

$\eta'(958)$ 

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

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

<u>VALUE (MeV)</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>957.78 ± 0.06 OUR AVERAGE</b>				
957.793 ± 0.054 ± 0.036	3.9k	LIBBY	08	CLEO $J/\psi \rightarrow \gamma\eta'$
957.9 ± 0.2 ± 0.6	4800	WURZINGER	96	SPEC 1.68 $pd \rightarrow {}^3\text{He}\eta'$
957.46 ± 0.33		DUANE	74	MMS $\pi^- p \rightarrow n\text{MM}$
958.2 ± 0.5	1414	DANBURG	73	HBC 2.2 $K^- p \rightarrow \Lambda\eta'$
958 ± 1	400	JACOBS	73	HBC 2.9 $K^- p \rightarrow \Lambda\eta'$
956.1 ± 1.1	3415	<sup>1</sup> BASILE	71	CNTR 1.6 $\pi^- p \rightarrow n\eta'$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
957.5 ± 0.2		BAI	04J	BES2 $J/\psi \rightarrow \gamma\gamma\pi^+\pi^-$
959 ± 1	630	<sup>2</sup> BELADIDZE	92C	VES 36 $\pi^- \text{Be} \rightarrow \pi^- \eta' \eta \text{Be}$
958 ± 1	340	<sup>2</sup> ARMSTRONG	91B	OMEG 300 $pp \rightarrow pp\eta\pi^+\pi^-$
958.2 ± 0.4	622	<sup>2</sup> AUGUSTIN	90	DM2 $J/\psi \rightarrow \gamma\eta\pi^+\pi^-$
957.8 ± 0.2	2420	<sup>2</sup> AUGUSTIN	90	DM2 $J/\psi \rightarrow \gamma\gamma\pi^+\pi^-$
956.3 ± 1.0	143	<sup>2</sup> GIDAL	87	MRK2 $e^+e^- \rightarrow e^+e^-\eta\pi^+\pi^-$
957.4 ± 1.4	535	<sup>3</sup> BASILE	71	CNTR 1.6 $\pi^- p \rightarrow n\eta'$
957 ± 1		RITTENBERG	69	HBC 1.7-2.7 $K^- p$

<sup>1</sup> Using all  $\eta'$  decays.<sup>2</sup> Systematic uncertainty not estimated.<sup>3</sup> Using  $\eta'$  decays into neutrals. Not independent of the other listed BASILE 71  $\eta'$  mass measurement.

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

<u>VALUE (MeV)</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>CHG</u>	<u>COMMENT</u>
<b>0.196 ± 0.009 OUR FIT</b>					
<b>0.230 ± 0.021 OUR AVERAGE</b>					
0.226 ± 0.017 ± 0.014	2300	CZERWINSKI	10	MMS	$pp \rightarrow pp\eta'$
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 $\pi^- p \rightarrow n\text{MM}$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●					
0.20 ± 0.04		BAI	04J	BES2	$J/\psi \rightarrow \gamma\gamma\pi^+\pi^-$

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

Mode	Fraction ( $\Gamma_i/\Gamma$ )	Confidence level
$\Gamma_1$ $\pi^+\pi^-\eta$	(42.6 $\pm$ 0.7) %	
$\Gamma_2$ $\rho^0\gamma$ (including non-resonant $\pi^+\pi^-\gamma$ )	(28.9 $\pm$ 0.5) %	
$\Gamma_3$ $\rho^0\gamma$		
$\Gamma_4$ $\pi^0\pi^0\eta$	(22.8 $\pm$ 0.8) %	
$\Gamma_5$ $\omega\gamma$	( 2.62 $\pm$ 0.13) %	
$\Gamma_6$ $\omega e^+ e^-$	( 2.0 $\pm$ 0.4 ) $\times 10^{-4}$	
$\Gamma_7$ $\gamma\gamma$	( 2.22 $\pm$ 0.08) %	
$\Gamma_8$ $3\pi^0$	( 2.54 $\pm$ 0.18) $\times 10^{-3}$	
$\Gamma_9$ $\mu^+\mu^-\gamma$	( 1.09 $\pm$ 0.27) $\times 10^{-4}$	
$\Gamma_{10}$ $\pi^+\pi^-\mu^+\mu^-$	< 2.9 $\times 10^{-5}$	90%
$\Gamma_{11}$ $\pi^+\pi^-\pi^0$	( 3.61 $\pm$ 0.17) $\times 10^{-3}$	
$\Gamma_{12}$ ( $\pi^+\pi^-\pi^0$ ) S-wave	( 3.8 $\pm$ 0.5 ) $\times 10^{-3}$	
$\Gamma_{13}$ $\pi^\mp\rho^\pm$	( 7.4 $\pm$ 2.3 ) $\times 10^{-4}$	
$\Gamma_{14}$ $\pi^0\rho^0$	< 4 %	90%
$\Gamma_{15}$ $2(\pi^+\pi^-)$	( 8.4 $\pm$ 0.9 ) $\times 10^{-5}$	
$\Gamma_{16}$ $\pi^+\pi^-2\pi^0$	( 1.8 $\pm$ 0.4 ) $\times 10^{-4}$	
$\Gamma_{17}$ $2(\pi^+\pi^-)$ neutrals	< 1 %	95%
$\Gamma_{18}$ $2(\pi^+\pi^-)\pi^0$	< 1.8 $\times 10^{-3}$	90%
$\Gamma_{19}$ $2(\pi^+\pi^-)2\pi^0$	< 1 %	95%
$\Gamma_{20}$ $3(\pi^+\pi^-)$	< 3.1 $\times 10^{-5}$	90%
$\Gamma_{21}$ $K^\pm\pi^\mp$	< 4 $\times 10^{-5}$	90%
$\Gamma_{22}$ $\pi^+\pi^-e^+e^-$	( 2.4 $^{+1.3}_{-1.0}$ ) $\times 10^{-3}$	
$\Gamma_{23}$ $\pi^+e^-\nu_e + \text{c.c.}$	< 2.1 $\times 10^{-4}$	90%
$\Gamma_{24}$ $\gamma e^+e^-$	( 4.73 $\pm$ 0.30) $\times 10^{-4}$	
$\Gamma_{25}$ $\pi^0\gamma\gamma$	( 3.20 $\pm$ 0.24) $\times 10^{-3}$	
$\Gamma_{26}$ $\pi^0\gamma\gamma$ (non resonant)	( 6.2 $\pm$ 0.9 ) $\times 10^{-4}$	
$\Gamma_{27}$ $4\pi^0$	< 3.2 $\times 10^{-4}$	90%
$\Gamma_{28}$ $e^+e^-$	< 5.6 $\times 10^{-9}$	90%
$\Gamma_{29}$ invisible	< 5 $\times 10^{-4}$	90%

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

$\Gamma_{30}$ $\pi^+\pi^-$	$P, CP$	< 1.8 $\times 10^{-5}$	90%
$\Gamma_{31}$ $\pi^0\pi^0$	$P, CP$	< 4 $\times 10^{-4}$	90%
$\Gamma_{32}$ $\pi^0e^+e^-$	$C$ [a]	< 1.4 $\times 10^{-3}$	90%
$\Gamma_{33}$ $\eta e^+e^-$	$C$ [a]	< 2.4 $\times 10^{-3}$	90%
$\Gamma_{34}$ $3\gamma$	$C$	< 1.1 $\times 10^{-4}$	90%
$\Gamma_{35}$ $\mu^+\mu^-\pi^0$	$C$ [a]	< 6.0 $\times 10^{-5}$	90%
$\Gamma_{36}$ $\mu^+\mu^-\eta$	$C$ [a]	< 1.5 $\times 10^{-5}$	90%
$\Gamma_{37}$ $e\mu$	$LF$	< 4.7 $\times 10^{-4}$	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 46 measurements and one constraint to determine 9 parameters. The overall fit has a  $\chi^2 = 62.7$  for 38 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.

$x_2$	-3							
$x_4$	-76	-58						
$x_5$	-10	-13	1					
$x_7$	-27	-24	29	-1				
$x_8$	-23	-18	28	0	8			
$x_{11}$	0	-1	-1	0	-1	0		
$x_{22}$	-5	-6	-5	-1	-3	-2	0	
$\Gamma$	24	4	-17	3	-71	-4	1	3
	$x_1$	$x_2$	$x_4$	$x_5$	$x_7$	$x_8$	$x_{11}$	$x_{22}$

Mode	Rate (MeV)
$\Gamma_1$ $\pi^+ \pi^- \eta$	0.084 $\pm$ 0.004
$\Gamma_2$ $\rho^0 \gamma$ (including non-resonant $\pi^+ \pi^- \gamma$ )	0.0567 $\pm$ 0.0027
$\Gamma_4$ $\pi^0 \pi^0 \eta$	0.0448 $\pm$ 0.0023
$\Gamma_5$ $\omega \gamma$	0.00514 $\pm$ 0.00035
$\Gamma_7$ $\gamma \gamma$	0.00436 $\pm$ 0.00013
$\Gamma_8$ $3\pi^0$	(5.0 $\pm$ 0.4) $\times 10^{-4}$
$\Gamma_{11}$ $\pi^+ \pi^- \pi^0$	(7.1 $\pm$ 0.5) $\times 10^{-4}$
$\Gamma_{22}$ $\pi^+ \pi^- e^+ e^-$	(4.6 $^{+2.5}_{-1.9}$ ) $\times 10^{-4}$

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

$\Gamma(\gamma\gamma)$	$\Gamma_7$			
VALUE (keV)	EVTS	DOCUMENT ID	TECN	COMMENT
<b>4.36 <math>\pm</math> 0.14 OUR FIT</b>				
<b>4.28 <math>\pm</math> 0.19 OUR AVERAGE</b>				
4.17 $\pm$ 0.10 $\pm$ 0.27	2000	<sup>1</sup> ACCIARRI	98Q 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 ±1.1 ±0.6	23	BARU	90	MD1	$e^+e^- \rightarrow e^+e^-\pi^+\pi^-\gamma$
4.57±0.25±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>Reevaluated by us using  $B(\eta' \rightarrow \rho(770)\gamma) = (30.2 \pm 1.3)\%$ .

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

<sup>4</sup>Reevaluated 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.

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

$\Gamma_{28}$

<u>VALUE (eV)</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>&lt;1.1 × 10<sup>-3</sup></b>	90	1,2 ACHASOV	15	SND 0.958 $e^+e^- \rightarrow \pi\pi\eta$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
<2.0 × 10 <sup>-3</sup>	90	<sup>2</sup> ACHASOV	15	SND 0.958 $e^+e^- \rightarrow \pi\pi\eta$
<2.4 × 10 <sup>-3</sup>	90	<sup>2</sup> AKHMETSIN	15	CMD3 0.958 $e^+e^- \rightarrow \pi^+\pi^-\eta$

<sup>1</sup>Combining data of ACHASOV 15 and AKHMETSIN 15.

<sup>2</sup>Using  $\eta$  and  $\eta'$  branching fractions from PDG 14.

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

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.

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

$\Gamma_7\Gamma_2/\Gamma$

<u>VALUE (keV)</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>1.26±0.04 OUR FIT</b>				
<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	82C	CELL $e^+e^- \rightarrow e^+e^-\rho\gamma$

$\Gamma(\gamma\gamma) \times \Gamma(\pi^0\pi^0\eta)/\Gamma_{\text{total}}$   $\Gamma_7\Gamma_4/\Gamma$

VALUE (keV)                      DOCUMENT ID      TECN      COMMENT

**1.00±0.05 OUR FIT**

**0.92±0.06±0.11**                      <sup>1</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>2</sup> KARCH              90      CBAL       $e^+e^- \rightarrow e^+e^-\eta\pi^0\pi^0$

1.00±0.08±0.10                      <sup>2,3</sup> ANTREASYAN 87      CBAL       $e^+e^- \rightarrow e^+e^-\eta\pi^0\pi^0$

<sup>1</sup> Reevaluated by us using  $B(\eta \rightarrow \gamma\gamma) = (39.21 \pm 0.34)\%$ . Supersedes ANTREASYAN 87 and KARCH 90.

<sup>2</sup> Superseded by KARCH 92.

<sup>3</sup> Using  $BR(\eta \rightarrow 2\gamma) = (38.9 \pm 0.5)\%$ .

$\eta'(958) \Gamma(i)\Gamma(e^+e^-)/\Gamma(\text{total})$

$\Gamma(\pi^+\pi^-\eta) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$   $\Gamma_1\Gamma_{28}/\Gamma$

VALUE ( $10^{-3}$  eV)      CL%      DOCUMENT ID      TECN      COMMENT

**<1.0**                      90              <sup>1</sup> AKHMETSHIN 15      CMD3       $0.958 e^+e^- \rightarrow \pi^+\pi^-\eta$

<sup>1</sup> AKHMETSHIN 15 reports  $[\Gamma(\eta'(958) \rightarrow \pi^+\pi^-\eta) \times \Gamma(\eta'(958) \rightarrow e^+e^-)/\Gamma_{\text{total}}] \times [B(\eta \rightarrow 2\gamma)] < 4.1 \times 10^{-4}$  eV which we divide by our best value  $B(\eta \rightarrow 2\gamma) = 39.41 \times 10^{-2}$ .

$\eta'(958)$  BRANCHING RATIOS

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

VALUE                      EVTS                      DOCUMENT ID      TECN      COMMENT

**0.426±0.007 OUR FIT**

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

0.424±0.011±0.004      1.2k              <sup>1</sup> PEDLAR              09      CLEO       $J/\psi \rightarrow \gamma\eta'$

<sup>1</sup> Not independent of other  $\eta'$  branching fractions and ratios in PEDLAR 09.

$\Gamma(\pi^+\pi^-\eta(\text{charged decay}))/\Gamma_{\text{total}}$  **0.2810 $\Gamma_1/\Gamma$**

VALUE                      EVTS                      DOCUMENT ID      TECN      COMMENT

**0.1196±0.0019 OUR FIT**

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

0.123 ±0.014              107              RITTENBERG 69      HBC      1.7-2.7  $K^-p$

0.10 ±0.04              10              LONDON              66      HBC      2.24  $K^-p \rightarrow \Lambda 2\pi^+ 2\pi^- \pi^0$

0.07 ±0.04              7              BADIER              65B      HBC      3  $K^-p$

$\Gamma(\pi^+\pi^-\eta(\text{neutral decay}))/\Gamma_{\text{total}}$  **0.7212 $\Gamma_1/\Gamma$**

VALUE                      EVTS                      DOCUMENT ID      TECN      COMMENT

**0.307±0.005 OUR FIT**

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

0.314±0.026              281              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

**0.289 ± 0.005 OUR FIT**

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

0.287 ± 0.007 ± 0.004	0.2k	<sup>1</sup> PEDLAR	09	CLEO	$J/\psi \rightarrow \gamma \eta'$
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 $K^- p$

<sup>1</sup> Not independent of other  $\eta'$  branching fractions and ratios in PEDLAR 09.

$\Gamma(\rho^0 \gamma)/\Gamma_{\text{total}}$   $\Gamma_3/\Gamma$

VALUE (%)                      EVTS                      DOCUMENT ID                      TECN                      COMMENT

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

33.34 ± 0.06 ± 1.60	970k	<sup>1</sup> ABLIKIM	18C	BES3	$\eta'(958) \rightarrow \gamma \pi^+ \pi^-$
34.43 ± 0.52 ± 1.97	970k	<sup>2</sup> ABLIKIM	18C	BES3	$\eta'(958) \rightarrow \gamma \pi^+ \pi^-$

<sup>1</sup> From a fit to  $\pi^+ \pi^-$  mass using  $\rho(770)$ ,  $\omega(782)$ , and box anomaly components.

<sup>2</sup> From a fit to  $\pi^+ \pi^-$  mass using  $\rho(770)$ ,  $\omega(782)$ , and  $\rho(1450)$  components.

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

VALUE    DOCUMENT ID                      TECN                      COMMENT

**0.679 ± 0.017 OUR FIT**

**0.683 ± 0.020 OUR AVERAGE**

0.677 ± 0.024 ± 0.011		PEDLAR	09	CLE3	$J/\psi \rightarrow \eta' \gamma$
0.69 ± 0.03		ABLIKIM	06E	BES2	$J/\psi \rightarrow \eta' \gamma$

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

VALUE                      EVTS                      DOCUMENT ID                      TECN                      COMMENT

**0.951 ± 0.024 OUR FIT**

**0.97 ± 0.09 OUR AVERAGE**

0.70 ± 0.22		AMSLER	04B	CBAR	0 $\bar{p} p \rightarrow \pi^+ \pi^- \eta$
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 $K^- p \rightarrow \Lambda X^0$

$\Gamma(\pi^0 \pi^0 \eta)/\Gamma_{\text{total}}$   $\Gamma_4/\Gamma$

VALUE                      EVTS                      DOCUMENT ID                      TECN                      COMMENT

**0.228 ± 0.008 OUR FIT**

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

0.235 ± 0.013 ± 0.004	3.2k	<sup>1</sup> PEDLAR	09	CLEO	$J/\psi \rightarrow \gamma \eta'$
-----------------------	------	---------------------	----	------	-----------------------------------

<sup>1</sup> Not independent of other  $\eta'$  branching fractions and ratios in PEDLAR 09.

$\Gamma(\pi^0 \pi^0 \eta (3\pi^0 \text{ decay}))/\Gamma_{\text{total}}$  **0.321** $\Gamma_4/\Gamma$

VALUE                      EVTS                      DOCUMENT ID                      TECN                      COMMENT

**0.0733 ± 0.0026 OUR FIT**

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

0.11 ± 0.06	4	BENSINGER	70	DBC	2.2 $\pi^+ d$
-------------	---	-----------	----	-----	---------------

$\Gamma(\pi^0\pi^0\eta)/\Gamma(\pi^+\pi^-\eta)$   $\Gamma_4/\Gamma_1$

<u>VALUE</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>0.536±0.026 OUR FIT</b>			
<b>0.555±0.043±0.013</b>	PEDLAR	09	CLE3 $J/\psi \rightarrow \eta'\gamma$

$\Gamma(\rho^0\gamma(\text{including non-resonant } \pi^+\pi^-\gamma))/\Gamma(\pi\pi\eta)$   $\Gamma_2/(\Gamma_1+\Gamma_4)$

<u>VALUE</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>0.442±0.012 OUR FIT</b>			
<b>0.43 ±0.02 ±0.02</b>	BARBERIS	98C	OMEG 450 $pp \rightarrow p_f\eta'p_s$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
0.31 ±0.15	DAVIS	68	HBC 5.5 $K^-p$

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

<u>VALUE (units 10<sup>-2</sup>)</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>2.62±0.13 OUR FIT</b>				
<b>2.55±0.03±0.16</b>	33.2k	<sup>1</sup> ABLIKIM	15AD BES3	$J/\psi \rightarrow \eta'\gamma$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
2.34±0.30±0.04	70	<sup>2</sup> PEDLAR	09	CLEO $J/\psi \rightarrow \gamma\eta'$
<sup>1</sup> Using $B(J/\psi \rightarrow \eta'\gamma) = (5.15 \pm 0.16) \times 10^{-3}$ and $B(\omega \rightarrow \pi^+\pi^-\pi^0) = (89.2 \pm 0.7)\%$ .				
<sup>2</sup> Not independent of other $\eta'$ branching fractions and ratios in PEDLAR 09.				

$\Gamma(\omega\gamma)/\Gamma(\pi^+\pi^-\eta)$   $\Gamma_5/\Gamma_1$

<u>VALUE</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>0.0615±0.0033 OUR FIT</b>				
<b>0.055 ±0.007 ±0.001</b>		PEDLAR	09	CLE3 $J/\psi \rightarrow \eta'\gamma$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.068 ±0.013	68	ZANFINO	77	ASPK 8.4 $\pi^-p$

$\Gamma(\omega\gamma)/\Gamma(\pi^0\pi^0\eta)$   $\Gamma_5/\Gamma_4$

<u>VALUE</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>0.115±0.007 OUR FIT</b>			
<b>0.147±0.016</b>	ALDE	87B	GAM2 38 $\pi^-p \rightarrow n4\gamma$

$\Gamma(\omega e^+e^-)/\Gamma(\omega\gamma)$   $\Gamma_6/\Gamma_5$

<u>VALUE (units 10<sup>-3</sup>)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
• • • We do not use the following data for averages, fits, limits, etc. • • •			
7.71±1.34±0.54	<sup>1</sup> ABLIKIM	15AD BES3	$J/\psi \rightarrow \eta'\gamma$
<sup>1</sup> Obtained from other ABLIKIM 15AD measurements with common systematics taken into account.			

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

<u>VALUE (units 10<sup>-4</sup>)</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>1.97±0.34±0.17</b>	66	<sup>1</sup> ABLIKIM	15AD BES3	$J/\psi \rightarrow \eta'\gamma$
<sup>1</sup> Using $B(J/\psi \rightarrow \eta'\gamma) = (5.15 \pm 0.16) \times 10^{-3}$ and $B(\omega \rightarrow \pi^+\pi^-\pi^0) = (89.2 \pm 0.7)\%$ .				

$$\frac{\Gamma(\rho^0 \gamma (\text{including non-resonant } \pi^+ \pi^- \gamma)) / [\Gamma(\pi^+ \pi^- \eta) + \Gamma(\pi^0 \pi^0 \eta) + \Gamma(\omega \gamma)]}{\Gamma_2 / (\Gamma_1 + \Gamma_4 + \Gamma_5)}$$

VALUE	DOCUMENT ID	TECN	COMMENT
-------	-------------	------	---------

**0.425 ± 0.011 OUR FIT**

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

0.25 ± 0.14	DAUBER	64	HBC	1.95 $K^- p$
-------------	--------	----	-----	--------------

$$\frac{[\Gamma(\pi^0 \pi^0 \eta (\text{charged decay})) + \Gamma(\omega (\text{charged decay}) \gamma)] / \Gamma_{\text{total}}}{(0.286\Gamma_4 + 0.89\Gamma_5) / \Gamma}$$

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
-------	------	-------------	------	---------

**0.0886 ± 0.0026 OUR FIT**

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

0.045 ± 0.029	42	RITTENBERG	69	HBC	1.7–2.7 $K^- p$
---------------	----	------------	----	-----	-----------------

$$\frac{\Gamma(\pi^+ \pi^- \text{ neutrals}) / \Gamma_{\text{total}}}{(0.714\Gamma_1 + 0.286\Gamma_4 + 0.89\Gamma_5) / \Gamma}$$

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
-------	------	-------------	------	---------

**0.3926 ± 0.0035 OUR FIT**

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

0.4 ± 0.1	39	LONDON	66	HBC	2.24 $K^- p \rightarrow \Lambda \pi^+ \pi^- \text{ neutrals}$
0.35 ± 0.06	33	BADIER	65B	HBC	3 $K^- p$

$$\frac{\Gamma(\gamma \gamma) / \Gamma_{\text{total}}}{\Gamma_7 / \Gamma}$$

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

**2.22 ± 0.08 OUR FIT**

**2.00 ± 0.15 OUR AVERAGE**

$1.98^{+0.31}_{-0.27} \pm 0.07$	114	<sup>1</sup> WICHT	08	BELL	$B^\pm \rightarrow K^\pm \gamma \gamma$
$2.00 \pm 0.18$		<sup>2</sup> STANTON	80	SPEC	$8.45 \pi^- p \rightarrow n \pi^+ \pi^- 2\gamma$
$2.25 \pm 0.16 \pm 0.03$	0.3k	<sup>3</sup> PEDLAR	09	CLEO	$J/\psi \rightarrow \gamma \eta'$
$1.8 \pm 0.2$	6000	<sup>4</sup> APEL	79	NICE	$15-40 \pi^- p \rightarrow n 2\gamma$
$2.5 \pm 0.7$		DUANE	74	MMS	$\pi^- p \rightarrow n \text{MM}$
$1.71 \pm 0.33$	68	DALPIAZ	72	CNTR	$1.6 \pi^- p \rightarrow n X^0$
$2.0^{+0.8}_{-0.6}$	31	HARVEY	71	OSPK	$3.65 \pi^- p \rightarrow n X^0$

<sup>1</sup> WICHT 08 reports  $[\Gamma(\eta'(958) \rightarrow \gamma \gamma) / \Gamma_{\text{total}}] \times [B(B^+ \rightarrow \eta' K^+)] = (1.40^{+0.16+0.15}_{-0.15-0.12}) \times 10^{-6}$  which we divide by our best value  $B(B^+ \rightarrow \eta' K^+) = (7.06 \pm 0.25) \times 10^{-5}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

<sup>2</sup> Includes APEL 79 result.

<sup>3</sup> Not independent of other  $\eta'$  branching fractions and ratios in PEDLAR 09.

<sup>4</sup> Data is included in STANTON 80 evaluation.

$$\frac{\Gamma(\gamma \gamma) / \Gamma(\pi^+ \pi^- \eta)}{\Gamma_7 / \Gamma_1}$$

VALUE	DOCUMENT ID	TECN	COMMENT
-------	-------------	------	---------

**0.0522 ± 0.0022 OUR FIT**

<b>0.053 ± 0.004 ± 0.001</b>	PEDLAR	09	CLE3	$J/\psi \rightarrow \eta' \gamma$
------------------------------	--------	----	------	-----------------------------------



$\Gamma(\gamma\gamma)/\Gamma(\rho^0\gamma(\text{including non-resonant } \pi^+\pi^-\gamma))$   $\Gamma_7/\Gamma_2$

VALUE	DOCUMENT ID	TECN	COMMENT
<b>0.0768±0.0033 OUR FIT</b>			
<b>0.080 ±0.008</b>	ABLIKIM	06E	BES2 $J/\psi \rightarrow \eta'\gamma$

$\Gamma(\gamma\gamma)/\Gamma(\pi^0\pi^0\eta)$   $\Gamma_7/\Gamma_4$

VALUE	DOCUMENT ID	TECN	COMMENT
<b>0.097±0.004 OUR FIT</b>			
<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 $\pi^-p \rightarrow n2\gamma$

$\Gamma(\gamma\gamma)/\Gamma(\pi^0\pi^0\eta(\text{neutral decay}))$   $\Gamma_7/0.714\Gamma_4$

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
<b>0.136±0.006 OUR FIT</b>				
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.188±0.058	16	APEL	72	OSPK 3.8 $\pi^-p \rightarrow nX^0$

$\Gamma(\text{neutrals})/\Gamma_{\text{total}}$   $(0.714\Gamma_4+0.09\Gamma_5+\Gamma_7)/\Gamma$

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
<b>0.188±0.006 OUR FIT</b>				
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.185±0.022	535	BASILE	71	CNTR 1.6 $\pi^-p \rightarrow nX^0$
0.189±0.026	123	RITTENBERG	69	HBC 1.7–2.7 $K^-p$

$\Gamma(3\pi^0)/\Gamma_{\text{total}}$   $\Gamma_8/\Gamma$

VALUE (units $10^{-3}$ )	EVTS	DOCUMENT ID	TECN	COMMENT
<b>2.54 ±0.18 OUR FIT</b>				
<b>3.57 ±0.26 OUR AVERAGE</b>				
3.522±0.082±0.254	2015	ABLIKIM	17	BES3 $J/\psi \rightarrow \gamma(3\pi^0)$
4.79 ±0.59 ±1.14	183	<sup>1</sup> ABLIKIM	15P	BES3 $J/\psi \rightarrow K^+K^-\pi$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
3.56 ±0.22 ±0.34	309	<sup>2</sup> ABLIKIM	12E	BES3 $J/\psi \rightarrow \gamma(3\pi^0)$

<sup>1</sup>We have added all systematic uncertainties in quadrature to a single value.

<sup>2</sup>Superseded by ABLIKIM 17.

$\Gamma(3\pi^0)/\Gamma(\pi^0\pi^0\eta)$   $\Gamma_8/\Gamma_4$

VALUE (units $10^{-4}$ )	EVTS	DOCUMENT ID	TECN	COMMENT
<b>111± 8 OUR FIT</b>				
<b>78±10 OUR AVERAGE</b>				
86±19	235	BLIK	08	GAMS 32 $\pi^-p \rightarrow \eta'n$
74±15		ALDE	87B	GAM2 38 $\pi^-p \rightarrow n6\gamma$
75±18		BINON	84	GAM2 30–40 $\pi^-p \rightarrow n6\gamma$

$\Gamma(\mu^+\mu^-\gamma)/\Gamma(\gamma\gamma)$   $\Gamma_9/\Gamma_7$

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

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

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

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

<0.29	90	<sup>1</sup> ABLIKIM	130	BES3	$J/\psi \rightarrow \gamma\eta'$
<2.4	90	<sup>2</sup> NAIK	09	CLEO	$J/\psi \rightarrow \gamma\eta'$

<sup>1</sup> Using  $\Gamma_2/\Gamma = (29.3 \pm 0.6)\%$  from PDG 12.

<sup>2</sup> Not independent of measured value of  $\Gamma_{10}/\Gamma_1$  from NAIK 09.

$\Gamma(\pi^+\pi^-\mu^+\mu^-)/\Gamma(\pi^+\pi^-\eta)$   $\Gamma_{10}/\Gamma_1$

VALUE (units $10^{-3}$ )	CL%	DOCUMENT ID	TECN	COMMENT
--------------------------	-----	-------------	------	---------

<0.5	90	<sup>1</sup> NAIK	09	CLEO	$J/\psi \rightarrow \gamma\eta'$
------	----	-------------------	----	------	----------------------------------

<sup>1</sup> NAIK 09 reports  $[\Gamma(\eta'(958) \rightarrow \pi^+\pi^-\mu^+\mu^-)/\Gamma(\eta'(958) \rightarrow \pi^+\pi^-\eta)] / [B(\eta \rightarrow 2\gamma)] < 1.3 \times 10^{-3}$  which we multiply by our best value  $B(\eta \rightarrow 2\gamma) = 39.41 \times 10^{-2}$ .

$\Gamma(\pi^+\pi^-\mu^+\mu^-)/\Gamma(\rho^0\gamma(\text{including non-resonant } \pi^+\pi^-\gamma))$   $\Gamma_{10}/\Gamma_2$

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

<1.0	90	ABLIKIM	130	BES3	$J/\psi \rightarrow \gamma\eta'$
------	----	---------	-----	------	----------------------------------

$\Gamma(\pi^+\pi^-\pi^0)/\Gamma_{\text{total}}$   $\Gamma_{11}/\Gamma$

VALUE (units $10^{-3}$ )	EVTS	DOCUMENT ID	TECN	COMMENT
--------------------------	------	-------------	------	---------

**3.61 ± 0.18 OUR FIT**

**3.61 ± 0.18 OUR AVERAGE**

3.591 ± 0.054 ± 0.174	6067	ABLIKIM	17	BES3	$J/\psi \rightarrow \gamma(\pi^+\pi^-\pi^0)$
4.28 ± 0.49 ± 1.11	78	<sup>1</sup> ABLIKIM	15P	BES3	$J/\psi \rightarrow K^+K^-3\pi$
3.7 $^{+1.1}_{-0.9}$ ± 0.4		<sup>2</sup> NAIK	09	CLEO	$J/\psi \rightarrow \gamma\eta'$

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

3.83 ± 0.15 ± 0.39	1014	<sup>3</sup> ABLIKIM	12E	BES3	$J/\psi \rightarrow \gamma(\pi^+\pi^-\pi^0)$
--------------------	------	----------------------	-----	------	--

<sup>1</sup> We have added all systematic uncertainties in quadrature to a single value.

<sup>2</sup> Not independent of measured value of  $\Gamma_{11}/\Gamma_1$  from NAIK 09.

<sup>3</sup> Superseded by ABLIKIM 17.

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

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

<b>37.63 ± 0.77 ± 5.00</b>	6580	<sup>1</sup> ABLIKIM	17	BES3	$J/\psi \rightarrow \gamma(\pi^+\pi^-\pi^0)$
----------------------------	------	----------------------	----	------	--

<sup>1</sup> We have added all systematic uncertainties in quadrature .

$\Gamma(\pi^\mp\rho^\pm)/\Gamma_{\text{total}}$   $\Gamma_{13}/\Gamma$

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

<b>7.44 ± 0.60 ± 2.23</b>	1231	<sup>1</sup> ABLIKIM	17	BES3	$J/\psi \rightarrow \gamma(\pi^\mp\rho^\pm)$
---------------------------	------	----------------------	----	------	--

<sup>1</sup> We have added all systematic uncertainties in quadrature .

$\Gamma(\pi^+\pi^-\pi^0)/\Gamma(\pi^+\pi^-\eta)$   $\Gamma_{11}/\Gamma_1$

VALUE (units $10^{-3}$ )	EVTS	DOCUMENT ID	TECN	COMMENT
<b>8.5 ± 0.4 OUR FIT</b>				
<b>8.28<sup>+2.49</sup><sub>-2.12</sub> ± 0.04</b>	20	<sup>1</sup> NAIK	09	CLEO $J/\psi \rightarrow \gamma\eta'$

<sup>1</sup> NAIK 09 reports  $[\Gamma(\eta'(958) \rightarrow \pi^+\pi^-\pi^0)/\Gamma(\eta'(958) \rightarrow \pi^+\pi^-\eta)] / [B(\eta \rightarrow 2\gamma)] = (21^{+6}_{-5} \pm 2) \times 10^{-3}$  which we multiply by our best value  $B(\eta \rightarrow 2\gamma) = (39.41 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

$\Gamma(\pi^0\rho^0)/\Gamma_{\text{total}}$   $\Gamma_{14}/\Gamma$

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

$\Gamma(2(\pi^+\pi^-))/\Gamma_{\text{total}}$   $\Gamma_{15}/\Gamma$

VALUE (units $10^{-5}$ )	CL%	EVTS	DOCUMENT ID	TECN	COMMENT
<b>8.4 ± 0.9 ± 0.3</b>		199	<sup>1</sup> ABLIKIM	14M	BES3 $J/\psi \rightarrow \gamma\eta'$

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

< 24	90	<sup>2</sup> NAIK	09	CLEO $J/\psi \rightarrow \gamma\eta'$
<1000	90	RITTENBERG 69	HBC	1.7–2.7 $K^-p$

<sup>1</sup> ABLIKIM 14M reports  $[\Gamma(\eta'(958) \rightarrow 2(\pi^+\pi^-))/\Gamma_{\text{total}}] \times [B(J/\psi(1S) \rightarrow \gamma\eta'(958))]$  =  $(4.40 \pm 0.35 \pm 0.30) \times 10^{-7}$  which we divide by our best value  $B(J/\psi(1S) \rightarrow \gamma\eta'(958)) = (5.21 \pm 0.17) \times 10^{-3}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

<sup>2</sup> Not independent of measured value of  $\Gamma_{15}/\Gamma_1$  from NAIK 09.

$\Gamma(2(\pi^+\pi^-))/\Gamma(\pi^+\pi^-\eta)$   $\Gamma_{15}/\Gamma_1$

VALUE (units $10^{-3}$ )	CL%	DOCUMENT ID	TECN	COMMENT
<b>&lt;0.6</b>	90	<sup>1</sup> NAIK	09	CLEO $J/\psi \rightarrow \gamma\eta'$

<sup>1</sup> NAIK 09 reports  $[\Gamma(\eta'(958) \rightarrow 2(\pi^+\pi^-))/\Gamma(\eta'(958) \rightarrow \pi^+\pi^-\eta)] / [B(\eta \rightarrow 2\gamma)] < 1.4 \times 10^{-3}$  which we multiply by our best value  $B(\eta \rightarrow 2\gamma) = 39.41 \times 10^{-2}$ .

$\Gamma(\pi^+\pi^-2\pi^0)/\Gamma_{\text{total}}$   $\Gamma_{16}/\Gamma$

VALUE (units $10^{-4}$ )	CL%	EVTS	DOCUMENT ID	TECN	COMMENT
<b>1.8 ± 0.4 ± 0.1</b>		84	<sup>1</sup> ABLIKIM	14M	BES3 $J/\psi \rightarrow \gamma\eta'$

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

<27	90	<sup>2</sup> NAIK	09	CLEO $J/\psi \rightarrow \gamma\eta'$
-----	----	-------------------	----	---------------------------------------

<sup>1</sup> ABLIKIM 14M reports  $[\Gamma(\eta'(958) \rightarrow \pi^+\pi^-2\pi^0)/\Gamma_{\text{total}}] \times [B(J/\psi(1S) \rightarrow \gamma\eta'(958))]$  =  $(9.38 \pm 1.79 \pm 0.89) \times 10^{-7}$  which we divide by our best value  $B(J/\psi(1S) \rightarrow \gamma\eta'(958)) = (5.21 \pm 0.17) \times 10^{-3}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

<sup>2</sup> Not independent of measured value of  $\Gamma_{16}/\Gamma_1$  from NAIK 09.

$\Gamma(\pi^+\pi^-2\pi^0)/\Gamma(\pi^+\pi^-\eta)$   $\Gamma_{16}/\Gamma_1$

VALUE (units $10^{-3}$ )	CL%	DOCUMENT ID	TECN	COMMENT
<b>&lt;6</b>	90	<sup>1</sup> NAIK	09	CLEO $J/\psi \rightarrow \gamma\eta'$
<sup>1</sup> NAIK 09 reports $[\Gamma(\eta'(958) \rightarrow \pi^+\pi^-2\pi^0)/\Gamma(\eta'(958) \rightarrow \pi^+\pi^-\eta)] / [B(\eta \rightarrow 2\gamma)] < 15 \times 10^{-3}$ which we multiply by our best value $B(\eta \rightarrow 2\gamma) = 39.41 \times 10^{-2}$ .				

$\Gamma(2(\pi^+\pi^-) \text{ neutrals})/\Gamma_{\text{total}}$   $\Gamma_{17}/\Gamma$

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<b>&lt;0.01</b>	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 $1.7-2.7 K^-p$

$\Gamma(2(\pi^+\pi^-)\pi^0)/\Gamma_{\text{total}}$   $\Gamma_{18}/\Gamma$

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
<0.002	90	<sup>1</sup> NAIK	09	CLEO $J/\psi \rightarrow \gamma\eta'$
<0.01	90	RITTENBERG	69	HBC $1.7-2.7 K^-p$
<sup>1</sup> Not independent of measured value of $\Gamma_{18}/\Gamma_1$ from NAIK 09.				

$\Gamma(2(\pi^+\pi^-)\pi^0)/\Gamma(\pi^+\pi^-\eta)$   $\Gamma_{18}/\Gamma_1$

VALUE (units $10^{-3}$ )	CL%	DOCUMENT ID	TECN	COMMENT
<b>&lt;4</b>	90	<sup>1</sup> NAIK	09	CLEO $J/\psi \rightarrow \gamma\eta'$
<sup>1</sup> NAIK 09 reports $[\Gamma(\eta'(958) \rightarrow 2(\pi^+\pi^-)\pi^0)/\Gamma(\eta'(958) \rightarrow \pi^+\pi^-\eta)] / [B(\eta \rightarrow 2\gamma)] < 11 \times 10^{-3}$ which we multiply by our best value $B(\eta \rightarrow 2\gamma) = 39.41 \times 10^{-2}$ .				

$\Gamma(2(\pi^+\pi^-)2\pi^0)/\Gamma_{\text{total}}$   $\Gamma_{19}/\Gamma$

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<b>&lt;0.01</b>	95	KALBFLEISCH	64B	HBC $K^-p \rightarrow \Lambda 2(\pi^+\pi^-)+MM$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
<0.01	90	LONDON	66	HBC Compilation

$\Gamma(3(\pi^+\pi^-))/\Gamma_{\text{total}}$   $\Gamma_{20}/\Gamma$

VALUE (units $10^{-5}$ )	CL%	DOCUMENT ID	TECN	COMMENT
<b>&lt; 3.1</b>	90	<sup>1</sup> ABLIKIM	13U	BES3 $J/\psi \rightarrow \gamma 3(\pi^+\pi^-)$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
< 53	90	<sup>2</sup> NAIK	09	CLEO $J/\psi \rightarrow \gamma\eta'$
<500	95	KALBFLEISCH	64B	HBC $K^-p \rightarrow \Lambda 2(\pi^+\pi^-)$
<sup>1</sup> Using $B(J/\psi \rightarrow \gamma\eta'(958)) = (5.16 \pm 0.15) \times 10^{-3}$ .				
<sup>2</sup> Not independent of measured value of $\Gamma_{20}/\Gamma_1$ from NAIK 09.				

$\Gamma(3(\pi^+\pi^-))/\Gamma(\pi^+\pi^-\eta)$   $\Gamma_{20}/\Gamma_1$

VALUE (units $10^{-3}$ )	CL%	DOCUMENT ID	TECN	COMMENT
<b>&lt;1.2</b>	90	<sup>1</sup> NAIK	09	CLEO $J/\psi \rightarrow \gamma\eta'$
<sup>1</sup> NAIK 09 reports $[\Gamma(\eta'(958) \rightarrow 3(\pi^+\pi^-))/\Gamma(\eta'(958) \rightarrow \pi^+\pi^-\eta)] / [B(\eta \rightarrow 2\gamma)] < 3.0 \times 10^{-3}$ which we multiply by our best value $B(\eta \rightarrow 2\gamma) = 39.41 \times 10^{-2}$ .				

$\Gamma(K^\pm \pi^\mp)/\Gamma(\rho^0 \gamma (\text{including non-resonant } \pi^+ \pi^- \gamma))$   $\Gamma_{21}/\Gamma_2$

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
$<1.3 \times 10^{-4}$	90	ABLIKIM	16M BES3	$e^+ e^- \rightarrow J/\psi \rightarrow \text{hadrons}$

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

VALUE (units $10^{-3}$ )	CL%	EVTS	DOCUMENT ID	TECN	COMMENT
--------------------------	-----	------	-------------	------	---------

**2.4  $\begin{smallmatrix} +1.3 \\ -1.0 \end{smallmatrix}$  OUR FIT**

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

$2.11 \pm 0.12 \pm 0.14$	429	<sup>1</sup> ABLIKIM	130	BES3	$J/\psi \rightarrow \gamma \eta'$
$2.5 \begin{smallmatrix} +1.2 \\ -0.9 \end{smallmatrix} \pm 0.5$		<sup>2</sup> NAIK	09	CLEO	$J/\psi \rightarrow \gamma \eta'$
$<6$	90	RITTENBERG	65	HBC	$2.7 K^- p$

<sup>1</sup> Using  $\Gamma_2/\Gamma = (29.3 \pm 0.6)\%$  from PDG 12.

<sup>2</sup> Not independent of measured value of  $\Gamma_{22}/\Gamma_1$  from NAIK 09.

$\Gamma(\pi^+ \pi^- e^+ e^-)/\Gamma(\pi^+ \pi^- \eta)$   $\Gamma_{22}/\Gamma_1$

VALUE (units $10^{-3}$ )	EVTS	DOCUMENT ID	TECN	COMMENT
--------------------------	------	-------------	------	---------

**5.5  $\begin{smallmatrix} +3.0 \\ -2.2 \end{smallmatrix}$  OUR FIT**

$5.52 \begin{smallmatrix} +3.00 \\ -2.30 \end{smallmatrix} \pm 0.03$	8	<sup>1</sup> NAIK	09	CLEO	$J/\psi \rightarrow \gamma \eta'$
--	---	-------------------	----	------	-----------------------------------

<sup>1</sup> NAIK 09 reports  $[\Gamma(\eta'(958) \rightarrow \pi^+ \pi^- e^+ e^-)/\Gamma(\eta'(958) \rightarrow \pi^+ \pi^- \eta)] / [B(\eta \rightarrow 2\gamma)] = (14 \begin{smallmatrix} +7 \\ -5 \end{smallmatrix} \pm 3) \times 10^{-3}$  which we multiply by our best value  $B(\eta \rightarrow 2\gamma) = (39.41 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

$\Gamma(\pi^+ \pi^- e^+ e^-)/\Gamma(\rho^0 \gamma (\text{including non-resonant } \pi^+ \pi^- \gamma))$   $\Gamma_{22}/\Gamma_2$

VALUE (units $10^{-3}$ )	EVTS	DOCUMENT ID	TECN	COMMENT
--------------------------	------	-------------	------	---------

$7.2 \pm 0.4 \pm 0.5$	429	ABLIKIM	130	BES3	$J/\psi \rightarrow \gamma \eta'$
-----------------------	-----	---------	-----	------	-----------------------------------

$\Gamma(\pi^+ e^- \nu_e + \text{c.c.})/\Gamma(\pi^+ \pi^- \eta)$   $\Gamma_{23}/\Gamma_1$

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

$<5.0$	90	ABLIKIM	13G	BES3	$J/\psi \rightarrow \phi \eta'$
--------	----	---------	-----	------	---------------------------------

$\Gamma(\gamma e^+ e^-)/\Gamma_{\text{total}}$   $\Gamma_{24}/\Gamma$

VALUE (units $10^{-3}$ )	CL%	DOCUMENT ID	TECN	COMMENT
--------------------------	-----	-------------	------	---------

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

$<0.9$	90	BRIERE	00	CLEO	$10.6 e^+ e^-$
--------	----	--------	----	------	----------------

$\Gamma(\gamma e^+ e^-)/\Gamma(\gamma \gamma)$   $\Gamma_{24}/\Gamma_7$

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

$2.13 \pm 0.09 \pm 0.07$	864	ABLIKIM	150	BES3	$J/\psi \rightarrow \gamma e^+ e^-$
--------------------------	-----	---------	-----	------	-------------------------------------

$\Gamma(\pi^0 \gamma \gamma)/\Gamma_{\text{total}}$   $\Gamma_{25}/\Gamma$

VALUE (units $10^{-3}$ )	EVTS	DOCUMENT ID	TECN	COMMENT
--------------------------	------	-------------	------	---------

$3.20 \pm 0.07 \pm 0.23$	3.4k	ABLIKIM	17T	BES3	$J/\psi \rightarrow \gamma \eta'$
--------------------------	------	---------	-----	------	-----------------------------------

$\Gamma(\pi^0 \gamma \gamma (\text{non resonant}))/\Gamma_{\text{total}}$   $\Gamma_{26}/\Gamma$

VALUE (units $10^{-4}$ )	EVTS	DOCUMENT ID	TECN	COMMENT
<b><math>6.16 \pm 0.64 \pm 0.67</math></b>	655	ABLIKIM 17T	BES3	$J/\psi \rightarrow \gamma \eta'$

$\Gamma(\pi^0 \gamma \gamma)/\Gamma(\pi^0 \pi^0 \eta)$   $\Gamma_{25}/\Gamma_4$

VALUE (units $10^{-4}$ )	CL%	DOCUMENT ID	TECN	COMMENT
<b><math>&lt; 37</math></b>	90	ALDE 87B	GAM2	$38 \pi^- p \rightarrow n 4\gamma$

$\Gamma(4\pi^0)/\Gamma_{\text{total}}$   $\Gamma_{27}/\Gamma$

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<b><math>&lt; 3.2 \times 10^{-4}</math></b>	90	DONSKOV 14	GAM4	$32.5 \pi^- p \rightarrow \eta' n$

$\Gamma(4\pi^0)/\Gamma(\pi^0 \pi^0 \eta)$   $\Gamma_{27}/\Gamma_4$

VALUE (units $10^{-4}$ )	CL%	DOCUMENT ID	TECN	COMMENT
<b><math>&lt; 23</math></b>	90	ALDE 87B	GAM2	$38 \pi^- p \rightarrow n 8\gamma$

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

$\Gamma(e^+ e^-)/\Gamma_{\text{total}}$   $\Gamma_{28}/\Gamma$

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<b><math>&lt; 5.6 \times 10^{-9}</math></b>	90	<sup>1</sup> ACHASOV 15	SND	$0.958 e^+ e^- \rightarrow \pi \pi \eta$

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

$< 12 \times 10^{-9}$	90	<sup>2</sup> AKHMETSHIN 15	CMD3	$0.958 e^+ e^- \rightarrow \pi^+ \pi^- \eta$
$< 2.1 \times 10^{-7}$	90	VOROBYEV 88	ND	$e^+ e^- \rightarrow \pi^+ \pi^- \eta$

<sup>1</sup> Combining data of ACHASOV 15 and AKHMETSHIN 15 and using  $\Gamma(\eta') = 0.198 \pm 0.009$  MeV.

<sup>2</sup> Using  $\Gamma_{\eta'(958)} = 198 \pm 9$  keV,  $B(\eta'(958) \rightarrow \pi^+ \pi^- \eta) = (42.9 \pm 0.7)\%$ , and  $B(\eta \rightarrow \gamma \gamma) = (39.41 \pm 0.20)\%$ .

$\Gamma(\text{invisible})/\Gamma_{\text{total}}$   $\Gamma_{29}/\Gamma$

VALUE (units $10^{-4}$ )	CL%	DOCUMENT ID	TECN	COMMENT
<b><math>&lt; 9.5</math></b>	90	<sup>1</sup> NAIK 09	CLEO	$J/\psi \rightarrow \gamma \eta'$

<sup>1</sup> Not independent of measured value of  $\Gamma_{29}/\Gamma_1$  from NAIK 09.

$\Gamma(\text{invisible})/\Gamma(\gamma \gamma)$   $\Gamma_{29}/\Gamma_7$

VALUE (units $10^{-2}$ )	CL%	DOCUMENT ID	TECN	COMMENT
<b><math>&lt; 2.4</math></b>	90	ABLIKIM 13	BES3	$J/\psi \rightarrow \phi \eta'$

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

$< 6.69$	90	ABLIKIM 06Q	BES	$J/\psi \rightarrow \phi \eta'$
----------	----	-------------	-----	---------------------------------

$\Gamma(\text{invisible})/\Gamma(\pi^+ \pi^- \eta)$   $\Gamma_{29}/\Gamma_1$

VALUE (units $10^{-3}$ )	CL%	DOCUMENT ID	TECN	COMMENT
<b><math>&lt; 2.1</math></b>	90	<sup>1</sup> NAIK 09	CLEO	$J/\psi \rightarrow \gamma \eta'$

<sup>1</sup> NAIK 09 reports  $[\Gamma(\eta'(958) \rightarrow \text{invisible})/\Gamma(\eta'(958) \rightarrow \pi^+ \pi^- \eta)] / [B(\eta \rightarrow 2\gamma)] < 5.4 \times 10^{-3}$  which we multiply by our best value  $B(\eta \rightarrow 2\gamma) = 39.41 \times 10^{-2}$ .

$\Gamma(\pi^+\pi^-)/\Gamma_{\text{total}}$   $\Gamma_{30}/\Gamma$

VALUE (units $10^{-4}$ )	CL%	DOCUMENT ID	TECN	COMMENT
<b>&lt; 0.18</b>	90	<sup>1</sup> AAIJ	17D	LHCB $D_{(s)}^+ \rightarrow \pi^+\pi^-\pi^+$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
< 0.5	90	<sup>2</sup> ABLIKIM	11G	BES3 $J/\psi \rightarrow \gamma\pi^+\pi^-$
< 29	90	<sup>3</sup> MORI	07A	BELL $\gamma\gamma \rightarrow \pi^+\pi^-$
< 3.3	90	<sup>4</sup> MORI	07A	BELL $\gamma\gamma \rightarrow \pi^+\pi^-$
<800	95	DANBURG	73	HBC $2.2 K^-p \rightarrow \Lambda X^0$
<200	90	RITTENBERG	69	HBC $1.7\text{--}2.7 K^-p$

<sup>1</sup> Using branching fractions of  $D_{(s)}^+$  decays from PDG 15.

<sup>2</sup> ABLIKIM 11G reports  $[\Gamma(\eta'(958) \rightarrow \pi^+\pi^-)/\Gamma_{\text{total}}] \times [\text{B}(J/\psi(1S) \rightarrow \gamma\eta'(958))] < 2.84 \times 10^{-7}$  which we divide by our best value  $\text{B}(J/\psi(1S) \rightarrow \gamma\eta'(958)) = 5.21 \times 10^{-3}$ .

<sup>3</sup> Taking into account interference with the  $\gamma\gamma \rightarrow \pi^+\pi^-$  continuum.

<sup>4</sup> Without interference with the  $\gamma\gamma \rightarrow \pi^+\pi^-$  continuum.

$\Gamma(\pi^0\pi^0)/\Gamma_{\text{total}}$   $\Gamma_{31}/\Gamma$

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<b>&lt;4 × 10<sup>-4</sup></b>	90	<sup>1</sup> ABLIKIM	11G	BES3 $J/\psi \rightarrow \gamma\pi^0\pi^0$

<sup>1</sup> ABLIKIM 11G reports  $[\Gamma(\eta'(958) \rightarrow \pi^+\pi^-)/\Gamma_{\text{total}}] \times [\text{B}(J/\psi(1S) \rightarrow \gamma\eta'(958))] < 2.84 \times 10^{-7}$  which we divide by our best value  $\text{B}(J/\psi(1S) \rightarrow \gamma\eta'(958)) = 5.21 \times 10^{-3}$ .

$\Gamma(\pi^0\pi^0)/\Gamma(\pi^0\pi^0\eta)$   $\Gamma_{31}/\Gamma_4$

VALUE (units $10^{-4}$ )	CL%	DOCUMENT ID	TECN	COMMENT
<b>&lt;45</b>	90	ALDE	87B	GAM2 $38 \pi^-p \rightarrow n4\gamma$

$\Gamma(\pi^0e^+e^-)/\Gamma_{\text{total}}$   $\Gamma_{32}/\Gamma$

VALUE (units $10^{-3}$ )	CL%	DOCUMENT ID	TECN	COMMENT
<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 $2.7 K^-p$
-----	----	------------	----	----------------

$\Gamma(\eta e^+e^-)/\Gamma_{\text{total}}$   $\Gamma_{33}/\Gamma$

VALUE (units $10^{-3}$ )	CL%	DOCUMENT ID	TECN	COMMENT
<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 $2.7 K^-p$
-----	----	------------	----	----------------

$\Gamma(3\gamma)/\Gamma(\pi^0\pi^0\eta)$   $\Gamma_{34}/\Gamma_4$

VALUE (units $10^{-4}$ )	CL%	DOCUMENT ID	TECN	COMMENT
<b>&lt;4.6</b>	90	ALDE	87B	GAM2 $38 \pi^-p \rightarrow n3\gamma$

$\Gamma(\mu^+\mu^-\pi^0)/\Gamma_{\text{total}}$   $\Gamma_{35}/\Gamma$

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

$\Gamma(\mu^+ \mu^- \eta)/\Gamma_{\text{total}}$					$\Gamma_{36}/\Gamma$
VALUE (units $10^{-5}$ )	CL%	DOCUMENT ID	TECN	COMMENT	
<1.5	90	DZHELYADIN 81	CNTR	$30 \pi^- p \rightarrow \eta' n$	

  

$\Gamma(e\mu)/\Gamma_{\text{total}}$					$\Gamma_{37}/\Gamma$
VALUE (units $10^{-4}$ )	CL%	DOCUMENT ID	TECN	COMMENT	
<4.7	90	BRIERE 00	CLEO	$10.6 e^+ e^-$	

### $\eta'(958) \rightarrow \eta\pi\pi$ DECAY PARAMETERS

$$|\text{MATRIX ELEMENT}|^2 = |1 + \alpha Y|^2 + CX + DX^2$$

$X$  and  $Y$  are Dalitz variables;  $\alpha$  is complex and  $C$ , and  $D$  are real-valued. Parameters  $C$  and  $D$  are not necessarily equal to  $c$  and  $d$ , respectively, in the generalized parameterization following this one. May be different for  $\eta'(958) \rightarrow \eta\pi^+\pi^-$  and  $\eta'(958) \rightarrow \eta\pi^0\pi^0$  decays. Because of different initial assumptions and strong correlations of the parameters we do not average the parameters in the section below.

#### $Re(\alpha)$ decay parameter

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
$-0.034 \pm 0.002 \pm 0.002$	351k	ABLIKIM 18	BES3	$\eta' \rightarrow \eta\pi^+\pi^-$
$-0.054 \pm 0.004 \pm 0.001$	56k	ABLIKIM 18	BES3	$\eta' \rightarrow \eta\pi^0\pi^0$
$-0.033 \pm 0.005 \pm 0.003$	44k	<sup>1</sup> ABLIKIM 11	BES3	$J/\psi \rightarrow \gamma\eta\pi^+\pi^-$
$-0.072 \pm 0.012 \pm 0.006$	7k	<sup>2</sup> AMELIN 05A	VES	$28 \pi^- A \rightarrow \eta\pi^+\pi^-\pi^- A^*$
$-0.021 \pm 0.018 \pm 0.017$	6.7k	<sup>3</sup> BRIERE 00	CLEO	$10.6 e^+ e^- \rightarrow \eta\pi^+\pi^- X$
$-0.058 \pm 0.013 \pm 0.003$	5.4k	<sup>4</sup> ALDE 86	GAM2	$38 \pi^- p \rightarrow n\eta\pi^0\pi^0$
$-0.08 \pm 0.03$		<sup>4,5</sup> KALBFLEISCH 74	RVUE	$\eta' \rightarrow \eta\pi^+\pi^-$

<sup>1</sup> See ABLIKIM 11 for the full correlation matrix.

<sup>2</sup> Superseded by DOROFEEV 07, which found this parameterization unacceptable. See below.

<sup>3</sup> Assuming  $\text{Im}(\alpha) = 0$ ,  $C = 0$ , and  $D = 0$ .

<sup>4</sup> Assuming  $C = 0$ .

<sup>5</sup> From the data of DAUBER 64, RITTENBERG 69, AGUILAR-BENITEZ 72B, JACOBS 73, and DANBURG 73.

#### $Im(\alpha)$ decay parameter

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
$0.000 \pm 0.019 \pm 0.001$	351k	ABLIKIM 18	BES3	$\eta' \rightarrow \eta\pi^+\pi^-$
$0.000 \pm 0.038 \pm 0.002$	56k	ABLIKIM 18	BES3	$\eta' \rightarrow \eta\pi^0\pi^0$
$0.000 \pm 0.049 \pm 0.001$	44k	<sup>1</sup> ABLIKIM 11	BES3	$J/\psi \rightarrow \gamma\eta\pi^+\pi^-$
$0.0 \pm 0.1 \pm 0.0$	7k	<sup>2</sup> AMELIN 05A	VES	$28 \pi^- A \rightarrow \eta\pi^+\pi^-\pi^- A^*$
$-0.00 \pm 0.13 \pm 0.00$	5.4k	<sup>3</sup> ALDE 86	GAM2	$38 \pi^- p \rightarrow n\eta\pi^0\pi^0$
$0.0 \pm 0.3$		<sup>3,4</sup> KALBFLEISCH 74	RVUE	$\eta' \rightarrow \eta\pi^+\pi^-$



<sup>1</sup> See ABLIKIM 11 for the full correlation matrix.

<sup>2</sup> Superseded by DOROFEEV 07, which found this parameterization unacceptable. See below.

<sup>3</sup> Assuming  $C = 0$ .

<sup>4</sup> From the data of DAUBER 64, RITTENBERG 69, AGUILAR-BENITEZ 72B, JACOBS 73, and DANBURG 73.

### C decay parameter

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
$0.0027 \pm 0.0024 \pm 0.0015$	351k	ABLIKIM	18 BES3	$\eta' \rightarrow \eta \pi^+ \pi^-$
$0.018 \pm 0.009 \pm 0.003$	44k	<sup>1</sup> ABLIKIM	11 BES3	$J/\psi \rightarrow \gamma \eta \pi^+ \pi^-$
$0.020 \pm 0.018 \pm 0.004$	7k	<sup>2</sup> AMELIN	05A VES	$28 \pi^- A \rightarrow \eta \pi^+ \pi^- \pi^- A^*$

<sup>1</sup> See ABLIKIM 11 for the full correlation matrix.

<sup>2</sup> Superseded by DOROFEEV 07, which found this parameterization unacceptable. See below.

### D decay parameter

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
$-0.053 \pm 0.004 \pm 0.004$	351k	ABLIKIM	18 BES3	$\eta' \rightarrow \eta \pi^+ \pi^-$
$-0.061 \pm 0.009 \pm 0.005$	56k	ABLIKIM	18 BES3	$\eta' \rightarrow \eta \pi^0 \pi^0$
$-0.059 \pm 0.012 \pm 0.004$	44k	<sup>1</sup> ABLIKIM	11 BES3	$J/\psi \rightarrow \gamma \eta \pi^+ \pi^-$
$-0.066 \pm 0.030 \pm 0.015$	7k	<sup>2</sup> AMELIN	05A VES	$28 \pi^- A \rightarrow \eta \pi^+ \pi^- \pi^- A^*$
$0.00 \pm 0.03 \pm 0.00$	5.4k	<sup>3</sup> ALDE	86 GAM2	$38 \pi^- p \rightarrow n \eta \pi^0 \pi^0$
0		<sup>3,4</sup> KALBFLEISCH 74	RVUE	$\eta' \rightarrow \eta \pi^+ \pi^-$

<sup>1</sup> See ABLIKIM 11 for the full correlation matrix.

<sup>2</sup> Superseded by DOROFEEV 07, which found this parameterization unacceptable. See below.

<sup>3</sup> Assuming  $C = 0$ .

<sup>4</sup> From the data of DAUBER 64, RITTENBERG 69, AGUILAR-BENITEZ 72B, JACOBS 73, and DANBURG 73.

## $\eta'(958) \rightarrow \eta \pi \pi$ DECAY PARAMETERS

$$|\text{MATRIX ELEMENT}|^2 \propto 1 + a Y + b Y^2 + c X + d X^2$$

$X$  and  $Y$  are Dalitz variables and  $a$ ,  $b$ ,  $c$ , and  $d$  are real-valued parameters. May be different for  $\eta'(958) \rightarrow \eta \pi^+ \pi^-$  and  $\eta'(958) \rightarrow \eta \pi^0 \pi^0$  decays. We do not average measurements in the section below because parameter values from each experiment are strongly correlated.

### a decay parameter

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
$-0.056 \pm 0.004 \pm 0.002$	351k	ABLIKIM	18 BES3	$\eta' \rightarrow \eta \pi^+ \pi^-$
$-0.087 \pm 0.009 \pm 0.006$	56k	ABLIKIM	18 BES3	$\eta' \rightarrow \eta \pi^0 \pi^0$
$-0.074 \pm 0.008 \pm 0.006$	124k	ADLARSON	18A A2MM	$\eta' \rightarrow \eta \pi^0 \pi^0$

$-0.072 \pm 0.007 \pm 0.008$		<sup>1</sup> GONZALEZ-S..18A	RVUE	$\eta' \rightarrow \eta \pi^0 \pi^0$
$-0.047 \pm 0.011 \pm 0.003$	44k	<sup>2</sup> ABLIKIM	11	BES3 $J/\psi \rightarrow \gamma \eta \pi^+ \pi^-$
$-0.066 \pm 0.016 \pm 0.003$	15k	<sup>3</sup> BLIK	09	GAM4 $32.5 \pi^- p \rightarrow \eta' n$
$-0.127 \pm 0.016 \pm 0.008$	20k	<sup>4</sup> DOROFEEV	07	VES $27 \pi^- p \rightarrow \eta' n,$ $\pi^- A \rightarrow \eta' \pi^- A^*$

<sup>1</sup>Theoretical analysis of ADLARSON 18A using resonance chiral perturbation theory to one loop.

<sup>2</sup>See ABLIKIM 11 for the full correlation matrix.

<sup>3</sup>From  $\eta' \rightarrow \eta \pi^0 \pi^0$  decay.

<sup>4</sup>From  $\eta' \rightarrow \eta \pi^+ \pi^-$  decay.

### b decay parameter

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
$-0.049 \pm 0.006 \pm 0.006$	351k	ABLIKIM	18	BES3 $\eta' \rightarrow \eta \pi^+ \pi^-$
$-0.073 \pm 0.014 \pm 0.005$	56k	ABLIKIM	18	BES3 $\eta' \rightarrow \eta \pi^0 \pi^0$
$-0.063 \pm 0.014 \pm 0.005$	124k	ADLARSON	18A	A2MM $\eta' \rightarrow \eta \pi^0 \pi^0$
$-0.052 \pm 0.001 \pm 0.002$		<sup>1</sup> GONZALEZ-S..18A	RVUE	$\eta' \rightarrow \eta \pi^0 \pi^0$
$-0.069 \pm 0.019 \pm 0.009$	44k	<sup>2</sup> ABLIKIM	11	BES3 $J/\psi \rightarrow \gamma \eta \pi^+ \pi^-$
$-0.063 \pm 0.028 \pm 0.004$	15k	<sup>3</sup> BLIK	09	GAM4 $32.5 \pi^- p \rightarrow \eta' n$
$-0.106 \pm 0.028 \pm 0.014$	20k	<sup>4</sup> DOROFEEV	07	VES $27 \pi^- p \rightarrow \eta' n,$ $\pi^- A \rightarrow \eta' \pi^- A^*$

<sup>1</sup>Theoretical analysis of ADLARSON 18A using resonance chiral perturbation theory to one loop.

<sup>2</sup>See ABLIKIM 11 for the full correlation matrix.

<sup>3</sup>From  $\eta' \rightarrow \eta \pi^0 \pi^0$  decay.

<sup>4</sup>From  $\eta' \rightarrow \eta \pi^+ \pi^-$  decay.

### c decay parameter

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
$0.0027 \pm 0.0024 \pm 0.0018$	351k	ABLIKIM	18	BES3 $\eta' \rightarrow \eta \pi^+ \pi^-$
$0.019 \pm 0.011 \pm 0.003$	44k	<sup>1</sup> ABLIKIM	11	BES3 $J/\psi \rightarrow \gamma \eta \pi^+ \pi^-$
$-0.107 \pm 0.096 \pm 0.003$	15k	<sup>2</sup> BLIK	09	GAM4 $32.5 \pi^- p \rightarrow \eta' n$
$0.015 \pm 0.011 \pm 0.014$	20k	<sup>3</sup> DOROFEEV	07	VES $27 \pi^- p \rightarrow \eta' n,$ $\pi^- A \rightarrow \eta' \pi^- A^*$

<sup>1</sup>See ABLIKIM 11 for the full correlation matrix.

<sup>2</sup>From  $\eta' \rightarrow \eta \pi^0 \pi^0$  decay.

<sup>3</sup>From  $\eta' \rightarrow \eta \pi^+ \pi^-$  decay.

### d decay parameter

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
$-0.063 \pm 0.004 \pm 0.003$	351k	ABLIKIM	18	BES3 $\eta' \rightarrow \eta \pi^+ \pi^-$
$-0.074 \pm 0.009 \pm 0.004$	56k	ABLIKIM	18	BES3 $\eta' \rightarrow \eta \pi^0 \pi^0$
$-0.050 \pm 0.009 \pm 0.005$	124k	ADLARSON	18A	A2MM $\eta' \rightarrow \eta \pi^0 \pi^0$
$-0.051 \pm 0.008 \pm 0.006$		<sup>1</sup> GONZALEZ-S..18A	RVUE	$\eta' \rightarrow \eta \pi^0 \pi^0$
$-0.073 \pm 0.012 \pm 0.003$	44k	<sup>2</sup> ABLIKIM	11	BES3 $J/\psi \rightarrow \gamma \eta \pi^+ \pi^-$
$0.018 \pm 0.078 \pm 0.006$	15k	<sup>3</sup> BLIK	09	GAM4 $32.5 \pi^- p \rightarrow \eta' n$
$-0.082 \pm 0.017 \pm 0.008$	20k	<sup>4</sup> DOROFEEV	07	VES $27 \pi^- p \rightarrow \eta' n,$ $\pi^- A \rightarrow \eta' \pi^- A^*$

<sup>1</sup>Theoretical analysis of ADLARSON 18A using resonance chiral perturbation theory to one loop.

<sup>2</sup>See ABLIKIM 11 for the full correlation matrix.

<sup>3</sup>From  $\eta' \rightarrow \eta\pi^0\pi^0$  decay. If  $c \equiv 0$  from Bose-Einstein symmetry,  $d = -0.067 \pm 0.020 \pm 0.003$ .

<sup>4</sup>From  $\eta' \rightarrow \eta\pi^+\pi^-$  decay.

## $\eta'(958)$ $\beta$ PARAMETER |MATRIX ELEMENT|<sup>2</sup> = (1 + 2 $\beta$ Z)

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

### $\beta$ decay parameter

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
<b>-0.61 ± 0.08 OUR AVERAGE</b>		Error includes scale factor of 1.2.		
-0.640 ± 0.046 ± 0.047	1.8k	ABLIKIM	15G BES3	$J/\psi \rightarrow \gamma(\pi^0\pi^0\pi^0)$
-0.59 ± 0.18	235	BLIK	08 GAMS	$32 \pi^- p \rightarrow \eta' n$
-0.1 ± 0.3		ALDE	87B GAM2	$38 \pi^- p \rightarrow n3\pi^0$

## $\eta'(958)$ 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>-0.03 ± 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	$2.18 K^- p \rightarrow \Lambda\pi^+\pi^-\gamma$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.07 ± 0.08	152	RITTENBERG	65 HBC	$2.1-2.7 K^- p$

### $\eta'(958) \rightarrow \gamma\ell^+\ell^-$ TRANSITION FORM FACTOR SLOPE

Related to the effective virtual meson mass  $\Lambda$ , via slope  $\approx \Lambda^{-2}$ . See e.g. LANDSBERG 85, eq. (3.8), for a detailed definition.

VALUE (GeV <sup>-2</sup> )	EVTS	DOCUMENT ID	TECN	COMMENT
<b>1.62 ± 0.17 OUR AVERAGE</b>				
1.60 ± 0.17 ± 0.08	864	<sup>1</sup> ABLIKIM	150 BES3	$J/\psi \rightarrow \gamma e^+e^-$
1.7 ± 0.4	33	<sup>1</sup> VIKTOROV	80	$25,33 \pi^- p \rightarrow 2\mu\gamma$

<sup>1</sup>In the single-pole Ansatz where slope =  $1/(\Lambda^2 + \gamma^2)$  with  $\Lambda$ ,  $\gamma$  being a Breit-Wigner mass, width for the effective contributing vector meson.

$\eta'(958)$  REFERENCES

ABLIKIM	18	PR D97 012003	M. Ablikim <i>et al.</i>	(BES III Collab.)
ABLIKIM	18C	PRL 120 242003	M. Ablikim <i>et al.</i>	(BES III Collab.)
ADLARSON	18A	PR D98 012001	P. Adlarson <i>et al.</i>	(A2 Collab. at MAMI)
GONZALEZ-S...	18A	EPJ C78 758	S. Gonzalez-Solis, E. Passemar	(BEIJ, IND+)
AAIJ	17D	PL B764 233	R. Aaij <i>et al.</i>	(LHCb Collab.)
ABLIKIM	17	PRL 118 012001	M. Ablikim <i>et al.</i>	(BES III Collab.)
ABLIKIM	17T	PR D96 012005	M. Ablikim <i>et al.</i>	(BES III Collab.)
ABLIKIM	16M	PR D93 072008	M. Ablikim <i>et al.</i>	(BES III Collab.)
ABLIKIM	15AD	PR D92 051101	M. Ablikim <i>et al.</i>	(BES III Collab.)
ABLIKIM	15G	PR D92 012014	M. Ablikim <i>et al.</i>	(BES III Collab.)
ABLIKIM	15O	PR D92 012001	M. Ablikim <i>et al.</i>	(BES III Collab.)
ABLIKIM	15P	PR D92 012007	M. Ablikim <i>et al.</i>	(BES III Collab.)
ACHASOV	15	PR D91 092010	M.N. Achasov <i>et al.</i>	(SND Collab.)
AKHMETSHIN	15	PL B740 273	R.R. Akhmetshin <i>et al.</i>	(CMD-3 Collab.)
PDG	15	RPP 2015 at pdg.lbl.gov		(PDG Collab.)
ABLIKIM	14M	PRL 112 251801	M. Ablikim <i>et al.</i>	(BES III Collab.)
DONSKOV	14	MPL A29 1450213	S. Donskov <i>et al.</i>	(GAMS-4 $\pi$ Collab.)
PDG	14	CP C38 070001	K. Olive <i>et al.</i>	(PDG Collab.)
ABLIKIM	13	PR D87 012009	M. Ablikim <i>et al.</i>	(BES III Collab.)
ABLIKIM	13G	PR D87 032006	M. Ablikim <i>et al.</i>	(BES III Collab.)
ABLIKIM	13O	PR D87 092011	M. Ablikim <i>et al.</i>	(BES III Collab.)
ABLIKIM	13U	PR D88 091502	M. Ablikim <i>et al.</i>	(BES III Collab.)
ABLIKIM	12E	PRL 108 182001	M. Ablikim <i>et al.</i>	(BES III Collab.)
PDG	12	PR D86 010001	J. Beringer <i>et al.</i>	(PDG Collab.)
ABLIKIM	11	PR D83 012003	M. Ablikim <i>et al.</i>	(BES III Collab.)
ABLIKIM	11G	PR D84 032006	M. Ablikim <i>et al.</i>	(BES III Collab.)
CZERWINSKI	10	PRL 105 122001	E. Czerwinski <i>et al.</i>	(COSY-11 Collab.)
BLIK	09	PAN 72 231	A.M. Blik <i>et al.</i>	(IHEP (Protvino))
		Translated from YAF 72	258.	
NAIK	09	PRL 102 061801	P. Naik <i>et al.</i>	(CLEO Collab.)
PEDLAR	09	PR D79 111101	T.K. Pedlar <i>et al.</i>	(CLEO Collab.)
BLIK	08	PAN 71 2124	A. Blik <i>et al.</i>	(GAMS-4 $\pi$ Collab.)
		Translated from YAF 71	2161.	
LIBBY	08	PRL 101 182002	J. Libby <i>et al.</i>	(CLEO Collab.)
WICHT	08	PL B662 323	J. Wicht <i>et al.</i>	(BELLE Collab.)
DOROFEEV	07	PL B651 22	V. Dorofeev <i>et al.</i>	(VES Collab.)
MORI	07A	JPSJ 76 074102	T. Mori <i>et al.</i>	(BELLE Collab.)
ABLIKIM	06E	PR D73 052008	M. Ablikim <i>et al.</i>	(BES Collab.)
ABLIKIM	06Q	PRL 97 202002	M. Ablikim <i>et al.</i>	(BES Collab.)
AMELIN	05A	PAN 68 372	D.V. Amelin <i>et al.</i>	(VES Collab.)
		Translated from YAF 68	401.	
AMSLER	04B	EPJ C33 23	C. Amsler <i>et al.</i>	(Crystal Barrel Collab.)
BAI	04J	PL B594 47	J.Z. Bai <i>et al.</i>	(BES Collab.)
BRIERE	00	PRL 84 26	R. Briere <i>et al.</i>	(CLEO Collab.)
ACCIARRI	98Q	PL B418 399	M. Acciarri <i>et al.</i>	(L3 Collab.)
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. Bitukov, 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.)
AIHARA	88C	PR D38 1	H. Aihara <i>et al.</i>	(TPC-2 $\gamma$ Collab.)
VOROBYEV	88	SJNP 48 273	P.V. Vorobiev <i>et al.</i>	(NOVO)
		Translated from YAF 48	436.	
WILLIAMS	88	PR D38 1365	D.A. Williams <i>et al.</i>	(Crystal Ball Collab.)
AIHARA	87	PR D35 2650	H. Aihara <i>et al.</i>	(TPC-2 $\gamma$ Collab.) JP
ALBRECHT	87B	PL B199 457	H. Albrecht <i>et al.</i>	(ARGUS Collab.)
ALDE	87B	ZPHY C36 603	D.M. Alde <i>et al.</i>	(LANL, BELG, SERP, LAPP)
ANTREASYAN	87	PR D36 2633	D. Antreasyan <i>et al.</i>	(Crystal Ball Collab.)
GIDAL	87	PRL 59 2012	G. Gidal <i>et al.</i>	(LBL, SLAC, HARV)
ALDE	86	PL B177 115	D.M. Alde <i>et al.</i>	(SERP, BELG, LANL, LAPP)

BARTEL	85E	PL 160B 421	W. Bartel <i>et al.</i>	(JADE Collab.)
LANDSBERG	85	PRPL 128 301	L.G. Landsberg	(SERP)
ALTHOFF	84E	PL 147B 487	M. Althoff <i>et al.</i>	(TASSO Collab.)
BERGER	84B	PL 142B 125	C. Berger	(PLUTO Collab.)
BINON	84	PL 140B 264	F.G. Binon <i>et al.</i>	(SERP, BELG, LAPP+)
JENNI	83	PR D27 1031	P. Jenni <i>et al.</i>	(SLAC, LBL)
BARTEL	82B	PL 113B 190	W. Bartel <i>et al.</i>	(JADE Collab.)
BEHREND	82C	PL 114B 378	H.J. Behrend <i>et al.</i>	(CELLO Collab.)
	Also	PL 125B 518 (erratum)	H.J. Behrend <i>et al.</i>	(CELLO Collab.)
DZHELADIN	81	PL 105B 239	R.I. Dzhelyadin <i>et al.</i>	(SERP)
STANTON	80	PL B92 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+)
BINNIE	79	PL 83B 141	D.M. Binnie <i>et al.</i>	(LOIC)
ZANFINO	77	PRL 38 930	C. Zanfino <i>et al.</i>	(CARL, MCGI, OHIO+)
GRIGORIAN	75	NP B91 232	A. Grigorian <i>et al.</i>	(+)
KALBFLEISCH	75	PR D11 987	G.R. Kalbfleisch, R.C. Strand, J.W. Chapman	(BNL+)
DUANE	74	PRL 32 425	A. Duane <i>et al.</i>	(LOIC, SHMP)
KALBFLEISCH	74	PR D10 916	G.R. Kalbfleisch	(BNL)
DANBURG	73	PR D8 3744	J.S. Danburg <i>et al.</i>	(BNL, MICH) JP
JACOBS	73	PR D8 18	S.M. Jacobs <i>et al.</i>	(BRAN, UMD, SYRA+) JP
AGUILAR-...	72B	PR D6 29	M. Aguilar-Benitez <i>et al.</i>	(BNL)
APEL	72	PL 40B 680	W.D. Apel <i>et al.</i>	(KARLK, KARLE, PISA)
DALPIAZ	72	PL 42B 377	P.F. Dalpiaz <i>et al.</i>	(CERN)
BASILE	71	NC 3A 371	M. Basile <i>et al.</i>	(CERN, BGNA, STRB)
HARVEY	71	PRL 27 885	E.H. Harvey <i>et al.</i>	(MINN, MICH)
BENSINGER	70	PL 33B 505	J.R. Bensinger <i>et al.</i>	(WISC)
RITTENBERG	69	Thesis UCRL 18863	A. Rittenberg	(LRL) I
DAVIS	68	PL 27B 532	R. Davis <i>et al.</i>	(NWES, ANL)
LONDON	66	PR 143 1034	G.W. London <i>et al.</i>	(BNL, SYRA) IJP
BADIER	65B	PL 17 337	J. Badier <i>et al.</i>	(EPOL, SACL, AMST)
RITTENBERG	65	PRL 15 556	A. Rittenberg, G.R. Kalbfleisch	(LRL, BNL)
DAUBER	64	PRL 13 449	P.M. Dauber <i>et al.</i>	(UCLA) JP
KALBFLEISCH	64B	PRL 13 349	G.R. Kalbfleisch, O.I. Dahl, A. Rittenberg	(LRL) JP