$\eta'(958)$

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

$\eta'(958)$ MASS

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

VALUE (MeV)	*EVTS*	*DOCUMENT ID*		*TECN*	*CHG*	*COMMENT*
0.204±0.015 OUR FIT Error includes scale factor of 1.2.						
0.30 ±0.09 OUR AVERAGE						
0.40 ±0.22	4800	WURZINGER	96	SPEC		1.68 $pd \to {}^3\mathrm{He}\eta'$
0.28 ±0.10	1000	BINNIE	79	MMS	0	$\pi^- p \to n\mathrm{MM}$
• • • We do not use the following data for averages, fits, limits, etc. • • •						
0.20 ±0.04		BAI	04J	BES2		$J/\psi \to \gamma\gamma\pi^+\pi^-$

$\eta'(958)$ DECAY MODES

	Mode	Fraction (Γ_i/Γ)	Scale factor/ Confidence level
Γ_1	$\pi^+\pi^-\eta$	(44.6 ±1.4) %	S=1.2
Γ_2	$\rho^0\gamma$(including non-resonant $\pi^+\pi^-\gamma$)	(29.4 ±0.9) %	S=1.1
Γ_3	$\pi^0\pi^0\eta$	(20.7 ±1.2) %	S=1.2
Γ_4	$\omega\gamma$	(3.02±0.31) %	

Γ_5	$\gamma\gamma$		(2.10±0.12) %		S=1.2
Γ_6	$3\pi^0$		(1.61±0.23) $\times 10^{-3}$		S=1.1
Γ_7	$\mu^+\mu^-\gamma$		(1.03±0.26) $\times 10^{-4}$		
Γ_8	$\pi^+\pi^-\mu^+\mu^-$		< 2.3	$\times 10^{-4}$	CL=90%
Γ_9	$\pi^+\pi^-\pi^0$		(3.7 $^{+1.1}_{-1.0}$) $\times 10^{-3}$		
Γ_{10}	$\pi^0\rho^0$		< 4	%	CL=90%
Γ_{11}	$2(\pi^+\pi^-)$		< 2.5	$\times 10^{-4}$	CL=90%
Γ_{12}	$\pi^+\pi^-2\pi^0$		< 2.6	$\times 10^{-3}$	CL=90%
Γ_{13}	$2(\pi^+\pi^-)$ neutrals		< 1	%	CL=95%
Γ_{14}	$2(\pi^+\pi^-)\pi^0$		< 1.9	$\times 10^{-3}$	CL=90%
Γ_{15}	$2(\pi^+\pi^-)2\pi^0$		< 1	%	CL=95%
Γ_{16}	$3(\pi^+\pi^-)$		< 5	$\times 10^{-4}$	CL=90%
Γ_{17}	$\pi^+\pi^- e^+ e^-$		(2.5 $^{+1.3}_{-1.0}$) $\times 10^{-3}$		
Γ_{18}	$\gamma e^+ e^-$		< 9	$\times 10^{-4}$	CL=90%
Γ_{19}	$\pi^0\gamma\gamma$		< 8	$\times 10^{-4}$	CL=90%
Γ_{20}	$4\pi^0$		< 5	$\times 10^{-4}$	CL=90%
Γ_{21}	$e^+ e^-$		< 2.1	$\times 10^{-7}$	CL=90%
Γ_{22}	invisible		< 9	$\times 10^{-4}$	CL=90%

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

Γ_{23}	$\pi^+\pi^-$	P,CP		< 2.9	$\times 10^{-3}$	CL=90%
Γ_{24}	$\pi^0\pi^0$	P,CP		< 9	$\times 10^{-4}$	CL=90%
Γ_{25}	$\pi^0 e^+ e^-$	C	[a]	< 1.4	$\times 10^{-3}$	CL=90%
Γ_{26}	$\eta e^+ e^-$	C	[a]	< 2.4	$\times 10^{-3}$	CL=90%
Γ_{27}	3γ	C		< 1.0	$\times 10^{-4}$	CL=90%
Γ_{28}	$\mu^+\mu^-\pi^0$	C	[a]	< 6.0	$\times 10^{-5}$	CL=90%
Γ_{29}	$\mu^+\mu^-\eta$	C	[a]	< 1.5	$\times 10^{-5}$	CL=90%
Γ_{30}	$e\mu$	LF		< 4.7	$\times 10^{-4}$	CL=90%

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

CONSTRAINED FIT INFORMATION

An overall fit to the total width, a partial width, 2 combinations of partial widths obtained from integrated cross section, and 16 branching ratios uses 51 measurements and one constraint to determine 7 parameters. The overall fit has a $\chi^2 = 37.1$ for 45 degrees of freedom.

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

x_2	−35					
x_3	−77	−28				
x_4	−35	−24	33			
x_5	−23	−11	23	7		
x_6	−33	−12	41	13	10	
Γ	29	−5	−21	−4	−85	−8
	x_1	x_2	x_3	x_4	x_5	x_6

	Mode	Rate (MeV)	Scale factor
Γ_1	$\pi^+\pi^-\eta$	0.091 ±0.008	1.1
Γ_2	$\rho^0\gamma$(including non-resonant $\pi^+\ \pi^-\ \gamma$)	0.060 ±0.005	1.2
Γ_3	$\pi^0\pi^0\eta$	0.042 ±0.004	1.5
Γ_4	$\omega\gamma$	0.0062 ±0.0008	1.2
Γ_5	$\gamma\gamma$	0.00430±0.00015	1.1
Γ_6	$3\pi^0$	(3.3 ±0.5) × 10^{-4}	1.1

$\eta'(958)$ PARTIAL WIDTHS

$\Gamma(\gamma\gamma)$ Γ_5

VALUE (keV)	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
4.30±0.15 OUR FIT Error includes scale factor of 1.1.					
4.28±0.19 OUR AVERAGE					
4.17±0.10±0.27	2000	[4] ACCIARRI	98Q	L3	$e^+e^- \to e^+e^-\pi^+\pi^-\gamma$
4.53±0.29±0.51	266	KARCH	92	CBAL	$e^+e^- \to e^+e^-\eta\pi^0\pi^0$
3.61±0.13±0.48		[5] BEHREND	91	CELL	$e^+e^- \to e^+e^-\eta'(958)$
4.6 ±1.1 ±0.6	23	BARU	90	MD1	$e^+e^- \to e^+e^-\pi^+\pi^-\gamma$
4.57±0.25±0.44		BUTLER	90	MRK2	$e^+e^- \to e^+e^-\eta'(958)$
5.08±0.24±0.71	547	[6] ROE	90	ASP	$e^+e^- \to e^+e^-2\gamma$
3.8 ±0.7 ±0.6	34	AIHARA	88C	TPC	$e^+e^- \to e^+e^-\eta\pi^+\pi^-$
4.9 ±0.5 ±0.5	136	[7] WILLIAMS	88	CBAL	$e^+e^- \to e^+e^-2\gamma$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
4.7 ±0.6 ±0.9	143	[8] GIDAL	87	MRK2	$e^+e^- \to e^+e^-\eta\pi^+\pi^-$
4.0 ±0.9		[9] BARTEL	85E	JADE	$e^+e^- \to e^+e^-2\gamma$

[4] No non-resonant $\pi^+\pi^-$ contribution found.
[5] Reevaluated by us using B($\eta' \to \rho(770)\gamma$) = (30.2 ± 1.3)%.
[6] Reevaluated by us using B($\eta' \to \gamma\gamma$) = (2.11 ± 0.13)%.
[7] Reevaluated by us using B($\eta' \to \gamma\gamma$) = (2.11 ± 0.13)%.
[8] Superseded by BUTLER 90.
[9] Systematic error not evaluated.

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

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

Γ($\gamma\gamma$) × Γ($\rho^0\gamma$(including non-resonant $\pi^+\pi^-\gamma$))/Γ$_{total}$ — Γ$_5$Γ$_2$/Γ

VALUE (keV)	EVTS	DOCUMENT ID		TECN	COMMENT
1.26±0.05 OUR FIT Error includes scale factor of 1.1.					
1.26±0.07 OUR AVERAGE Error includes scale factor of 1.2.					
1.09±0.04±0.13		BEHREND	91	CELL	$e^+e^- \to e^+e^-\rho(770)^0\gamma$
1.35±0.09±0.21		AIHARA	87	TPC	$e^+e^- \to e^+e^-\rho\gamma$
1.13±0.04±0.13	867	ALBRECHT	87B	ARG	$e^+e^- \to e^+e^-\rho\gamma$
1.53±0.09±0.21		ALTHOFF	84E	TASS	$e^+e^- \to e^+e^-\rho\gamma$
1.14±0.08±0.11	243	BERGER	84B	PLUT	$e^+e^- \to e^+e^-\rho\gamma$
1.73±0.34±0.35	95	JENNI	83	MRK2	$e^+e^- \to e^+e^-\rho\gamma$
1.49±0.13±0.027	213	BARTEL	82B	JADE	$e^+e^- \to e^+e^-\rho\gamma$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
1.85±0.31±0.24	43	BEHREND	83B	CELL	$e^+e^- \to e^+e^-\rho\gamma$

Γ($\gamma\gamma$) × Γ($\pi^0\pi^0\eta$)/Γ$_{total}$ — Γ$_5$Γ$_3$/Γ

VALUE (keV)	DOCUMENT ID		TECN	COMMENT
0.89±0.06 OUR FIT Error includes scale factor of 1.2.				
0.92±0.06±0.11	[10] KARCH	92	CBAL	$e^+e^- \to e^+e^-\eta\pi^0\pi^0$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.95±0.05±0.08	[11] KARCH	90	CBAL	$e^+e^- \to e^+e^-\eta\pi^0\pi^0$
1.00±0.08±0.10	[11,12] ANTREASYAN	87	CBAL	$e^+e^- \to e^+e^-\eta\pi^0\pi^0$

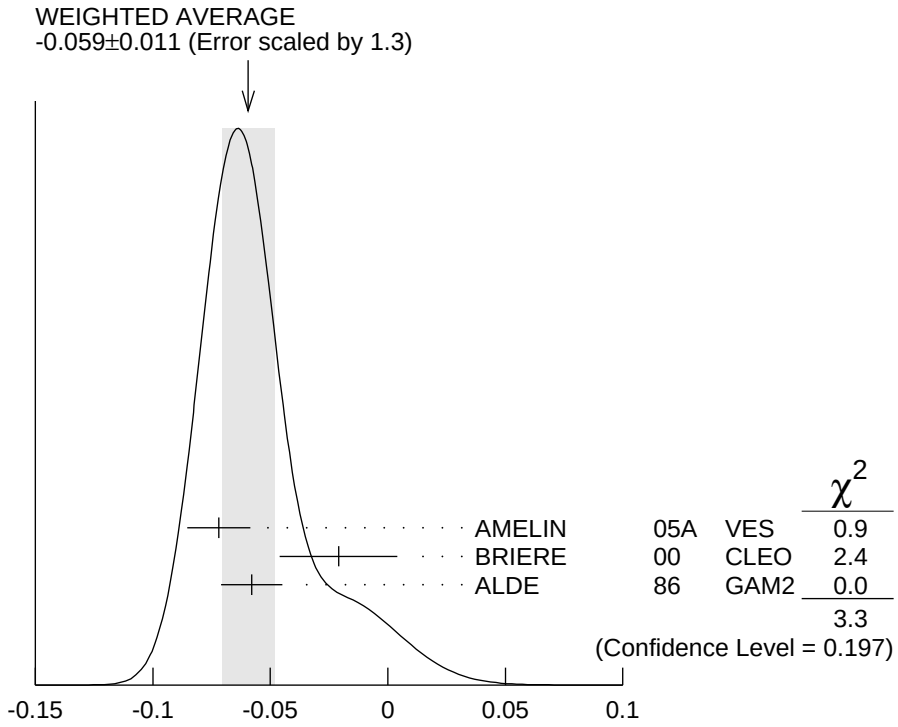
[10] Reevaluated by us using B($\eta \to \gamma\gamma$) = (39.21 ± 0.34)%. Supersedes ANTREASYAN 87 and KARCH 90.
[11] Superseded by KARCH 92.
[12] Using BR($\eta \to 2\gamma$)=(38.9 ± 0.5)%.

$\eta'(958)$ DECAY PARAMETERS
|MATRIX ELEMENT|^2 = |1 + αy|^2 + cx + dx^2

α decay parameter

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
−0.059±0.011 OUR AVERAGE Error includes scale factor of 1.3. See the ideogram below.					
−0.072±0.012±0.006	7k	[13] AMELIN	05A	VES	28 $\pi^- A \to \eta'\pi^- A^*$
−0.021±0.025	6.7k	[14] BRIERE	00	CLEO	10.6 $e^+e^- \to$ hadrons
−0.058±0.013		[15,16] ALDE	86	GAM2	38 $\pi^- p \to n\eta 2\pi^0$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
−0.08 ±0.03		[15,16] KALBFLEISCH	74	RVUE	$\eta' \to \eta\pi^+\pi^-$

[13] This is a real part of α while Im(α) = 0.0 ± 0.1 ± 0.0.
[14] Assuming Im(α) = 0, $c = 0$, and $d = 0$.
[15] May not necessarily be the same for $\eta' \to \eta\pi^+\pi^-$ and $\eta' \to \eta\pi^0\pi^0$.
[16] Assuming Im(α) = 0, $c = 0$.



c C-violating decay parameter

VALUE	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
0.015±0.011±0.014	20k	[17] DOROFEEV	07	VES	27 $\pi^- p \to \eta' n$ and $\pi^- A \to \eta' \pi^- A^*$

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

0.020±0.018±0.004	7k	AMELIN	05A	VES	Sup. by DOROFEEV 07

[17] Using the more general parameterization $|M|^2 = 1 + aY + bY^2 + cX + dX^2$.

$\eta'(958)$ β PARAMETER
$|\text{MATRIX ELEMENT}|^2 = (1 + 2\beta Z)$

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

β decay parameter

VALUE	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
−0.46±0.22 OUR AVERAGE		Error includes scale factor of 1.4.			
−0.59±0.18	235	BLIK	08	GAMS	32 $\pi^- p \to \eta' n$
−0.1 ±0.3		ALDE	87B	GAM2	38 $\pi^- p \to n3\pi^0$

$\eta'(958)$ BRANCHING RATIOS

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

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.127±0.004 OUR FIT Error includes scale factor of 1.2.					
0.116±0.013 OUR AVERAGE					
0.123±0.014	107	RITTENBERG	69	HBC	1.7–2.7 K^-p
0.10 ±0.04	10	LONDON	66	HBC	2.24 $K^-p \to \Lambda 2\pi^+2\pi^-\pi^0$
0.07 ±0.04	7	BADIER	65B	HBC	3 K^-p

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

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.318±0.010 OUR FIT Error includes scale factor of 1.2.					
0.314±0.026	281	RITTENBERG	69	HBC	1.7–2.7 K^-p

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

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.294±0.009 OUR FIT Error includes scale factor of 1.1.					
0.319±0.030 OUR AVERAGE					
0.329±0.033	298	RITTENBERG	69	HBC	1.7–2.7 K^-p
0.2 ±0.1	20	LONDON	66	HBC	2.24 $K^-p \to \Lambda\pi^+\pi^-\gamma$
0.34 ±0.09	35	BADIER	65B	HBC	3 K^-p

$\Gamma(\pi^+\pi^-\eta)/\Gamma(\rho^0\gamma(\text{including non-resonant } \pi^+\pi^-\gamma))$ Γ_1/Γ_2

VALUE	DOCUMENT ID		TECN	COMMENT
1.45±0.07	ABLIKIM	06E	BES2	$J/\psi \to \eta'\gamma$

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

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.92±0.05 OUR FIT Error includes scale factor of 1.1.					
0.97±0.09 OUR AVERAGE					
0.70±0.22		AMSLER	04B	CBAR	0 $\overline{p}p \to \pi^+\pi^-\eta$
1.07±0.17		BELADIDZE	92C	VES	36 π^- Be $\to \pi^-\eta'\eta$ Be
0.92±0.14	473	DANBURG	73	HBC	2.2 $K^-p \to \Lambda X^0$
1.11±0.18	192	JACOBS	73	HBC	2.9 $K^-p \to \Lambda X^0$

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

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

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

VALUE	DOCUMENT ID		TECN	COMMENT
0.450±0.020 OUR FIT Error includes scale factor of 1.1.				
0.426±0.028 OUR AVERAGE				
0.43 ±0.02 ±0.02	BARBERIS	98C	OMEG	450 $pp \to p_f\eta' p_s$
0.31 ±0.15	DAVIS	68	HBC	5.5 K^-p

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

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.068±0.008 OUR FIT	Error includes scale factor of 1.1.				
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
0.146±0.014 OUR FIT				
0.147±0.016	ALDE	87B	GAM2	38 $\pi^- p \rightarrow n4\gamma$

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

VALUE	DOCUMENT ID		TECN	COMMENT
0.430±0.019 OUR FIT	Error includes scale factor of 1.1.			
0.25 ±0.14	DAUBER	64	HBC	1.95 $K^- p$

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

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.086±0.005 OUR FIT	Error includes scale factor of 1.2.				
0.045±0.029	42	RITTENBERG	69	HBC	1.7–2.7 $K^- p$

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

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.404±0.007 OUR FIT	Error includes scale factor of 1.1.				
0.36 ±0.05 OUR AVERAGE					
0.4 ±0.1	39	LONDON	66	HBC	2.24 $K^- p \rightarrow \Lambda\pi^+\pi^-$ neutrals
0.35 ±0.06	33	BADIER	65B	HBC	3 $K^- p$

$\Gamma(\gamma\gamma)/\Gamma_{total}$ Γ_5/Γ

VALUE (units 10^{-2})	EVTS	DOCUMENT ID		TECN	COMMENT
2.10±0.12 OUR FIT	Error includes scale factor of 1.2.				
1.97±0.13 OUR AVERAGE					
$2.00^{+0.31}_{-0.27}\pm0.07$	114	[18] WICHT	08	BELL	$B^\pm \rightarrow K^\pm\gamma\gamma$
2.00±0.18		[19] STANTON	80	SPEC	8.45 $\pi^- p \rightarrow n\pi^+\pi^- 2\gamma$
2.5 ±0.7		DUANE	74	MMS	$\pi^- p \rightarrow n$MM
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 $\pi^- p \rightarrow nX^0$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
1.8 ±0.2	6000	[20] APEL	79	NICE	15–40 $\pi^- p \rightarrow n2\gamma$

[18] WICHT 08 reports $[\Gamma(\eta'(958) \rightarrow \gamma\gamma)/\Gamma_{total}] \times [B(B^+ \rightarrow \eta' K^+)] = (1.40^{+0.16+0.15}_{-0.15-0.12}) \times 10^{-6}$. We divide by our best value $B(B^+ \rightarrow \eta' K^+) = (7.00 \pm 0.24) \times 10^{-5}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

[19] Includes APEL 79 result.

[20] Data is included in STANTON 80 evaluation.

$\Gamma(\gamma\gamma)/\Gamma(\rho^0\gamma$(including non-resonant $\pi^+\pi^-\gamma$)) Γ_5/Γ_2

VALUE	DOCUMENT ID		TECN	COMMENT
0.080±0.008	ABLIKIM	06E	BES2	$J/\psi \to \eta'\gamma$

$\Gamma(\gamma\gamma)/\Gamma(\pi^0\pi^0\eta)$ Γ_5/Γ_3

VALUE	DOCUMENT ID		TECN	COMMENT
0.101±0.007 OUR FIT Error includes scale factor of 1.5.				
0.105±0.010 OUR AVERAGE Error includes scale factor of 1.9.				
0.091±0.009	AMSLER	93	CBAR	0.0 $\overline{p}p$
0.112±0.002±0.006	ALDE	87B	GAM2	38 $\pi^- p \to n2\gamma$

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

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.142±0.010 OUR FIT Error includes scale factor of 1.5.					
0.188±0.058	16	APEL	72	OSPK	3.8 $\pi^- p \to nX^0$

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

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.172±0.009 OUR FIT Error includes scale factor of 1.2.					
0.187±0.017 OUR AVERAGE					
0.185±0.022	535	BASILE	71	CNTR	1.6 $\pi^- p \to nX^0$
0.189±0.026	123	RITTENBERG	69	HBC	1.7–2.7 $K^- p$

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

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

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

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

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

VALUE (units 10^{-3})	CL%		DOCUMENT ID		TECN	COMMENT
<0.5	90	[21]	NAIK	09	CLEO	$J/\psi \to \gamma\eta'$

[21] NAIK 09 reports $[\Gamma(\eta'(958) \to \pi^+\pi^-\mu^+\mu^-)/\Gamma(\eta'(958) \to \pi^+\pi^-\eta)]$ / $[B(\eta \to 2\gamma)] < 1.3 \times 10^{-3}$. We multiply by our best value $B(\eta \to 2\gamma) = 39.30 \times 10^{-2}$.

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

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

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

VALUE (units 10^{-3})	EVTS	DOCUMENT ID		TECN	COMMENT
$\mathbf{8.25^{+2.49}_{-2.12}\pm0.04}$	20	[22] NAIK	09	CLEO	$J/\psi \to \gamma\eta'$

[22] NAIK 09 reports $[\Gamma(\eta'(958) \to \pi^+\pi^-\pi^0)/\Gamma(\eta'(958) \to \pi^+\pi^-\eta)]$ / $[B(\eta \to 2\gamma)] = (21^{+6}_{-5}\pm2)\times10^{-3}$. We multiply by our best value $B(\eta \to 2\gamma) = (39.30\pm0.20)\times10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

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

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

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

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<0.01	90	RITTENBERG	69	HBC	1.7–2.7 K^-p

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

VALUE (units 10^{-3})	CL%	DOCUMENT ID		TECN	COMMENT
<0.6	90	[23] NAIK	09	CLEO	$J/\psi \to \gamma\eta'$

[23] NAIK 09 reports $[\Gamma(\eta'(958) \to 2(\pi^+\pi^-))/\Gamma(\eta'(958) \to \pi^+\pi^-\eta)]$ / $[B(\eta \to 2\gamma)] < 1.4\times10^{-3}$. We multiply by our best value $B(\eta \to 2\gamma) = 39.30\times10^{-2}$.

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

VALUE (units 10^{-3})	CL%	DOCUMENT ID		TECN	COMMENT
<6	90	[24] NAIK	09	CLEO	$J/\psi \to \gamma\eta'$

[24] NAIK 09 reports $[\Gamma(\eta'(958) \to \pi^+\pi^-2\pi^0)/\Gamma(\eta'(958) \to \pi^+\pi^-\eta)]$ / $[B(\eta \to 2\gamma)] < 15\times10^{-3}$. We multiply by our best value $B(\eta \to 2\gamma) = 39.30\times10^{-2}$.

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

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.01	95	DANBURG	73	HBC	2.2 $K^-p \to \Lambda X^0$
• • • 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. • • •					
<0.01	90	RITTENBERG	69	HBC	1.7–2.7 K^-p

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

VALUE (units 10^{-3})	CL%	DOCUMENT ID		TECN	COMMENT
<4	90	[25] NAIK	09	CLEO	$J/\psi \to \gamma\eta'$

[25] NAIK 09 reports $[\Gamma(\eta'(958) \to 2(\pi^+\pi^-)\pi^0)/\Gamma(\eta'(958) \to \pi^+\pi^-\eta)]$ / $[B(\eta \to 2\gamma)] < 11\times10^{-3}$. We multiply by our best value $B(\eta \to 2\gamma) = 39.30\times10^{-2}$.

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

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

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

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

<5	95	KALBFLEISCH	64B	HBC	$K^- p \rightarrow \Lambda 2(\pi^+\pi^-)$

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

VALUE (units 10^{-3})	CL%	DOCUMENT ID		TECN	COMMENT
<1.2	90	[26] NAIK	09	CLEO	$J/\psi \rightarrow \gamma\eta'$

[26] NAIK 09 reports $[\Gamma(\eta'(958) \rightarrow 3(\pi^+\pi^-))/\Gamma(\eta'(958) \rightarrow \pi^+\pi^-\eta)]$ / $[B(\eta \rightarrow 2\gamma)] < 3.0 \times 10^{-3}$. We multiply by our best value $B(\eta \rightarrow 2\gamma) = 39.30 \times 10^{-2}$.

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

VALUE	CL%	DOCUMENT ID		TECN	COMMENT

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

<0.006	90	RITTENBERG	65	HBC	2.7 $K^- p$

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

VALUE (units 10^{-3})	EVTS	DOCUMENT ID		TECN	COMMENT
$\mathbf{5.50^{+2.99}_{-2.29} \pm 0.03}$	8	[27] NAIK	09	CLEO	$J/\psi \rightarrow \gamma\eta'$

[27] NAIK 09 reports $[\Gamma(\eta'(958) \rightarrow \pi^+\pi^- e^+ e^-)/\Gamma(\eta'(958) \rightarrow \pi^+\pi^-\eta)]$ / $[B(\eta \rightarrow 2\gamma)] = (14^{+7}_{-5} \pm 3) \times 10^{-3}$. We multiply by our best value $B(\eta \rightarrow 2\gamma) = (39.30 \pm 0.20) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

$\Gamma(\gamma e^+ e^-)/\Gamma_{total}$ Γ_{18}/Γ

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

$\Gamma(\pi^0\gamma\gamma)/\Gamma(\pi^0\pi^0\eta)$ Γ_{19}/Γ_3

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

$\Gamma(4\pi^0)/\Gamma(\pi^0\pi^0\eta)$ Γ_{20}/Γ_3

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

$\Gamma(e^+ e^-)/\Gamma_{total}$ Γ_{21}/Γ

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

$\Gamma(\text{invisible})/\Gamma(\gamma\gamma)$ Γ_{22}/Γ_5

VALUE (units 10^{-2})	CL%	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<6.69	90	ABLIKIM	06Q	BES	$J/\psi \to \phi\eta'$

$\Gamma(\text{invisible})/\Gamma(\pi^+\pi^-\eta)$ Γ_{22}/Γ_1

VALUE (units 10^{-3})	CL%	DOCUMENT ID		TECN	COMMENT
<2.1	90	[28] NAIK	09	CLEO	$J/\psi \to \gamma\eta'$

[28] NAIK 09 reports $[\Gamma(\eta'(958) \to \text{invisible})/\Gamma(\eta'(958) \to \pi^+\pi^-\eta)]$ / $[B(\eta \to 2\gamma)]$ $< 5.4 \times 10^{-3}$. We multiply by our best value $B(\eta \to 2\gamma) = 39.30 \times 10^{-2}$.

$\Gamma(\pi^+\pi^-)/\Gamma_{\text{total}}$ Γ_{23}/Γ

VALUE (units 10^{-4})	CL%	DOCUMENT ID		TECN	COMMENT
< 29	90	[29] MORI	07A	BELL	$\gamma\gamma \to \pi^+\pi^-$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
< 3.3	90	[30] MORI	07A	BELL	$\gamma\gamma \to \pi^+\pi^-$
<800	95	DANBURG	73	HBC	2.2 $K^- p \to \Lambda X^0$
<200	90	RITTENBERG	69	HBC	1.7–2.7 $K^- p$

[29] Taking into account interference with the $\gamma\gamma \to \pi^+\pi^-$ continuum.
[30] Without interference with the $\gamma\gamma \to \pi^+\pi^-$ continuum.

$\Gamma(\pi^0\pi^0)/\Gamma(\pi^0\pi^0\eta)$ Γ_{24}/Γ_3

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

$\Gamma(\pi^0 e^+ e^-)/\Gamma_{\text{total}}$ Γ_{25}/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 $K^- p$

$\Gamma(\eta e^+ e^-)/\Gamma_{\text{total}}$ Γ_{26}/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 $K^- p$

$\Gamma(3\gamma)/\Gamma(\pi^0\pi^0\eta)$ Γ_{27}/Γ_3

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

$\Gamma(\mu^+\mu^-\pi^0)/\Gamma_{\text{total}}$ Γ_{28}/Γ

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

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

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

$\Gamma(e\mu)/\Gamma_{total}$ Γ_{30}/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
-0.01 ± 0.04 OUR AVERAGE					
-0.019 ± 0.056		AIHARA	87	TPC	$2\gamma \rightarrow \pi^+\pi^-\gamma$
-0.069 ± 0.078	295	GRIGORIAN	75	STRC	2.1 $\pi^- p$
0.00 ± 0.10	103	KALBFLEISCH	75	HBC	2.18 $K^- p \rightarrow \Lambda\pi^+\pi^-\gamma$
0.07 ± 0.08	152	RITTENBERG	65	HBC	2.1–2.7 $K^- p$

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BLIK	08	PAN 71 2124	A. Blik *et al.*	(GAMS-4π Collab.)
		Translated from YAF 71 2161.		
LIBBY	08	PRL 101 182002	J. Libby *et al.*	(CLEO Collab.)
WICHT	08	PL B662 323	J. Wicht *et al.*	(BELLE Collab.)
DOROFEEV	07	PL B651 22	V. Dorofeev *et al.*	(VES Collab.)
MORI	07A	JPSJ 76 074102	T. Mori *et al.*	(BELLE Collab.)
ABLIKIM	06E	PR D73 052008	M. Ablikim *et al.*	(BES Collab.)
ABLIKIM	06Q	PRL 97 202002	M. Ablikim *et al.*	(BES Collab.)
AMELIN	05A	PAN 68 372	D.V. Amelin *et al.*	(VES Collab.)
		Translated from YAF 68 401.		
AMSLER	04B	EPJ C33 23	C. Amsler *et al.*	(Crystal Barrel Collab.)
BAI	04J	PL B594 47	J.Z. Bai *et al.*	(BES Collab.)
BRIERE	00	PRL 84 26	R. Briere *et al.*	(CLEO Collab.)
ACCIARRI	98Q	PL B418 399	M. Acciarri *et al.*	(L3 Collab.)
BARBERIS	98C	PL B440 225	D. Barberis *et al.*	(WA 102 Collab.)
WURZINGER	96	PL B374 283	R. Wurzinger *et al.*	(BONN, ORSAY, SACL+)
PDG	94	PR D50 1173	L. Montanet *et al.*	(CERN, LBL, BOST+)
AMSLER	93	ZPHY C58 175	C. Amsler *et al.*	(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 *et al.*	(Crystal Ball Collab.)
ARMSTRONG	91B	ZPHY C52 389	T.A. Armstrong *et al.*	(ATHU, BARI, BIRM+)
BEHREND	91	ZPHY C49 401	H.J. Behrend *et al.*	(CELLO Collab.)
AUGUSTIN	90	PR D42 10	J.E. Augustin *et al.*	(DM2 Collab.)
BARU	90	ZPHY C48 581	S.E. Baru *et al.*	(MD-1 Collab.)
BUTLER	90	PR D42 1368	F. Butler *et al.*	(Mark II Collab.)
KARCH	90	PL B249 353	K. Karch *et al.*	(Crystal Ball Collab.)
ROE	90	PR D41 17	N.A. Roe *et al.*	(ASP Collab.)
AIHARA	88C	PR D38 1	H. Aihara *et al.*	(TPC-2γ Collab.)
VOROBYEV	88	SJNP 48 273	P.V. Vorobiev *et al.*	(NOVO)
		Translated from YAF 48 436.		
WILLIAMS	88	PR D38 1365	D.A. Williams *et al.*	(Crystal Ball Collab.)
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ALBRECHT	87B	PL B199 457	H. Albrecht *et al.*	(ARGUS Collab.)
ALDE	87B	ZPHY C36 603	D.M. Alde *et al.*	(LANL, BELG, SERP, LAPP)
ANTREASYAN	87	PR D36 2633	D. Antreasyan *et al.*	(Crystal Ball Collab.)

GIDAL	87	PRL 59 2012	G. Gidal *et al.*	(LBL, SLAC, HARV)
ALDE	86	PL B177 115	D.M. Alde *et al.*	(SERP, BELG, LANL, LAPP)
BARTEL	85E	PL 160B 421	W. Bartel *et al.*	(JADE Collab.)
ALTHOFF	84E	PL 147B 487	M. Althoff *et al.*	(TASSO Collab.)
BERGER	84B	PL 142B 125	C. Berger	(PLUTO Collab.)
BINON	84	PL 140B 264	F.G. Binon *et al.*	(SERP, BELG, LAPP+)
BEHREND	83B	PL 125B 518 (erratum)	H.J. Behrend *et al.*	(CELLO Collab.)
Also		PL 114B 378	H.J. Behrend *et al.*	(CELLO Collab.)
JENNI	83	PR D27 1031	P. Jenni *et al.*	(SLAC, LBL)
BARTEL	82B	PL 113B 190	W. Bartel *et al.*	(JADE Collab.)
DZHELYADIN	81	PL 105B 239	R.I. Dzhelyadin *et al.*	(SERP)
STANTON	80	PL B92 353	N.R. Stanton *et al.*	(OSU, CARL, MCGI+)
VIKTOROV	80	SJNP 32 520	V.A. Viktorov *et al.*	(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 *et al.*	(LOIC)
ZANFINO	77	PRL 38 930	C. Zanfino *et al.*	(CARL, MCGI, OHIO+)
GRIGORIAN	75	NP B91 232	A. Grigorian *et al.*	(+)
KALBFLEISCH	75	PR D11 987	G.R. Kalbfleisch, R.C. Strand, J.W. Chapman	(BNL+)
DUANE	74	PRL 32 425	A. Duane *et al.*	(LOIC, SHMP)
KALBFLEISCH	74	PR D10 916	G.R. Kalbfleisch	(BNL)
DANBURG	73	PR D8 3744	J.S. Danburg *et al.*	(BNL, MICH) JP
JACOBS	73	PR D8 18	S.M. Jacobs *et al.*	(BRAN, UMD, SYRA+) JP
APEL	72	PL 40B 680	W.D. Apel *et al.*	(KARLK, KARLE, PISA)
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BASILE	71	NC 3A 371	M. Basile *et al.*	(CERN, BGNA, STRB)
HARVEY	71	PRL 27 885	E.H. Harvey *et al.*	(MINN, MICH)
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