\(\omega(782)\)

\[
l^G(j^PC) = 0^-(1^+)\]

**\(\omega(782)\) MASS**

<table>
<thead>
<tr>
<th>VALUE (MeV)</th>
<th>EVTS</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>782.65±0.12 OUR AVERAGE</td>
<td>Error includes scale factor of 1.9.</td>
<td>See the ideogram below.</td>
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<tr>
<td>783.20±0.13±0.16</td>
<td>18680</td>
<td>AKHMETSHIN 05</td>
<td>CMD2</td>
<td>60.0±1.38 (e^+ e^- \rightarrow \pi^+ \pi^- )</td>
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<tr>
<td>782.68±0.09±0.04</td>
<td>11200</td>
<td>1 AKHMETSHIN 04</td>
<td>CMD2</td>
<td>(e^+ e^- \rightarrow \pi^+ \pi^- \pi^0)</td>
</tr>
<tr>
<td>782.79±0.08±0.09</td>
<td>1.2M</td>
<td>2 ACHASOV 03D</td>
<td>RVUE</td>
<td>0.44–2.00 (e^+ e^- \rightarrow \pi^+ \pi^- \pi^0)</td>
</tr>
<tr>
<td>782.7 ± 0.1 ± 1.5</td>
<td>19500</td>
<td>WURZINGER 95</td>
<td>SPEC</td>
<td>1.33 (p d \rightarrow ^3\text{He} \omega)</td>
</tr>
<tr>
<td>781.96±0.17±0.80</td>
<td>11k</td>
<td>3 AMSLER 94C</td>
<td>CBAR</td>
<td>0.0 (\pi p \rightarrow \omega \eta \pi^0)</td>
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<tr>
<td>782.08±0.36±0.82</td>
<td>3463</td>
<td>4 AMSLER 94C</td>
<td>CBAR</td>
<td>0.0 (\pi p \rightarrow \omega \eta \pi^0)</td>
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<tr>
<td>781.96±0.13±0.17</td>
<td>15k</td>
<td>AMSLER 93B</td>
<td>CBAR</td>
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<tr>
<td>782.4 ± 0.2</td>
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<td>WEIDENAUER 93</td>
<td>ASTE</td>
<td>(\pi p \rightarrow 2\pi^+ 2\pi^- 0)</td>
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<tr>
<td>782.2 ± 0.4</td>
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<td>KURDADZE 83B</td>
<td>OLYA</td>
<td>(e^+ e^- \rightarrow \pi^+ \pi^- \pi^0)</td>
</tr>
<tr>
<td>782.4 ± 0.5</td>
<td>7000</td>
<td>5 KEYNE 76</td>
<td>CNTR</td>
<td>(\pi^- p \rightarrow \omega n)</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>VALUE (MeV)</th>
<th>EVTS</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
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</thead>
<tbody>
<tr>
<td>781.91±0.24</td>
<td>6</td>
<td>LEES 12G</td>
<td>BABR</td>
<td>(e^+ e^- \rightarrow \pi^+ \pi^- \gamma)</td>
</tr>
<tr>
<td>781.78±0.10</td>
<td>7</td>
<td>BARKOV 87</td>
<td>CMD</td>
<td>(e^+ e^- \rightarrow \pi^+ \pi^- \pi^0)</td>
</tr>
<tr>
<td>783.3±0.4</td>
<td>433</td>
<td>CORDIER 80</td>
<td>DM1</td>
<td>(e^+ e^- \rightarrow \pi^+ \pi^- \pi^0)</td>
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<tr>
<td>782.5±0.8</td>
<td>33260</td>
<td>ROOS 80</td>
<td>RVUE</td>
<td>0.0–3.6 (\pi p)</td>
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<tr>
<td>782.6±0.8</td>
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<td>OMEG</td>
<td>9–12 (\pi^\pm p)</td>
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<tr>
<td>783.8±0.6</td>
<td>1430</td>
<td>COOPER 78B</td>
<td>HBC</td>
<td>0.7–0.8 (\pi p \rightarrow 5\pi)</td>
</tr>
<tr>
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<td>VANAPEL... 78</td>
<td>HBC</td>
<td>7.2 (\pi p \rightarrow \pi p\omega)</td>
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<tr>
<td>783.5±0.8</td>
<td>2100</td>
<td>GESSAROLI 77</td>
<td>HBC</td>
<td>11 (\pi^- p \rightarrow \omega n)</td>
</tr>
<tr>
<td>782.5±0.8</td>
<td>418</td>
<td>AGUILAR... 72B</td>
<td>HBC</td>
<td>3.9,4.6 (K^- p)</td>
</tr>
<tr>
<td>783.4±1.0</td>
<td>248</td>
<td>BIZZARRI 71</td>
<td>HBC</td>
<td>0.0 (p \pi \rightarrow K^+ K^-\omega)</td>
</tr>
<tr>
<td>780.6±0.6</td>
<td>510</td>
<td>BIZZARRI 71</td>
<td>HBC</td>
<td>0.0 (p \pi \rightarrow K_1 K_1\omega)</td>
</tr>
<tr>
<td>783.7±1.0</td>
<td>3583</td>
<td>8 COYNE 71</td>
<td>HBC</td>
<td>3.7 (\pi^\pm p \rightarrow \rho\pi^+ \pi^- \pi^0)</td>
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<tr>
<td>784.1±1.2</td>
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<td>ABRAMOVI... 70</td>
<td>HBC</td>
<td>3.9 (\pi^- p)</td>
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<td>783.2±1.6</td>
<td>9 BIGGS 70B</td>
<td>CNTR</td>
<td>(&lt;4.1\ C \rightarrow \pi^+ \pi^- C)</td>
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<tr>
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<td>2400</td>
<td>BIZZARRI 69</td>
<td>HBC</td>
<td>0.0 (\pi p)</td>
</tr>
</tbody>
</table>

1. Update of AKHMETSHIN 00c.
2. From the combined fit of ANTONELLI 92, ACHASOV 01E, ACHASOV 02E, and ACHASOV 03D data on the \(\pi^+ \pi^- \pi^0\) and ANTONELLI 92 on the \(\omega \pi^+ \pi^-\) final states.
3. Supersedes ACHASOV 99E and ACHASOV 02E.
4. From the \(\eta \rightarrow \gamma \gamma\) decay.
5. From the \(\eta \rightarrow 3\pi^0\) decay.
6. From the \(\rho - \omega\) interference in the \(\pi^+ \pi^-\) mass spectrum using the Breit-Wigner for the \(\omega\) and leaving its mass and width as free parameters of the fit.
7. Systematic uncertainties underestimated.
8. From best-resolution sample of COYNE 71.
9. From \(\omega - \rho\) interference in the \(\pi^+ \pi^-\) mass spectrum assuming \(\omega\) width 12.6 MeV.

Citation: C. Patrignani et al. (Particle Data Group), Chin. Phys. C, 40, 100001 (2016)
**WEIGHTED AVERAGE**

782.65±0.12 (Error scaled by 1.9)

\[
\chi^2 = \frac{1}{22.0} \text{ (Confidence Level = 0.0012)}
\]

\[\omega(782)\] mass (MeV)

\[
\omega(782) \text{ WIDTH}
\]

<table>
<thead>
<tr>
<th>VALUE (MeV)</th>
<th>EVTS</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
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</thead>
<tbody>
<tr>
<td>8.49±0.08 OUR AVERAGE</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>8.68±0.23±0.10</td>
<td>11200</td>
<td>AKHMETSHIN 04</td>
<td>CMD2</td>
<td>(e^+ e^- \rightarrow \pi^+ \pi^- \pi^0)</td>
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<tr>
<td>8.68±0.04±0.15</td>
<td>1.2M</td>
<td>ACHASOV 03D</td>
<td>RVUE</td>
<td>0.44–2.00 (e^+ e^- \rightarrow \pi^+ \pi^- \pi^0)</td>
</tr>
<tr>
<td>8.2 ± 0.3</td>
<td>19500</td>
<td>WURZINGER 95</td>
<td>SPEC</td>
<td>1.33 (p d \rightarrow ^3\text{He}\omega)</td>
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<tr>
<td>8.4 ± 0.1</td>
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<td>ND</td>
<td>(e^+ e^- \rightarrow \pi^+ \pi^- \pi^0)</td>
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<td>CMD</td>
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<tr>
<td>9.8 ± 0.9</td>
<td>1488</td>
<td>KURDADZE 83B</td>
<td>OLYA</td>
<td>(e^+ e^- \rightarrow \pi^+ \pi^- \pi^0)</td>
</tr>
<tr>
<td>9.0 ± 0.8</td>
<td>433</td>
<td>CORDIER 80</td>
<td>DM1</td>
<td>(e^+ e^- \rightarrow \pi^+ \pi^- \pi^0)</td>
</tr>
<tr>
<td>9.1 ± 0.8</td>
<td>451</td>
<td>BENAKSAS 72B</td>
<td>OSPK</td>
<td>(e^+ e^- \rightarrow \pi^+ \pi^- \pi^0)</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>VALUE (MeV)</th>
<th>EVTS</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
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<td>12 ± 2</td>
<td>1430</td>
<td>COOPER 78B</td>
<td>HBC</td>
<td>0.7–0.8 (\rho p \rightarrow 5\pi)</td>
</tr>
<tr>
<td>9.4 ± 2.5</td>
<td>2100</td>
<td>GESSAROLI 77</td>
<td>HBC</td>
<td>(11 \pi^- p \rightarrow \omega n)</td>
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<td>CNTR</td>
<td>(\pi^- p \rightarrow \omega n)</td>
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<td>13.3 ± 2</td>
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<td>AGUILAR-... 72B</td>
<td>HBC</td>
<td>3.9.46 (K^- p)</td>
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<td>10.5 ± 1.5</td>
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<td>BORENSTEIN 72</td>
<td>HBC</td>
<td>2.18 (K^- p)</td>
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<td>7.70±0.9 ± 1.15</td>
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<td>BROWN 72</td>
<td>MMS</td>
<td>2.5 (\pi^- p \rightarrow n\mathrm{MM})</td>
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<tr>
<td>10.3 ± 1.4</td>
<td>510</td>
<td>BIZZARRI 71</td>
<td>HBC</td>
<td>0.0 (p \bar{p} \rightarrow K_1 K_1\omega)</td>
</tr>
<tr>
<td>12.8 ± 3.0</td>
<td>248</td>
<td>BIZZARRI 71</td>
<td>HBC</td>
<td>0.0 (p \bar{p} \rightarrow K^+ K^- \omega)</td>
</tr>
<tr>
<td>9.5 ± 1.0</td>
<td>3583</td>
<td>COYNE 71</td>
<td>HBC</td>
<td>3.7 (\pi^+ p \rightarrow p \pi^+ \pi^+ \pi^- \pi^-)</td>
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</table>

**HTTP://PDG.LBL.GOV**
1 Update of AKHMETSHIN 00C.
2 From the combined fit of ANTONELLI 92, ACHASOV 01E, ACHASOV 02E, and
   ACHASOV 03D data on the $\pi^+\pi^-\pi^0$ and ANTONELLI 92 on the $\omega\pi^+\pi^-$ final states.
   Supersedes ACHASOV 99E and ACHASOV 02E.
3 Relativistic Breit-Wigner includes radiative corrections.
4 From the $\rho - \omega$ interference in the $\pi^+\pi^-$ mass spectrum using the Breit-Wigner for the
   $\omega$ and leaving its mass and width as free parameters of the fit.
5 Observed by threshold-crossing technique. Mass resolution = 4.8 MeV FWHM.

<table>
<thead>
<tr>
<th>Mode</th>
<th>Fraction ($\Gamma_i/\Gamma$)</th>
<th>Scale factor/Confidence level</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\Gamma_1$</td>
<td>$\pi^+\pi^-\pi^0$</td>
<td>(89.2 ± 0.7)%</td>
</tr>
<tr>
<td>$\Gamma_2$</td>
<td>$\pi^0\gamma$</td>
<td>(8.28±0.28)%</td>
</tr>
<tr>
<td>$\Gamma_3$</td>
<td>$\pi^+\pi^-$</td>
<td>(1.53±0.11,-0.13)%</td>
</tr>
<tr>
<td>$\Gamma_4$</td>
<td>neutrals (excluding $\pi^0\gamma$)</td>
<td>(8 ±8,-5) x 10^{-3}</td>
</tr>
<tr>
<td>$\Gamma_5$</td>
<td>$\eta\gamma$</td>
<td>(4.6 ± 0.4) x 10^{-4}</td>
</tr>
<tr>
<td>$\Gamma_6$</td>
<td>$\pi^0 e^+ e^-$</td>
<td>(7.7 ± 0.6) x 10^{-4}</td>
</tr>
<tr>
<td>$\Gamma_7$</td>
<td>$\pi^0 \mu^+ \mu^-$</td>
<td>(1.3 ± 0.4) x 10^{-4}</td>
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<tr>
<td>$\Gamma_8$</td>
<td>$\eta e^+ e^-$</td>
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<tr>
<td>$\Gamma_9$</td>
<td>$e^+ e^-$</td>
<td>(7.28±0.14) x 10^{-5}</td>
</tr>
<tr>
<td>$\Gamma_{10}$</td>
<td>$\pi^+\pi^-\pi^0\pi^0$</td>
<td>&lt; 2 x 10^{-4}</td>
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<tr>
<td>$\Gamma_{11}$</td>
<td>$\pi^+\pi^-\gamma$</td>
<td>&lt; 3.6 x 10^{-3}</td>
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<tr>
<td>$\Gamma_{12}$</td>
<td>$\pi^+\pi^-\pi^+\pi^-$</td>
<td>&lt; 1 x 10^{-3}</td>
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<tr>
<td>$\Gamma_{13}$</td>
<td>$\pi^0\pi^0\pi^0\gamma$</td>
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<tr>
<td>$\Gamma_{14}$</td>
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<td>$\Gamma_{15}$</td>
<td>$\mu^+\mu^-$</td>
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</tr>
<tr>
<td>$\Gamma_{16}$</td>
<td>$3\gamma$</td>
<td>&lt; 1.9 x 10^{-4}</td>
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</table>

**Charge conjugation (C) violating modes**

<table>
<thead>
<tr>
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<th>Fraction ($\Gamma_i/\Gamma$)</th>
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<tr>
<td>$\Gamma_{17}$</td>
<td>$\eta\pi^0$</td>
<td>C &lt; 2.1 x 10^{-4}</td>
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<tr>
<td>$\Gamma_{18}$</td>
<td>$2\pi^0$</td>
<td>C &lt; 2.1 x 10^{-4}</td>
</tr>
<tr>
<td>$\Gamma_{19}$</td>
<td>$3\pi^0$</td>
<td>C &lt; 2.3 x 10^{-4}</td>
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</table>
CONSTRAINED FIT INFORMATION

An overall fit to 15 branching ratios uses 51 measurements and one constraint to determine 10 parameters. The overall fit has a $\chi^2 = 51.8$ for 42 degrees of freedom.

The following off-diagonal array elements are the correlation coefficients $\langle \delta x_i \delta x_j \rangle / (\delta x_i \cdot \delta x_j)$, 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.

$$
\begin{array}{cccccccc}
 x_2 & 22 \\
 x_3 & -18 & -4 \\
 x_4 & -92 & -56 & 1 \\
 x_5 & 7 & 7 & -1 & -9 \\
 x_6 & -1 & 0 & 0 & 0 & 0 \\
 x_7 & -1 & 0 & 0 & 0 & 0 \\
 x_9 & -38 & -33 & 7 & 44 & -21 & 0 & 0 \\
 x_{13} & 1 & 4 & 0 & -2 & 0 & 0 & 0 & -1 \\
 x_{15} & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
\end{array}
$$

$\omega(782)$ PARTIAL WIDTHS

<table>
<thead>
<tr>
<th>$\Gamma(\pi^0 \gamma)$</th>
<th>$\Gamma_2$</th>
<th>$\Gamma_5$</th>
<th>$\Gamma_9$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\text{VALUE (keV)}$</td>
<td>$\text{EVTS}$</td>
<td>$\text{DOCUMENT ID}$</td>
<td>$\text{TECN}$</td>
</tr>
<tr>
<td>$880 \pm 50$</td>
<td>$7815$</td>
<td>$1$ ACHASOV 13</td>
<td>SND</td>
</tr>
<tr>
<td>$788 \pm 12 \pm 27$</td>
<td>$36500$</td>
<td>$2$ ACHASOV 03</td>
<td>SND</td>
</tr>
<tr>
<td>$764 \pm 51$</td>
<td>$10625$</td>
<td>DOLINSKY 89</td>
<td>ND</td>
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</table>

1 Systematic uncertainty not estimated.

2 Using $\Gamma_\omega = 8.44 \pm 0.09$ MeV and $B(\omega \rightarrow \pi^0 \gamma)$ from ACHASOV 03.

<table>
<thead>
<tr>
<th>$\Gamma(\eta \gamma)$</th>
<th>$\Gamma_5$</th>
<th>$\Gamma_9$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\text{VALUE (keV)}$</td>
<td>$\text{DOCUMENT ID}$</td>
<td>$\text{TECN}$</td>
</tr>
<tr>
<td>$6.1 \pm 2.5$</td>
<td>$1$ DOLINSKY 89</td>
<td>ND</td>
</tr>
</tbody>
</table>

1 Using $\Gamma_\omega = 8.4 \pm 0.1$ MeV and $B(\omega \rightarrow \eta \gamma)$ from DOLINSKY 89.
1 Using \( B(\omega \to \pi^+\pi^-\pi^0) = 0.891 \pm 0.007 \) and \( \Gamma_{\text{total}} = 8.44 \pm 0.09 \) MeV.

2 Update of AKHMETSHIN 00c.

3 Using ACHASOV 03, ACHASOV 03d and \( B(\omega \to \pi^+\pi^-) = (1.70 \pm 0.28)\% \).

\[
\omega(782) \Gamma(e^+e^-)/\Gamma(\pi^+\pi^-\pi^0)/\Gamma_{\text{total}} \quad \Gamma_9/\Gamma \times \Gamma_1/\Gamma
\]

<table>
<thead>
<tr>
<th>VALUE (units 10^{-5})</th>
<th>EVTS</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
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<tr>
<td>6.49\pm0.11 OUR FIT</td>
<td>Error includes scale factor of 1.3.</td>
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<tr>
<td>6.38\pm0.10 OUR AVERAGE</td>
<td>Error includes scale factor of 1.1.</td>
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</tr>
<tr>
<td>6.24\pm0.11\pm0.08</td>
<td>11.2k</td>
<td>1 AKHMETSHIN 04</td>
<td>CMD2</td>
<td>e^+e^- → \pi^+\pi^-\pi^0</td>
</tr>
<tr>
<td>6.70\pm0.06\pm0.27</td>
<td>AUBERT,B</td>
<td>04N</td>
<td>BABR</td>
<td>10.6 e^+e^- → \pi^+\pi^-\pi^0</td>
</tr>
<tr>
<td>6.74\pm0.04\pm0.24</td>
<td>1.2M</td>
<td>2,3 ACHASOV 03D</td>
<td>RVUE</td>
<td>0.44–2.00 e^+e^- → \pi^+\pi^-\pi^0</td>
</tr>
<tr>
<td>6.37\pm0.35</td>
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<td>ND</td>
<td>e^+e^- → \pi^+\pi^-\pi^0</td>
</tr>
<tr>
<td>6.45\pm0.24</td>
<td>2 BARKOV</td>
<td>87</td>
<td>CMD</td>
<td>e^+e^- → \pi^+\pi^-\pi^0</td>
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<tr>
<td>5.79\pm0.42</td>
<td>1488</td>
<td>2 KURDADZE</td>
<td>83b</td>
<td>OLYA</td>
</tr>
<tr>
<td>5.89\pm0.54</td>
<td>433</td>
<td>2 CORDIER</td>
<td>80</td>
<td>DM1</td>
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<tr>
<td>7.54\pm0.84</td>
<td>451</td>
<td>2 BENAKSAS</td>
<td>72b</td>
<td>OSPK</td>
</tr>
</tbody>
</table>

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

| 6.20\pm0.13 | 4 BENAYOUN | 10 | RVUE | 0.4–1.05 e^+e^- |

1 Using \( \rho \omega \) interference equal to \(( -10.2 \pm 7.0) \)°.

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

3 From the combined fit of ANTONELLI 92, ACHASOV 01E, ACHASOV 02E, and ACHASOV 03d data on the \( \pi^+\pi^-\pi^0 \) and ANTONELLI 92 on the \( \omega \pi^+\pi^- \) final states.

4 A simultaneous fit of \( e^+e^- → \pi^+\pi^-\pi^0 \) and ACHASOV 02E.

\[
\Gamma(e^+e^-)/\Gamma_{\text{total}} \times \Gamma(\pi^0\gamma)/\Gamma_{\text{total}} \quad \Gamma_9/\Gamma \times \Gamma_2/\Gamma
\]

<table>
<thead>
<tr>
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<tr>
<td>6.02\pm0.20 OUR FIT</td>
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<td>6.45\pm0.17 OUR AVERAGE</td>
<td>Error includes scale factor of 1.1.</td>
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<tr>
<td>6.47\pm0.14\pm0.39</td>
<td>18680</td>
<td>AKHMETSHIN 05</td>
<td>CMD2</td>
<td>0.60-1.38 e^+e^- → \pi^0\gamma</td>
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<tr>
<td>6.50\pm0.11\pm0.20</td>
<td>1 ACHASOV 03</td>
<td>SND</td>
<td>0.60-0.97 e^+e^- → \pi^0\gamma</td>
<td></td>
</tr>
<tr>
<td>6.34\pm0.21\pm0.21</td>
<td>10625</td>
<td>2 DOLINSKY</td>
<td>89</td>
<td>ND</td>
</tr>
</tbody>
</table>

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

| 6.80\pm0.13 | 3 BENAYOUN | 10 | RVUE | 0.4–1.05 e^+e^- |

1 Using \( \sigma_{\phi^-\pi^0\gamma} \) from ACHASOV 00 and \( m_\omega = 782.57 \) MeV in the model with the energy-independent phase of \( \phi^-\omega \) interference equal to \(( -10.2 \pm 7.0) \)°.

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

3 A simultaneous fit of \( e^+e^- → \pi^+\pi^-\pi^0, \pi^+\pi^-\pi^0, \pi^0\gamma, \eta\gamma \) data.

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

<table>
<thead>
<tr>
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<th>DOCUMENT ID</th>
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<td>1.225\pm0.058\pm0.041</td>
<td>800k</td>
<td>1 ACHASOV</td>
<td>06</td>
<td>SND</td>
</tr>
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• • • We do not use the following data for averages, fits, limits, etc. • • •

| 1.166 \pm 0.036 | 2 BENAYOUN | 13 | RVUE | 0.4–1.05 e^+e^- |
| 1.05 \pm 0.08 | 3 DAVIER | 13 | RVUE | e^+e^- → \pi^+\pi^- (\gamma) |
\( \Gamma(e^+e^-)/\Gamma_{\text{total}} \times \Gamma(\eta\gamma)/\Gamma_{\text{total}} \)

\begin{table}[h]
\centering
\begin{tabular}{cccc}
\textbf{VALUE} (10^{-6}) & \textbf{EVTS} & \textbf{DOCUMENT ID} & \textbf{TECN} & \textbf{COMMENT} \\
\hline
3.32 & 0.28 & \textit{OUR FIT} & Error includes scale factor of 1.1. & \\
3.18 & 0.28 & \textit{OUR AVERAGE} & & \\
3.10 & ±0.31 & ±0.11 & 33k & 1 ACHASOV 07b SND 0.6–1.38 \( e^+e^- \rightarrow \eta\gamma \) \\
3.17 & +1.85 & −1.31 & ±0.21 & 17.4k & 2 AKHMETSHEIN 05 CMD2 0.60–1.38 \( e^+e^- \rightarrow \eta\gamma \) \\
3.41 & ±0.52 & ±0.21 & 23k & 3 ACHASOV 01a CMD2 \( e^+e^- \rightarrow \eta\gamma \) \\
\hline
\end{tabular}
\end{table}

1. Supersedes ACHASOV 05a.
2. A simultaneous fit to \( e^+e^- \rightarrow \pi^+\pi^-, \pi^+\pi^-\bar{\pi}^0, \pi^0\gamma, \eta\gamma, K\bar{K}, \) and \( \tau^- \rightarrow \pi^-\pi^0\nu_\tau \) data. Supersedes BENAYOUN 10.
3. From \( e^+e^- \rightarrow \pi^+\pi^-(\gamma) \) data of LEES 12G.

\( \omega(782) \) BRANCHING RATIOS

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

\begin{table}[h]
\centering
\begin{tabular}{cccc}
\textbf{VALUE} (10^{-2}) & \textbf{EVTS} & \textbf{DOCUMENT ID} & \textbf{TECN} & \textbf{COMMENT} \\
\hline
0.9024 & ±0.0019 & 1 AMBROSINO 08G KLOE 1.0–1.03 \( e^+e^- \rightarrow \pi^+\pi^-2\pi^0, 2\pi^0\gamma \) & \\
0.8965 & ±0.0016 & ±0.0048 & 1.2M & 2,3 ACHASOV 03D RVUE 0.44–2.00 \( e^+e^- \rightarrow \pi^+\pi^-\pi^0 \) \\
0.880 & ±0.020 & ±0.032 & 11200 & 3 ACHASOV 00c CMD2 \( e^+e^- \rightarrow \pi^+\pi^-\pi^0 \) \\
0.8942 & ±0.0062 & 34 DOLINSKY 89 ND \( e^+e^- \rightarrow \pi^+\pi^-\pi^0 \) & \\
\hline
\end{tabular}
\end{table}

1. Not independent of \( \Gamma(\pi^0\gamma)/\Gamma(\pi^+\pi^-\pi^0) \) from AMBROSINO 08G.
2. Using ACHASOV 03, ACHASOV 03D and \( B(\omega \rightarrow \pi^+\pi^-) = (1.70 \pm 0.28)\% \).
3. Not independent of the corresponding \( \Gamma(\pi^+\pi^-\pi^0)/\Gamma_{\text{total}} \).
4. Using \( \Gamma(e^+e^-) = 0.60 \pm 0.02 \) keV.

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

\begin{table}[h]
\centering
\begin{tabular}{cccc}
\textbf{VALUE} (10^{-2}) & \textbf{EVTS} & \textbf{DOCUMENT ID} & \textbf{TECN} & \textbf{COMMENT} \\
\hline
8.09 & ±0.14 & 1 AMBROSINO 08G KLOE \( e^+e^- \rightarrow \pi^+\pi^-2\pi^0, 2\pi^0\gamma \) & \\
9.06 & ±0.20 & ±0.57 & 18680 & 2,3 AKHMETSHEIN 05 CMD2 0.60–1.38 \( e^+e^- \rightarrow \pi^0\gamma \) \\
9.34 & ±0.15 & ±0.31 & 36500 & 3 ACHASOV 03 SND 0.60–0.97 \( e^+e^- \rightarrow \pi^0\gamma \) \\
8.65 & ±0.16 & ±0.42 & 1.2M & 4,5 ACHASOV 03D RVUE 0.44–2.00 \( e^+e^- \rightarrow \pi^+\pi^-\pi^0 \) \\
8.39 & ±0.24 & 9975 & 6 BENAYOUN 96 RVUE \( e^+e^- \rightarrow \pi^0\gamma \) \\
8.88 & ±0.62 & 10625 & 3 DOLINSKY 89 ND \( e^+e^- \rightarrow \pi^0\gamma \) & \\
\hline
\end{tabular}
\end{table}

1. Supersedes ACHASOV 05a.
2. A simultaneous fit to \( e^+e^- \rightarrow \pi^+\pi^-, \pi^+\pi^-\bar{\pi}^0, \pi^0\gamma, \eta\gamma, K\bar{K}, \) and \( \tau^- \rightarrow \pi^-\pi^0\nu_\tau \) data. Supersedes BENAYOUN 10.
3. From \( e^+e^- \rightarrow \pi^+\pi^-(\gamma) \) data of LEES 12G.

\section*{\textit{Citation:} C. Patrignani et al. (Particle Data Group), Chin. Phys. C, 40, 100001 (2016)}

\section*{HTTP://PDG.LBL.GOV | Page 6 | Created: 10/1/2016 20:05
\[ \Gamma(p^0 \gamma) / \Gamma(\pi^+ \pi^- \pi^0) \]

\[ \Gamma_2/\Gamma_1 \]

\begin{tabular}{|l|l|l|l|}
\hline
VALUE (units \(10^{-2}\)) & DOCUMENT ID & TECN & COMMENT \\
\hline
9.28 ± 0.31 OUR FIT & Error includes scale factor of 2.3. & & \\
9.05 ± 0.27 OUR AVERAGE & Error includes scale factor of 1.8. & & \\
8.97 ± 0.16 & AMBROSINO 08G & KLOE & \( e^+ e^- \rightarrow \pi^+ \pi^- 2\pi^0, 2\pi^0 \gamma \) \\
9.94 ± 0.36 ± 0.38 & 1 AULCHENKO 00A & SND & \( e^+ e^- \rightarrow \pi^+ \pi^- 2\pi^0, 2\pi^0 \gamma \) \\
8.4 ± 1.3 & KEYNE 76 & CNTR & \( \pi^- p \rightarrow \omega n \) \\
10.9 ± 2.5 & BENAKSAS 72C & OSPK & \( e^+ e^- \rightarrow \pi^0 \gamma \) \\
8.1 ± 2.0 & BALDIN 71 & HLBC & 2.9 \( \pi^+ p \) \\
13 ± 4 & JACQUET 69B & HLBC & 2.05 \( \pi^+ p \rightarrow \pi^+ p \omega \) \\
\hline
\end{tabular}

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

\( \frac{\Gamma_3/\Gamma}{\text{See also } \Gamma(\pi^+ \pi^-) / \Gamma(\pi^+ \pi^- \pi^0)} \)

\begin{tabular}{|l|l|l|l|}
\hline
VALUE (units \(10^{-2}\)) & EVTS & DOCUMENT ID & TECN & COMMENT \\
\hline
1.53 ± 0.11 & 1.13 & 900k & 1 AKHMETSHIN 07 & \( e^+ e^- \rightarrow \pi^+ \pi^- \) \\
1.49 ± 0.13 OUR AVERAGE & Error includes scale factor of 1.3. See the ideogram below. & & & \\
1.46 ± 0.12 ± 0.02 & 0.10 & 900k & 2 AKHMETSHIN 04 & CMD2 & \( e^+ e^- \rightarrow \pi^+ \pi^- \) \\
1.30 ± 0.24 ± 0.05 & 0.15 & 11.2k & & & \\
4 & 3 ACHASOV 02E & SND & 1.1–1.38 \( e^+ e^- \rightarrow \pi^+ \pi^- \pi^0 \) & \\
2.38 ± 1.77 ± 0.90 ± 0.18 & 0.54k & 5.4k & & & \\
2.3 ± 0.5 & BARKOV 85 & OLYA & \( e^+ e^- \rightarrow \pi^+ \pi^- \) & \\
1.6 ± 0.9 & QUENZER 78 & DM1 & \( e^+ e^- \rightarrow \pi^+ \pi^- \) & \\
3.6 ± 1.9 & BENAKSAS 72 & OSPK & \( e^+ e^- \rightarrow \pi^+ \pi^- \) & \\
\hline
\end{tabular}

\( \frac{\Gamma_3}{\Gamma} \)

\begin{tabular}{|l|l|l|l|}
\hline
VALUE (units \(10^{-2}\)) & DOCUMENT ID & TECN & COMMENT \\
\hline
1.75 ± 0.11 & 4.5M & 4 ACHASOV 05A & SND & \( e^+ e^- \rightarrow \pi^+ \pi^- \) \\
2.01 ± 0.29 & & & & \\
1.9 ± 0.3 & 6 GARDNER 99 & RVUE & \( e^+ e^- \rightarrow \pi^+ \pi^- \) & \\
2.3 ± 0.4 & 7 BENAYOUN 98 & RVUE & \( e^+ e^- \rightarrow \pi^+ \pi^-, \mu^+ \mu^- \) & \\
1.0 ± 0.11 & 8 WICKLUND 78 & ASPK & 3.4, 6 \pi^\pm N & \\
1.22 ± 0.30 & & & & \\
1.3 ± 1.2 ± 0.9 & MOFFEIT 71 & HBC & 2.8, 4.7 \gamma p & \\
0.80 ± 0.28 ± 0.20 & 9 BIGGS 70B & CNTR & 4.2γC \rightarrow \pi^+ \pi^- C & \\
\hline
\end{tabular}
1 A combined fit of AKHMETSHIN 07, AULCHENKO 06, and AULCHENKO 05.
2 Update of AKHMETSHIN 02.
3 From the $m_{\pi^+\pi^-}$ spectrum taking into account the interference of the $\rho\pi$ and $\omega\pi$ amplitudes.
4 Using $\Gamma(\omega \rightarrow e^+ e^-)$ from the 2004 Edition of this Review (PDG 04).
5 Using the data of AKHMETSHIN 02 in the hidden local symmetry model.
6 Using the data of BARKOV 85.
7 Using the data of BARKOV 85 in the hidden local symmetry model.
8 From a model-dependent analysis assuming complete coherence.
9 Re-evaluated under $\Gamma(\pi^+\pi^-)/\Gamma(\pi^+\pi^-\pi_0)$ by BEHREND 71 using more accurate $\omega \rightarrow \rho$ photoproduction cross-section ratio.

WEIGHTED AVERAGE
1.49±0.13 (Error scaled by 1.3)

Values above of weighted average, error, and scale factor are based upon the data in this ideogram only. They are not necessarily the same as our 'best' values, obtained from a least-squares constrained fit utilizing measurements of other (related) quantities as additional information.

$\chi^2$

<table>
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<td>Error includes scale factor of 1.2.</td>
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<tr>
<td>0.026 ±0.005 OUR AVERAGE</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>0.021 +0.028</td>
<td>1.2 RATCLIFF</td>
<td>ASPK</td>
<td>15 $\pi^-\rho \rightarrow n 2\pi$</td>
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<tr>
<td>-0.009</td>
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<td></td>
<td></td>
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<tr>
<td>0.028 ±0.006</td>
<td>1 BEHREND</td>
<td>ASPK</td>
<td>Photoproduction</td>
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<tr>
<td>0.022 +0.009</td>
<td>3 ROOS</td>
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1 The fitted width of these data is 160 MeV in agreement with present average, thus the $\omega$ contribution is overestimated. Assuming $\rho$ width 145 MeV.
2 Significant interference effect observed. NB of $\omega \rightarrow 3\pi$ comes from an extrapolation.
3 ROOS 70 combines ABRAMOVICH 70 and BIZZARRI 70.
\[ \Gamma (\pi^+ \pi^-)/\Gamma (\pi^0 \gamma) \]

- **VALUE**
  - 0.20 ± 0.04

- **EVTS**
  - 1.98M

- **DOCUMENT ID**
  - ALOISIO 03

- **TECN**
  - KLOE

- **COMMENT**
  - \[ \Gamma (\pi^+ \pi^-)/\Gamma (\pi^0 \gamma) \]

1. Using the data of ALOISIO 02D.

- **\( \Gamma (\text{neutrals})/\Gamma_{\text{total}} \)\]**

- **VALUE**
  - 0.091 ± 0.006 OUR FIT
  - 0.081 ± 0.011 OUR AVERAGE

- **EVTS**
  - 0.075 ± 0.025
  - 0.079 ± 0.019
  - 0.084 ± 0.015

- **DOCUMENT ID**
  - BIZZARRI 71
  - DEINET 69b
  - BOLLINI 68c

- **TECN**
  - HBC
  - OSPK
  - CNTR

- **COMMENT**
  - 0.0 p\( \bar{p} \)
  - 1.5 \( \pi^- p \)
  - 2.1 \( \pi^- p \)

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

- **VALUE**
  - 0.073 ± 0.018

- **EVTS**
  - 42

- **DOCUMENT ID**
  - BASILE 72b

- **TECN**
  - CNTR

- **COMMENT**
  - 1.67 \( \pi^- p \)

- **\( \Gamma (\text{neutrals})/\Gamma (\pi^+ \pi^- \pi^0) \)\]**

- **VALUE**
  - 0.102 ± 0.008 OUR FIT
  - 0.103 ± 0.011 OUR AVERAGE

- **EVTS**
  - 0.15 ± 0.04
  - 0.10 ± 0.03
  - 0.134 ± 0.026
  - 0.097 ± 0.016
  - 0.06 ± 0.05
  - 0.08 ± 0.03

- **DOCUMENT ID**
  - AGUILAR-... 72b
  - BARASH 67b
  - DIGIUGNO 66b
  - FLATTE 66
  - JAMES 66
  - KRAEMER 64

- **TECN**
  - HBC
  - HBC
  - CNTR
  - HBC
  - HBC
  - DBC

- **COMMENT**
  - 3.9, 4.6 K\( p \)
  - 0.0 \( \bar{p} p \)
  - 1.4 \( \pi^- p \)
  - 1.4 – 1.7 K\( p \) \( \rightarrow \) \( \Lambda MM \)
  - 2.1 \( \pi^+ p \)
  - 1.2 \( \pi^+ d \)

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

- **VALUE**
  - 0.11 ± 0.02

- **EVTS**
  - 20

- **DOCUMENT ID**
  - BUSCHBECK 63

- **TECN**
  - HBC

- **COMMENT**
  - 1.5 K\( p \)

- **\( \Gamma (\pi^0 \gamma)/\Gamma (\text{neutrals}) \)\]**

- **VALUE**
  - 0.78 ± 0.07
  - >0.81

- **CL%**
  - 1
  - 90

- **DOCUMENT ID**
  - 1 DAKIN 72
  - DEINET 69b

- **TECN**
  - OSPK
  - OSPK

- **COMMENT**
  - 1.4 \( \pi^- p \) \( \rightarrow \) \( n MM \)
  - 1 Error statistical only. Authors obtain good fit also assuming \( \pi^0 \gamma \) as the only neutral decay.

- **\( \Gamma (\text{neutrals})/\Gamma (\text{charged particles}) \)\]**

- **VALUE**
  - 0.100 ± 0.008 OUR FIT
  - 0.124 ± 0.021

- **DOCUMENT ID**
  - FELDMAN 67c

- **TECN**
  - OSPK

- **COMMENT**
  - 1.2 \( \pi^- p \)
\[ \Gamma(\eta \gamma)/\Gamma_{\text{total}} \]

<table>
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<tr>
<td>6.3 ± 1.3 <strong>OUR AVERAGE</strong></td>
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<td></td>
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</tbody>
</table>

Error includes scale factor of 1.1.
Error includes scale factor of 1.2.

- 6.6 ± 1.7 1 ABELE 97E CBAR 0.0 \( \not{\mathbf{p}} \rightarrow 5 \gamma 
- 8.3 ± 2.1 ALDE 93 GAM2 38\( \pi^- \mathbf{p} \rightarrow \omega \mathbf{n} 
- 3.0 = 2.5\quad = 1.8 \quad 2 ANDREWS 77 CNTR 6.7–10 \gamma \mathbf{Cu} 
- 4.3 ± 0.5 ± 0.1 33k 3 ACHASOV 07B SND 0.6–1.38 e^+ e^- \rightarrow \eta \gamma 
- 4.44 ± 2.59 ± 1.83 ± 0.28 17.4k 4,5 AKHMETSHIN 05 CMD2 0.60–1.38 e^+ e^- \rightarrow \eta \gamma 
- 5.10 ± 0.72 ± 0.54 23k 6 AKHMETSHIN 01b CMD2 e^+ e^- \rightarrow \eta \gamma 
- 0.7 to 5.5 7 CASE 00 CBAR 0.0 \( \rho \not{\mathbf{p}} \rightarrow \eta \eta \gamma 
- 6.56 ± 2.41 ± 2.55 352k 2,8 BENAYOUN 96 RVUE e^+ e^- \rightarrow \eta \gamma 
- 7.3 ± 2.9 2,4 DOLINSKY 89 ND e^+ e^- \rightarrow \eta \gamma 

1 No flat \( \eta \eta \gamma \) background assumed.
2 Solution corresponding to constructive \( \omega-\rho \) interference.
3 ACHASOV 07B reports \( [\Gamma(\omega(782) \rightarrow \eta \gamma)/\Gamma_{\text{total}}] \times [B(\omega(782) \rightarrow e^+ e^-)] = (3.10 ± 0.31 ± 0.11) \times 10^{-8} \) which we divide by our best value \( B(\omega(782) \rightarrow e^+ e^-) = (7.28 ± 0.14) \times 10^{-5} \). Our first error is their experiment’s error and second is the systematic error from using our best value. Supersedes ACHASOV 00D and ACHASOV 06A.
4 Not independent of the corresponding \( \Gamma(e^+ e^-) \times \Gamma(\eta \gamma)/\Gamma_{\text{total}}^2 \) .
5 Using \( B(\omega \rightarrow e^+ e^-) = (7.14 ± 0.13) \times 10^{-5} \) and \( B(\eta \rightarrow \gamma \gamma) = 39.43 ± 0.26\% \).
6 Using \( B(\omega \rightarrow e^+ e^-) = (7.07 ± 0.19) \times 10^{-5} \) and using \( B(\eta \rightarrow 3\pi^0) = (32.24 ± 0.29) \times 10^{-2} \). Solution corresponding to constructive \( \omega-\rho \) interference. 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). Not independent of the corresponding \( \Gamma(e^+ e^-) \times \Gamma(\eta \gamma)/\Gamma_{\text{total}}^2 \).
7 Depending on the degree of coherence with the flat \( \eta \eta \gamma \) background and using \( B(\omega \rightarrow \pi^0 \gamma) = (8.5 ± 0.5) \times 10^{-2} \).
8 Reanalysis of DRUZHININ 84, DOLINSKY 89, DOLINSKY 91 taking into account the triangle anomaly contributions.

\[ \Gamma(\pi^0 \gamma)/\Gamma(\pi^0 \gamma) \]

<table>
<thead>
<tr>
<th>VALUE (units 10^{-4})</th>
<th>DOCUMENT ID</th>
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<th>COMMENT</th>
</tr>
</thead>
</table>
| 0.0098 ± 0.0024       | 1 ALDE 93   | GAM2 | 38\( \pi^- \mathbf{p} \rightarrow \omega \mathbf{n} 
| 0.0082 ± 0.0033       | 2 DOLINSKY 89 | ND   | e^+ e^- \rightarrow \eta \gamma 
| 0.010 ± 0.045         | 3 APEL 72B | OSPK | 4–8 \( \pi^- \mathbf{p} \rightarrow n3\gamma 

1 Model independent determination.
2 Solution corresponding to constructive \( \omega-\rho \) interference.

\[ \Gamma(\pi^0 e^+ e^-)/\Gamma_{\text{total}} \]

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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.7 ± 0.6 <strong>OUR AVERAGE</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- 7.61 ± 0.53 ± 0.64 ACHASOV 08 SND 0.36–0.97 e^+ e^- \rightarrow \pi^0 e^+ e^-
- 8.19 ± 0.71 ± 0.62 AKHMETSHIN 05A CMD2 0.72–0.84 e^+ e^-
- 5.9 ± 1.9 43 DOLINSKY 88 ND e^+ e^- \rightarrow \pi^0 e^+ e^-

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\[ \Gamma(\pi^0 \mu^+ \mu^-)/\Gamma_{\text{total}} \] \[ \Gamma_7/\Gamma \]

<table>
<thead>
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<th>COMMENT</th>
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<tbody>
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<td>3k</td>
<td>ARNALDI 09</td>
<td>NA60</td>
<td>Error includes scale factor of 2.1.</td>
</tr>
<tr>
<td>1.3 ±0.4 OUR AVERAGE</td>
<td>0.96 ±0.23</td>
<td>DZHELYADIN 81B</td>
<td>CNTR</td>
<td>158A In–In collisions</td>
</tr>
</tbody>
</table>

\[ \Gamma(\eta e^+ e^-)/\Gamma_{\text{total}} \] \[ \Gamma_8/\Gamma \]

<table>
<thead>
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<th>VALUE (units 10^{-5})</th>
<th>DOCUMENT ID</th>
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<td>&lt; 1.1</td>
<td>AKHMETSHIN 05A</td>
<td>CMD2</td>
<td>0.72-0.84 e^+ e^-</td>
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</tbody>
</table>

\[ \Gamma(e^+ e^-)/\Gamma_{\text{total}} \] \[ \Gamma_9/\Gamma \]

<table>
<thead>
<tr>
<th>VALUE (units 10^{-4})</th>
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<tbody>
<tr>
<td>0.728 ±0.014 OUR FIT</td>
<td>11200</td>
<td>1,2 AKHMETSHIN 04</td>
<td>CMD2</td>
<td>e^+ e^- → π^+ π^- π^0</td>
</tr>
<tr>
<td>0.700 ±0.016</td>
<td>1,2 AKHMETSHIN 04</td>
<td>CMD2</td>
<td>0.44–2.00 e^+ e^- → π^+ π^- π^0</td>
<td></td>
</tr>
<tr>
<td>0.752 ±0.004 ±0.024</td>
<td>1.2M</td>
<td>ACHASOV 03D</td>
<td>RVUE</td>
<td>e^+ e^- → π^+ π^- π^0</td>
</tr>
<tr>
<td>0.714 ±0.036</td>
<td>2 DOLINSKY</td>
<td>89</td>
<td>ND</td>
<td>e^+ e^- → π^+ π^- π^0</td>
</tr>
<tr>
<td>0.72 ±0.03</td>
<td>2 BARKOV</td>
<td>87</td>
<td>CMD</td>
<td>e^+ e^- → π^+ π^- π^0</td>
</tr>
<tr>
<td>0.64 ±0.04</td>
<td>2 KURDADZE</td>
<td>83B</td>
<td>OLYA</td>
<td>e^+ e^- → π^+ π^- π^0</td>
</tr>
<tr>
<td>0.675 ±0.069</td>
<td>2 CORDIER</td>
<td>80</td>
<td>DM1</td>
<td>e^+ e^- → π^+ π^- π^0</td>
</tr>
<tr>
<td>0.83 ±0.10</td>
<td>2 BENAKSAS</td>
<td>72B</td>
<td>OSPK</td>
<td>e^+ e^- → π^+ π^- π^0</td>
</tr>
<tr>
<td>0.77 ±0.06</td>
<td>2 AUGUSTIN</td>
<td>69D</td>
<td>OSPK</td>
<td>e^+ e^- → π^+ π^- π^0</td>
</tr>
<tr>
<td>0.65 ±0.13</td>
<td>5 ASTVACAT...</td>
<td>68</td>
<td>OSPK</td>
<td>Assume SU(3)+mixing</td>
</tr>
</tbody>
</table>

1 Using B(\omega → π^+ π^- π^0) = 0.891 ± 0.007. Update of AKHMETSHIN 00c.
2 Not independent of the corresponding \( \Gamma(e^+ e^-) \times \Gamma(\pi^+ \pi^- \pi^0)/\Gamma_{\text{total}}^2 \).
3 Using ACHASOV 03, ACHASOV 03D and B(\omega → π^+ π^-) = (1.70 ± 0.28)%.
4 Rescaled by us to correspond to \( \omega \) width 8.4 MeV. Systematic errors underestimated.
5 Not resolved from \( \rho \) decay. Error statistical only.

\[ \Gamma(\pi^+ \pi^- \pi^0)/\Gamma_{\text{total}} \] \[ \Gamma_{10}/\Gamma \]

<table>
<thead>
<tr>
<th>VALUE (units 10^{-4})</th>
<th>CL%</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 2</td>
<td>90</td>
<td>ACHASOV 09A</td>
<td>SND</td>
<td>e^+ e^- → π^+ π^- π^0</td>
</tr>
<tr>
<td>&lt;200</td>
<td>KURDADZE</td>
<td>86</td>
<td>OLYA</td>
<td>e^+ e^- → π^+ π^- π^0</td>
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</table>

\[ \Gamma(\pi^+ \pi^- \gamma)/\Gamma_{\text{total}} \] \[ \Gamma_{11}/\Gamma \]

<table>
<thead>
<tr>
<th>VALUE (units 10^{-4})</th>
<th>CL%</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;0.0036</td>
<td>WEIDENAUER 90</td>
<td>ASTE</td>
<td>( \rho \bar{\rho} ) → ( \pi^+ \pi^- \pi^+ \pi^- \gamma )</td>
<td></td>
</tr>
<tr>
<td>&lt;0.004</td>
<td>BITYUKOV 88B</td>
<td>SPEC</td>
<td>32 ( \pi^+ \pi^- \rho ) → ( \pi^+ \pi^- \gamma ) X</td>
<td></td>
</tr>
</tbody>
</table>
\[ \Gamma(\pi^+\pi^-\gamma)/\Gamma(\pi^+\pi^-\pi^0) \]

<table>
<thead>
<tr>
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<tr>
<td>&lt;0.066</td>
<td>90</td>
<td>KALBFLEISCH 75</td>
<td>HBC</td>
<td>2.18 ( K^- p \rightarrow \Lambda \pi^+\pi^- \gamma )</td>
</tr>
<tr>
<td>&lt;0.05</td>
<td>90</td>
<td>FLATTE 66</td>
<td>HBC</td>
<td>1.2 - 1.7 ( K^- p \rightarrow \Lambda \pi^+\pi^- \gamma )</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>VALUE</th>
<th>CL%</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
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</thead>
<tbody>
<tr>
<td>&lt;1 \times 10^{-3}</td>
<td>90</td>
<td>KURDADZE 88</td>
<td>OLYA</td>
<td>( e^+e^- \rightarrow \pi^+\pi^-\pi^+\pi^- )</td>
</tr>
</tbody>
</table>

\[ \Gamma(\pi^0\pi^0\gamma)/\Gamma_{\text{total}} \]

<table>
<thead>
<tr>
<th>VALUE (units ( 10^{-5} ))</th>
<th>EVTS</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
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<tbody>
<tr>
<td>6.6 \pm 1.1</td>
<td>OUR FIT</td>
<td>6.4 \pm 2.4</td>
<td>190</td>
<td>AKHMETSHIN 04</td>
</tr>
<tr>
<td>6.6 \pm 1.4</td>
<td>OUR AVERAGE</td>
<td>0.6 - 0.97</td>
<td>AKHMETSHIN 04</td>
<td>CMD2</td>
</tr>
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</table>

\[ \Gamma(\pi^0\pi^0\gamma)/\Gamma(\pi^+\pi^-\pi^0) \]

<table>
<thead>
<tr>
<th>VALUE</th>
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<th>COMMENT</th>
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</thead>
<tbody>
<tr>
<td>&lt;0.00045</td>
<td>90</td>
<td>DOLINSKY 89</td>
<td>ND</td>
<td>( e^+e^- \rightarrow \pi^0\pi^0\gamma )</td>
</tr>
<tr>
<td>&lt;0.08</td>
<td>95</td>
<td>JACQUET 69</td>
<td>HLBC</td>
<td>2.05 ( \pi^+p \rightarrow \pi^+p\omega )</td>
</tr>
</tbody>
</table>

\[ \Gamma(\pi^0\pi^0\gamma)/\Gamma(\pi^0\gamma) \]

<table>
<thead>
<tr>
<th>VALUE (units ( 10^{-4} ))</th>
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<th>COMMENT</th>
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<tbody>
<tr>
<td>8.0 \pm 1.3</td>
<td>OUR FIT</td>
<td>8.5 \pm 2.9</td>
<td>40 \pm 14</td>
<td>ALDE 94</td>
<td>GAM2</td>
</tr>
</tbody>
</table>

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

\[ \Gamma(\pi^0\pi^0\gamma)/\Gamma(\pi^0\gamma) \]

<table>
<thead>
<tr>
<th>VALUE (units ( 10^{-4} ))</th>
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<tr>
<td>&lt;</td>
<td>50</td>
<td>DOLINSKY 89</td>
<td>ND</td>
<td>( e^+e^- \rightarrow \pi^0\pi^0\gamma )</td>
</tr>
<tr>
<td>&lt;800</td>
<td>95</td>
<td>KEYNE 76</td>
<td>CNTR</td>
<td>( \pi^-p \rightarrow \omega n )</td>
</tr>
<tr>
<td>&lt;1500</td>
<td>90</td>
<td>BENAKSAS 72</td>
<td>OSPK</td>
<td>( e^+e^- )</td>
</tr>
<tr>
<td>&lt;1400</td>
<td>71</td>
<td>BALDIN</td>
<td>HLBC</td>
<td>2.9 ( \pi^+p )</td>
</tr>
<tr>
<td>&lt;1000</td>
<td>90</td>
<td>BARMIN 64</td>
<td>HLBC</td>
<td>1.3 - 2.8 ( \pi^- p )</td>
</tr>
</tbody>
</table>
\[
\frac{\Gamma(\pi^0\pi^0\gamma)}{\Gamma(\text{neutrals})} = \frac{\Gamma_13}{\Gamma_2 + \Gamma_4}
\]

<table>
<thead>
<tr>
<th>Value</th>
<th>Cl%</th>
<th>Document ID</th>
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</thead>
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<tr>
<td>0.22 ± 0.07</td>
<td></td>
<td>1 DAKIN 72</td>
<td>OSPK</td>
<td>1.4 (\pi^- p \rightarrow nM)</td>
</tr>
<tr>
<td>&lt;0.19</td>
<td>90</td>
<td>DEINET 69B</td>
<td>OSPK</td>
<td></td>
</tr>
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</table>

\[\Gamma_13/(\Gamma_2 + \Gamma_4)\]

\[
\frac{\Gamma(\eta\pi^0\gamma)}{\Gamma_{\text{total}}} = \frac{\Gamma_{14}}{\Gamma}
\]

<table>
<thead>
<tr>
<th>Value</th>
<th>Cl%</th>
<th>Document ID</th>
<th>TECN</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;3.3</td>
<td>90</td>
<td>AKHMETSHIN 04B</td>
<td>CMD2</td>
<td>0.6–0.97 (e^+ e^- \rightarrow\eta\pi^0\gamma)</td>
</tr>
</tbody>
</table>

\[\Gamma(\mu^+\mu^-)/\Gamma_{\text{total}} = \frac{\Gamma_{14}}{\Gamma}
\]

<table>
<thead>
<tr>
<th>Value (units 10(^{-5}))</th>
<th>Cl%</th>
<th>Document ID</th>
<th>TECN</th>
<th>Comment</th>
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<tbody>
<tr>
<td>9.0 ± 3.1 OUR FIT</td>
<td>18</td>
<td>HEISTER 02c</td>
<td>ALEP</td>
<td>(Z \rightarrow \mu^+\mu^- + X)</td>
</tr>
</tbody>
</table>

\[\Gamma(\mu^+\mu^-)/\Gamma(\pi^+\pi^-\pi^0) = \frac{\Gamma_{15}}{\Gamma_1}
\]

<table>
<thead>
<tr>
<th>Value (units 10(^{-3}))</th>
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<th>Document ID</th>
<th>TECN</th>
<th>Comment</th>
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</thead>
<tbody>
<tr>
<td>&lt;0.2</td>
<td>90</td>
<td>WILSON 69</td>
<td>OSPK</td>
<td>12 (\pi^- C \rightarrow Fe)</td>
</tr>
<tr>
<td>&lt;1.7</td>
<td>74</td>
<td>FLATTE 66</td>
<td>HBC</td>
<td>1.2 – 1.7 (K^- p \rightarrow \Lambda\mu^+\mu^-)</td>
</tr>
<tr>
<td>&lt;1.2</td>
<td></td>
<td>BARBARO-... 65</td>
<td>HBC</td>
<td>2.7 (K^- p)</td>
</tr>
</tbody>
</table>

\[\Gamma(\pi^0\mu^+\mu^-)/\Gamma(\mu^+\mu^-) = \frac{\Gamma_7}{\Gamma_{15}}
\]

<table>
<thead>
<tr>
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<th>Document ID</th>
<th>TECN</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.2 ± 0.6</td>
<td>30</td>
<td>1 DZHELYADIN 79</td>
<td>CNTR</td>
<td>25–33 (\pi^- p)</td>
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</tbody>
</table>

\[\Gamma(3\gamma)/\Gamma_{\text{total}} = \frac{\Gamma_{16}}{\Gamma} \]

<table>
<thead>
<tr>
<th>Value (units 10(^{-4}))</th>
<th>Cl%</th>
<th>Document ID</th>
<th>TECN</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;1.9</td>
<td>95</td>
<td>1 ABELE 97E</td>
<td>CBAR</td>
<td>0.0 (\bar{p} p \rightarrow 5\gamma)</td>
</tr>
<tr>
<td>&lt;2</td>
<td>90</td>
<td>1 PROKOSHKIN 95</td>
<td>GAM2</td>
<td>38 (\pi^- p \rightarrow 3\gamma n)</td>
</tr>
</tbody>
</table>

\[\Gamma(\eta\pi^0)/\Gamma_{\text{total}} = \frac{\Gamma_{17}}{\Gamma}
\]

<table>
<thead>
<tr>
<th>Value</th>
<th>Cl%</th>
<th>Document ID</th>
<th>TECN</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;0.001</td>
<td>90</td>
<td>ALDE 94B</td>
<td>GAM2</td>
<td>38(\pi^- p \rightarrow \eta\pi^0 n)</td>
</tr>
</tbody>
</table>

Violates \(C\) conservation.

\[\Gamma(\eta\pi^0)/\Gamma_{\text{total}} \]

<table>
<thead>
<tr>
<th>Value</th>
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<th>Comment</th>
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</thead>
<tbody>
<tr>
<td>&lt;0.001</td>
<td>90</td>
<td>ALDE 94B</td>
<td>GAM2</td>
<td>38(\pi^- p \rightarrow \eta\pi^0 n)</td>
</tr>
</tbody>
</table>

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

1 Superseded by DZHELYADIN 81B result above.

1 From direct \(3\gamma\) decay search.
\[
\frac{\Gamma(\eta \pi^0) + \Gamma(\eta \pi^0 \pi^- \pi^0)}{\Gamma(\pi^+ \pi^- \pi^0)} \frac{(\Gamma_5 + \Gamma_{17})}{\Gamma_1}
\]

\[
V A L U E \quad C L \% \quad D O C U M E N T \ I D \quad T E C N \quad C O M M E N T
\]

\begin{tabular}{|c|c|c|c|c|}
\hline
\textgreater 0.16 & 90 & FLATTE & 66 & HBC \hline
\textless 0.045 & 95 & JACQUET & 69 & HLBC \hline
\end{tabular}

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

\[
\Gamma(\eta \pi^0) / \Gamma(\pi^0 \gamma) \Gamma_{17} / \Gamma_2
\]

Violates C conservation.

\[
V A L U E \quad C L \% \quad D O C U M E N T \ I D \quad T E C N \quad C O M M E N T
\]

\begin{tabular}{|c|c|c|c|c|}
\hline
\textless 2.6 & 90 & STAROSTIN & 09 & CRYM \hline
\end{tabular}

\[
\Gamma(2 \pi^0) / \Gamma(\pi^0 \gamma) \Gamma_{18} / \Gamma_2
\]

Violates C conservation and Bose-Einstein statistics.

\[
V A L U E \quad C L \% \quad D O C U M E N T \ I D \quad T E C N \quad C O M M E N T
\]

\begin{tabular}{|c|c|c|c|c|}
\hline
\textless 2.59 & 90 & STAROSTIN & 09 & CRYM \hline
\end{tabular}

\[
\Gamma(3 \pi^0) / \Gamma_{\text{total}} \Gamma_{19} / \Gamma
\]

Violates C conservation.

\[
V A L U E \quad C L \% \quad D O C U M E N T \ I D \quad T E C N \quad C O M M E N T
\]

\begin{tabular}{|c|c|c|c|c|}
\hline
\textless 3 \times 10^{-4} & 90 & PROKOSHKIN & 95 & GAM2 \hline
\end{tabular}

\[
\Gamma(3 \pi^0) / \Gamma(\pi^0 \gamma) \Gamma_{19} / \Gamma_2
\]

Violates C conservation.

\[
V A L U E \quad C L \% \quad D O C U M E N T \ I D \quad T E C N \quad C O M M E N T
\]

\begin{tabular}{|c|c|c|c|c|}
\hline
\textless 2.72 & 90 & STAROSTIN & 09 & CRYM \hline
\end{tabular}

\[
\Gamma(3 \pi^0) / \Gamma(\pi^+ \pi^- \pi^0) \Gamma_{19} / \Gamma_1
\]

Violates C conservation.

\[
V A L U E \quad C L \% \quad D O C U M E N T \ I D \quad C O M M E N T
\]

\begin{tabular}{|c|c|c|c|}
\hline
\textless 0.009 & 90 & BARBERIS & 01 \hline
\end{tabular}

\[
\text{PARAMETER } \Lambda_{\pi \rightarrow \eta^0} \mu^+ \mu^- \text{ DECAY}
\]

In the pole approximation the electromagnetic transition form factor for a resonance of mass \( M \) is given by the expression:

\[
|F|^2 = \left(1 - M^2 / \Lambda^2\right)^{-2},
\]

where for the parameter \( \Lambda \) vector dominance predicts \( \Lambda = M_\pi \approx 0.770 \text{ GeV} \). The ARNALDI 09 measurement is in obvious conflict with this expectation. Note that for \( \eta \rightarrow \mu^+ \mu^- \gamma \) decay ARNALDI 09 and DZHELYADIN 80 obtain the value of \( \Lambda \) consistent with vector dominance.

\[
V A L U E \quad E V T S \quad D O C U M E N T \ I D \quad T E C N \quad C O M M E N T
\]

\begin{tabular}{|c|c|c|c|c|}
\hline
0.668 \pm 0.009 \pm 0.003 & 3k & ARNALDI & 09 & NA60 \hline
0.65 \pm 0.03 & 181B & DZHELYADIN & 81B & CNTR \hline
\end{tabular}

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

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\( \omega \) (782) REFERENCES

ACHASOV 13 PR D88 054013 M.N. Achasov et al. (SND Collab.)

BENAYOUN 13 EPJ C73 2453 M. Benayoun, P. David, L. DelBuono (PARIN, BERLIN+)

DAVIER 13 EPJ C73 2597 M. Davier et al.

LEES 12G PR D86 032013 J.P. Lees et al. (BABAR Collab.)

NIECKNIG 12 EPJ C72 2014 F. Niecknig, B. Kubis, S.P. Schneider (BONN)

BENAYOUN 10 EPJ C65 211 M. Benayoun et al.

ACHASOV 09A JETP 109 379 M.N. Achasov et al. (SND Collab.)

Translated from ZETF 136 442.

ARNALDI 09 PL B677 260 R. Arnaldi et al. (NA60 Collab.)

STAROSTIN 09 PR C79 065201 A. Starostin et al. (Crystal Ball Collab. at MAMI)

ACHASOV 08 JETP 107 61 M.N. Achasov et al. (SND Collab.)

Translated from ZETF 134 80.

AMBROSINO 08G PL B669 223 F. Ambrosino et al. (KLOE Collab.)

ACHASOV 07B PR D76 077101 M.N. Achasov et al. (SND Collab.)

Translated from ZETF 130 437.

ACHASOV 06A PR D74 014016 M.N. Achasov et al. (SND Collab.)

Translated from ZETF 128 1201.

AKHMETSHIN 05 PL B605 26 R.R. Akhmetshin et al. (Novosibirsk CMD-2 Collab.)

AKHMETSHIN 05A PL B613 29 R.R. Akhmetshin et al. (Novosibirsk CMD-2 Collab.)

AULCHENKO 05 JETPL 82 413 V.M. Aulchenko et al. (Novosibirsk CMD-2 Collab.)

Translated from ZETF 82 841.

AKHMETSHIN 04B PL B580 119 R.R. Akhmetshin et al. (Novosibirsk CMD-2 Collab.)

AUERB.B 04N PR D70 072004 B. Aubert et al. (BABAR Collab.)

PDG 04 PL B592 1 S. Eidelman et al. (PDG Collab.)

ACHASOV 03 PL B559 171 M.N. Achasov et al. (Novosibirsk SND Collab.)

ACHASOV 03D PR D68 052006 M.N. Achasov et al. (Novosibirsk SND Collab.)

ALOISIO 03 PL B561 55 A. Aloisio et al. (KLOE Collab.)

BENAYOUN 03 EPJ C29 397 M. Benayoun et al.

ACHASOV 02E PR D66 032001 M.N. Achasov et al. (Novosibirsk SND Collab.)

ACHASOV 02F PL B537 201 M.N. Achasov et al. (Novosibirsk SND Collab.)

AKHMETSHIN 02 PL B527 161 R.R. Akhmetshin et al. (Novosibirsk CMD-2 Collab.)

ALOISIO 02D PL B537 21 A. Aloisio et al. (KLOE Collab.)

HEISTER 02C PL B528 19 A. Heister et al. (ALEPH Collab.)

ACHASOV 01E PR D63 072002 M.N. Achasov et al. (Novosibirsk SND Collab.)

AKHMETSHIN 01B PL B509 217 R.R. Akhmetshin et al. (Novosibirsk CMD-2 Collab.)

BARTERIS 01 PL B507 14 D. Barberis et al.

ACHASOV 00 EPJ C12 25 M.N. Achasov et al. (Novosibirsk SND Collab.)

ACHASOV 00D JETPL 72 282 M.N. Achasov et al. (Novosibirsk SND Collab.)

Translated from ZETF 72 411.

ACHASOV 00C JETPL 71 355 M.N. Achasov et al. (Novosibirsk SND Collab.)

Translated from ZETF 71 519.

AKHMETSHIN 00C PL B476 33 R.R. Akhmetshin et al. (Novosibirsk CMD-2 Collab.)

AULCHENKO 00A JETP 90 927 V.M. Aulchenko et al. (Novosibirsk SND Collab.)

Translated from ZETF 117 1067.

CASE 00 PR D61 032002 T. Case et al. (Crystal Barrel Collab.)

ACHASOV 99E PL B462 365 M.N. Achasov et al. (Novosibirsk SND Collab.)

GARDNER 99 PR D59 076002 S. Gardner, H.B. O'Connell

BENAYOUN 98 EPJ C2 269 M. Benayoun et al. (IPNP, NOVO, ADLD+).

ABELE 97E PL B411 361 A. Abele et al. (Crystal Barrel Collab.)

BENAYOUN 96 ZPHY C72 221 M. Benayoun et al. (IPNP, NOVO)

PROKOSHIN 95 SPD 40 273 Y.D. Prokoshkin, V.D. Samoilenko (SERP)

Translated from DANS 342 610.

WURZINGER 95 PR C51 443 R. Wurzinger et al. (BONN, ORSA, SACL+).

ALDE 94B PL B340 122 D.M. Alde et al. (SERP, BELG, LANL, LAPP+).

AMSLER 94C PL B327 425 C. AMSLER et al. (Crystal Barrel Collab.)

ALDE 93 PAN 56 1229 D.M. Alde et al. (SERP, LAPP, LANL, BELG+).

Also ZPHY C61 35 D.M. Alde et al. (Crystal Barrel Collab.)

AMSLER 93B PL B311 362 C. AMSLER et al. (Crystal Barrel Collab.)

WEIDENAUER 93 ZPHY C59 387 P. Weidenauer et al. (ASTERIX Collab.)

ANTONELLI 92 ZPHY C56 15 A. Antonelli et al. (DM2 Collab.)

DOLINSKY 91 PRP 202 99 S.I. Dolinsky et al. (NOVO)

WEIDENAUER 90 ZPHY C47 253 P. Weidenauer et al. (ASTERIX Collab.)

DOLINSKY 89 ZPHY C42 511 S.I. Dolinsky et al. (NOVO)

BITYUKOV 88B SJNP 47 800 S.I. Bityukov et al.

Translated from YAF 47 1258.