# $\eta'(958)$

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

## $\eta'(958)$ MASS

| *VALUE* (MeV) | *EVTS* | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|---|
| **957.78±0.14 OUR AVERAGE** | | | | | |
| 957.9 ±0.2 ±0.6 | 4800 | WURZINGER | 96 | SPEC | 1.68 $pd \to {}^3\mathrm{He}\eta'$ |
| 959 ±1 | 630 | BELADIDZE | 92C | VES | 36 $\pi^-\mathrm{Be} \to \pi^-\eta'\eta\mathrm{Be}$ |
| 958 ±1 | 340 | ARMSTRONG | 91B | OMEG | 300 $pp \to pp\eta\pi^+\pi^-$ |
| 958.2 ±0.4 | 622 | AUGUSTIN | 90 | DM2 | $J/\psi \to \gamma\eta\pi^+\pi^-$ |
| 957.8 ±0.2 | 2420 | AUGUSTIN | 90 | DM2 | $J/\psi \to \gamma\gamma\pi^+\pi^-$ |
| 956.3 ±1.0 | 143 | GIDAL | 87 | MRK2 | $e^+e^- \to e^+e^-\eta\pi^+\pi^-$ |
| 957.46±0.33 | | DUANE | 74 | MMS | $\pi^- p \to n\mathrm{MM}$ |
| 958.2 ±0.5 | 1414 | DANBURG | 73 | HBC | 2.2 $K^- p \to \Lambda X^0$ |
| 958 ±1 | 400 | JACOBS | 73 | HBC | 2.9 $K^- p \to \Lambda X^0$ |
| 956.1 ±1.1 | 3415 | BASILE | 71 | CNTR | 1.6 $\pi^- p \to nX^0$ |
| 957.4 ±1.4 | 535 | BASILE | 71 | CNTR | 1.6 $\pi^- p \to nX^0$ |
| 957 ±1 | | RITTENBERG | 69 | HBC | 1.7–2.7 $K^- p$ |

## $\eta'(958)$ WIDTH

| *VALUE* (MeV) | *EVTS* | *DOCUMENT ID* | | *TECN* | *CHG* | *COMMENT* |
|---|---|---|---|---|---|---|
| **0.202±0.016 OUR FIT** Error includes scale factor of 1.3. | | | | | | |
| **0.30 ±0.09 OUR AVERAGE** | | | | | | |
| 0.40 ±0.22 | 4800 | WURZINGER | 96 | SPEC | | 1.68 $pd \to {}^3\mathrm{He}\eta'$ |
| 0.28 ±0.10 | 1000 | BINNIE | 79 | MMS | 0 | $\pi^- p \to n\mathrm{MM}$ |

## $\eta'(958)$ DECAY MODES

| | Mode | Fraction ($\Gamma_i/\Gamma$) | Scale factor/ Confidence level |
|---|---|---|---|
| $\Gamma_1$ | $\pi^+\pi^-\eta$ | (44.3 ±1.5 ) % | S=1.2 |
| $\Gamma_2$ | $\rho^0\gamma$(including non-resonant $\pi^+\pi^-\gamma$) | (29.5 ±1.0 ) % | S=1.2 |
| $\Gamma_3$ | $\pi^0\pi^0\eta$ | (20.9 ±1.2 ) % | S=1.2 |
| $\Gamma_4$ | $\omega\gamma$ | ( 3.03±0.31) % | |
| $\Gamma_5$ | $\gamma\gamma$ | ( 2.12±0.14) % | S=1.3 |
| $\Gamma_6$ | $3\pi^0$ | ( 1.56±0.26) $\times 10^{-3}$ | |
| $\Gamma_7$ | $\mu^+\mu^-\gamma$ | ( 1.04±0.26) $\times 10^{-4}$ | |
| $\Gamma_8$ | $\pi^+\pi^-\pi^0$ | $<$ 5 % | CL=90% |
| $\Gamma_9$ | $\pi^0\rho^0$ | $<$ 4 % | CL=90% |

| | | | | | |
|---|---|---|---|---|---|
| $\Gamma_{10}$ | $\pi^+\pi^+\pi^-\pi^-$ | $<$ | 1 | % | CL=90% |
| $\Gamma_{11}$ | $\pi^+\pi^+\pi^-\pi^-$ neutrals | $<$ | 1 | % | CL=95% |
| $\Gamma_{12}$ | $\pi^+\pi^+\pi^-\pi^-\pi^0$ | $<$ | 1 | % | CL=90% |
| $\Gamma_{13}$ | $6\pi$ | $<$ | 1 | % | CL=90% |
| $\Gamma_{14}$ | $\pi^+\pi^- e^+ e^-$ | $<$ | 6 | $\times 10^{-3}$ | CL=90% |
| $\Gamma_{15}$ | $\gamma e^+ e^-$ | $<$ | 9 | $\times 10^{-4}$ | CL=90% |
| $\Gamma_{16}$ | $\pi^0\gamma\gamma$ | $<$ | 8 | $\times 10^{-4}$ | CL=90% |
| $\Gamma_{17}$ | $4\pi^0$ | $<$ | 5 | $\times 10^{-4}$ | CL=90% |
| $\Gamma_{18}$ | $e^+ e^-$ | $<$ | 2.1 | $\times 10^{-7}$ | CL=90% |

## Charge conjugation (*C*), Parity (*P*), Lepton family number (*LF*) violating modes

| | | | | | | |
|---|---|---|---|---|---|---|
| $\Gamma_{19}$ | $\pi^+\pi^-$ | *P*,*CP* | $<$ | 2 | % | CL=90% |
| $\Gamma_{20}$ | $\pi^0\pi^0$ | *P*,*CP* | $<$ | 9 | $\times 10^{-4}$ | CL=90% |
| $\Gamma_{21}$ | $\pi^0 e^+ e^-$ | *C* | [a] $<$ | 1.4 | $\times 10^{-3}$ | CL=90% |
| $\Gamma_{22}$ | $\eta e^+ e^-$ | *C* | [a] $<$ | 2.4 | $\times 10^{-3}$ | CL=90% |
| $\Gamma_{23}$ | $3\gamma$ | *C* | $<$ | 1.0 | $\times 10^{-4}$ | CL=90% |
| $\Gamma_{24}$ | $\mu^+\mu^-\pi^0$ | *C* | [a] $<$ | 6.0 | $\times 10^{-5}$ | CL=90% |
| $\Gamma_{25}$ | $\mu^+\mu^-\eta$ | *C* | [a] $<$ | 1.5 | $\times 10^{-5}$ | CL=90% |
| $\Gamma_{26}$ | $e\mu$ | *LF* | $<$ | 4.7 | $\times 10^{-4}$ | CL=90% |

[a] *C* parity forbids this to occur as a single-photon process.

## CONSTRAINED FIT INFORMATION

An overall fit to the total width, a partial width, 2 combinations of partial widths obtained from integrated cross section, and 16 branching ratios uses 48 measurements and one constraint to determine 7 parameters. The overall fit has a $\chi^2 = 35.6$ for 42 degrees of freedom.

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

| | | | | | | |
|---|---|---|---|---|---|---|
| $x_2$ | −39 | | | | | |
| $x_3$ | −74 | −29 | | | | |
| $x_4$ | −33 | −24 | 32 | | | |
| $x_5$ | −25 | −12 | 26 | 8 | | |
| $x_6$ | −27 | −11 | 35 | 11 | 9 | |
| $\Gamma$ | 32 | −3 | −24 | −5 | −88 | −8 |
| | $x_1$ | $x_2$ | $x_3$ | $x_4$ | $x_5$ | $x_6$ |

| | Mode | Rate (MeV) | Scale factor |
|---|---|---|---|
| $\Gamma_1$ | $\pi^+\pi^-\eta$ | 0.090 ±0.008 | 1.2 |
| $\Gamma_2$ | $\rho^0\gamma$(including non-resonant $\pi^+\pi^-\gamma$) | 0.060 ±0.005 | 1.3 |
| $\Gamma_3$ | $\pi^0\pi^0\eta$ | 0.042 ±0.004 | 1.6 |
| $\Gamma_4$ | $\omega\gamma$ | 0.0061 ±0.0008 | 1.2 |
| $\Gamma_5$ | $\gamma\gamma$ | 0.00429±0.00015 | 1.1 |
| $\Gamma_6$ | $3\pi^0$ | (3.1 ±0.6 ) × $10^{-4}$ | 1.1 |

## $\eta'(958)$ PARTIAL WIDTHS

### $\Gamma(\gamma\gamma)$ $\Gamma_5$

| *VALUE* (keV) | *EVTS* | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|---|
| **4.29±0.15 OUR FIT** Error includes scale factor of 1.1. | | | | | |
| **4.28±0.19 OUR AVERAGE** | | | | | |
| 4.17±0.10±0.27 | 2000 | [1] ACCIARRI | 98B | L3 | $e^+e^- \to e^+e^-\pi^+\pi^-\gamma$ |
| 4.53±0.29±0.51 | 266 | KARCH | 92 | CBAL | $e^+e^- \to e^+e^-\eta\pi^0\pi^0$ |
| 3.61±0.13±0.48 | | [2] BEHREND | 91 | CELL | $e^+e^- \to e^+e^-\eta'(958)$ |
| 4.6 ±1.1 ±0.6 | 23 | BARU | 90 | MD1 | $e^+e^- \to e^+e^-\pi^+\pi^-\gamma$ |
| 4.57±0.25±0.44 | | BUTLER | 90 | MRK2 | $e^+e^- \to e^+e^-\eta'(958)$ |
| 5.08±0.24±0.71 | 547 | [3] ROE | 90 | ASP | $e^+e^- \to e^+e^-2\gamma$ |
| 3.8 ±0.7 ±0.6 | 34 | AIHARA | 88C | TPC | $e^+e^- \to e^+e^-\eta\pi^+\pi^-$ |
| 4.9 ±0.5 ±0.5 | 136 | [4] WILLIAMS | 88 | CBAL | $e^+e^- \to e^+e^-2\gamma$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | |
| 4.7 ±0.6 ±0.9 | 143 | [5] GIDAL | 87 | MRK2 | $e^+e^- \to e^+e^-\eta\pi^+\pi^-$ |
| 4.0 ±0.9 | | [6] BARTEL | 85E | JADE | $e^+e^- \to e^+e^-2\gamma$ |

[1] No non-resonant $\pi^+\pi^-$ contribution found.
[2] Revaluated by us using $B(\eta' \to \rho(770)\gamma) = (30.2 \pm 1.3)\%$.

[3] Revalued by us using B($\eta' \to \gamma\gamma$) = (2.11 ± 0.13)%.
[4] Revalued by us using B($\eta' \to \gamma\gamma$) = (2.11 ± 0.13)%.
[5] Superseded by BUTLER 90.
[6] Systematic error not evaluated.

## $\eta'(958)$ Γ(i)Γ($\gamma\gamma$)/Γ(total)

This combination of a partial width with the partial width into $\gamma\gamma$ and with the total width is obtained from the integrated cross section into channel(i) in the $\gamma\gamma$ annihilation.

### Γ($\gamma\gamma$) × Γ($\rho^0\gamma$(including non-resonant $\pi^+\pi^-\gamma$))/Γ$_{total}$ — $\Gamma_5\Gamma_2/\Gamma$

| VALUE (keV) | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **1.27±0.05 OUR FIT** Error includes scale factor of 1.2. | | | | | |
| **1.26±0.07 OUR AVERAGE** Error includes scale factor of 1.2. | | | | | |
| 1.09±0.04±0.13 | | BEHREND | 91 | CELL | $e^+e^- \to e^+e^-\rho(770)^0\gamma$ |
| 1.35±0.09±0.21 | | AIHARA | 87 | TPC | $e^+e^- \to e^+e^-\rho\gamma$ |
| 1.13±0.04±0.13 | 867 | ALBRECHT | 87B | ARG | $e^+e^- \to e^+e^-\rho\gamma$ |
| 1.53±0.09±0.21 | | ALTHOFF | 84E | TASS | $e^+e^- \to e^+e^-\rho\gamma$ |
| 1.14±0.08±0.11 | 243 | BERGER | 84B | PLUT | $e^+e^- \to e^+e^-\rho\gamma$ |
| 1.73±0.34±0.35 | 95 | JENNI | 83 | MRK2 | $e^+e^- \to e^+e^-\rho\gamma$ |
| 1.49±0.13±0.027 | 213 | BARTEL | 82B | JADE | $e^+e^- \to e^+e^-\rho\gamma$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | |
| 1.85±0.31±0.24 | 43 | BEHREND | 83B | CELL | $e^+e^- \to e^+e^-\rho\gamma$ |

### Γ($\gamma\gamma$) × Γ($\pi^0\pi^0\eta$)/Γ$_{total}$ — $\Gamma_5\Gamma_3/\Gamma$

| VALUE (keV) | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| **0.90±0.06 OUR FIT** Error includes scale factor of 1.2. | | | | |
| **0.92±0.06±0.11** | [7] KARCH | 92 | CBAL | $e^+e^- \to e^+e^-\eta\pi^0\pi^0$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 0.95±0.05±0.08 | [8] KARCH | 90 | CBAL | $e^+e^- \to e^+e^-\eta\pi^0\pi^0$ |
| 1.00±0.08±0.10 | [8,9] ANTREASYAN | 87 | CBAL | $e^+e^- \to e^+e^-\eta\pi^0\pi^0$ |

[7] Revalued by us using B($\eta \to \gamma\gamma$) = (39.21 ± 0.34)%. Supersedes ANTREASYAN 87 and KARCH 90.
[8] Superseded by KARCH 92.
[9] Using BR($\eta \to 2\gamma$)=(38.9 ± 0.5)%.

## $\eta'(958)$ $\alpha$ PARAMETER

### |MATRIX ELEMENT|$^2 = (1 + \alpha y)^2 + cx^2$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| **−0.058±0.013** | [10] ALDE | 86 | GAM2 | 38 $\pi^- p \to n\eta 2\pi^0$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| −0.08 ±0.03 | [10] KALBFLEISCH | 74 | RVUE | $\eta' \to \eta\pi^+\pi^-$ |

[10] May not necessarily be the same for $\eta' \to \eta\pi^+\pi^-$ and $\eta' \to \eta\pi^0\pi^0$.

## $\eta'(958)$ $\beta$ PARAMETER

See the "Note on $\eta$ Decay Parameters" in our 1994 edition Physical Review **D50** 1173 (1994), p. 1454.

### $|\text{MATRIX ELEMENT}|^2 = (1 + 2\beta Z)$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| **$-0.1 \pm 0.3$** | ALDE | 87B | GAM2 | 38 $\pi^- p \rightarrow n3\pi^0$ |

## $\eta'(958)$ BRANCHING RATIOS

### $\Gamma(\pi^+\pi^-\eta(\text{neutral decay}))/\Gamma_{\text{total}}$ $0.714\Gamma_1/\Gamma$

| VALUE | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **$0.316 \pm 0.010$ OUR FIT** | Error includes scale factor of 1.2. | | | | |
| **$0.314 \pm 0.026$** | 281 | RITTENBERG | 69 | HBC | 1.7–2.7 $K^- p$ |

### $\Gamma(\pi^+\pi^-\text{neutrals})/\Gamma_{\text{total}}$ $(0.714\Gamma_1+0.286\Gamma_3+0.89\Gamma_4)/\Gamma$

| VALUE | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **$0.403 \pm 0.008$ OUR FIT** | Error includes scale factor of 1.2. | | | | |
| **$0.36 \pm 0.05$ OUR AVERAGE** | | | | | |
| $0.4 \pm 0.1$ | 39 | LONDON | 66 | HBC | 2.24 $K^- p \rightarrow \Lambda\pi^+\pi^-$ neutrals |
| $0.35 \pm 0.06$ | 33 | BADIER | 65B | HBC | 3 $K^- p$ |

### $\Gamma(\pi^+\pi^-\eta(\text{charged decay}))/\Gamma_{\text{total}}$ $0.286\Gamma_1/\Gamma$

| VALUE | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **$0.127 \pm 0.004$ OUR FIT** | Error includes scale factor of 1.2. | | | | |
| **$0.116 \pm 0.013$ OUR AVERAGE** | | | | | |
| $0.123 \pm 0.014$ | 107 | RITTENBERG | 69 | HBC | 1.7–2.7 $K^- p$ |
| $0.10 \pm 0.04$ | 10 | LONDON | 66 | HBC | 2.24 $K^- p \rightarrow \Lambda\pi^+\pi^-\pi^+\pi^-\pi^0$ |
| $0.07 \pm 0.04$ | 7 | BADIER | 65B | HBC | 3 $K^- p$ |

### $[\Gamma(\pi^0\pi^0\eta(\text{charged decay})) + \Gamma(\omega(\text{charged decay})\gamma)]/\Gamma_{\text{total}}$ $(0.286\Gamma_3+0.89\Gamma_4)/\Gamma$

| VALUE | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **$0.087 \pm 0.005$ OUR FIT** | Error includes scale factor of 1.2. | | | | |
| **$0.045 \pm 0.029$** | 42 | RITTENBERG | 69 | HBC | 1.7–2.7 $K^- p$ |

### $\Gamma(\text{neutrals})/\Gamma_{\text{total}}$ $(0.714\Gamma_3+0.09\Gamma_4+\Gamma_5)/\Gamma$

| VALUE | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **$0.173 \pm 0.009$ OUR FIT** | Error includes scale factor of 1.2. | | | | |
| **$0.187 \pm 0.017$ OUR AVERAGE** | | | | | |
| $0.185 \pm 0.022$ | 535 | BASILE | 71 | CNTR | 1.6 $\pi^- p \rightarrow n X^0$ |
| $0.189 \pm 0.026$ | 123 | RITTENBERG | 69 | HBC | 1.7–2.7 $K^- p$ |

## $\Gamma(\rho^0\gamma(\text{including non-resonant}\,\pi^+\pi^-\gamma))/\Gamma_{\text{total}}$ $\Gamma_2/\Gamma$

| VALUE | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **0.295±0.010 OUR FIT** | Error includes scale factor of 1.2. | | | | |
| **0.319±0.030 OUR AVERAGE** | | | | | |
| 0.329±0.033 | 298 | RITTENBERG | 69 | HBC | 1.7–2.7 $K^- p$ |
| 0.2 ±0.1 | 20 | LONDON | 66 | HBC | 2.24 $K^- p \to \Lambda\pi^+\pi^-\gamma$ |
| 0.34 ±0.09 | 35 | BADIER | 65B | HBC | 3 $K^- p$ |

## $\Gamma(\rho^0\gamma(\text{including non-resonant}\,\pi^+\pi^-\gamma))/\Gamma(\pi\pi\eta)$ $\Gamma_2/(\Gamma_1+\Gamma_3)$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| **0.453±0.022 OUR FIT** | Error includes scale factor of 1.2. | | | |
| **0.426±0.028 OUR AVERAGE** | | | | |
| 0.43 ±0.02 ±0.02 | BARBERIS | 98C | OMEG | 450 $pp \to p_f \eta' p_s$ |
| 0.31 ±0.15 | DAVIS | 68 | HBC | 5.5 $K^- p$ |

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

| VALUE (units $10^{-3}$) | CL% | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **<0.9** | 90 | BRIERE | 00 | CLEO | 10.6 $e^+ e^-$ |

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

| VALUE (units $10^{-3}$) | CL% | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **< 1.4** | 90 | BRIERE | 00 | CLEO | 10.6 $e^+ e^-$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | |
| <13 | 90 | RITTENBERG | 65 | HBC | 2.7 $K^- p$ |

## $\Gamma(\eta e^+ e^-)/\Gamma_{\text{total}}$ $\Gamma_{22}/\Gamma$

| VALUE (units $10^{-3}$) | CL% | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **< 2.4** | 90 | BRIERE | 00 | CLEO | 10.6 $e^+ e^-$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | |
| <11 | 90 | RITTENBERG | 65 | HBC | 2.7 $K^- p$ |

## $\Gamma(\pi^0\rho^0)/\Gamma_{\text{total}}$ $\Gamma_9/\Gamma$

| VALUE | CL% | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **<0.04** | 90 | RITTENBERG | 65 | HBC | 2.7 $K^- p$ |

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

| VALUE | CL% | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **<0.006** | 90 | RITTENBERG | 65 | HBC | 2.7 $K^- p$ |

## $\Gamma(6\pi)/\Gamma_{\text{total}}$ $\Gamma_{13}/\Gamma$

| VALUE | CL% | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **<0.01** | 90 | LONDON | 66 | HBC | Compilation |

## $\Gamma(\omega\gamma)/\Gamma(\pi^+\pi^-\eta)$ $\Gamma_4/\Gamma_1$

| VALUE | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **0.069±0.008 OUR FIT** | Error includes scale factor of 1.1. | | | | |
| **0.068±0.013** | 68 | ZANFINO | 77 | ASPK | 8.4 $\pi^- p$ |

### $\Gamma(\rho^0\gamma$(including non-resonant $\pi^+\pi^-\gamma$))/[$\Gamma(\pi^+\pi^-\eta)+\Gamma(\pi^0\pi^0\eta)+\Gamma(\omega\gamma)$] $\Gamma_2/(\Gamma_1+\Gamma_3+\Gamma_4)$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| **0.433±0.021 OUR FIT** Error includes scale factor of 1.2. | | | | |
| **0.25 ±0.14** | DAUBER | 64 | HBC | 1.95 $K^-p$ |

### $\Gamma(\gamma\gamma)/\Gamma_{total}$ $\Gamma_5/\Gamma$

| VALUE | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **0.0212±0.0014 OUR FIT** Error includes scale factor of 1.3. | | | | | |
| **0.0196±0.0015 OUR AVERAGE** | | | | | |
| 0.0200±0.0018 | | [11] STANTON | 80 | SPEC | 8.45 $\pi^-p\rightarrow$ $n\pi^+\pi^-2\gamma$ |
| 0.025 ±0.007 | | DUANE | 74 | MMS | $\pi^-p\rightarrow$ $n$MM |
| 0.0171±0.0033 | 68 | DALPIAZ | 72 | CNTR | 1.6 $\pi^-p\rightarrow$ $nX^0$ |
| $0.020\ ^{+0.008}_{-0.006}$ | 31 | HARVEY | 71 | OSPK | 3.65 $\pi^-p\rightarrow$ $nX^0$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | |
| 0.018 ±0.002 | 6000 | [12] APEL | 79 | NICE | 15–40 $\pi^-p\rightarrow$ $n2\gamma$ |

[11] Includes APEL 79 result.
[12] Data is included in STANTON 80 evaluation.

### $\Gamma(e^+e^-)/\Gamma_{total}$ $\Gamma_{18}/\Gamma$

| VALUE (units $10^{-7}$) | CL% | DOCUMENT ID | TECN | COMMENT |
|---|---|---|---|---|
| **<2.1** | 90 | VOROBYEV 88 | ND | $e^+e^-\rightarrow$ $\pi^+\pi^-\eta$ |

### $\Gamma(\pi^+\pi^-)/\Gamma_{total}$ $\Gamma_{19}/\Gamma$

| VALUE | CL% | DOCUMENT ID | TECN | COMMENT |
|---|---|---|---|---|
| **<0.02** | 90 | RITTENBERG 69 | HBC | 1.7–2.7 $K^-p$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| <0.08 | 95 | DANBURG 73 | HBC | 2.2 $K^-p\rightarrow$ $\Lambda X^0$ |

### $\Gamma(\pi^+\pi^-\pi^0)/\Gamma_{total}$ $\Gamma_8/\Gamma$

| VALUE | CL% | DOCUMENT ID | TECN | COMMENT |
|---|---|---|---|---|
| **<0.05** | 90 | RITTENBERG 69 | HBC | 1.7–2.7 $K^-p$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| <0.09 | 95 | DANBURG 73 | HBC | 2.2 $K^-p\rightarrow$ $\Lambda X^0$ |

### $\Gamma(\pi^+\pi^+\pi^-\pi^-$ neutrals$)/\Gamma_{total}$ $\Gamma_{11}/\Gamma$

| VALUE | CL% | DOCUMENT ID | TECN | COMMENT |
|---|---|---|---|---|
| **<0.01** | 95 | DANBURG 73 | HBC | 2.2 $K^-p\rightarrow$ $\Lambda X^0$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| <0.01 | 90 | RITTENBERG 69 | HBC | 1.7–2.7 $K^-p$ |

### $\Gamma(\pi^+\pi^+\pi^-\pi^-\pi^0)/\Gamma_{total}$ $\Gamma_{12}/\Gamma$

| VALUE | CL% | DOCUMENT ID | TECN | COMMENT |
|---|---|---|---|---|
| **<0.01** | 90 | RITTENBERG 69 | HBC | 1.7–2.7 $K^-p$ |

### $\Gamma(\pi^+\pi^+\pi^-\pi^-)/\Gamma_{total}$ — $\Gamma_{10}/\Gamma$

| VALUE | CL% | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **<0.01** | 90 | RITTENBERG | 69 | HBC | 1.7–2.7 $K^- p$ |

### $\Gamma(\pi^0\pi^0\eta(3\pi^0\text{decay}))/\Gamma_{total}$ — $0.321\Gamma_3/\Gamma$

| VALUE | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **0.067±0.004 OUR FIT** | Error includes scale factor of 1.2. | | | | |
| **0.11 ±0.06** | 4 | BENSINGER | 70 | DBC | 2.2 $\pi^+ d$ |

### $\Gamma(\rho^0\gamma(\text{including non-resonant}\,\pi^+\pi^-\gamma))/\Gamma(\pi^+\pi^-\eta(\text{neutral decay}))$ — $\Gamma_2/0.714\Gamma_1$

| VALUE | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **0.93±0.05 OUR FIT** | Error includes scale factor of 1.2. | | | | |
| **1.01±0.09 OUR AVERAGE** | | | | | |
| 1.07±0.17 | | BELADIDZE | 92C | VES | 36 $\pi^-$ Be $\rightarrow$ $\pi^-\eta'\eta$ Be |
| 0.92±0.14 | 473 | DANBURG | 73 | HBC | 2.2 $K^- p \rightarrow \Lambda X^0$ |
| 1.11±0.18 | 192 | JACOBS | 73 | HBC | 2.9 $K^- p \rightarrow \Lambda X^0$ |

### $\Gamma(\gamma\gamma)/\Gamma(\pi^0\pi^0\eta(\text{neutral decay}))$ — $\Gamma_5/0.714\Gamma_3$

| VALUE | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **0.142±0.010 OUR FIT** | Error includes scale factor of 1.6. | | | | |
| **0.188±0.058** | 16 | APEL | 72 | OSPK | 3.8 $\pi^- p \rightarrow n X^0$ |

### $\Gamma(\mu^+\mu^-\gamma)/\Gamma(\gamma\gamma)$ — $\Gamma_7/\Gamma_5$

| VALUE (units $10^{-3}$) | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **4.9±1.2** | 33 | VIKTOROV | 80 | CNTR | 25,33 $\pi^- p \rightarrow 2\mu\gamma$ |

### $\Gamma(\mu^+\mu^-\eta)/\Gamma_{total}$ — $\Gamma_{25}/\Gamma$

| VALUE (units $10^{-5}$) | CL% | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **<1.5** | 90 | DZHELYADIN | 81 | CNTR | 30 $\pi^- p \rightarrow \eta' n$ |

### $\Gamma(\mu^+\mu^-\pi^0)/\Gamma_{total}$ — $\Gamma_{24}/\Gamma$

| VALUE (units $10^{-5}$) | CL% | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **<6.0** | 90 | DZHELYADIN | 81 | CNTR | 30 $\pi^- p \rightarrow \eta' n$ |

### $\Gamma(3\pi^0)/\Gamma(\pi^0\pi^0\eta)$ — $\Gamma_6/\Gamma_3$

| VALUE (units $10^{-4}$) | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| **74±12 OUR FIT** | | | | |
| **74±12 OUR AVERAGE** | | | | |
| 74±15 | ALDE | 87B | GAM2 | 38 $\pi^- p \rightarrow n 6\gamma$ |
| 75±18 | BINON | 84 | GAM2 | 30–40 $\pi^- p \rightarrow n 6\gamma$ |

### $\Gamma(\gamma\gamma)/\Gamma(\pi^0\pi^0\eta)$ — $\Gamma_5/\Gamma_3$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| **0.101±0.007 OUR FIT** | Error includes scale factor of 1.6. | | | |
| **0.105±0.010 OUR AVERAGE** | Error includes scale factor of 1.9. | | | |
| 0.091±0.009 | AMSLER | 93 | CBAR | 0.0 $\bar{p}p$ |
| 0.112±0.002±0.006 | ALDE | 87B | GAM2 | 38 $\pi^- p \rightarrow n 2\gamma$ |

### $\Gamma(\omega\gamma)/\Gamma(\pi^0\pi^0\eta)$ $\Gamma_4/\Gamma_3$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| **0.145±0.014 OUR FIT** | | | | |
| **0.147±0.016** | ALDE | 87B | GAM2 | 38 $\pi^- p \rightarrow n4\gamma$ |

### $\Gamma(3\gamma)/\Gamma(\pi^0\pi^0\eta)$ $\Gamma_{23}/\Gamma_3$

| VALUE (units $10^{-4}$) | CL% | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **<4.6** | 90 | ALDE | 87B | GAM2 | 38 $\pi^- p \rightarrow n3\gamma$ |

### $\Gamma(\pi^0\gamma\gamma)/\Gamma(\pi^0\pi^0\eta)$ $\Gamma_{16}/\Gamma_3$

| VALUE (units $10^{-4}$) | CL% | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **<37** | 90 | ALDE | 87B | GAM2 | 38 $\pi^- p \rightarrow n4\gamma$ |

### $\Gamma(\pi^0\pi^0)/\Gamma(\pi^0\pi^0\eta)$ $\Gamma_{20}/\Gamma_3$

| VALUE (units $10^{-4}$) | CL% | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **<45** | 90 | ALDE | 87B | GAM2 | 38 $\pi^- p \rightarrow n4\gamma$ |

### $\Gamma(4\pi^0)/\Gamma(\pi^0\pi^0\eta)$ $\Gamma_{17}/\Gamma_3$

| VALUE (units $10^{-4}$) | CL% | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **<23** | 90 | ALDE | 87B | GAM2 | 38 $\pi^- p \rightarrow n8\gamma$ |

### $\Gamma(e\mu)/\Gamma_{\text{total}}$ $\Gamma_{26}/\Gamma$

| VALUE (units $10^{-4}$) | CL% | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **<4.7** | 90 | BRIERE | 00 | CLEO | 10.6 $e^+e^-$ |

## $\eta'(958)$ *C*-NONCONSERVING DECAY PARAMETER

See the note on $\eta$ decay parameters in the Stable Particle Particle Listings for definition of this parameter.

## DECAY ASYMMETRY PARAMETER FOR $\pi^+\pi^-\gamma$

| VALUE | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **−0.01 ±0.04 OUR AVERAGE** | | | | | |
| −0.019±0.056 | | AIHARA | 87 | TPC | $2\gamma \rightarrow \pi^+\pi^-\gamma$ |
| −0.069±0.078 | 295 | GRIGORIAN | 75 | STRC | 2.1 $\pi^- p$ |
| 0.00 ±0.10 | 103 | KALBFLEISCH | 75 | HBC | 2.18 $K^- p \rightarrow \Lambda\pi^+\pi^-\gamma$ |
| 0.07 ±0.08 | 152 | RITTENBERG | 65 | HBC | 2.1–2.7 $K^- p$ |

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