

$\eta'(958)$

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

$\eta'(958)$ MASS

<u>VALUE (MeV)</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
957.78 ± 0.06 OUR AVERAGE				
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	¹ 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	² BELADIDZE	92C	VES 36 $\pi^- \text{Be} \rightarrow \pi^- \eta' \eta \text{Be}$
958 ± 1	340	² ARMSTRONG	91B	OMEG 300 $pp \rightarrow pp\eta\pi^+\pi^-$
958.2 ± 0.4	622	² AUGUSTIN	90	DM2 $J/\psi \rightarrow \gamma\eta\pi^+\pi^-$
957.8 ± 0.2	2420	² AUGUSTIN	90	DM2 $J/\psi \rightarrow \gamma\gamma\pi^+\pi^-$
956.3 ± 1.0	143	² GIDAL	87	MRK2 $e^+e^- \rightarrow e^+e^-\eta\pi^+\pi^-$
957.4 ± 1.4	535	³ BASILE	71	CNTR 1.6 $\pi^- p \rightarrow n\eta'$
957 ± 1		RITTENBERG	69	HBC 1.7-2.7 $K^- p$

¹ Using all η' decays.² Systematic uncertainty not estimated.³ Using η' decays into neutrals. Not independent of the other listed BASILE 71 η' 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>
0.198 ± 0.009 OUR FIT					
0.230 ± 0.021 OUR AVERAGE					
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 (Γ_i/Γ)	Confidence level
Γ_1 $\pi^+\pi^-\eta$	(42.9 \pm 0.7) %	
Γ_2 $\rho^0\gamma$ (including non-resonant $\pi^+\pi^-\gamma$)	(29.1 \pm 0.5) %	
Γ_3 $\pi^0\pi^0\eta$	(22.2 \pm 0.8) %	
Γ_4 $\omega\gamma$	(2.75 \pm 0.23) %	
Γ_5 $\gamma\gamma$	(2.20 \pm 0.08) %	
Γ_6 $3\pi^0$	(2.14 \pm 0.20) $\times 10^{-3}$	
Γ_7 $\mu^+\mu^-\gamma$	(1.08 \pm 0.27) $\times 10^{-4}$	
Γ_8 $\pi^+\pi^-\mu^+\mu^-$	< 2.9 $\times 10^{-5}$	90%
Γ_9 $\pi^+\pi^-\pi^0$	(3.8 \pm 0.4) $\times 10^{-3}$	
Γ_{10} $\pi^0\rho^0$	< 4 %	90%
Γ_{11} $2(\pi^+\pi^-)$	(8.5 \pm 0.9) $\times 10^{-5}$	
Γ_{12} $\pi^+\pi^-2\pi^0$	(1.8 \pm 0.4) $\times 10^{-4}$	
Γ_{13} $2(\pi^+\pi^-)$ neutrals	< 1 %	95%
Γ_{14} $2(\pi^+\pi^-)\pi^0$	< 1.9 $\times 10^{-3}$	90%
Γ_{15} $2(\pi^+\pi^-)2\pi^0$	< 1 %	95%
Γ_{16} $3(\pi^+\pi^-)$	< 3.1 $\times 10^{-5}$	90%
Γ_{17} $\pi^+\pi^-e^+e^-$	(2.4 $^{+1.3}_{-1.0}$) $\times 10^{-3}$	
Γ_{18} $\pi^+e^-\nu_e + c.c.$	< 2.1 $\times 10^{-4}$	90%
Γ_{19} γe^+e^-	< 9 $\times 10^{-4}$	90%
Γ_{20} $\pi^0\gamma\gamma$	< 8 $\times 10^{-4}$	90%
Γ_{21} $4\pi^0$	< 3.2 $\times 10^{-4}$	90%
Γ_{22} e^+e^-	< 1.2 $\times 10^{-8}$	90%
Γ_{23} invisible	< 5 $\times 10^{-4}$	90%

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

Γ_{24} $\pi^+\pi^-$	<i>P, CP</i>	< 6 $\times 10^{-5}$	90%
Γ_{25} $\pi^0\pi^0$	<i>P, CP</i>	< 4 $\times 10^{-4}$	90%
Γ_{26} $\pi^0e^+e^-$	<i>C</i> [a]	< 1.4 $\times 10^{-3}$	90%
Γ_{27} ηe^+e^-	<i>C</i> [a]	< 2.4 $\times 10^{-3}$	90%
Γ_{28} 3γ	<i>C</i>	< 1.0 $\times 10^{-4}$	90%
Γ_{29} $\mu^+\mu^-\pi^0$	<i>C</i> [a]	< 6.0 $\times 10^{-5}$	90%
Γ_{30} $\mu^+\mu^-\eta$	<i>C</i> [a]	< 1.5 $\times 10^{-5}$	90%
Γ_{31} $e\mu$	<i>LF</i>	< 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 15 branching ratios uses 43 measurements and one constraint to determine 9 parameters. The overall fit has a $\chi^2 = 48.0$ for 35 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	0							
x_3	-76	-58						
x_4	-19	-23	4					
x_5	-29	-25	32	-1				
x_6	-24	-18	29	1	9			
x_9	0	-2	-3	-1	-1	-1		
x_{17}	-4	-6	-5	-2	-3	-2	0	
Γ	25	5	-19	5	-71	-5	1	3
	x_1	x_2	x_3	x_4	x_5	x_6	x_9	x_{17}

Mode	Rate (MeV)
Γ_1 $\pi^+ \pi^- \eta$	0.085 \pm 0.004
Γ_2 $\rho^0 \gamma$ (including non-resonant $\pi^+ \pi^- \gamma$)	0.0575 \pm 0.0028
Γ_3 $\pi^0 \pi^0 \eta$	0.0439 \pm 0.0023
Γ_4 $\omega \gamma$	0.0054 \pm 0.0005
Γ_5 $\gamma \gamma$	0.00435 \pm 0.00013
Γ_6 $3\pi^0$	(4.2 \pm 0.4) $\times 10^{-4}$
Γ_9 $\pi^+ \pi^- \pi^0$	(7.5 \pm 0.8) $\times 10^{-4}$
Γ_{17} $\pi^+ \pi^- e^+ e^-$	(4.7 $^{+2.6}_{-1.9}$) $\times 10^{-4}$

$\eta'(958)$ PARTIAL WIDTHS

$\Gamma(\gamma\gamma)$	Γ_5			
VALUE (keV)	EVTS	DOCUMENT ID	TECN	COMMENT
4.35 \pm 0.14 OUR FIT				
4.28 \pm 0.19 OUR AVERAGE				
4.17 \pm 0.10 \pm 0.27	2000	⁴ 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		⁵ 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±0.25±0.44		BUTLER	90	MRK2	$e^+e^- \rightarrow e^+e^-\eta'(958)$
5.08±0.24±0.71	547	⁶ 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	⁷ 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	⁸ GIDAL	87	MRK2	$e^+e^- \rightarrow e^+e^-\eta\pi^+\pi^-$
4.0 ±0.9		⁹ BARTEL	85E	JADE	$e^+e^- \rightarrow e^+e^-2\gamma$

⁴ No non-resonant $\pi^+\pi^-$ contribution found.

⁵ Reevaluated by us using $B(\eta' \rightarrow \rho(770)\gamma) = (30.2 \pm 1.3)\%$.

⁶ Reevaluated by us using $B(\eta' \rightarrow \gamma\gamma) = (2.11 \pm 0.13)\%$.

⁷ Reevaluated by us using $B(\eta' \rightarrow \gamma\gamma) = (2.11 \pm 0.13)\%$.

⁸ Superseded by BUTLER 90.

⁹ 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>
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1.27±0.04 OUR FIT

1.26±0.07 OUR AVERAGE 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	$e^+e^- \rightarrow e^+e^-\rho\gamma$
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$\Gamma(\gamma\gamma) \times \Gamma(\pi^0\pi^0\eta)/\Gamma_{\text{total}} \quad \Gamma_5\Gamma_3/\Gamma$

<u>VALUE (keV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
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0.97±0.05 OUR FIT

0.92±0.06±0.11 ¹⁰ 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	¹¹ KARCH	90	CBAL	$e^+e^- \rightarrow e^+e^-\eta\pi^0\pi^0$
1.00±0.08±0.10	^{11,12} ANTREASYAN	87	CBAL	$e^+e^- \rightarrow e^+e^-\eta\pi^0\pi^0$

¹⁰ Reevaluated by us using $B(\eta \rightarrow \gamma\gamma) = (39.21 \pm 0.34)\%$. Supersedes ANTREASYAN 87 and KARCH 90.

¹¹ Superseded by KARCH 92.

¹² Using $BR(\eta \rightarrow 2\gamma) = (38.9 \pm 0.5)\%$.

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

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

VALUE (10^{-3} eV)	CL%	DOCUMENT ID	TECN	COMMENT
<1.0	90	¹³ AKHMETSHIN 15	CMD3	0.958 $e^+e^- \rightarrow \pi^+\pi^-\eta$
¹³ 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 $B(\eta \rightarrow 2\gamma) = 39.41 \times 10^{-2}$.				

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

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

X and Y are Dalitz variables; α 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(α) decay parameter

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
$-0.033 \pm 0.005 \pm 0.003$	44k	¹⁴ ABLIKIM	11	BES3 $J/\psi \rightarrow \gamma\eta\pi^+\pi^-$
$-0.072 \pm 0.012 \pm 0.006$	7k	¹⁵ AMELIN	05A	VES $28 \pi^- A \rightarrow \eta\pi^+\pi^-\pi^- A^*$
$-0.021 \pm 0.018 \pm 0.017$	6.7k	¹⁶ BRIERE	00	CLEO $10.6 e^+e^- \rightarrow \eta\pi^+\pi^- X$
$-0.058 \pm 0.013 \pm 0.003$	5.4k	¹⁷ ALDE	86	GAM2 $38 \pi^- p \rightarrow n\eta\pi^0\pi^0$
-0.08 ± 0.03		^{17,18} KALBFLEISCH 74	RVUE	$\eta' \rightarrow \eta\pi^+\pi^-$

¹⁴ See ABLIKIM 11 for the full correlation matrix.

¹⁵ Superseded by DOROFEEV 07, which found this parameterization unacceptable. See below.

¹⁶ Assuming $\text{Im}(\alpha) = 0$, $C = 0$, and $D = 0$.

¹⁷ Assuming $C = 0$.

¹⁸ From the data of DAUBER 64, RITTENBERG 69, AGUILAR-BENITEZ 72B, JACOBS 73, and DANBURG 73.

Im(α) decay parameter

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
$0.000 \pm 0.049 \pm 0.001$	44k	¹⁹ ABLIKIM	11	BES3 $J/\psi \rightarrow \gamma\eta\pi^+\pi^-$
$0.0 \pm 0.1 \pm 0.0$	7k	²⁰ AMELIN	05A	VES $28 \pi^- A \rightarrow \eta\pi^+\pi^-\pi^- A^*$
$-0.00 \pm 0.13 \pm 0.00$	5.4k	²¹ ALDE	86	GAM2 $38 \pi^- p \rightarrow n\eta\pi^0\pi^0$
0.0 ± 0.3		^{21,22} KALBFLEISCH 74	RVUE	$\eta' \rightarrow \eta\pi^+\pi^-$

¹⁹ See ABLIKIM 11 for the full correlation matrix.

²⁰ Superseded by DOROFEEV 07, which found this parameterization unacceptable. See below.

²¹ Assuming $C = 0$.

²² From the data of DAUBER 64, RITTENBERG 69, AGUILAR-BENITEZ 72B, JACOBS 73, and DANBURG 73.

C decay parameter

<u>VALUE</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
$+0.018 \pm 0.009 \pm 0.003$	44k	²³ ABLIKIM	11 BES3	$J/\psi \rightarrow \gamma \eta \pi^+ \pi^-$
$0.020 \pm 0.018 \pm 0.004$	7k	²⁴ AMELIN	05A VES	$28 \pi^- A \rightarrow \eta \pi^+ \pi^- \pi^- A^*$

²³ See ABLIKIM 11 for the full correlation matrix.

²⁴ Superseded by DOROFEEV 07, which found this parameterization unacceptable. See below.

D decay parameter

<u>VALUE</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
$-0.059 \pm 0.012 \pm 0.004$	44k	²⁵ ABLIKIM	11 BES3	$J/\psi \rightarrow \gamma \eta \pi^+ \pi^-$
$-0.066 \pm 0.030 \pm 0.015$	7k	²⁶ AMELIN	05A VES	$28 \pi^- A \rightarrow \eta \pi^+ \pi^- \pi^- A^*$
$0.00 \pm 0.03 \pm 0.00$	5.4k	²⁷ ALDE	86 GAM2	$38 \pi^- p \rightarrow n \eta \pi^0 \pi^0$
0		^{27,28} KALBFLEISCH	74 RVUE	$\eta' \rightarrow \eta \pi^+ \pi^-$

²⁵ See ABLIKIM 11 for the full correlation matrix.

²⁶ Superseded by DOROFEEV 07, which found this parameterization unacceptable. See below.

²⁷ Assuming $C = 0$.

²⁸ 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

<u>VALUE</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
$-0.047 \pm 0.011 \pm 0.003$	44k	²⁹ ABLIKIM	11 BES3	$J/\psi \rightarrow \gamma \eta \pi^+ \pi^-$
$-0.066 \pm 0.016 \pm 0.003$	15k	³⁰ BLIK	09 GAM4	$32.5 \pi^- p \rightarrow \eta' n$
$-0.127 \pm 0.016 \pm 0.008$	20k	³¹ DOROFEEV	07 VES	$27 \pi^- p \rightarrow \eta' n,$ $\pi^- A \rightarrow \eta' \pi^- A^*$

²⁹ See ABLIKIM 11 for the full correlation matrix.

³⁰ From $\eta' \rightarrow \eta \pi^0 \pi^0$ decay.

³¹ From $\eta' \rightarrow \eta \pi^+ \pi^-$ decay.

b decay parameter

<u>VALUE</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
$-0.069 \pm 0.019 \pm 0.009$	44k	32 ABLIKIM	11 BES3	$J/\psi \rightarrow \gamma \eta \pi^+ \pi^-$
$-0.063 \pm 0.028 \pm 0.004$	15k	33 BLIK	09 GAM4	$32.5 \pi^- p \rightarrow \eta' n$
$-0.106 \pm 0.028 \pm 0.014$	20k	34 DOROFEEV	07 VES	$27 \pi^- p \rightarrow \eta' n,$ $\pi^- A \rightarrow \eta' \pi^- A^*$

³² See ABLIKIM 11 for the full correlation matrix.

³³ From $\eta' \rightarrow \eta \pi^0 \pi^0$ decay.

³⁴ From $\eta' \rightarrow \eta \pi^+ \pi^-$ decay.

c decay parameter

<u>VALUE</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
$+0.019 \pm 0.011 \pm 0.003$	44k	35 ABLIKIM	11 BES3	$J/\psi \rightarrow \gamma \eta \pi^+ \pi^-$
$-0.107 \pm 0.096 \pm 0.003$	15k	36 BLIK	09 GAM4	$32.5 \pi^- p \rightarrow \eta' n$
$0.015 \pm 0.011 \pm 0.014$	20k	37 DOROFEEV	07 VES	$27 \pi^- p \rightarrow \eta' n,$ $\pi^- A \rightarrow \eta' \pi^- A^*$

³⁵ See ABLIKIM 11 for the full correlation matrix.

³⁶ From $\eta' \rightarrow \eta \pi^0 \pi^0$ decay.

³⁷ From $\eta' \rightarrow \eta \pi^+ \pi^-$ decay.

d decay parameter

<u>VALUE</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
$-0.073 \pm 0.012 \pm 0.003$	44k	38 ABLIKIM	11 BES3	$J/\psi \rightarrow \gamma \eta \pi^+ \pi^-$
$0.018 \pm 0.078 \pm 0.006$	15k	39 BLIK	09 GAM4	$32.5 \pi^- p \rightarrow \eta' n$
$-0.082 \pm 0.017 \pm 0.008$	20k	40 DOROFEEV	07 VES	$27 \pi^- p \rightarrow \eta' n,$ $\pi^- A \rightarrow \eta' \pi^- A^*$

³⁸ See ABLIKIM 11 for the full correlation matrix.

³⁹ From $\eta' \rightarrow \eta \pi^0 \pi^0$ decay. If $c \equiv 0$ from Bose-Einstein symmetry, $d = -0.067 \pm 0.020 \pm 0.003$.

⁴⁰ From $\eta' \rightarrow \eta \pi^+ \pi^-$ decay.

$$\eta'(958) \beta \text{ PARAMETER}$$

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

See the "Note on η Decay Parameters" in our 1994 edition *Physical Review D* **50** 1173 (1994), p. 1454.

β decay parameter

<u>VALUE</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
-0.46 ± 0.22 OUR AVERAGE		Error includes scale factor of 1.4.		
-0.59 ± 0.18	235	BLIK	08 GAMS	$32 \pi^- p \rightarrow \eta' n$
-0.1 ± 0.3		ALDE	87B GAM2	$38 \pi^- p \rightarrow n 3\pi^0$

$\eta'(958)$ BRANCHING RATIOS

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

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
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0.429±0.007 OUR FIT

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

0.424±0.011±0.004	1.2k	⁴¹ PEDLAR	09	CLEO $J/\psi \rightarrow \gamma\eta'$
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⁴¹Not independent of other η' branching fractions and ratios in PEDLAR 09.

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

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
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0.1228±0.0020 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

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

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
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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
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$$\Gamma(\rho^0\gamma(\text{including non-resonant } \pi^+\pi^-\gamma))/\Gamma_{\text{total}} \qquad \Gamma_2/\Gamma$$

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
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0.291±0.006 OUR FIT

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

0.287±0.007±0.004	0.2k	⁴² 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

⁴²Not independent of other η' branching fractions and ratios in PEDLAR 09.

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

VALUE	DOCUMENT ID	TECN	COMMENT
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0.677±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	$J/\psi \rightarrow \eta'\gamma$

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

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
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0.949±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 $K^-p \rightarrow \Lambda X^0$

$\Gamma(\pi^0\pi^0\eta)/\Gamma_{\text{total}}$ Γ_3/Γ

VALUE EVTS DOCUMENT ID TECN COMMENT
0.222±0.008 OUR FIT

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

0.235±0.013±0.004 3.2k ⁴³ PEDLAR 09 CLEO $J/\psi \rightarrow \gamma\eta'$

⁴³ Not independent of other η' branching fractions and ratios in PEDLAR 09.

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

VALUE EVTS DOCUMENT ID TECN COMMENT
0.0712±0.0026 OUR FIT

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

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

$\Gamma(\pi^0\pi^0\eta)/\Gamma(\pi^+\pi^-\eta)$ Γ_3/Γ_1

VALUE DOCUMENT ID TECN COMMENT
0.517±0.026 OUR FIT

0.555±0.043±0.013 PEDLAR 09 CLE3 $J/\psi \rightarrow \eta'\gamma$

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

VALUE DOCUMENT ID TECN COMMENT
0.447±0.012 OUR FIT

0.43 ±0.02 ±0.02 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 $5.5 K^- p$

$\Gamma(\omega\gamma)/\Gamma_{\text{total}}$ Γ_4/Γ

VALUE EVTS DOCUMENT ID TECN COMMENT
0.0275±0.0023 OUR FIT

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

0.0234±0.0030±0.0004 70 ⁴⁴ PEDLAR 09 CLEO $J/\psi \rightarrow \gamma\eta'$

⁴⁴ Not independent of other η' branching fractions and ratios in PEDLAR 09.

$\Gamma(\omega\gamma)/\Gamma(\pi^+\pi^-\eta)$ Γ_4/Γ_1

VALUE EVTS DOCUMENT ID TECN COMMENT
0.064±0.006 OUR FIT

0.055±0.007±0.001 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 $8.4 \pi^- p$

$\Gamma(\omega\gamma)/\Gamma(\pi^0\pi^0\eta)$ Γ_4/Γ_3

VALUE DOCUMENT ID TECN COMMENT
0.124±0.011 OUR FIT

0.147±0.016 ALDE 87B GAM2 $38 \pi^- p \rightarrow n4\gamma$

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

VALUE DOCUMENT ID TECN COMMENT
0.428±0.011 OUR FIT

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

0.25 ±0.14 DAUBER 64 HBC $1.95 K^- p$

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

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
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0.0880±0.0031 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 $K^- p$
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$$\frac{\Gamma(\pi^+\pi^-\text{ neutrals})/\Gamma_{\text{total}}}{(0.714\Gamma_1+\Gamma_3+0.89\Gamma_4)/\Gamma}$$

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
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0.395±0.004 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 $K^- p$

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

VALUE (units 10^{-2})	EVTS	DOCUMENT ID	TECN	COMMENT
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2.20±0.08 OUR FIT

2.00±0.15 OUR AVERAGE

$1.98^{+0.31}_{-0.27} \pm 0.07$	114	45 WICHT	08	BELL $B^\pm \rightarrow K^\pm\gamma\gamma$
2.00 ± 0.18		46 STANTON	80	SPEC $8.45 \pi^- p \rightarrow n\pi^+\pi^-2\gamma$

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

$2.25 \pm 0.16 \pm 0.03$	0.3k	47 PEDLAR	09	CLEO $J/\psi \rightarrow \gamma\eta'$
1.8 ± 0.2	6000	48 APEL	79	NICE $15-40 \pi^- p \rightarrow n2\gamma$
2.5 ± 0.7		DUANE	74	MMS $\pi^- p \rightarrow nMM$
1.71 ± 0.33	68	DALPIAZ	72	CNTR $1.6 \pi^- p \rightarrow nX^0$
$2.0^{+0.8}_{-0.6}$	31	HARVEY	71	OSPK $3.65 \pi^- p \rightarrow nX^0$

⁴⁵ 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.

⁴⁶ Includes APEL 79 result.

⁴⁷ Not independent of other η' branching fractions and ratios in PEDLAR 09.

⁴⁸ Data is included in STANTON 80 evaluation.

$$\frac{\Gamma(\gamma\gamma)/\Gamma(\pi^+\pi^-\eta)}{\Gamma_5/\Gamma_1}$$

VALUE	DOCUMENT ID	TECN	COMMENT
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0.0513±0.0022 OUR FIT

0.053 ±0.004 ±0.001	PEDLAR	09	CLE3 $J/\psi \rightarrow \eta'\gamma$
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$$\frac{\Gamma(\gamma\gamma)/\Gamma(\rho^0\gamma(\text{including non-resonant } \pi^+\pi^-\gamma))}{\Gamma_5/\Gamma_2}$$

VALUE	DOCUMENT ID	TECN	COMMENT
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0.0757±0.0033 OUR FIT

0.080 ±0.008	ABLIKIM	06E	BES2 $J/\psi \rightarrow \eta'\gamma$
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$\Gamma(\gamma\gamma)/\Gamma(\pi^0\pi^0\eta)$ Γ_5/Γ_3

<u>VALUE</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
0.099±0.004 OUR FIT				
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 $\pi^- p \rightarrow n2\gamma$

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

<u>VALUE</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
0.139±0.006 OUR FIT				
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.188±0.058	16	APEL	72	OSPK 3.8 $\pi^- p \rightarrow nX^0$

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

<u>VALUE</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
0.183±0.006 OUR FIT				
• • • 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 $K^- p$

$\Gamma(3\pi^0)/\Gamma_{\text{total}}$ Γ_6/Γ

<u>VALUE (units 10⁻³)</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
2.14±0.20 OUR FIT				
3.56±0.22±0.34	309	ABLIKIM	12E	BES3 $J/\psi \rightarrow \gamma(3\pi^0)$

$\Gamma(3\pi^0)/\Gamma(\pi^0\pi^0\eta)$ Γ_6/Γ_3

<u>VALUE (units 10⁻⁴)</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
96± 9 OUR FIT				
78±10 OUR AVERAGE				
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 $\pi^- p \rightarrow n6\gamma$

$\Gamma(\mu^+\mu^-\gamma)/\Gamma(\gamma\gamma)$ Γ_7/Γ_5

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

$\Gamma(\pi^+\pi^-\mu^+\mu^-)/\Gamma_{\text{total}}$ Γ_8/Γ

<u>VALUE (units 10⁻⁴)</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
• • • We do not use the following data for averages, fits, limits, etc. • • •				
<0.29	90	⁴⁹ ABLIKIM	130	BES3 $J/\psi \rightarrow \gamma\eta'$
<2.4	90	⁵⁰ NAIK	09	CLEO $J/\psi \rightarrow \gamma\eta'$

⁴⁹ Using $\Gamma_2/\Gamma = (29.3 \pm 0.6)\%$ from PDG 12.

⁵⁰ Not independent of measured value of Γ_8/Γ_1 from NAIK 09.

$\Gamma(\pi^+\pi^-\mu^+\mu^-)/\Gamma(\pi^+\pi^-\eta)$ Γ_8/Γ_1

VALUE (units 10^{-3})	CL%	DOCUMENT ID	TECN	COMMENT
<0.5	90	⁵¹ NAIK	09	CLEO $J/\psi \rightarrow \gamma\eta'$

⁵¹ 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 $B(\eta \rightarrow 2\gamma) = 39.41 \times 10^{-2}$.

$\Gamma(\pi^+\pi^-\mu^+\mu^-)/\Gamma(\rho^0\gamma(\text{including non-resonant } \pi^+\pi^-\gamma))$ Γ_8/Γ_2

VALUE (units 10^{-4})	CL%	DOCUMENT ID	TECN	COMMENT
<1.0	90	ABLIKIM	130	BES3 $J/\psi \rightarrow \gamma\eta'$

$\Gamma(\pi^+\pi^-\pi^0)/\Gamma_{\text{total}}$ Γ_9/Γ

VALUE (units 10^{-3})	EVTS	DOCUMENT ID	TECN	COMMENT
3.8 ± 0.4 OUR FIT				
3.8 ± 0.4 OUR AVERAGE				
3.83 ± 0.15 ± 0.39	1014	ABLIKIM	12E	BES3 $J/\psi \rightarrow \gamma(\pi^+\pi^-\pi^0)$
3.7 ^{+1.1} _{-0.9} ± 0.4		⁵² NAIK	09	CLEO $J/\psi \rightarrow \gamma\eta'$

⁵² Not independent of measured value of Γ_9/Γ_1 from NAIK 09.

$\Gamma(\pi^+\pi^-\pi^0)/\Gamma(\pi^+\pi^-\eta)$ Γ_9/Γ_1

VALUE (units 10^{-3})	EVTS	DOCUMENT ID	TECN	COMMENT
8.8 ± 0.9 OUR FIT				
8.28 ^{+2.49}_{-2.12} ± 0.04	20	⁵³ NAIK	09	CLEO $J/\psi \rightarrow \gamma\eta'$

⁵³ NAIK 09 reports $[\Gamma(\eta'(958) \rightarrow \pi^+\pi^-\pi^0)/\Gamma(\eta'(958) \rightarrow \pi^+\pi^-\eta)] / [B(\eta \rightarrow 2\gamma)] = (21 ⁺⁶₋₅ ± 2) \times 10^{-3}$ 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.

$\Gamma(\pi^0\rho^0)/\Gamma_{\text{total}}$ Γ_{10}/Γ

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

$\Gamma(2(\pi^+\pi^-))/\Gamma_{\text{total}}$ Γ_{11}/Γ

VALUE (units 10^{-5})	CL%	EVTS	DOCUMENT ID	TECN	COMMENT
8.5 ± 0.9 ± 0.3		199	⁵⁴ ABLIKIM	14M	BES3 $J/\psi \rightarrow \gamma\eta'$

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

< 24	90	⁵⁵ NAIK	09	CLEO $J/\psi \rightarrow \gamma\eta'$
<1000	90	RITTENBERG	69	HBC $1.7-2.7 K^- p$

⁵⁴ 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 $B(J/\psi(1S) \rightarrow \gamma\eta'(958)) = (5.15 \pm 0.16) \times 10^{-3}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

⁵⁵ Not independent of measured value of Γ_{11}/Γ_1 from NAIK 09.

$\Gamma(2(\pi^+\pi^-))/\Gamma(\pi^+\pi^-\eta)$ Γ_{11}/Γ_1

VALUE (units 10^{-3})	CL%	DOCUMENT ID	TECN	COMMENT
<0.6	90	⁵⁶ NAIK	09	CLEO $J/\psi \rightarrow \gamma\eta'$
⁵⁶ 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 $B(\eta \rightarrow 2\gamma) = 39.41 \times 10^{-2}$.				

$\Gamma(\pi^+\pi^-2\pi^0)/\Gamma_{total}$ Γ_{12}/Γ

VALUE (units 10^{-4})	CL%	EVTS	DOCUMENT ID	TECN	COMMENT
$1.8 \pm 0.4 \pm 0.1$		84	⁵⁷ ABLIKIM	14M	BES3 $J/\psi \rightarrow \gamma\eta'$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<27	90		⁵⁸ NAIK	09	CLEO $J/\psi \rightarrow \gamma\eta'$
⁵⁷ ABLIKIM 14M reports $[\Gamma(\eta'(958) \rightarrow \pi^+\pi^-2\pi^0)/\Gamma_{total}] \times [B(J/\psi(1S) \rightarrow \gamma\eta'(958))] = (9.38 \pm 1.79 \pm 0.89) \times 10^{-7}$ which we divide by our best value $B(J/\psi(1S) \rightarrow \gamma\eta'(958)) = (5.15 \pm 0.16) \times 10^{-3}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.					
⁵⁸ Not independent of measured value of Γ_{12}/Γ_1 from NAIK 09.					

$\Gamma(\pi^+\pi^-2\pi^0)/\Gamma(\pi^+\pi^-\eta)$ Γ_{12}/Γ_1

VALUE (units 10^{-3})	CL%	DOCUMENT ID	TECN	COMMENT
<6	90	⁵⁹ NAIK	09	CLEO $J/\psi \rightarrow \gamma\eta'$
⁵⁹ 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 $B(\eta \rightarrow 2\gamma) = 39.41 \times 10^{-2}$.				

$\Gamma(2(\pi^+\pi^-) neutrals)/\Gamma_{total}$ Γ_{13}/Γ

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 $1.7-2.7 K^- p$

$\Gamma(2(\pi^+\pi^-)\pi^0)/\Gamma_{total}$ Γ_{14}/Γ

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
<0.002	90	⁶⁰ NAIK	09	CLEO $J/\psi \rightarrow \gamma\eta'$
<0.01	90	RITTENBERG	69	HBC $1.7-2.7 K^- p$
⁶⁰ Not independent of measured value of Γ_{14}/Γ_1 from NAIK 09.				

$\Gamma(2(\pi^+\pi^-)\pi^0)/\Gamma(\pi^+\pi^-\eta)$ Γ_{14}/Γ_1

VALUE (units 10^{-3})	CL%	DOCUMENT ID	TECN	COMMENT
<4	90	⁶¹ NAIK	09	CLEO $J/\psi \rightarrow \gamma\eta'$
⁶¹ 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 $B(\eta \rightarrow 2\gamma) = 39.41 \times 10^{-2}$.				

$\Gamma(2(\pi^+\pi^-)2\pi^0)/\Gamma_{total}$ Γ_{15}/Γ

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<0.01	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

$\Gamma(3(\pi^+\pi^-))/\Gamma_{\text{total}}$ Γ_{16}/Γ

VALUE (units 10^{-5})	CL%	DOCUMENT ID	TECN	COMMENT
< 3.1	90	⁶² ABLIKIM	13U BES3	$J/\psi \rightarrow \gamma 3(\pi^+\pi^-)$

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

< 53	90	⁶³ NAIK	09 CLEO	$J/\psi \rightarrow \gamma \eta'$
< 500	95	KALBFLEISCH	64B HBC	$K^- p \rightarrow \Lambda 2(\pi^+\pi^-)$

⁶² Using $B(J/\psi \rightarrow \gamma \eta'(958)) = (5.16 \pm 0.15) \times 10^{-3}$.

⁶³ Not independent of measured value of Γ_{16}/Γ_1 from NAIK 09.

$\Gamma(3(\pi^+\pi^-))/\Gamma(\pi^+\pi^-\eta)$ Γ_{16}/Γ_1

VALUE (units 10^{-3})	CL%	DOCUMENT ID	TECN	COMMENT
< 1.2	90	⁶⁴ NAIK	09 CLEO	$J/\psi \rightarrow \gamma \eta'$

⁶⁴ 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 $B(\eta \rightarrow 2\gamma) = 39.41 \times 10^{-2}$.

$\Gamma(\pi^+\pi^-e^+e^-)/\Gamma_{\text{total}}$ Γ_{17}/Γ

VALUE (units 10^{-3})	CL%	EVTS	DOCUMENT ID	TECN	COMMENT
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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	⁶⁵ ABLIKIM	130 BES3	$J/\psi \rightarrow \gamma \eta'$
$2.5 \begin{smallmatrix} +1.2 \\ -0.9 \end{smallmatrix} \pm 0.5$		⁶⁶ NAIK	09 CLEO	$J/\psi \rightarrow \gamma \eta'$
< 6	90	RITTENBERG	65 HBC	$2.7 K^- p$

⁶⁵ Using $\Gamma_2/\Gamma = (29.3 \pm 0.6)\%$ from PDG 12.

⁶⁶ Not independent of measured value of Γ_{17}/Γ_1 from NAIK 09.

$\Gamma(\pi^+\pi^-e^+e^-)/\Gamma(\pi^+\pi^-\eta)$ Γ_{17}/Γ_1

VALUE (units 10^{-3})	EVTS	DOCUMENT ID	TECN	COMMENT
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5.6 $\begin{smallmatrix} +3.0 \\ -2.2 \end{smallmatrix}$ OUR FIT

$5.52 \begin{smallmatrix} +3.00 \\ -2.30 \end{smallmatrix} \pm 0.03$	8	⁶⁷ NAIK	09 CLEO	$J/\psi \rightarrow \gamma \eta'$
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⁶⁷ 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.

$\Gamma(\pi^+\pi^-e^+e^-)/\Gamma(\rho^0\gamma(\text{including non-resonant } \pi^+\pi^-\gamma))$ Γ_{17}/Γ_2

VALUE (units 10^{-3})	EVTS	DOCUMENT ID	TECN	COMMENT
$7.2 \pm 0.4 \pm 0.5$	429	ABLIKIM	130 BES3	$J/\psi \rightarrow \gamma \eta'$

$\Gamma(\pi^+e^-\nu_e + \text{c.c.})/\Gamma(\pi^+\pi^-\eta)$ Γ_{18}/Γ_1

VALUE (units 10^{-4})	CL%	DOCUMENT ID	TECN	COMMENT
< 5.0	90	ABLIKIM	13G BES3	$J/\psi \rightarrow \phi \eta'$

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

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

$\Gamma(\pi^0 \gamma \gamma)/\Gamma(\pi^0 \pi^0 \eta)$ Γ_{20}/Γ_3

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

$\Gamma(4\pi^0)/\Gamma_{\text{total}}$ Γ_{21}/Γ

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

$\Gamma(4\pi^0)/\Gamma(\pi^0 \pi^0 \eta)$ Γ_{21}/Γ_3

<u>VALUE (units 10^{-4})</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
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• • • We do not use the following data for averages, fits, limits, etc. • • •

<23	90	ALDE	87B	GAM2 $38 \pi^- p \rightarrow n 8\gamma$
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$\Gamma(e^+ e^-)/\Gamma_{\text{total}}$ Γ_{22}/Γ

<u>VALUE (units 10^{-7})</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
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• • • We do not use the following data for averages, fits, limits, etc. • • •

<2.1	90	VOROBYEV	88	ND $e^+ e^- \rightarrow \pi^+ \pi^- \eta$
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$\Gamma(\text{invisible})/\Gamma_{\text{total}}$ Γ_{23}/Γ

<u>VALUE (units 10^{-4})</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
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• • • We do not use the following data for averages, fits, limits, etc. • • •

<9.5	90	⁶⁸ NAIK	09	CLEO $J/\psi \rightarrow \gamma \eta'$
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⁶⁸ Not independent of measured value of Γ_{23}/Γ_1 from NAIK 09.

$\Gamma(\text{invisible})/\Gamma(\gamma \gamma)$ Γ_{23}/Γ_5

<u>VALUE (units 10^{-2})</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
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<2.4	90	ABLIKIM	13	BES3 $J/\psi \rightarrow \phi \eta'$
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• • • We do not use the following data for averages, fits, limits, etc. • • •

<6.69	90	ABLIKIM	06Q	BES $J/\psi \rightarrow \phi \eta'$
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$\Gamma(\text{invisible})/\Gamma(\pi^+ \pi^- \eta)$ Γ_{23}/Γ_1

<u>VALUE (units 10^{-3})</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
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• • • We do not use the following data for averages, fits, limits, etc. • • •

<2.1	90	⁶⁹ NAIK	09	CLEO $J/\psi \rightarrow \gamma \eta'$
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⁶⁹ 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 $B(\eta \rightarrow 2\gamma) = 39.41 \times 10^{-2}$.

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

VALUE (units 10^{-4})	CL%	DOCUMENT ID	TECN	COMMENT
< 0.6	90	⁷⁰ ABLIKIM	11G	BES3 $J/\psi \rightarrow \gamma\pi^+\pi^-$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
< 29	90	⁷¹ MORI	07A	BELL $\gamma\gamma \rightarrow \pi^+\pi^-$
< 3.3	90	⁷² 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 $1.7\text{--}2.7 K^- p$

⁷⁰ ABLIKIM 11G reports $[\Gamma(\eta'(958) \rightarrow \pi^+\pi^-)/\Gamma_{\text{total}}] \times [B(J/\psi(1S) \rightarrow \gamma\eta'(958))] < 2.84 \times 10^{-7}$ which we divide by our best value $B(J/\psi(1S) \rightarrow \gamma\eta'(958)) = 5.15 \times 10^{-3}$.

⁷¹ Taking into account interference with the $\gamma\gamma \rightarrow \pi^+\pi^-$ continuum.

⁷² Without interference with the $\gamma\gamma \rightarrow \pi^+\pi^-$ continuum.

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

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<4 × 10⁻⁴	90	⁷³ ABLIKIM	11G	BES3 $J/\psi \rightarrow \gamma\pi^0\pi^0$

⁷³ ABLIKIM 11G reports $[\Gamma(\eta'(958) \rightarrow \pi^+\pi^-)/\Gamma_{\text{total}}] \times [B(J/\psi(1S) \rightarrow \gamma\eta'(958))] < 2.84 \times 10^{-7}$ which we divide by our best value $B(J/\psi(1S) \rightarrow \gamma\eta'(958)) = 5.15 \times 10^{-3}$.

$\Gamma(\pi^0\pi^0)/\Gamma(\pi^0\pi^0\eta)$ Γ_{25}/Γ_3

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

$\Gamma(\pi^0 e^+ e^-)/\Gamma_{\text{total}}$ Γ_{26}/Γ

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 $2.7 K^- p$
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$\Gamma(\eta e^+ e^-)/\Gamma_{\text{total}}$ Γ_{27}/Γ

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 $2.7 K^- p$
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$\Gamma(3\gamma)/\Gamma(\pi^0\pi^0\eta)$ Γ_{28}/Γ_3

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

$\Gamma(\mu^+\mu^-\pi^0)/\Gamma_{\text{total}}$ Γ_{29}/Γ

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

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

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

$\Gamma(e\mu)/\Gamma_{\text{total}}$					Γ_{31}/Γ
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 η 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
-0.03 ± 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 $2.18 K^- p \rightarrow \Lambda \pi^+ \pi^- \gamma$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
0.07 ± 0.08	152	RITTENBERG	65	HBC $2.1-2.7 K^- p$

$\eta'(958)$ REFERENCES

AKHMETSHIN	15	PL B740 273	R.R. Akhmetshin <i>et al.</i>	(CMD-3 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 π 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 π 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. 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.)
AIHARA	88C	PR D38 1	H. Aihara <i>et al.</i>	(TPC-2 γ Collab.)
VOROBYEV	88	SJNP 48 273	P.V. Vorobiev <i>et al.</i>	(NOVO)
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 γ 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.)
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+)
BEHREND	83B	PL 125B 518 (erratum)	H.J. Behrend <i>et al.</i>	(CELLO Collab.)
Also		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)
BARTEL	82B	PL 113B 190	W. Bartel <i>et al.</i>	(JADE Collab.)
DZHELJADIN	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)
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