

$f_2(1270)$

$$I^G(J^{PC}) = 0^+(2^{++})$$

 $f_2(1270)$ MASS

VALUE (MeV)	EVTS	DOCUMENT ID	TECN	COMMENT
1275.5 ± 0.8 OUR AVERAGE				
1275.8 ± 1.0 ± 0.4		¹ BOGOLYUB...	13 SPEC	$7\pi^+(K^+, p)A \rightarrow n\gamma + X$
1262 $\begin{smallmatrix} + \\ - \end{smallmatrix} \frac{1}{2} \pm 8$		² ABLIKIM	06v BES2	$e^+e^- \rightarrow J/\psi \rightarrow \gamma\pi^+\pi^-$
1275 ± 15		ABLIKIM	05 BES2	$J/\psi \rightarrow \phi\pi^+\pi^-$
1283 ± 5		ALDE	98 GAM4	$100\pi^-p \rightarrow \pi^0\pi^0n$
1278 ± 5		³ BERTIN	97c OBLX	$0.0\bar{p}p \rightarrow \pi^+\pi^-\pi^0$
1272 ± 8	200k	PROKOSHKIN	94 GAM2	$38\pi^-p \rightarrow \pi^0\pi^0n$
1269.7 ± 5.2	5730	AUGUSTIN	89 DM2	$e^+e^- \rightarrow 5\pi$
1283 ± 8	400	⁴ ALDE	87 GAM4	$100\pi^-p \rightarrow 4\pi^0n$
1274 ± 5		⁴ AUGUSTIN	87 DM2	$J/\psi \rightarrow \gamma\pi^+\pi^-$
1283 ± 6		⁵ LONGACRE	86 MPS	$22\pi^-p \rightarrow n2K_S^0$
1276 ± 7		COURAU	84 DLCO	$e^+e^- \rightarrow e^+e^-\pi^+\pi^-$
1273.3 ± 2.3		⁶ CHABAUD	83 ASPK	$17\pi^-p$ polarized
1280 ± 4		⁷ CASON	82 STRC	$8\pi^+p \rightarrow \Delta^{++}\pi^0\pi^0$
1281 ± 7	11600	GIDAL	81 MRK2	J/ψ decay
1282 ± 5		⁸ CORDEN	79 OMEG	$12-15\pi^-p \rightarrow n2\pi$
1269 ± 4	10k	APEL	75 NICE	$40\pi^-p \rightarrow n2\pi^0$
1272 ± 4	4600	ENGLER	74 DBC	$6\pi^+n \rightarrow \pi^+\pi^-p$
1277 ± 4	5300	FLATTE	71 HBC	$7.0\pi^+p$
1273 ± 8		⁴ STUNTEBECK	70 HBC	$8\pi^-p, 5.4\pi^+d$
1265 ± 8		BOESEBECK	68 HBC	$8\pi^+p$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
1259 ± 4 ± 4	1.7k	^{9,10} DOBBS	15	$J/\psi \rightarrow \gamma\pi^+\pi^-$
1267 ± 4 ± 3	1.5k	^{9,10} DOBBS	15	$\psi(2S) \rightarrow \gamma\pi^+\pi^-$
1270 ± 8		¹¹ ANISOVICH	09 RVUE	$0.0\bar{p}p, \pi N$
1277 ± 6	870	¹² SCHEGELSKY	06A RVUE	$\gamma\gamma \rightarrow K_S^0 K_S^0$
1251 ± 10		TIKHOMIROV	03 SPEC	$40.0\pi^-C \rightarrow K_S^0 K_S^0 K_L^0 X$
1260 ± 10		¹³ ALDE	97 GAM2	$450pp \rightarrow pp\pi^0\pi^0$
1278 ± 6		¹³ GRYGOREV	96 SPEC	$40\pi^-N \rightarrow K_S^0 K_S^0 X$
1262 ± 11		AGUILAR-...	91 EHS	$400pp$
1275 ± 10		AKER	91 CBAR	$0.0\bar{p}p \rightarrow 3\pi^0$
1220 ± 10		BREAKSTONE	90 SFM	$pp \rightarrow pp\pi^+\pi^-$
1288 ± 12		ABACHI	86B HRS	$e^+e^- \rightarrow \pi^+\pi^-X$
1284 ± 30	3k	BINON	83 GAM2	$38\pi^-p \rightarrow n2\eta$
1280 ± 20	3k	APEL	82 CNTR	$25\pi^-p \rightarrow n2\pi^0$
1284 ± 10	16000	DEUTSCH...	76 HBC	$16\pi^+p$
1258 ± 10	600	TAKAHASHI	72 HBC	$8\pi^-p \rightarrow n2\pi$
1275 ± 13		ARMENISE	70 HBC	$9\pi^+n \rightarrow p\pi^+\pi^-$
1261 ± 5	1960	⁴ ARMENISE	68 DBC	$5.1\pi^+n \rightarrow p\pi^+MM^-$
1270 ± 10	360	⁴ ARMENISE	68 DBC	$5.1\pi^+n \rightarrow p\pi^0MM$
1268 ± 6		¹⁴ JOHNSON	68 HBC	$3.7-4.2\pi^-p$

- ¹ Averaged over six nuclear targets, no statistically significant dependence on target nucleus observed.
- ² Breit-Wigner mass.
- ³ T-matrix pole.
- ⁴ Mass errors enlarged by us to Γ/\sqrt{N} ; see the note with the $K^*(892)$ mass.
- ⁵ From a partial-wave analysis of data using a K-matrix formalism with 5 poles.
- ⁶ From an energy-independent partial-wave analysis.
- ⁷ From an amplitude analysis of the reaction $\pi^+\pi^-\rightarrow 2\pi^0$.
- ⁸ From an amplitude analysis of $\pi^+\pi^-\rightarrow \pi^+\pi^-$ scattering data.
- ⁹ Using CLEO-c data but not authored by the CLEO Collaboration.
- ¹⁰ From a fit to a Breit-Wigner line shape with fixed $\Gamma = 185$ MeV.
- ¹¹ 4-poles, 5-channel K matrix fit.
- ¹² From analysis of L3 data at 91 and 183–209 GeV.
- ¹³ Systematic uncertainties not estimated.
- ¹⁴ JOHNSON 68 includes BONDAR 63, LEE 64, DERADO 65, EISNER 67.

$f_2(1270)$ WIDTH

VALUE (MeV)	EVTS	DOCUMENT ID	TECN	COMMENT
$186.7^{+2.2}_{-2.5}$ OUR FIT		Error includes scale factor of 1.4.		
$185.9^{+2.8}_{-2.1}$ OUR AVERAGE		Error includes scale factor of 1.6. See the ideogram below.		
$190.3 \pm 1.9 \pm 1.8$		¹ BOGOLYUB...	13 SPEC	$7\pi^+(K^+,p)A \rightarrow n\gamma + X$
$175^{+6}_{-4} \pm 10$		² ABLIKIM	06v BES2	$e^+e^- \rightarrow J/\psi \rightarrow \gamma\pi^+\pi^-$
190 ± 20		ABLIKIM	05 BES2	$J/\psi \rightarrow \phi\pi^+\pi^-$
171 ± 10		ALDE	98 GAM4	$100\pi^-p \rightarrow \pi^0\pi^0n$
204 ± 20		³ BERTIN	97c OBLX	$0.0\bar{p}p \rightarrow \pi^+\pi^-\pi^0$
192 ± 5	200k	PROKOSHKIN	94 GAM2	$38\pi^-p \rightarrow \pi^0\pi^0n$
180 ± 24		AGUILAR-...	91 EHS	$400pp$
169 ± 9	5730	⁴ AUGUSTIN	89 DM2	$e^+e^- \rightarrow 5\pi$
150 ± 30	400	⁴ ALDE	87 GAM4	$100\pi^-p \rightarrow 4\pi^0n$
186^{+9}_{-2}		⁵ LONGACRE	86 MPS	$22\pi^-p \rightarrow n2K_S^0$
$179.2^{+6.9}_{-6.6}$		⁶ CHABAUD	83 ASPK	$17\pi^-p$ polarized
160 ± 11		DENNEY	83 LASS	$10\pi^+N$
196 ± 10	3k	APEL	82 CNTR	$25\pi^-p \rightarrow n2\pi^0$
152 ± 9		⁷ CASON	82 STRC	$8\pi^+p \rightarrow \Delta^{++}\pi^0\pi^0$
186 ± 27	11600	GIDAL	81 MRK2	J/ψ decay
216 ± 13		⁸ CORDEN	79 OMEG	$12-15\pi^-p \rightarrow n2\pi$
190 ± 10	10k	APEL	75 NICE	$40\pi^-p \rightarrow n2\pi^0$
192 ± 16	4600	ENGLER	74 DBC	$6\pi^+n \rightarrow \pi^+\pi^-p$
183 ± 15	5300	FLATTE	71 HBC	$7\pi^+p \rightarrow \Delta^{++}f_2$
196 ± 30		⁴ STUNTEBECK	70 HBC	$8\pi^-p, 5.4\pi^+d$
216 ± 20	1960	⁴ ARMENISE	68 DBC	$5.1\pi^+n \rightarrow p\pi^+MM^-$
128 ± 27		⁴ BOESEBECK	68 HBC	$8\pi^+p$
176 ± 21		^{4,9} JOHNSON	68 HBC	$3.7-4.2\pi^-p$

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

194	±36		¹⁰	ANISOVICH	09	RVUE	0.0	$\bar{p}p, \pi N$
195	±15	870	¹¹	SCHEGELSKY	06A	RVUE	$\gamma\gamma \rightarrow K_S^0 K_S^0$	
121	±26			TIKHOMIROV	03	SPEC	$40.0 \pi^- C \rightarrow K_S^0 K_S^0 K_L^0 X$	
187	±20		¹²	ALDE	97	GAM2	$450 pp \rightarrow pp\pi^0\pi^0$	
184	±10		¹²	GRYGOREV	96	SPEC	$40 \pi^- N \rightarrow K_S^0 K_S^0 X$	
200	±10			AKER	91	CBAR	$0.0 \bar{p}p \rightarrow 3\pi^0$	
240	±40	3k		BINON	83	GAM2	$38 \pi^- p \rightarrow n2\eta$	
187	±30	650	⁴	ANTIPOV	77	CIBS	$25 \pi^- p \rightarrow p3\pi$	
225	±38	16000		DEUTSCH...	76	HBC	$16 \pi^+ p$	
166	±28	600	⁴	TAKAHASHI	72	HBC	$8 \pi^- p \rightarrow n2\pi$	
173	±53		⁴	ARMENISE	70	HBC	$9 \pi^+ n \rightarrow p\pi^+\pi^-$	

¹ Averaged over six nuclear targets, no statistically significant dependence on target nucleus observed.

² Breit-Wigner width

³ T-matrix pole.

⁴ Width errors enlarged by us to $4\Gamma/\sqrt{N}$; see the note with the $K^*(892)$ mass.

⁵ From a partial-wave analysis of data using a K-matrix formalism with 5 poles.

⁶ From an energy-independent partial-wave analysis.

⁷ From an amplitude analysis of the reaction $\pi^+\pi^- \rightarrow 2\pi^0$.

⁸ From an amplitude analysis of $\pi^+\pi^- \rightarrow \pi^+\pi^-$ scattering data.

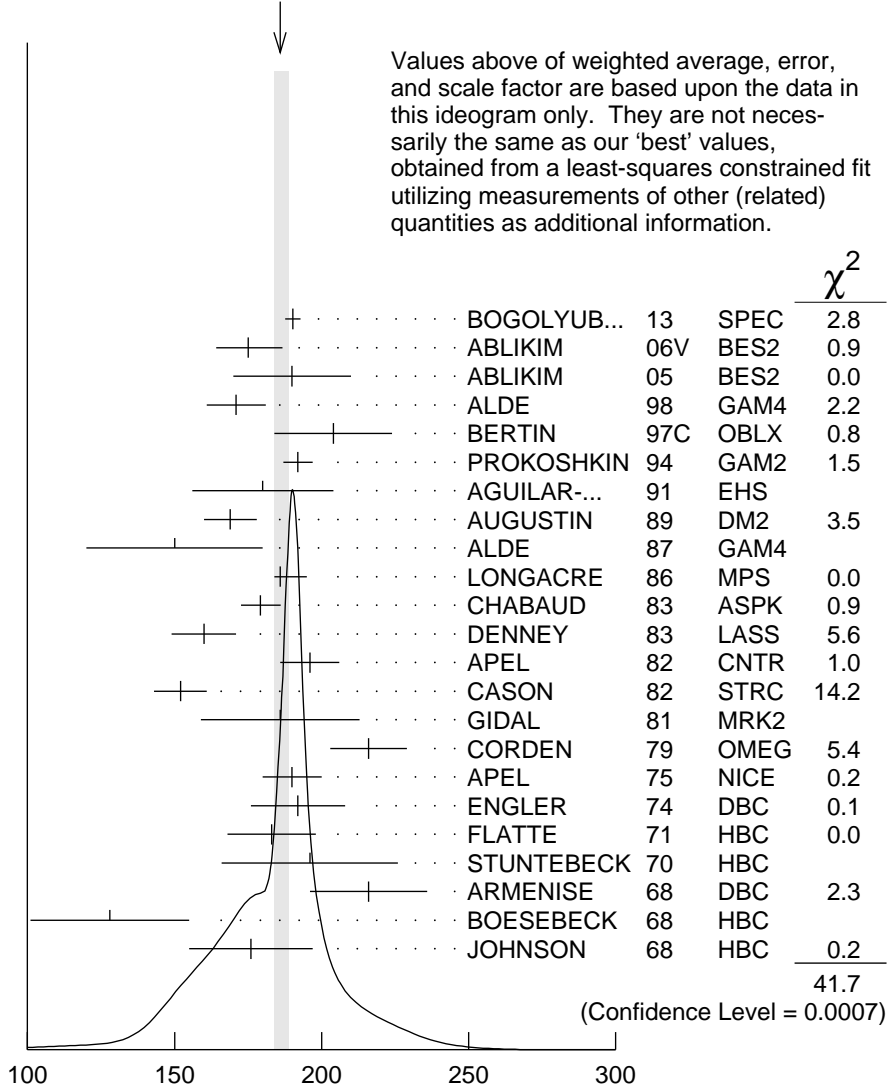
⁹ JOHNSON 68 includes BONDAR 63, LEE 64, DERADO 65, EISNER 67.

¹⁰ 4-poles, 5-channel K matrix fit.

¹¹ From analysis of L3 data at 91 and 183–209 GeV.

¹² Systematic uncertainties not estimated.

WEIGHTED AVERAGE
 $185.9 \pm 2.8 - 2.1$ (Error scaled by 1.6)



$f_2(1270)$ width (MeV)

¹ Averaged over six nuclear targets, no statistically significant dependence on target nucleus observed.

$f_2(1270)$ DECAY MODES

Mode	Fraction (Γ_j/Γ)	Scale factor/ Confidence level
Γ_1 $\pi\pi$	$(84.2^{+2.9}_{-0.9})\%$	S=1.1
Γ_2 $\pi^+\pi^-2\pi^0$	$(7.7^{+1.1}_{-3.2})\%$	S=1.2
Γ_3 $K\bar{K}$	$(4.6^{+0.5}_{-0.4})\%$	S=2.7
Γ_4 $2\pi^+2\pi^-$	$(2.8 \pm 0.4)\%$	S=1.2

Γ_5	$\eta\eta$	$(4.0 \pm 0.8) \times 10^{-3}$	S=2.1
Γ_6	$4\pi^0$	$(3.0 \pm 1.0) \times 10^{-3}$	
Γ_7	$\gamma\gamma$	$(1.42 \pm 0.24) \times 10^{-5}$	S=1.4
Γ_8	$\eta\pi\pi$	$< 8 \times 10^{-3}$	CL=95%
Γ_9	$K^0 K^- \pi^+ + \text{c.c.}$	$< 3.4 \times 10^{-3}$	CL=95%
Γ_{10}	$e^+ e^-$	$< 6 \times 10^{-10}$	CL=90%

CONSTRAINED FIT INFORMATION

An overall fit to the total width, 4 partial widths, a combination of partial widths obtained from integrated cross sections, and 6 branching ratios uses 45 measurements and one constraint to determine 8 parameters. The overall fit has a $\chi^2 = 83.0$ 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	-90						
x_3	10	-39					
x_4	10	-38	1				
x_5	1	-6	0	0			
x_6	0	-7	0	0	0		
x_7	3	1	-15	0	0	0	
Γ	-71	65	-10	-7	-1	0	-6
	x_1	x_2	x_3	x_4	x_5	x_6	x_7

Mode	Rate (MeV)	Scale factor
Γ_1 $\pi\pi$	157.2 $\begin{smallmatrix} +4.0 \\ -1.1 \end{smallmatrix}$	
Γ_2 $\pi^+ \pi^- 2\pi^0$	14.4 $\begin{smallmatrix} +2.1 \\ -6.0 \end{smallmatrix}$	1.2
Γ_3 $K\bar{K}$	8.5 ± 0.8	2.8
Γ_4 $2\pi^+ 2\pi^-$	5.2 ± 0.7	1.2
Γ_5 $\eta\eta$	0.75 ± 0.14	2.1
Γ_6 $4\pi^0$	0.56 ± 0.19	
Γ_7 $\gamma\gamma$	0.0026 ± 0.0005	1.4

$f_2(1270)$ PARTIAL WIDTHS **$\Gamma(\pi\pi)$** **Γ_1**

VALUE (MeV)	EVTS	DOCUMENT ID	TECN	COMMENT
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157.2^{+4.0}_{-1.1} OUR FIT

157.0^{+6.0}_{-1.0}		¹ LONGACRE	86	MPS	22 $\pi^- p \rightarrow n 2K_S^0$
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• • • We do not use the following data for averages, fits, limits, etc. • • •

152 ± 8	870	² SCHEGELSKY 06A		RVUE	$\gamma\gamma \rightarrow K_S^0 K_S^0$
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 $\Gamma(K\bar{K})$ **Γ_3**

VALUE (MeV)	EVTS	DOCUMENT ID	TECN	COMMENT
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8.5±0.8 OUR FIT Error includes scale factor of 2.8.

9.0^{+0.7}_{-0.3}		¹ LONGACRE	86	MPS	22 $\pi^- p \rightarrow n 2K_S^0$
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• • • We do not use the following data for averages, fits, limits, etc. • • •

7.5±2.0	870	² SCHEGELSKY 06A		RVUE	$\gamma\gamma \rightarrow K_S^0 K_S^0$
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 $\Gamma(\eta\eta)$ **Γ_5**

VALUE (MeV)	EVTS	DOCUMENT ID	TECN	COMMENT
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0.75±0.14 OUR FIT Error includes scale factor of 2.1.

1.0 ± 0.1		¹ LONGACRE	86	MPS	22 $\pi^- p \rightarrow n 2K_S^0$
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• • • We do not use the following data for averages, fits, limits, etc. • • •

1.8 ± 0.4	870	² SCHEGELSKY 06A		RVUE	$\gamma\gamma \rightarrow K_S^0 K_S^0$
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 $\Gamma(\gamma\gamma)$ **Γ_7**

The value of this width depends on the theoretical model used. Unitary approaches with scalars typically (with exception of PENNINGTON 08) give values clustering around 2.6 keV; without an *S*-wave contribution, values are systematically higher (typically around 3 keV).

VALUE (keV)	EVTS	DOCUMENT ID	TECN	COMMENT
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2.6 ± 0.5 OUR FIT Error includes scale factor of 1.4.

2.93±0.40		³ DAI	14A	RVUE	Compilation
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• • • We do not use the following data for averages, fits, limits, etc. • • •

3.14±0.20		^{4,5} PENNINGTON 08		RVUE	Compilation
3.82±0.30		^{5,6} PENNINGTON 08		RVUE	Compilation
2.55±0.15	870	² SCHEGELSKY 06A		RVUE	$\gamma\gamma \rightarrow K_S^0 K_S^0$
2.84±0.35		BOGLIONE	99	RVUE	$\gamma\gamma \rightarrow \pi^+ \pi^-, \pi^0 \pi^0$
2.93±0.23±0.32		⁷ YABUKI	95	VNS	
2.58±0.13 ^{+0.36} _{-0.27}		⁸ BEHREND	92	CELL	$e^+ e^- \rightarrow e^+ e^- \pi^+ \pi^-$
3.10±0.35±0.35		⁹ BLINOV	92	MD1	$e^+ e^- \rightarrow e^+ e^- \pi^+ \pi^-$
2.27±0.47±0.11		ADACHI	90D	TOPZ	$e^+ e^- \rightarrow e^+ e^- \pi^+ \pi^-$
3.15±0.04±0.39		BOYER	90	MRK2	$e^+ e^- \rightarrow e^+ e^- \pi^+ \pi^-$
3.19±0.16 ^{+0.29} _{-0.28}		MARSISKE	90	CBAL	$e^+ e^- \rightarrow e^+ e^- \pi^0 \pi^0$
2.35±0.65		¹⁰ MORGAN	90	RVUE	$\gamma\gamma \rightarrow \pi^+ \pi^-, \pi^0 \pi^0$

$3.19 \pm 0.09^{+0.22}_{-0.38}$	2177	OEST	90	JADE	$e^+e^- \rightarrow e^+e^-\pi^0\pi^0$
$3.2 \pm 0.1 \pm 0.4$		¹¹ AIHARA	86B	TPC	$e^+e^- \rightarrow e^+e^-\pi^+\pi^-$
$2.5 \pm 0.1 \pm 0.5$		BEHREND	84B	CELL	$e^+e^- \rightarrow e^+e^-\pi^+\pi^-$
$2.85 \pm 0.25 \pm 0.5$		¹² BERGER	84	PLUT	$e^+e^- \rightarrow e^+e^-2\pi$
$2.70 \pm 0.05 \pm 0.20$		COURAU	84	DLCO	$e^+e^- \rightarrow e^+e^-\pi^+\pi^-$
$2.52 \pm 0.13 \pm 0.38$		¹³ SMITH	84C	MRK2	$e^+e^- \rightarrow e^+e^-\pi^+\pi^-$
$2.7 \pm 0.2 \pm 0.6$		EDWARDS	82F	CBAL	$e^+e^- \rightarrow e^+e^-2\pi^0$
$2.9^{+0.6}_{-0.4} \pm 0.6$		¹⁴ EDWARDS	82F	CBAL	$e^+e^- \rightarrow e^+e^-2\pi^0$
$3.2 \pm 0.2 \pm 0.6$		BRANDELIK	81B	TASS	$e^+e^- \rightarrow e^+e^-\pi^+\pi^-$
$3.6 \pm 0.3 \pm 0.5$		ROUSSARIE	81	MRK2	$e^+e^- \rightarrow e^+e^-\pi^+\pi^-$
2.3 ± 0.8		¹⁵ BERGER	80B	PLUT	e^+e^-

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

Γ_{10}

VALUE (eV)	CL%	DOCUMENT ID	TECN	COMMENT
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<0.11 90 ACHASOV 00K SND $e^+e^- \rightarrow \pi^0\pi^0$

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

<1.7 90 VOROBYEV 88 ND $e^+e^- \rightarrow \pi^0\pi^0$

¹ From a partial-wave analysis of data using a K-matrix formalism with 5 poles.

² From analysis of L3 data at 91 and 183–209 GeV and using SU(3) relations.

³ Based on a K-matrix analysis of BELLE data from MORI 07, UEHARA 08A, UEHARA 09 and UEHARA 13. The width is derived for the pole on the third sheet which is closest to the physical axis. Supersedes PENNINGTON 08.

⁴ Solution A (preferred solution based on χ^2 -analysis).

⁵ Dispersion theory based amplitude analysis of BOYER 90, MARSISKE 90, BEHREND 92, and MORI 07.

⁶ Solution B (worse than solution A; still acceptable when systematic uncertainties are included).

⁷ With a narrow scalar state around 1220 MeV.

⁸ Using a unitarized model with a 300 - 500 keV wide scalar at 1100 MeV.

⁹ Using the unitarized model of LYTH 85.

¹⁰ Error includes spread of different solutions. Data of MARK2 and CRYSTAL BALL used in the analysis. Authors report strong correlations with $\gamma\gamma$ width of $f_0(1370)$: $\Gamma(f_2) + 1/4 \Gamma(f_0) = 3.6 \pm 0.3$ KeV.

¹¹ Radiative corrections modify the partial widths; for instance the COURAU 84 value becomes 2.66 ± 0.21 in the calculation of LANDRO 86.

¹² Using the MENNESSIER 83 model.

¹³ Superseded by BOYER 90.

¹⁴ If helicity = 2 assumption is not made.

¹⁵ Using mass, width and $B(f_2(1270) \rightarrow 2\pi)$ from PDG 78.

$f_2(1270) \Gamma(i)\Gamma(\gamma\gamma)/\Gamma(\text{total})$

$\Gamma(K\bar{K}) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$

$\Gamma_3\Gamma_7/\Gamma$

VALUE (keV)	DOCUMENT ID	TECN	COMMENT
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0.121 ± 0.020 OUR FIT Error includes scale factor of 1.3.

0.091 ± 0.007 ± 0.027 ¹ ALBRECHT 90G ARG $e^+e^- \rightarrow e^+e^-K^+K^-$

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

0.104 ± 0.007 ± 0.072 ² ALBRECHT 90G ARG $e^+e^- \rightarrow e^+e^-K^+K^-$

¹ Using an incoherent background.

² Using a coherent background.

$\Gamma(\eta\eta) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$					$\Gamma_5\Gamma_7/\Gamma$
VALUE (eV)	DOCUMENT ID	TECN	COMMENT		
$11.5^{+1.8+4.5}_{-2.0-3.7}$	¹ UEHARA	10A	BELL	10.6	$e^+e^- \rightarrow e^+e^-\eta\eta$

¹Including interference with the $f_2'(1525)$ (parameters fixed to the values from the 2008 edition of this review, PDG 08) and $f_0(Y)$.

Helicity-0/Helicity-2 RATIO IN $\gamma\gamma \rightarrow f_2(1270) \rightarrow \pi\pi$

VALUE (units 10^{-2})	DOCUMENT ID	TECN	COMMENT	
$3.7 \pm 0.3^{+15.9}_{-2.9}$	UEHARA	08A	BELL	10.6 $e^+e^- \rightarrow e^+e^-\pi^0\pi^0$

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

9.5 ± 1.8	¹ DAI	14A	RVUE	Compilation
13	^{2,3} PENNINGTON 08		RVUE	Compilation
26	^{3,4} PENNINGTON 08		RVUE	Compilation

¹Based on a K -matrix analysis of BELLE data from MORI 07, UEHARA 08A, UEHARA 09 and UEHARA 13. The width is derived for the pole on the third sheet which is closest to the physical axis.

²Solution A (preferred solution based on χ^2 -analysis).

³Dispersion theory based amplitude analysis of BOYER 90, MARSISKE 90, BEHREND 92, and MORI 07.

⁴Solution B (worse than solution A; still acceptable when systematic uncertainties are included).

$f_2(1270)$ BRANCHING RATIOS

$\Gamma(\pi\pi)/\Gamma_{\text{total}}$					Γ_1/Γ
VALUE	EVTS	DOCUMENT ID	TECN	COMMENT	
$0.842^{+0.029}_{-0.009}$ OUR FIT				Error includes scale factor of 1.1.	
0.837 ± 0.020 OUR AVERAGE					
0.849 ± 0.025		CHABAUD	83	ASPK	17 $\pi^- p$ polarized
0.85 ± 0.05	250	BEAUPRE	71	HBC	8 $\pi^+ p \rightarrow \Delta^{++} f_2$
0.8 ± 0.04	600	OH	70	HBC	1.26 $\pi^- p \rightarrow \pi^+ \pi^- n$

$\Gamma(\pi^+ \pi^- 2\pi^0)/\Gamma(\pi\pi)$					Γ_2/Γ_1
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Should be twice $\Gamma(2\pi^+ 2\pi^-)/\Gamma(\pi\pi)$ if decay is $\rho\rho$. (See ASCOLI 68D.)

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT	
$0.091^{+0.014}_{-0.040}$ OUR FIT				Error includes scale factor of 1.2.	

0.15 ± 0.06	600	EISENBERG	74	HBC	4.9 $\pi^+ p \rightarrow \Delta^{++} f_2$
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• • • We do not use the following data for averages, fits, limits, etc. • • •

0.07		EMMS	75D	DBC	4 $\pi^+ n \rightarrow p f_2$
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$\Gamma(K\bar{K})/\Gamma(\pi\pi)$ Γ_3/Γ_1

We average only experiments which either take into account $f_2(1270)$ - $a_2(1320)$ interference explicitly or demonstrate that $a_2(1320)$ production is negligible.

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
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0.054^{+0.005}_{-0.006} OUR FIT Error includes scale factor of 2.7.

0.041^{+0.004}_{-0.005} OUR AVERAGE

0.045±0.01		¹ BARGIOTTI	03	OBLX	$\bar{p}p$
0.037 ^{+0.008} _{-0.021}		ETKIN	82B	MPS	$23 \pi^- p \rightarrow n 2K_S^0$
0.045±0.009		CHABAUD	81	ASPK	$17 \pi^- p$ polarized
0.039±0.008		LOVERRE	80	HBC	$4 \pi^- p \rightarrow K\bar{K}N$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.052±0.025		ABLIKIM	04E	BES2	$J/\psi \rightarrow \omega K^+ K^-$
0.036±0.005		² COSTA	80	OMEG	$1-2.2 \pi^- p \rightarrow K^+ K^- n$
0.030±0.005		³ MARTIN	79	RVUE	
0.027±0.009		⁴ POLYCHRO...	79	STRC	$7 \pi^- p \rightarrow n 2K_S^0$
0.025±0.015		EMMS	75D	DBC	$4 \pi^+ n \rightarrow p f_2$
0.031±0.012	20	ADERHOLZ	69	HBC	$8 \pi^+ p \rightarrow K^+ K^- \pi^+ p$

 $\Gamma(2\pi^+ 2\pi^-)/\Gamma(\pi\pi)$ Γ_4/Γ_1

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
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0.033±0.005 OUR FIT Error includes scale factor of 1.2.

0.033±0.004 OUR AVERAGE Error includes scale factor of 1.1.

0.024±0.006	160	EMMS	75D	DBC	$4 \pi^+ n \rightarrow p f_2$
0.051±0.025	70	EISENBERG	74	HBC	$4.9 \pi^+ p \rightarrow \Delta^{++} f_2$
0.043 ^{+0.007} _{-0.011}	285	LOUIE	74	HBC	$3.9 \pi^- p \rightarrow n f_2$
0.037±0.007	154	ANDERSON	73	DBC	$6 \pi^+ n \rightarrow p f_2$
0.047±0.013		OH	70	HBC	$1.26 \pi^- p \rightarrow \pi^+ \pi^- n$

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

VALUE (units 10 ⁻³)	DOCUMENT ID	TECN	COMMENT
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4.0±0.8 OUR FIT Error includes scale factor of 2.1.

2.9±0.5 OUR AVERAGE

2.7±0.7	BINON	05	GAMS	33 $\pi^- p \rightarrow \eta\eta n$
2.8±0.7	ALDE	86D	GAM4	100 $\pi^- p \rightarrow 2\eta n$
5.2±1.7	BINON	83	GAM2	38 $\pi^- p \rightarrow 2\eta n$

 $\Gamma(\eta\eta)/\Gamma(\pi\pi)$ Γ_5/Γ_1

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
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0.003±0.001 BARBERIS 00E 450 $pp \rightarrow p_f \eta \eta p_S$

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

<0.05	95	EDWARDS	82F	CBAL	$e^+ e^- \rightarrow e^+ e^- 2\eta$
<0.016	95	EMMS	75D	DBC	$4 \pi^+ n \rightarrow p f_2$
<0.09	95	EISENBERG	74	HBC	$4.9 \pi^+ p \rightarrow \Delta^{++} f_2$

$\Gamma(4\pi^0)/\Gamma_{\text{total}}$ Γ_6/Γ

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
0.0030 ± 0.0010 OUR FIT				
0.003 ± 0.001	400 ± 50	ALDE	87	GAM4 100 $\pi^- p \rightarrow 4\pi^0 n$

 $\Gamma(\gamma\gamma)/\Gamma_{\text{total}}$ Γ_7/Γ

VALUE (units 10^{-5})	DOCUMENT ID	TECN	COMMENT
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• • • We do not use the following data for averages, fits, limits, etc. • • •

$1.57 \pm 0.01^{+1.39}_{-0.14}$	UEHARA	08A	BELL	10.6 $e^+ e^- \rightarrow e^+ e^- \pi^0 \pi^0$
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 $\Gamma(\eta\pi\pi)/\Gamma(\pi\pi)$ Γ_8/Γ_1

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
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< 0.010	95	EMMS	75D	DBC 4 $\pi^+ n \rightarrow p f_2$
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 $\Gamma(K^0 K^- \pi^+ + \text{c.c.})/\Gamma(\pi\pi)$ Γ_9/Γ_1

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
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< 0.004	95	EMMS	75D	DBC 4 $\pi^+ n \rightarrow p f_2$
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 $\Gamma(e^+ e^-)/\Gamma_{\text{total}}$ Γ_{10}/Γ

VALUE (units 10^{-10})	CL%	DOCUMENT ID	TECN	COMMENT
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< 6	90	ACHASOV	00K	SND $e^+ e^- \rightarrow \pi^0 \pi^0$
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¹ Coupled channel analysis of $\pi^+ \pi^- \pi^0$, $K^+ K^- \pi^0$, and $K^\pm K_S^0 \pi^\mp$.

² Re-evaluated by CHABAUD 83.

³ Includes PAWLICKI 77 data.

⁴ Takes into account the $f_2(1270)$ - $f_2'(1525)$ interference.

 $f_2(1270)$ REFERENCES

DOBBS	15	PR D91 052006	S. Dobbs <i>et al.</i>	(NWES)
DAI	14A	PR D90 036004	L.-Y. Dai, M.R. Pennington	(CEBAF)
BOGOLYUB...	13	PAN 76 1324	M.Yu. Bogolyubsky <i>et al.</i>	(HYPERON-M Collab.)
		Translated from YAF 76	1389.	
UEHARA	13	PTEP 2013 123C01	S. Uehara <i>et al.</i>	(BELLE Collab.)
UEHARA	10A	PR D82 114031	S. Uehara <i>et al.</i>	(BELLE Collab.)
ANISOVICH	09	IJMP A24 2481	V.V. Anisovich, A.V. Sarantsev	
UEHARA	09	PR D79 052009	S. Uehara <i>et al.</i>	(BELLE Collab.)
PDG	08	PL B667 1	C. Amsler <i>et al.</i>	(PDG Collab.)
PENNINGTON	08	EPJ C56 1	M.R. Pennington <i>et al.</i>	
UEHARA	08A	PR D78 052004	S. Uehara <i>et al.</i>	(BELLE Collab.)
MORI	07	PR D75 051101	T. Mori <i>et al.</i>	(BELLE Collab.)
ABLIKIM	06V	PL B642 441	M. Ablikim <i>et al.</i>	(BES Collab.)
SCHEGELSKY	06A	EPJ A27 207	V.A. Schegelsky <i>et al.</i>	
ABLIKIM	05	PL B607 243	M. Ablikim <i>et al.</i>	(BES Collab.)
BINON	05	PAN 68 960	F. Binon <i>et al.</i>	
		Translated from YAF 68	998.	
ABLIKIM	04E	PL B603 138	M. Ablikim <i>et al.</i>	(BES Collab.)
BARGIOTTI	03	EPJ C26 371	M. Bargiotti <i>et al.</i>	(OBELIX Collab.)
TIKHOMIROV	03	PAN 66 828	G.D. Tikhomirov <i>et al.</i>	
		Translated from YAF 66	860.	
ACHASOV	00K	PL B492 8	M.N. Achasov <i>et al.</i>	(Novosibirsk SND Collab.)
BARBERIS	00E	PL B479 59	D. Barberis <i>et al.</i>	(WA 102 Collab.)
BOGLIONE	99	EPJ C9 11	M. Boggione, M.R. Pennington	
ALDE	98	EPJ A3 361	D. Alde <i>et al.</i>	(GAM4 Collab.)
Also		PAN 62 405	D. Alde <i>et al.</i>	(GAMS Collab.)
		Translated from YAF 62	446.	

ALDE	97	PL B397 350	D.M. Alde <i>et al.</i>	(GAMS Collab.)
BERTIN	97C	PL B408 476	A. Bertin <i>et al.</i>	(OBELIX Collab.)
GRYGOREV	96	PAN 59 2105	V.K. Grigoriev, O.N. Baloshin, B.P. Barkov	(ITEP)
YABUKI	95	Translated from JPSJ 64 435	F. Yabuki <i>et al.</i>	(VENUS Collab.)
PROKOSHKIN	94	PD 39 420	Y.D. Prokoshkin, A.A. Kondashov	(SERP)
BEHREND	92	Translated from ZPHY C56 381	H.J. Behrend	(CELLO Collab.)
BLINOV	92	ZPHY C53 33	A.E. Blinov <i>et al.</i>	(NOVO)
AGUILAR-...	91	ZPHY C50 405	M. Aguilar-Benitez <i>et al.</i>	(LEBC-EHS Collab.)
AKER	91	PL B260 249	E. Aker <i>et al.</i>	(Crystal Barrel Collab.)
ADACHI	90D	PL B234 185	I. Adachi <i>et al.</i>	(TOPAZ Collab.)
ALBRECHT	90G	ZPHY C48 183	H. Albrecht <i>et al.</i>	(ARGUS Collab.)
BOYER	90	PR D42 1350	J. Boyer <i>et al.</i>	(Mark II Collab.)
BREAKSTONE	90	ZPHY C48 569	A.M. Breakstone <i>et al.</i>	(ISU, BGNA, CERN+)
MARSISKE	90	PR D41 3324	H. Marsiske <i>et al.</i>	(Crystal Ball Collab.)
MORGAN	90	ZPHY C48 623	D. Morgan, M.R. Pennington	(RAL, DURH)
OEST	90	ZPHY C47 343	T. Oest <i>et al.</i>	(JADE Collab.)
AUGUSTIN	89	NP B320 1	J.E. Augustin, G. Cosme	(DM2 Collab.)
VOROBYEV	88	SJNP 48 273	P.V. Vorobiev <i>et al.</i>	(NOVO)
ALDE	87	Translated from PL B198 286	D.M. Alde <i>et al.</i>	(LANL, BRUX, SERP, LAPP)
AUGUSTIN	87	ZPHY C36 369	J.E. Augustin <i>et al.</i>	(LALO, CLER, FRAS+)
ABACHI	86B	PRL 57 1990	S. Abachi <i>et al.</i>	(PURD, ANL, IND, MICH+)
AIHARA	86B	PRL 57 404	H. Aihara <i>et al.</i>	(TPC-2 γ Collab.)
ALDE	86D	NP B269 485	D.M. Alde <i>et al.</i>	(BELG, LAPP, SERP, CERN+)
LANDRO	86	PL B172 445	M. Landro, K.J. Mork, H.A. Olsen	(UTRO)
LONGACRE	86	PL B177 223	R.S. Longacre <i>et al.</i>	(BNL, BRAN, CUNY+)
LYTH	85	JP G11 459	D.H. Lyth	
BEHREND	84B	ZPHY C23 223	H.J. Behrend <i>et al.</i>	(CELLO Collab.)
BERGER	84	ZPHY C26 199	C. Berger <i>et al.</i>	(PLUTO Collab.)
COURAU	84	PL 147B 227	A. Courau <i>et al.</i>	(CIT, SLAC)
SMITH	84C	PR D30 851	J.R. Smith <i>et al.</i>	(SLAC, LBL, HARV)
BINON	83	NC 78A 313	F.G. Binon <i>et al.</i>	(BELG, LAPP, SERP+)
Also		SJNP 38 561	F.G. Binon <i>et al.</i>	(BELG, LAPP, SERP+)
CHABAUD	83	Translated from NP B223 1	V. Chabaud <i>et al.</i>	(CERN, CRAC, MPIM)
DENNEY	83	PR D28 2726	D.L. Denney <i>et al.</i>	(IOWA, MICH)
MENNESSIER	83	ZPHY C16 241	G. Mennessier	(MONP)
APEL	82	NP B201 197	W.D. Apel <i>et al.</i>	(KARLK, KARLE, PISA, SERP+)
CASON	82	PRL 48 1316	N.M. Cason <i>et al.</i>	(NDAM, ANL)
EDWARDS	82F	PL 110B 82	C. Edwards <i>et al.</i>	(CIT, HARV, PRIN+)
ETKIN	82B	PR D25 1786	A. Etkin <i>et al.</i>	(BNL, CUNY, TUFTS, VAND)
BRANDELIK	81B	ZPHY C10 117	R. Brandelik <i>et al.</i>	(TASSO Collab.)
CHABAUD	81	APP B12 575	V. Chabaud <i>et al.</i>	(CERN, CRAC, MPIM)
GIDAL	81	PL 107B 153	G. Gidal <i>et al.</i>	(SLAC, LBL)
ROUSSARIE	81	PL 105B 304	A. Roussarie <i>et al.</i>	(SLAC, LBL)
BERGER	80B	PL 94B 254	C. Berger <i>et al.</i>	(PLUTO Collab.)
COSTA	80	NP B175 402	G. Costa <i>et al.</i>	(BARI, BONN, CERN, GLAS+)
LOVERRE	80	ZPHY C6 187	P.F. Loverre <i>et al.</i>	(CERN, CDEF, MADR+)
CORDEN	79	NP B157 250	M.J. Corden <i>et al.</i>	(BIRM, RHEL, TELA+)
MARTIN	79	NP B158 520	A.D. Martin, E.N. Ozmutlu	(DURH)
POLYCHRO...	79	PR D19 1317	V.A. Polychronakos <i>et al.</i>	(NDAM, ANL)
PDG	78	PL 75B 1	C. Bricman <i>et al.</i>	
ANTIPOV	77	NP B119 45	Y.M. Antipov <i>et al.</i>	(SERP, GEVA)
PAWLICKI	77	PR D15 3196	A.J. Pawlicki <i>et al.</i>	(ANL)
DEUTSCH...	76	NP B103 426	M. Deutschmann <i>et al.</i>	(AACH3, BERL, BONN+)
APEL	75	PL 57B 398	W.D. Apel <i>et al.</i>	(KARLK, KARLE, PISA, SERP+)
EMMS	75D	NP B96 155	M.J. Emms <i>et al.</i>	(BIRM, DURH, RHEL)
EISENBERG	74	PL 52B 239	Y. Eisenberg <i>et al.</i>	(REHO)
ENGLER	74	PR D10 2070	A. Engler <i>et al.</i>	(CMU, CASE)
LOUIE	74	PL 48B 385	J. Louie <i>et al.</i>	(SACL, CERN)
ANDERSON	73	PRL 31 562	J.C. Anderson <i>et al.</i>	(CMU, CASE)
TAKAHASHI	72	PR D6 1266	K. Takahashi <i>et al.</i>	(TOHOK, PENN, NDAM+)
BEAUPRE	71	NP B28 77	J.V. Beaupre <i>et al.</i>	(AACH, BERL, CERN)
FLATTE	71	PL 34B 551	S.M. Flatte <i>et al.</i>	(LBL)
ARMENISE	70	LNC 4 199	N. Armenise <i>et al.</i>	(BARI, BGNA, FIRZ)
OH	70	PR D1 2494	B.Y. Oh <i>et al.</i>	(WISC, TNTN) JP
STUNTEBECK	70	PL 32B 391	P.H. Stuntebeck <i>et al.</i>	(NDAM)
ADERHOLZ	69	NP B11 259	M. Aderholz <i>et al.</i>	(AACH3, BERL, CERN+)
ARMENISE	68	NC 54A 999	N. Armenise <i>et al.</i>	(BARI, BGNA, FIRZ+)

ASCOLI	68D	PRL 21 1712	G. Ascoli <i>et al.</i>	(ILL)
BOESEBECK	68	NP B4 501	K. Boesebeck <i>et al.</i>	(AACH, BERL, CERN)
JOHNSON	68	PR 176 1651	P.B. Johnson <i>et al.</i>	(NDAM, PURD, SLAC)
EISNER	67	PR 164 1699	R.L. Eisner <i>et al.</i>	(PURD)
DERADO	65	PRL 14 872	I. Derado <i>et al.</i>	(NDAM)
LEE	64	PRL 12 342	Y.Y. Lee <i>et al.</i>	(MICH)
BONDAR	63	PL 5 153	L. Bondar <i>et al.</i>	(AACH, BIRM, BONN, DESY+)
