \pi^0$, and $\eta\gamma$ decays modes and using ACHASOV 00B for the $\eta\gamma$ decay mode.
- 25 Using total width 4.2 MeV. They detect 3π mode and observe significant interference with ω tail. This is accounted for in the result quoted above.
- 26 Neglecting interference between resonance and continuum.
- 27 Using $B(\phi \rightarrow e^+ e^-) = (2.91 \pm 0.07) \times 10^{-4}$.
- 28 Recalculated by us using $B(\phi \rightarrow e^+ e^-) = (2.99 \pm 0.08) \times 10^{-4}$.
- 29 Using $B(\eta \rightarrow \gamma\gamma) = (39.25 \pm 0.32)\%$, $B(\phi \rightarrow \eta\gamma) = (1.26 \pm 0.06)\%$, and $B(\phi \rightarrow e^+ e^-) = (3.00 \pm 0.06) \times 10^{-4}$.
- 30 The average of the branching ratios separately obtained from the $\eta \rightarrow \gamma\gamma, 3\pi^0, \pi^+ \pi^- \pi^0$ decays.
- 31 From $\eta \rightarrow \gamma\gamma$ decays and using $B(\eta \rightarrow \gamma\gamma) = (39.33 \pm 0.25) \times 10^{-2}$, $B(\eta \rightarrow \pi^+ \pi^- \gamma) = (4.75 \pm 11) \times 10^{-2}$, and $B(\phi \rightarrow \eta\gamma) = (1.297 \pm 0.033) \times 10^{-2}$.

- 32 From $\eta \rightarrow 3\pi^0$ decays and using $B(\pi^0 \rightarrow \gamma\gamma) = (98.798 \pm 0.033) \times 10^{-2}$, $B(\eta \rightarrow 3\pi^0) = (32.24 \pm 0.29) \times 10^{-2}$, $B(\eta \rightarrow \pi^+\pi^-\gamma) = (4.75 \pm 0.11) \times 10^{-2}$, and $B(\phi \rightarrow \eta\gamma) = (1.297 \pm 0.033) \times 10^{-2}$.
- 33 From $\eta \rightarrow \pi^+\pi^-\pi^0$ decays and using $B(\pi^0 \rightarrow \gamma\gamma) = (98.798 \pm 0.033) \times 10^{-2}$, $B(\pi^0 \rightarrow e^+e^-\gamma) = (1.198 \pm 0.032) \times 10^{-2}$, $B(\eta \rightarrow \pi^+\pi^-\pi^0) = (23.0 \pm 0.4) \times 10^{-2}$, $B(\phi \rightarrow \pi^+\pi^-\pi^0) = (15.5 \pm 0.6) \times 10^{-2}$, and $B(\phi \rightarrow \eta\gamma) = (1.297 \pm 0.033) \times 10^{-2}$.
- 34 Using the 1996 and 1998 data.
- 35 $(2.3 \pm 0.3)\%$ correction for other decay modes of the $\omega(782)$ applied.
- 36 Not independent of the corresponding $\Gamma(\omega\pi^0) \times \Gamma(e^+e^-) / \Gamma^2(\text{total})$.
- 37 Using the 1996 data.
- 38 Using the 1998 data.
- 39 Supersedes AKHMETSHIN 97C.
- 40 For $E_\gamma > 20$ MeV and assuming that $B(\phi(1020) \rightarrow f_0(980)\gamma)$ is negligible. Supersedes AKHMETSHIN 97C.
- 41 For $E_\gamma > 20$ MeV and assuming that $B(\phi(1020) \rightarrow f_0(980)\gamma)$ is negligible.
- 42 Obtained by the authors taking into account the $\pi^+\pi^-$ decay mode. Includes a component due to $\pi\pi$ production via the $f_0(500)$ meson. Supersedes ALOISIO 02D.
- 43 From the combined fit of the photon spectra in the reactions $e^+e^- \rightarrow \pi^+\pi^-\gamma$, $\pi^0\pi^0\gamma$.
- 44 From the negative interference with the $f_0(500)$ meson of AITALA 01B using the ACHASOV 89 parameterization for the $f_0(980)$, a Breit-Wigner for the $f_0(500)$, and ACHASOV 01F for the $\rho\pi$ contribution. Superseded by AMBROSINO 07.
- 45 Assuming that the $\pi^0\pi^0\gamma$ final state is completely determined by the $f_0\gamma$ mechanism, neglecting the decay $B(\phi \rightarrow K\bar{K}\gamma)$ and using $B(f_0 \rightarrow \pi^+\pi^-) = 2B(f_0 \rightarrow \pi^0\pi^0)$.
- 46 Using the value $B(\phi \rightarrow \eta\gamma) = (1.338 \pm 0.053) \times 10^{-2}$.
- 47 For $E_\gamma > 20$ MeV. Supersedes AKHMETSHIN 97C.
- 48 Neglecting other intermediate mechanisms ($\rho\pi$, $\sigma\gamma$).
- 49 A narrow pole fit taking into account $f_0(980)$ and $f_0(1200)$ intermediate mechanisms.
- 50 For destructive interference with the Bremsstrahlung process
- 51 For constructive interference with the Bremsstrahlung process
- 52 Supersedes ALOISIO 02D.
- 53 Supersedes ACHASOV 98I. Excluding $\omega\pi^0$.
- 54 Using various branching ratios from the 2000 Edition of this Review (PDG 00).
- 55 Using $B(\pi^0 \rightarrow \gamma\gamma) = 0.98798 \pm 0.00032$, $B(\phi \rightarrow \eta\gamma) = (1.297 \pm 0.033) \times 10^{-2}$, and $B(\eta \rightarrow \pi^+\pi^-\gamma) = (4.75 \pm 0.11) \times 10^{-2}$.
- 56 Combined results of $\eta \rightarrow \gamma\gamma$ and $\eta \rightarrow \pi^+\pi^-\pi^0$ decay modes measurements.
- 57 From the decay mode $\eta \rightarrow \gamma\gamma$.
- 58 From the decay mode $\eta \rightarrow \pi^+\pi^-\pi^0$.
- 59 Supersedes ACHASOV 98B.
- 60 Using $B(\phi \rightarrow \eta\gamma) = (1.304 \pm 0.025)\%$, $B(\eta \rightarrow 3\pi^0) = (32.56 \pm 0.23)\%$, and $B(\eta \rightarrow \gamma\gamma) = (39.31 \pm 0.20)\%$.
- 61 Using $B(\phi \rightarrow \eta\gamma) = (1.304 \pm 0.025)\%$, $B(\eta \rightarrow 3\pi^0) = (32.56 \pm 0.23)\%$, and $B(\eta \rightarrow \pi^+\pi^-\pi^0) = (22.73 \pm 0.28)\%$.
- 62 Using $M_{a_0(980)} = 984.8$ MeV and assuming $a_0(980)\gamma$ dominance.
- 63 Assuming $a_0(980)\gamma$ dominance in the $\eta\pi^0\gamma$ final state.
- 64 Using data of ACHASOV 00F.
- 65 Using results of ALOISIO 02D and assuming that $f_0(980)$ decays into $\pi\pi$ only and $a_0(980)$ into $\eta\pi$ only.
- 66 AMBROSINO 07A reports $[\Gamma(\phi(1020) \rightarrow \eta'(958)\gamma) / \Gamma_{\text{total}}] / [B(\phi(1020) \rightarrow \eta\gamma)] = (4.77 \pm 0.09 \pm 0.19) \times 10^{-3}$ which we multiply by our best value $B(\phi(1020) \rightarrow \eta\gamma) =$

$(1.309 \pm 0.024) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

- 67 Averaging AULCHENKO 03B with AULCHENKO 99.
- 68 Using $B(\phi \rightarrow \eta\gamma) = (1.297 \pm 0.033)\%$.
- 69 Using the value $B(\phi \rightarrow \eta\gamma) = (1.26 \pm 0.06) \times 10^{-2}$.
- 70 Using $B(\phi \rightarrow K_L^0 K_S^0) = (33.8 \pm 0.6)\%$.
- 71 Averaging AKHMETSHIN 00B with AKHMETSHIN 00F.
- 72 Using the value $B(\eta' \rightarrow \eta\pi^+\pi^-) = (43.7 \pm 1.5) \times 10^{-2}$ and $B(\eta \rightarrow \gamma\gamma) = (39.25 \pm 0.31) \times 10^{-2}$.
- 73 Using various branching ratios of K_S^0 , K_L^0 , η , η' from the 2000 edition (The European Physical Journal **C15** 1 (2000)) of this Review.
- 74 From the decay mode $\eta' \rightarrow \eta\pi^+\pi^-$, $\eta \rightarrow \gamma\gamma$.
- 75 Superseded by AKHMETSHIN 00B.
- 76 For $E_\gamma > 20$ MeV.
- 77 For a narrow vector U with mass between 5 and 470 MeV, from the combined analysis of $\eta \rightarrow \pi^+\pi^-\pi^0$ and $\eta \rightarrow \pi^0\pi^0\pi^0$ from ARCHILLI 12. Measured 90% CL limits as a function of m_U range from 2.2×10^{-8} to 10^{-6} .

———— Lepton Family number (LF) violating modes ————

| $\Gamma(e^\pm \mu^\mp) / \Gamma_{\text{total}}$ | | | | | Γ_{32} / Γ |
|---|------------|--------------------|-------------|----------------|------------------------------------|
| <u>VALUE</u> | <u>CL%</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> | |
| $< 2 \times 10^{-6}$ | 90 | ACHASOV | 10A | SND | $e^+e^- \rightarrow e^\pm \mu^\mp$ |

$\pi^+\pi^-\pi^0 / \rho\pi$ AMPLITUDE RATIO a_1 IN DECAY OF $\phi \rightarrow \pi^+\pi^-\pi^0$

NIECKNIG 12 describes final-state interactions between the three pions in a dispersive framework using data on the $\pi\pi$ P -wave scattering phase shift.

| <u>VALUE (units 10^{-2})</u> | <u>CL%</u> | <u>EVTS</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|---|------------|-------------|----------------------------|-------------|--|
| 9.1±1.2 OUR AVERAGE | | | | | |
| $10.1 \pm 4.4 \pm 1.7$ | | 80k | ¹ AKHMETSHIN 06 | CMD2 | $1.017-1.021 e^+e^- \rightarrow \pi^+\pi^-\pi^0$ |
| $9.0 \pm 1.1 \pm 0.6$ | | 1.98M | ^{2,3} ALOISIO | 03 | KLOE $1.02 e^+e^- \rightarrow \pi^+\pi^-\pi^0$ |

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

| | | | | | |
|------------------|----|------|------------------------------|------|---|
| $-6 < a_1 < 6$ | | 500k | ³ ACHASOV | 02 | SND $e^+e^- \rightarrow \pi^+\pi^-\pi^0$ |
| $-16 < a_1 < 11$ | 90 | 9.8k | ^{1,4} AKHMETSHIN 98 | CMD2 | $e^+e^- \rightarrow \pi^+\pi^-\gamma\gamma$ |

¹ Dalitz plot analysis taking into account interference between the contact and $\rho\pi$ amplitudes.

² From a fit without limitations on charged and neutral ρ masses and widths.

³ Recalculated by us to match the notations of AKHMETSHIN 98.

⁴ Assuming zero phase for the contact term.

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