

# $\eta'(958)$

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

## $\eta'(958)$ MASS

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

## $\eta'(958)$ WIDTH

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

## $\eta'(958)$ 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) × 10 <sup>-3</sup>	
$\Gamma_7$ $\mu^+\mu^-\gamma$	(1.04 ± 0.26) × 10 <sup>-4</sup>	
$\Gamma_8$ $\pi^+\pi^-\pi^0$	< 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.

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

$x_2$	-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 $\pm$ 0.008	1.2
$\Gamma_2$	$\rho^0 \gamma$ (including non-resonant $\pi^+ \pi^- \gamma$ )	0.060 $\pm$ 0.005	1.3
$\Gamma_3$	$\pi^0 \pi^0 \eta$	0.042 $\pm$ 0.004	1.6
$\Gamma_4$	$\omega \gamma$	0.0061 $\pm$ 0.0008	1.2
$\Gamma_5$	$\gamma \gamma$	0.00429 $\pm$ 0.00015	1.1
$\Gamma_6$	$3\pi^0$	(3.1 $\pm$ 0.6) $\times 10^{-4}$	1.1

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

$\Gamma(\gamma\gamma)$					$\Gamma_5$	
VALUE (keV)	EVTS	DOCUMENT ID	TECN	COMMENT		
<b>4.29 <math>\pm</math> 0.15 OUR FIT</b>	Error includes scale factor of 1.1.					
<b>4.28 <math>\pm</math> 0.19 OUR AVERAGE</b>						
4.17 $\pm$ 0.10 $\pm$ 0.27	2000	<sup>1</sup> ACCIARRI	98B L3	$e^+ e^- \rightarrow e^+ e^- \pi^+ \pi^- \gamma$		
4.53 $\pm$ 0.29 $\pm$ 0.51	266	KARCH	92 CBAL	$e^+ e^- \rightarrow e^+ e^- \eta \pi^0 \pi^0$		
3.61 $\pm$ 0.13 $\pm$ 0.48		<sup>2</sup> BEHREND	91 CELL	$e^+ e^- \rightarrow e^+ e^- \eta'(958)$		
4.6 $\pm$ 1.1 $\pm$ 0.6	23	BARU	90 MD1	$e^+ e^- \rightarrow e^+ e^- \pi^+ \pi^- \gamma$		
4.57 $\pm$ 0.25 $\pm$ 0.44		BUTLER	90 MRK2	$e^+ e^- \rightarrow e^+ e^- \eta'(958)$		

5.08±0.24±0.71	547	<sup>3</sup> ROE	90 ASP	$e^+e^- \rightarrow e^+e^-2\gamma$
3.8 ±0.7 ±0.6	34	AIHARA	88C TPC	$e^+e^- \rightarrow e^+e^-\eta\pi^+\pi^-$
4.9 ±0.5 ±0.5	136	<sup>4</sup> WILLIAMS	88 CBAL	$e^+e^- \rightarrow e^+e^-2\gamma$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
4.7 ±0.6 ±0.9	143	<sup>5</sup> GIDAL	87 MRK2	$e^+e^- \rightarrow e^+e^-\eta\pi^+\pi^-$
4.0 ±0.9		<sup>6</sup> BARTEL	85E JADE	$e^+e^- \rightarrow e^+e^-2\gamma$

<sup>1</sup> No non-resonant  $\pi^+\pi^-$  contribution found.

<sup>2</sup> Revaluated by us using  $B(\eta' \rightarrow \rho(770)\gamma) = (30.2 \pm 1.3)\%$ .

<sup>3</sup> Revaluated by us using  $B(\eta' \rightarrow \gamma\gamma) = (2.11 \pm 0.13)\%$ .

<sup>4</sup> Revaluated by us using  $B(\eta' \rightarrow \gamma\gamma) = (2.11 \pm 0.13)\%$ .

<sup>5</sup> Superseded by BUTLER 90.

<sup>6</sup> Systematic error not evaluated.

### $\eta'(958) \Gamma(i)\Gamma(\gamma\gamma)/\Gamma(\text{total})$

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.

#### $\Gamma(\gamma\gamma) \times \Gamma(\rho^0\gamma(\text{including non-resonant } \pi^+\pi^-\gamma))/\Gamma_{\text{total}} \quad \Gamma_5\Gamma_2/\Gamma$

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

#### $\Gamma(\gamma\gamma) \times \Gamma(\pi^0\pi^0\eta)/\Gamma_{\text{total}} \quad \Gamma_5\Gamma_3/\Gamma$

<u>VALUE (keV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>0.90±0.06 OUR FIT</b>	Error includes scale factor of 1.2.		
<b>0.92±0.06±0.11</b>	<sup>7</sup> KARCH	92 CBAL	$e^+e^- \rightarrow e^+e^-\eta\pi^0\pi^0$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
0.95±0.05±0.08	<sup>8</sup> KARCH	90 CBAL	$e^+e^- \rightarrow e^+e^-\eta\pi^0\pi^0$
1.00±0.08±0.10	<sup>8,9</sup> ANTREASYAN	87 CBAL	$e^+e^- \rightarrow e^+e^-\eta\pi^0\pi^0$
<sup>7</sup> Revaluated by us using $B(\eta \rightarrow \gamma\gamma) = (39.21 \pm 0.34)\%$ . Supersedes ANTREASYAN 87 and KARCH 90.			
<sup>8</sup> Superseded by KARCH 92.			
<sup>9</sup> Using $BR(\eta \rightarrow 2\gamma) = (38.9 \pm 0.5)\%$ .			

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

$$|\text{MATRIX ELEMENT}|^2 = (1 + \alpha y)^2 + \alpha^2$$

VALUE	DOCUMENT ID	TECN	COMMENT
$-0.058 \pm 0.013$	<sup>10</sup> ALDE	86	GAM2 38 $\pi^- p \rightarrow n\eta 2\pi^0$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
$-0.08 \pm 0.03$	<sup>10</sup> KALBFLEISCH 74	RVUE	$\eta' \rightarrow \eta\pi^+\pi^-$
<sup>10</sup> May not necessarily be the same for $\eta' \rightarrow \eta\pi^+\pi^-$ and $\eta' \rightarrow \eta\pi^0\pi^0$ .			

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

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

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 $K^- p$

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

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 $K^- p \rightarrow \Lambda\pi^+\pi^-\text{neutrals}$
$0.35 \pm 0.06$	33	BADIER	65B	HBC 3 $K^- p$

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

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 $K^- p$

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

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 $K^- p$

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

<u>VALUE</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>0.173±0.009 OUR FIT</b>				Error includes scale factor of 1.2.
<b>0.187±0.017 OUR AVERAGE</b>				
0.185±0.022	535	BASILE	71 CNTR	1.6 $\pi^- p \rightarrow n\chi^0$
0.189±0.026	123	RITTENBERG	69 HBC	1.7-2.7 $K^- p$

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

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

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

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

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

<u>VALUE (units 10<sup>-3</sup>)</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>&lt;0.9</b>	90	BRIERE	00 CLEO	10.6 $e^+ e^-$

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

<u>VALUE (units 10<sup>-3</sup>)</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>&lt; 1.4</b>	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 $K^- p$

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

<u>VALUE (units 10<sup>-3</sup>)</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>&lt; 2.4</b>	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 $K^- p$

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

<u>VALUE</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>&lt;0.04</b>	90	RITTENBERG	65 HBC	2.7 $K^- p$

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

<u>VALUE</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>&lt;0.006</b>	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	
<b>0.069±0.008 OUR FIT</b>	Error includes scale factor of 1.1.				
<b>0.068±0.013</b>	68	ZANFINO	77 ASPK	8.4 $\pi^- p$	

$\Gamma(\rho^0\gamma(\text{including non-resonant } \pi^+\pi^-\gamma))/[\Gamma(\pi^+\pi^-\eta) + \Gamma(\pi^0\pi^0\eta) + \Gamma(\omega\gamma)]$					$\Gamma_2/(\Gamma_1+\Gamma_3+\Gamma_4)$
VALUE	DOCUMENT ID	TECN	COMMENT		
<b>0.433±0.021 OUR FIT</b>	Error includes scale factor of 1.2.				
<b>0.25 ±0.14</b>	DAUBER	64 HBC	1.95 $K^- p$		

$\Gamma(\gamma\gamma)/\Gamma_{\text{total}}$					$\Gamma_5/\Gamma$
VALUE	EVTS	DOCUMENT ID	TECN	COMMENT	
<b>0.0212±0.0014 OUR FIT</b>	Error includes scale factor of 1.3.				
<b>0.0196±0.0015 OUR AVERAGE</b>					
0.0200±0.0018		<sup>11</sup> STANTON	80 SPEC	8.45 $\pi^- p \rightarrow n\pi^+\pi^-2\gamma$	
0.025 ±0.007		DUANE	74 MMS	$\pi^- p \rightarrow nMM$	
0.0171±0.0033	68	DALPIAZ	72 CNTR	1.6 $\pi^- p \rightarrow nX^0$	
0.020 <sup>+0.008</sup> <sub>-0.006</sub>	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	<sup>12</sup> APEL	79 NICE	15–40 $\pi^- p \rightarrow n2\gamma$	
<sup>11</sup> Includes APEL 79 result.					
<sup>12</sup> Data is included in STANTON 80 evaluation.					

$\Gamma(e^+e^-)/\Gamma_{\text{total}}$					$\Gamma_{18}/\Gamma$
VALUE (units $10^{-7}$ )	CL%	DOCUMENT ID	TECN	COMMENT	
<2.1	90	VOROBYEV	88 ND	$e^+e^- \rightarrow \pi^+\pi^-\eta$	

$\Gamma(\pi^+\pi^-)/\Gamma_{\text{total}}$					$\Gamma_{19}/\Gamma$
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 $K^- p \rightarrow \Lambda X^0$	

$\Gamma(\pi^+\pi^-\pi^0)/\Gamma_{\text{total}}$					$\Gamma_8/\Gamma$
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 $K^- p \rightarrow \Lambda X^0$	

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

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 $K^- p$

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

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

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

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

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

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
<b>0.067±0.004 OUR FIT</b>		Error includes scale factor of 1.2.		
<b>0.11 ±0.06</b>	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
<b>0.93±0.05 OUR FIT</b>		Error includes scale factor of 1.2.		
<b>1.01±0.09 OUR AVERAGE</b>				
1.07±0.17		BELADIDZE	92C VES	36 $\pi^- \text{Be} \rightarrow \pi^- \eta' \eta \text{Be}$
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
<b>0.142±0.010 OUR FIT</b>		Error includes scale factor of 1.6.		
<b>0.188±0.058</b>	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
<b>4.9±1.2</b>	33	VIKTOROV	80 CNTR	25,33 $\pi^- p \rightarrow 2\mu\gamma$

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

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

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

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

$\Gamma(3\pi^0)/\Gamma(\pi^0\pi^0\eta)$					$\Gamma_6/\Gamma_3$
<u>VALUE (units <math>10^{-4}</math>)</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>	
<b>74±12 OUR FIT</b>					
<b>74±12 OUR AVERAGE</b>					
74±15		ALDE	87B	GAM2	38 $\pi^- p \rightarrow n6\gamma$
75±18		BINON	84	GAM2	30–40 $\pi^- p \rightarrow n6\gamma$
$\Gamma(\gamma\gamma)/\Gamma(\pi^0\pi^0\eta)$					$\Gamma_5/\Gamma_3$
<u>VALUE</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>	
<b>0.101±0.007 OUR FIT</b> Error includes scale factor of 1.6.					
<b>0.105±0.010 OUR AVERAGE</b> 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 $\pi^- p \rightarrow n2\gamma$
$\Gamma(\omega\gamma)/\Gamma(\pi^0\pi^0\eta)$					$\Gamma_4/\Gamma_3$
<u>VALUE</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>	
<b>0.145±0.014 OUR FIT</b>					
<b>0.147±0.016</b>					
		ALDE	87B	GAM2	38 $\pi^- p \rightarrow n4\gamma$
$\Gamma(3\gamma)/\Gamma(\pi^0\pi^0\eta)$					$\Gamma_{23}/\Gamma_3$
<u>VALUE (units <math>10^{-4}</math>)</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>	
<b>&lt;4.6</b>	90	ALDE	87B	GAM2	38 $\pi^- p \rightarrow n3\gamma$
$\Gamma(\pi^0\gamma\gamma)/\Gamma(\pi^0\pi^0\eta)$					$\Gamma_{16}/\Gamma_3$
<u>VALUE (units <math>10^{-4}</math>)</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>	
<b>&lt;37</b>	90	ALDE	87B	GAM2	38 $\pi^- p \rightarrow n4\gamma$
$\Gamma(\pi^0\pi^0)/\Gamma(\pi^0\pi^0\eta)$					$\Gamma_{20}/\Gamma_3$
<u>VALUE (units <math>10^{-4}</math>)</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>	
<b>&lt;45</b>	90	ALDE	87B	GAM2	38 $\pi^- p \rightarrow n4\gamma$
$\Gamma(4\pi^0)/\Gamma(\pi^0\pi^0\eta)$					$\Gamma_{17}/\Gamma_3$
<u>VALUE (units <math>10^{-4}</math>)</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>	
<b>&lt;23</b>	90	ALDE	87B	GAM2	38 $\pi^- p \rightarrow n8\gamma$
$\Gamma(e\mu)/\Gamma_{\text{total}}$					$\Gamma_{26}/\Gamma$
<u>VALUE (units <math>10^{-4}</math>)</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>	
<b>&lt;4.7</b>	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
<b>-0.01 ± 0.04 OUR AVERAGE</b>				
-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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BARBERIS	98C	PL B440 225	D. Barberis <i>et al.</i>	(WA 102 Collab.)
WURZINGER	96	PL B374 283	R. Wurzinger <i>et al.</i>	(BONN, ORSAY, SACL+)
PDG	94	PR D50 1173	L. Montanet <i>et al.</i>	(CERN, LBL, BOST+)
AMSLER	93	ZPHY C58 175	C. Amsler <i>et al.</i>	(Crystal Barrel Collab.)
BELADIDZE	92C	SJNP 55 1535	G.M. Beladidze, S.I. Bityukov, G.V. Borisov	(SERP+)
		Translated from YAF 55 2748.		
KARCH	92	ZPHY C54 33	K. Karch <i>et al.</i>	(Crystal Ball Collab.)
ARMSTRONG	91B	ZPHY C52 389	T.A. Armstrong <i>et al.</i>	(ATHU, BARI, BIRM+)
BEHREND	91	ZPHY C49 401	H.J. Behrend <i>et al.</i>	(CELLO Collab.)
AUGUSTIN	90	PR D42 10	J.E. Augustin <i>et al.</i>	(DM2 Collab.)
BARU	90	ZPHY C48 581	S.E. Baru <i>et al.</i>	(MD-1 Collab.)
BUTLER	90	PR D42 1368	F. Butler <i>et al.</i>	(Mark II Collab.)
KARCH	90	PL B249 353	K. Karch <i>et al.</i>	(Crystal Ball Collab.)
ROE	90	PR D41 17	N.A. Roe <i>et al.</i>	(ASP Collab.)
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ALBRECHT	87B	PL B199 457	H. Albrecht <i>et al.</i>	(ARGUS Collab.)
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BARTEL	85E	PL 160B 421	W. Bartel <i>et al.</i>	(JADE Collab.)
ALTHOFF	84E	PL 147B 487	M. Althoff <i>et al.</i>	(TASSO Collab.)
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BEHREND	83B	PL 125B 518	H.J. Behrend <i>et al.</i>	(CELLO Collab.)
Also	82C	PL 114B 378	H.J. Behrend <i>et al.</i>	(CELLO Collab.)
JENNI	83	PR D27 1031	P. Jenni <i>et al.</i>	(SLAC, LBL)
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DZHELADIN	81	PL 105B 239	R.I. Dzhelyadin <i>et al.</i>	(SERP)
STANTON	80	PL 92 B 353	N.R. Stanton <i>et al.</i>	(OSU, CARL, MCGI+)
VIKTOROV	80	SJNP 32 520	V.A. Viktorov <i>et al.</i>	(SERP)
		Translated from YAF 32 1005.		
APEL	79	PL 83B 131	W.D. Apel, K.H. Augenstein, E. Bertolucci	(KARLK+)
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GRIGORIAN	75	NP B91 232	A. Grigorian <i>et al.</i>	(+)
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