LIGHT UNFLAVORED MESONS
$(S = C = B = 0)$

For $I = 1$ (π, b, ρ, a): $u\overline{d}$, $(u\overline{u}-d\overline{d})/\sqrt{2}$, $d\overline{u}$;
for $I = 0$ (η, η', h, h', ω, ϕ, f, f'): $c_1(u\overline{u} + d\overline{d}) + c_2(s\overline{s})$

$\rho(770)$

$I^G(J^{PC}) = 1^+(1^{--})$

Our latest mini-review on this particle can be found in the 1984 edition.

MINIREVIEW GOES HERE

$\rho(770)$ MASS

We no longer list S-wave Breit-Wigner fits, or data with high combinatorial background.

MIXED CHARGES

VALUE (MeV)	*DOCUMENT ID*
768.8±1.0 OUR AVERAGE	Includes data from the 3 datablocks that follow this one. Error includes scale factor of 2.4. See the ideogram below.

$\rho(770)$ MASS MIXED CHARGES

*CITATION: L. Montanet et al., Physical Review D50, 1173 (1994) and 1995 off-year partial update for the 1996 edition (URL: http://pdg.lbl.gov/)

CHARGED ONLY

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	CHG	COMMENT

The data in this block is included in the average printed for a previous datablock.

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	CHG	COMMENT
766.9±1.2 OUR AVERAGE						
768 ±9		AGUILAR-...	91	EHS		400 pp
767 ±3	2935	[2] CAPRARO	87	SPEC	−	200 $\pi^- Cu \rightarrow \pi^- \pi^0 Cu$
761 ±5	967	[2] CAPRARO	87	SPEC	−	200 $\pi^- Pb \rightarrow \pi^- \pi^0 Pb$
771 ±4		HUSTON	86	SPEC	+	202 $\pi^+ A \rightarrow \pi^+ \pi^0 A$
766 ±7	6500	[3] BYERLY	73	OSPK	−	5 $\pi^- p$
766.8±1.5	9650	[4] PISUT	68	RVUE	−	1.7–3.2 $\pi^- p$, t <10
767 ±6	900	[2] EISNER	67	HBC	−	4.2 $\pi^- p$, t <10

NEUTRAL ONLY, PHOTOPRODUCED

The data in this block is included in the average printed for a previous datablock.

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	CHG	COMMENT
768.1± 1.3 OUR AVERAGE						
767.6± 2.7		BARTALUCCI	78	CNTR	0	$\gamma p \rightarrow e^+ e^- p$
775 ± 5		GLADDING	73	CNTR	0	2.9–4.7 γp
767.0± 4.0	1930	BALLAM	72	HBC	0	2.8 γp
770.0± 4.0	2430	BALLAM	72	HBC	0	4.7 γp
765.0±10.0		ALVENSLEBEN	70	CNTR	0	γA, t <0.01
767.7± 1.9	140k	BIGGS	70	CNTR	0	<4.1 $\gamma C \rightarrow \pi^+ \pi^- C$
765 ± 5.0	4000	ASBURY	67B	CNTR	0	$\gamma +$ Pb

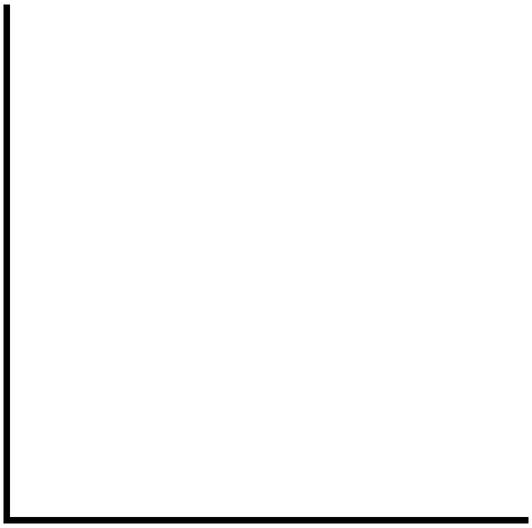
NEUTRAL ONLY, OTHER REACTIONS

The data in this block is included in the average printed for a previous datablock.

769.3±1.6 OUR AVERAGE Error includes scale factor of 3.2. See the ideogram below.

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	CHG	COMMENT
757.5±1.5		[1] BERNICHA	94	RVUE		$e^+ e^- \rightarrow \pi^+ \pi^-$
773 ±1.6		WEIDENAUER	93	ASTE		$\overline{p} p \rightarrow \pi^+ \pi^- \omega$
762.6±2.6		AGUILAR-...	91	EHS		400 pp
775.9±1.1		[5] BARKOV	85	OLYA	0	$e^+ e^- \rightarrow \pi^+ \pi^-$
768.0±4.0		[6,7] BOHACIK	80	RVUE	0	
769.0±3.0		[3] WICKLUND	78	ASPK	0	3,4,6 $\pi^\pm N$
768.0±1.0	76000	DEUTSCH...	76	HBC	0	16 $\pi^+ p$
767 ±4	4100	ENGLER	74	DBC	0	6 $\pi^+ n \rightarrow \pi^+ \pi^- p$
775.0±4.0	32000	[6] PROTOPOP...	73	HBC	0	7.1 $\pi^+ p$, t <0.4
764.0±3.0	6800	RATCLIFF	72	ASPK	0	15 $\pi^- p$, t <0.3
774.0±3.0	1700	REYNOLDS	69	HBC	0	2.26 $\pi^- p$
775.0±3.0	2250	HYAMS	68	OSPK	0	11.2 $\pi^- p$
769.2±1.5	13300	[8] PISUT	68	RVUE	0	1.7–3.2 $\pi^- p$, t <10
• • • We do not use the following data for averages, fits, limits, etc. • • •						
761.1±2.9		DUBNICKA	89	RVUE		π form factor
768 ±1		[9] GESHKENBEIN	89	RVUE		π form factor
777.4±2.0		[10] CHABAUD	83	ASPK	0	17 $\pi^- p$ polarized
770 ±2		[11] HEYN	81	RVUE		Pion form factor
769.5±0.7		[6,7] LANG	79	RVUE	0	
770 ±9		[7] ESTABROOKS	74	RVUE	0	17 $\pi^- p \rightarrow \pi^+ \pi^- n$
773.5±1.7	11200	[2] JACOBS	72	HBC	0	2.8 $\pi^- p$

[1] Applying the S-matrix formalism to the BARKOV 85 data.



$\rho(770)^0$ mass (MeV)

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

[3] Phase shift analysis. Systematic errors added corresponding to spread of different fits.

[4] From fit of 3-parameter relativistic P-wave Breit-Wigner to total mass distribution. Includes BATON 68, MILLER 67B, ALFF-STEINBERGER 66, HAGOPIAN 66, HAGOPIAN 66B, JACOBS 66B, JAMES 66, WEST 66, BLIEDEN 65 and CARMONY 64.

[5] From the Gounaris-Sakurai parametrization of the pion form factor.

[6] From pole extrapolation.

[7] From phase shift analysis of GRAYER 74 data.

[8] Includes MALAMUD 69, ARMENISE 68, BACON 67, HUWE 67, MILLER 67B, ALFF-STEINBERGER 66, HAGOPIAN 66, HAGOPIAN 66B, JACOBS 66B, JAMES 66, WEST 66, GOLDHABER 64, ABOLINS 63.

[9] Includes BARKOV 85 data. Model-dependent width definition.

[10] From fit of 3-parameter relativistic Breit-Wigner to helicity-zero part of P-wave intensity. CHABAUD 83 includes data of GRAYER 74.

[11] HEYN 81 includes all spacelike and timelike F_π values until 1978.

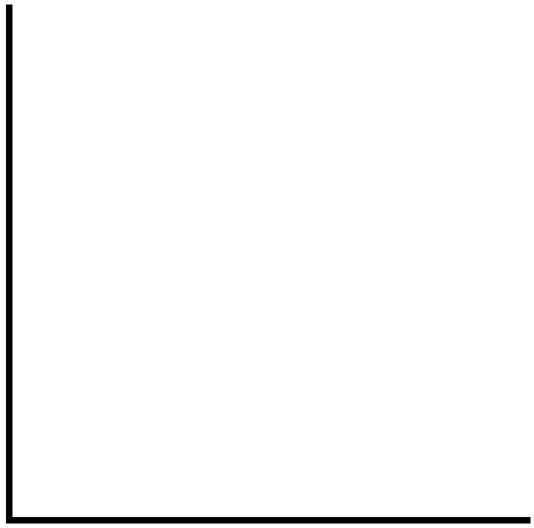
$m_{\rho(770)^0} - m_{\rho(770)^\pm}$

VALUE (MeV)	*EVTS*	*DOCUMENT ID*		*TECN*	*CHG*	*COMMENT*
0.3±2.2 OUR AVERAGE	Error includes scale factor of 1.3. See the ideogram below.					
-4.0 ± 4.0	3000	[12] REYNOLDS	69	HBC	-0	2.26 $\pi^- p$
$-5\ \pm5$	3600	[12] FOSTER	68	HBC	±0	0.0 $\overline{p}p$
2.4 ± 2.1	22950	[13] PISUT	68	RVUE		$\pi N \to \rho N$

[12] From quoted masses of charged and neutral modes.

[13] Includes MALAMUD 69, ARMENISE 68, BATON 68, BACON 67, HUWE 67, MILLER 67B, ALFF-STEINBERGER 66, HAGOPIAN 66, HAGOPIAN 66B, JACOBS 66B, JAMES 66, WEST 66, BLIEDEN 65, CARMONY 64, GOLDHABER 64, ABOLINS 63.

*CITATION: L. Montanet et al., Physical Review D50, 1173 (1994) and 1995 off-year partial update for the 1996 edition (URL: http://pdg.lbl.gov/)



$m_{\rho(770)^0} - m_{\rho(770)^\pm}$ (MeV)

$\rho(770)$ RANGE PARAMETER

The range parameter R enters an energy-dependent correction to the width, of the form $(1 + q_r^2\ R^2)\ /\ (1 + q^2\ R^2)$, where q is the momentum of one of the pions in the $\pi\pi$ rest system. At resonance, $q = q_r$.

VALUE (GeV^{-1})	*DOCUMENT ID*		*TECN*	*CHG*	*COMMENT*
$5.3^{+0.9}_{-0.7}$	CHABAUD	83	ASPK	0	17 $\pi^- p$ polarized

$\rho(770)$ WIDTH

We no longer list S-wave Breit-Wigner fits, or data with high combinatorial background.

MIXED CHARGES

VALUE (MeV)	*DOCUMENT ID*
150.3±1.1 OUR AVERAGE	Includes data from the 3 datablocks that follow this one.

CHARGED ONLY

VALUE (MeV)	*EVTS*	*DOCUMENT ID*		*TECN*	*CHG*	*COMMENT*
The data in this block is included in the average printed for a previous datablock.						
149.1± 2.9 OUR FIT						
149.1± 2.9 OUR AVERAGE						
155 ±11	2935	[15] CAPRARO	87	SPEC	−	200 π^- Cu → $\pi^- \pi^0$ Cu
154 ±20	967	[15] CAPRARO	87	SPEC	−	200 π^- Pb → $\pi^- \pi^0$ Pb
150 ± 5		HUSTON	86	SPEC	+	202 π^+ A → $\pi^+ \pi^0$ A
146 ±12	6500	[16] BYERLY	73	OSPK	−	5 $\pi^- p$
148.2± 4.1	9650	[17] PISUT	68	RVUE	−	1.7–3.2 $\pi^- p$, t <10
146 ±13	900	EISNER	67	HBC	−	4.2 $\pi^- p$, t <10

NEUTRAL ONLY, PHOTOPRODUCED

VALUE (MeV)	*EVTS*	*DOCUMENT ID*		*TECN*	*CHG*	*COMMENT*
The data in this block is included in the average printed for a previous datablock.						
150.9± 3.0		BARTALUCCI	78	CNTR	0	$\gamma p \rightarrow e^+ e^- p$

*CITATION: L. Montanet et al., Physical Review D50, 1173 (1994) and 1995 off-year partial update for the 1996 edition (URL: http://pdg.lbl.gov/)

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

147 $\pm$11		GLADDING	73	CNTR	0	2.9–4.7 γp
155.0$\pm$12.0	2430	BALLAM	72	HBC	0	4.7 γp
145.0$\pm$13.0	1930	BALLAM	72	HBC	0	2.8 γp
140.0$\pm$ 5.0		ALVENSLEBEN	70	CNTR	0	γA, t <0.01
146.1$\pm$ 2.9	140k	BIGGS	70	CNTR	0	<4.1 $\gamma \mathrm{C} \to \pi^+ \pi^- \mathrm{C}$
160.0$\pm$10.0		LANZEROTTI	68	CNTR	0	γp
130 $\pm$ 5	4000	ASBURY	67B	CNTR	0	$\gamma +$ Pb

NEUTRAL ONLY, OTHER REACTIONS

VALUE (MeV)	*EVTS*	*DOCUMENT ID*		*TECN*	*CHG*	*COMMENT*

The data in this block is included in the average printed for a previous datablock.

150.5$\pm$ 1.8 OUR FIT Error includes scale factor of 1.3.
150.5$\pm$ 1.7 OUR AVERAGE Error includes scale factor of 1.2.

142.5$\pm$ 3.5		[14] BERNICHA	94	RVUE		$e^+ e^- \to \pi^+ \pi^-$
145.7$\pm$ 5.3		WEIDENAUER	93	ASTE		$\overline{p} p \to \pi^+ \pi^- \omega$
150.5$\pm$ 3.0		[18] BARKOV	85	OLYA	0	$e^+ e^- \to \pi^+ \pi^-$
148.0$\pm$ 6.0		[19,20] BOHACIK	80	RVUE	0	
152.0$\pm$ 9.0		[16] WICKLUND	78	ASPK	0	3,4,6 $\pi^\pm p N$
154.0$\pm$ 2.0	76000	DEUTSCH...	76	HBC	0	16 $\pi^+ p$
157.0$\pm$ 8.0	6800	RATCLIFF	72	ASPK	0	15 $\pi^- p$, t <0.3
143.0$\pm$ 8.0	1700	REYNOLDS	69	HBC	0	2.26 $\pi^- p$

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

144.9$\pm$ 3.7		DUBNICKA	89	RVUE		π form factor
138 $\pm$ 1		[21] GESHKENBEIN	89	RVUE		π form factor
$160.0^{+\ 4.1}_{-\ 4.0}$		[22] CHABAUD	83	ASPK	0	17 $\pi^- p$ polarized
155 $\pm$ 1		[23] HEYN	81	RVUE	0	π form factor
148.0$\pm$ 1.3		[19,20] LANG	79	RVUE	0	
146 $\pm$14	4100	ENGLER	74	DBC	0	6 $\pi^+ n \to \pi^+ \pi^- p$
143 $\pm$13		[20] ESTABROOKS	74	RVUE	0	17 $\pi^- p \to \pi^+ \pi^- n$
160.0$\pm$10.0	32000	[19] PROTOPOP...	73	HBC	0	7.1 $\pi^+ p$, t <0.4
145.0$\pm$12.0	2250	[15] HYAMS	68	OSPK	0	11.2 $\pi^- p$
163.0$\pm$15.0	13300	[24] PISUT	68	RVUE	0	1.7–3.2 $\pi^- p$, t <10

[14] Applying the S-matrix formalism to the BARKOV 85 data.
[15] Width errors enlarged by us to $4\Gamma/\sqrt{N}$; see the note with the $K^*(892)$ mass.
[16] Phase shift analysis. Systematic errors added corresponding to spread of different fits.
[17] From fit of 3-parameter relativistic P-wave Breit-Wigner to total mass distribution. Includes BATON 68, MILLER 67B, ALFF-STEINBERGER 66, HAGOPIAN 66, HAGOPIAN 66B, JACOBS 66B, JAMES 66, WEST 66, BLIEDEN 65 and CARMONY 64.
[18] From the Gounaris-Sakurai parametrization of the pion form factor.
[19] From pole extrapolation.
[20] From phase shift analysis of GRAYER 74 data.
[21] Includes BARKOV 85 data. Model-dependent width definition.
[22] From fit of 3-parameter relativistic Breit-Wigner to helicity-zero part of P-wave intensity. CHABAUD 83 includes data of GRAYER 74.
[23] HEYN 81 includes all spacelike and timelike F_π values until 1978.
[24] Includes MALAMUD 69, ARMENISE 68, BACON 67, HUWE 67, MILLER 67B, ALFF-STEINBERGER 66, HAGOPIAN 66, HAGOPIAN 66B, JACOBS 66B, JAMES 66, WEST 66, GOLDHABER 64, ABOLINS 63.

$\rho(770)$ DECAY MODES

	Mode	Fraction (Γ_i/Γ)	Scale factor/ Confidence level
Γ_1	$\pi\pi$	$\sim$ 100 %	
	$\rho(770)^\pm$ decays		
Γ_2	$\pi^\pm \pi^0$	$\sim$ 100 %	
Γ_3	$\pi^\pm \gamma$	(4.5 $\pm$0.5) $\times 10^{-4}$	S=2.2
Γ_4	$\pi^\pm \eta$	< 6 $\times 10^{-3}$	CL=84%
Γ_5	$\pi^\pm \pi^+ \pi^- \pi^0$	< 2.0 $\times 10^{-3}$	CL=84%

$\rho(770)^0$ decays

Γ_6	$\pi^+\pi^-$		$\sim$ 100 %	
Γ_7	$\pi^+\pi^-\gamma$		$(9.9 \pm 1.6) \times 10^{-3}$	
Γ_8	$\pi^0\gamma$		$(7.9 \pm 2.0) \times 10^{-4}$	
Γ_9	$\eta\gamma$		$(3.8 \pm 0.7) \times 10^{-4}$	
Γ_{10}	$\mu^+\mu^-$	[a]	$(4.60 \pm 0.28) \times 10^{-5}$	
Γ_{11}	e^+e^-	[a]	$(4.50 \pm 0.22) \times 10^{-5}$	
Γ_{12}	$\pi^+\pi^-\pi^0$		$< 1.2 \times 10^{-4}$	CL=90%
Γ_{13}	$\pi^+\pi^-\pi^+\pi^-$		$< 2 \times 10^{-4}$	CL=90%
Γ_{14}	$\pi^+\pi^-\pi^0\pi^0$		$< 4 \times 10^{-5}$	CL=90%

[a] The e^+e^- branching fraction is from $e^+e^- \to \pi^+\pi^-$ experiments only. The $\omega\rho$ interference is then due to $\omega\rho$ mixing only, and is expected to be small. If $e\mu$ universality holds, $\Gamma(\rho^0 \to \mu^+\mu^-) = \Gamma(\rho^0 \to e^+e^-) \times 0.99785$.

CONSTRAINED FIT INFORMATION

An overall fit to the total width and a partial width uses 9 measurements and one constraint to determine 3 parameters. The overall fit has a $\chi^2 = 10.2$ for 7 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, $x_i \equiv \Gamma_i/\Gamma_{\rm total}$. The fit constrains the x_i whose labels appear in this array to sum to one.

x_3	−100	
Γ	18	−18
	x_2	x_3

	Mode	Rate (MeV)	Scale factor
Γ_2	$\pi^\pm\pi^0$	149.1 ± 2.9	
Γ_3	$\pi^\pm\gamma$	0.068 ± 0.007	2.3

CONSTRAINED FIT INFORMATION

An overall fit to the total width, a partial width, and a branching ratio uses 10 measurements and one constraint to determine 4 parameters. The overall fit has a $\chi^2 = 10.8$ for 7 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, $x_i \equiv \Gamma_i/\Gamma_{\rm total}$. The fit constrains the x_i whose labels appear in this array to sum to one.

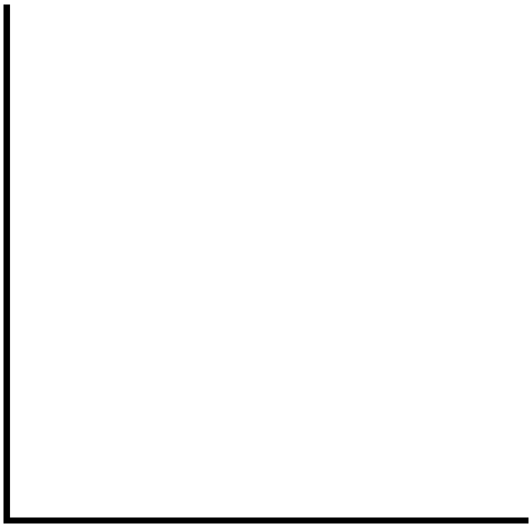
x_{10}	−79		
x_{11}	−61	0	
Γ	15	0	−25
	x_6	x_{10}	x_{11}

	Mode		Rate (MeV)	Scale factor
Γ_6	$\pi^+\pi^-$		150.5 ± 1.8	1.3
Γ_{10}	$\mu^+\mu^-$	[a]	0.0069 ± 0.0004	
Γ_{11}	e^+e^-	[a]	0.00677 ± 0.00032	

$\rho(770)$ PARTIAL WIDTHS

$\Gamma(\pi^\pm\gamma)$ — Γ_3

VALUE (keV)	DOCUMENT ID		TECN	CHG	COMMENT
68 ±7 OUR FIT Error includes scale factor of 2.3.					
68 ±7 OUR AVERAGE Error includes scale factor of 2.2. See the ideogram below.					
81.0±4.0±4.0	CAPRARO	87	SPEC	−	200 $\pi^- A \rightarrow \pi^- \pi^0 A$
59.8±4.0	HUSTON	86	SPEC	+	202 $\pi^+ A \rightarrow \pi^+ \pi^0 A$
71.0±7.0	JENSEN	83	SPEC	−	156–260 $\pi^- A \rightarrow \pi^- \pi^0 A$



$\Gamma\left(\pi^\pm\gamma\right)$ (keV)

$\Gamma(e^+e^-)$ — Γ_{11}

VALUE (keV)	DOCUMENT ID		TECN	COMMENT
6.77±0.32 OUR FIT				
6.77±0.10±0.30	BARKOV	85	OLYA	$e^+e^- \rightarrow \pi^+\pi^-$

$\Gamma(\pi^0\gamma)$ — Γ_8

VALUE (keV)	DOCUMENT ID		TECN	COMMENT
121±31	DOLINSKY	89	ND	$e^+e^- \rightarrow \pi^0\gamma$

$\Gamma(\eta\gamma)$ — Γ_9

VALUE (keV)	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
62±17	[25] DOLINSKY	89	ND	$e^+e^- \rightarrow \eta\gamma$
111±22	[26] DOLINSKY	89	ND	$e^+e^- \rightarrow \eta\gamma$

[25] Solution corresponding to constructive ω-ρ interference. The quark model predicts a relative decay phase of zero. Also much favored by the ALDE 93 model-independent measurement of B($\omega \rightarrow \eta\gamma$).

[26] Solution corresponding to destructive ρ-ω interference.

$\rho(770)$ BRANCHING RATIOS

$\Gamma(\pi^\pm\eta)/\Gamma(\pi\pi)$ — Γ_4/Γ_1

VALUE (units 10^{-4})	CL%	DOCUMENT ID		TECN	CHG	COMMENT
<60	84	FERBEL	66	HBC	±	$\pi^\pm p$ above 2.5

$\Gamma(\pi^{\pm}\pi^{+}\pi^{-}\pi^{0})/\Gamma(\pi\pi)$ — Γ_5/Γ_1

VALUE (units 10^{-4})	CL%	DOCUMENT ID		TECN	CHG	COMMENT
<20	84	FERBEL	66	HBC	$\pm$	$\pi^{\pm} p$ above 2.5
• • • We do not use the following data for averages, fits, limits, etc. • • •						
35±40		JAMES	66	HBC	+	2.1 $\pi^{+} p$

$\Gamma(\mu^{+}\mu^{-})/\Gamma(\pi^{+}\pi^{-})$ — Γ_{10}/Γ_6

VALUE (units 10^{-5})	DOCUMENT ID		TECN	COMMENT
4.60±0.28 OUR FIT				
4.6 ±0.2 ±0.2	ANTIPOV	89	SIGM	π^{-} Cu $\rightarrow$ $\mu^{+}\mu^{-}\pi^{-}$ Cu
• • • We do not use the following data for averages, fits, limits, etc. • • •				
$8.2\ ^{+1.6}_{-3.6}$	[27] ROTHWELL	69	CNTR	Photoproduction
5.6 ±1.5	[28] WEHMANN	69	OSPK	12 π^{-} C, Fe
$9.7\ ^{+3.1}_{-3.3}$	[29] HYAMS	67	OSPK	11 π^{-} Li, H

[27] Possibly large ρ-ω interference leads us to increase the minus error.

[28] Result contains 11 ± 11% correction using SU(3) for central value. The error on the correction takes account of possible ρ-ω interference and the upper limit agrees with the upper limit of $\omega \rightarrow \mu^{+}\mu^{-}$ from this experiment.

[29] HYAMS 67's mass resolution is 20 MeV. The ω region was excluded.

$\Gamma(e^{+}e^{-})/\Gamma(\pi\pi)$ — Γ_{11}/Γ_1

VALUE (units 10^{-4})	DOCUMENT ID		TECN	COMMENT
0.41±0.05	BENAKSAS	72	OSPK	$e^{+}e^{-}$

$\Gamma(\eta\gamma)/\Gamma_{\text{total}}$ — Γ_9/Γ

VALUE (units 10^{-4})	DOCUMENT ID		TECN	CHG	COMMENT
3.8±0.7 OUR AVERAGE					
4.0±1.1	[30] DOLINSKY	89	ND		$e^{+}e^{-} \rightarrow \eta\gamma$
3.6±0.9	[30] ANDREWS	77	CNTR	0	6.7–10 γCu
• • • We do not use the following data for averages, fits, limits, etc. • • •					
7.3±1.5	[31] DOLINSKY	89	ND		$e^{+}e^{-} \rightarrow \eta\gamma$
5.4±1.1	[31] ANDREWS	77	CNTR	0	6.7–10 γCu

[30] Solution corresponding to constructive ω-ρ interference. The quark model predicts a relative phase of zero. Also much favored by the ALDE 93 model-independent measurement of B($\omega \rightarrow \eta\gamma$).

[31] Solution corresponding to destructive ω-ρ interference.

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

VALUE (units 10^{-4})	CL%	DOCUMENT ID		TECN	COMMENT
<2	90	KURDADZE	88	OLYA	$e^{+}e^{-} \rightarrow \pi^{+}\pi^{-}\pi^{+}\pi^{-}$

$\Gamma(\pi^{+}\pi^{-}\pi^{+}\pi^{-})/\Gamma(\pi\pi)$ — Γ_{13}/Γ_1

VALUE (units 10^{-4})	CL%	DOCUMENT ID		TECN	CHG	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •						
<15	90	ERBE	69	HBC	0	2.5–5.8 γp
<20		CHUNG	68	HBC	0	3.2,4.2 $\pi^{-} p$
<20	90	HUSON	68	HLBC	0	16.0 $\pi^{-} p$
<80		JAMES	66	HBC	0	2.1 $\pi^{+} p$

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

VALUE (units 10^{-4})	CL%	DOCUMENT ID		TECN	COMMENT
<1.2	90	VASSERMAN	88B	ND	$e^{+}e^{-} \rightarrow \pi^{+}\pi^{-}\pi^{0}$

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

VALUE	CL%	DOCUMENT ID		TECN	CHG	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •						
~ 0.01		BRAMON	86	RVUE	0	$J/\psi \rightarrow \omega\pi^{0}$
<0.01	84	[32] ABRAMS	71	HBC	0	3.7 $\pi^{+} p$

[32] Model dependent, assumes I = 1, 2, or 3 for the 3π system.

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

VALUE (units 10^{-4})	*CL%*	*DOCUMENT ID*		*TECN*	*CHG*	*COMMENT*
<0.4	90	AULCHENKO	87C	ND	0	$e^+e^- \rightarrow \pi^+\pi^-\pi^0\pi^0$
• • • We do not use the following data for averages, fits, limits, etc. • • •						
<2	90	KURDADZE	86	OLYA	0	$e^+e^- \rightarrow \pi^+\pi^-\pi^0\pi^0$

$\Gamma(\pi^+\pi^-\gamma)/\Gamma_{total}$ Γ_7/Γ

VALUE	*CL%*	*DOCUMENT ID*		*TECN*	*COMMENT*
0.0099±0.0016		[33] DOLINSKY	91	ND	$e^+e^- \rightarrow \pi^+\pi^-\gamma$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.0111±0.0014		[34] VASSERMAN	88	ND	$e^+e^- \rightarrow \pi^+\pi^-\gamma$
<0.005	90	[35] VASSERMAN	88	ND	$e^+e^- \rightarrow \pi^+\pi^-\gamma$

[33] Bremsstrahlung from a decay pion and for photon energy above 50 MeV.
[34] Superseded by DOLINSKY 91.
[35] Structure radiation due to quark rearrangement in the decay.

$\Gamma(\pi^0\gamma)/\Gamma_{total}$ Γ_8/Γ

VALUE (units 10^{-4})	*DOCUMENT ID*		*TECN*	*COMMENT*
7.9±2.0	DOLINSKY	89	ND	$e^+e^- \rightarrow \pi^0\gamma$

$\rho(770)$ REFERENCES

BERNICHA 94 PR D50 4454 +Lopez Castro, Pestieau (LEUV, CINV)
ALDE 93 PAN 56 1229 +Binon+ (SERP, LAPP, LANL, BELG, BRUX, CERN)
Translated from YAF 56 137.
WEIDENAUER 93 ZPHY C59 387 +Duch+ (ASTERIX Collab.)
AGUILAR-... 91 ZPHY C50 405 Aguilar-Benitez, Allison, Batalor+ (LEBC-EHS Collab.)
DOLINSKY 91 PRPL 202 99 +Druzhinin, Dubrovin+ (NOVO)
ANTIPOV 89 ZPHY C42 185 +Batarin+ (SERP, JINR, BGNA, MILA, TBIL)
DOLINSKY 89 ZPHY C42 511 +Druzhinin, Dubrovin, Golubev+ (NOVO)
DUBNICKA 89 JPG 15 1349 +Martinovic+ (JINR, SLOV)
GESHKENBEIN 89 ZPHY 45 351 (ITEP)
KURDADZE 88 JETPL 47 512 +Leltchouk, Pakhtusova, Sidorov+ (NOVO)
Translated from ZETFP 47 432.
VASSERMAN 88 SJNP 47 1035 +Golubev, Dolinsky+ (NOVO)
Translated from YAF 47 1635.
VASSERMAN 88B SJNP 48 480 +Golubev, Dolinsky+ (NOVO)
Translated from YAF 48 753.
AULCHENKO 87C IYF 87-90 Preprint +Dolinsky, Druzhinin+ (NOVO)
CAPRARO 87 NP B288 659 +Levy+ (CLER, FRAS, MILA, PISA, LCGT, TRST+)
BRAMON 86 PL B173 97 +Casulleras (BARC)
HUSTON 86 PR 33 3199 +Berg, Collick, Jonckheere+ (ROCH, FNAL, MINN)
KURDADZE 86 JETPL 43 643 +Lelchuk, Pakhtusova, Sidorov, Skrinskii+ (NOVO)
Translated from ZETFP 43 497.
BARKOV 85 NP B256 365 +Chilingarov, Eidelman, Khazin, Lelchuk+ (NOVO)
CHABAUD 83 NP B223 1 +Gorlich, Cerrada+ (CERN, CRAC, MPIM)
JENSEN 83 PR D27 26 +Berg, Biel, Collick+ (ROCH, FNAL, MINN)
HEYN 81 ZPHY C7 169 +Lang (GRAZ)
BOHACIK 80 PR D21 1342 +Kuhnelt (SLOV, WIEN)
LANG 79 PR D19 956 +Mas-Parareda (GRAZ)
BARTALUCCI 78 NC 44A 587 +Basini, Bertolucci+ (DESY, FRAS)
WICKLUND 78 PR D17 1197 +Ayres, Diebold, Greene, Kramer, Pawlicki (ANL)
ANDREWS 77 PRL 38 198 +Fukushima, Harvey, Lobkowicz, May+ (ROCH)
DEUTSCH... 76 NP B103 426 Deutschmann+ (AACH3, BERL, BONN, CERN+)
ENGLER 74 PR D10 2070 +Kraemer, Toaff, Weisser, Diaz+ (CMU, CASE)
ESTABROOKS 74 NP B79 301 +Martin (DURH)
GRAYER 74 NP B75 189 +Hyams, Blum, Dietl+ (CERN, MPIM)
BYERLY 73 PR D7 637 +Anthony, Coffin, Meanley, Meyer, Rice+ (MICH)
GLADDING 73 PR D8 3721 +Russell, Tannenbaum, Weiss, Thomson (HARV)
PROTOPOP... 73 PR D7 1279 Protopopescu, Alston-Garnjost, Galtieri, Flatte+ (LBL)
BALLAM 72 PR D5 545 +Chadwick, Bingham, Milburn+ (SLAC, LBL, TUFTS)
BENAKSAS 72 PL 39B 289 +Cosme, Jean-Marie, Jullian, Laplanche+ (ORSAY)
JACOBS 72 PR D6 1291 (SACL)
RATCLIFF 72 PL 38B 345 +Bulos, Carnegie, Kluge, Leith, Lynch+ (SLAC)
ABRAMS 71 PR D4 653 +Barnham, Butler, Coyne, Goldhaber, Hall+ (LBL)
ALVENSLEBEN 70 PRL 24 786 +Becker, Bertram, Chen, Cohen (DESY)
BIGGS 70 PRL 24 1197 +Braben, Clifft, Gabathuler, Kitching+ (DARE)
ERBE 69 PR 188 2060 +Hilpert+ (German Bubble Chamber Collab.)
MALAMUD 69 Argonne Conf. 93 +Schlein (UCLA)
REYNOLDS 69 PR 184 1424 +Albright, Bradley, Brucker, Harms+ (FSU)
ROTHWELL 69 PRL 23 1521 +Chase, Earles, Gettner, Glass, Weinstein+ (NEAS)
WEHMANN 69 PR 178 2095 + (HARV, CASE, SLAC, CORN, MCGI)
ARMENISE 68 NC 54A 999 +Ghidini, Forino+ (BARI, BGNA, FIRZ, ORSAY)
BATON 68 PR 176 1574 +Laurens (SACL)
CHUNG 68 PR 165 1491 +Dahl, Kirz, Miller (LRL)
FOSTER 68 NP B6 107 +Gavillet, Labrosse, Montanet+ (CERN, CDEF)

HUSON	68	PL 28B 208	+Lubatti, Six, Veillet+	(ORSAY, MILA, UCLA)
HYAMS	68	NP B7 1	+Koch, Potter, Wilson, VonLindern+	(CERN, MPIM)
LANZEROTTI	68	PR 166 1365	+Blumenthal, Ehn, Faissler+	(HARV)
PISUT	68	NP B6 325	+Roos	(CERN)
ASBURY	67B	PRL 19 865	+Becker, Bertram, Joos, Jordan+	(DESY, COLU)
BACON	67	PR 157 1263	+Fickinger, Hill, Hopkins, Robinson+	(BNL)
EISNER	67	PR 164 1699	+Johnson, Klein, Peters, Sahni, Yen+	(PURD)
HUWE	67	PL 24B 252	+Marquit, Oppenheimer, Schultz, Wilson	(COLU)
HYAMS	67	PL 24B 634	+Koch, Pellett, Potter, VonLindern+	(CERN, MPIM)
MILLER	67B	PR 153 1423	+Gutay, Johnson, Loeffler+	(PURD)
ALFF-...	66	PR 145 1072	Alff-Steinberger, Berley+	(COLU, RUTG)
FERBEL	66	PL 21 111		(ROCH)
HAGOPIAN	66	PR 145 1128	+Selove, Alitti, Baton+	(PENN, SACL)
HAGOPIAN	66B	PR 152 1183	+Pan	(PENN, LRL)
JACOBS	66B	UCRL 16877		(LRL)
JAMES	66	PR 142 896	+Kraybill	(YALE, BNL)
WEST	66	PR 149 1089	+Boyd, Erwin, Walker	(WISC)
BLIEDEN	65	PL 19 444	+Freytag, Geibel+	(CERN Missing Mass Spect. Collab.)
CARMONY	64	PRL 12 254	+Lander, Rindfleisch, Xuong, Yager	(UCB)
GOLDHABER	64	PRL 12 336	+Brown, Kadyk, Shen+	(LRL, UCB)
ABOLINS	63	PRL 11 381	+Lander, Mehlhop, Nguyen, Yager	(UCSD)

OTHER RELATED PAPERS

BENAYOUN	93	ZPHY 58 31	+Feindt, Girone+	(CDEF, CERN, BARI)
LAFFERTY	93	ZPHY C60 659		(MCHS)
Bose-Einstein Correlations				
KAMAL	92	PL B284 421	+Xu	(ALBE)
ERKAL	85	ZPHY C29 485	+Olsson	(WISC)
RYBICKI	85	ZPHY C28 65	+Sakrejda	(CRAC)
KURDADZE	83	JETPL 37 733	+Lelchuk, Pakhtusova+	(NOVO)
		Translated from ZETFP 37 613.		
ALEKSEEV	82	JETP 55 591	+Kartamyshev, Makarin+	(KIAE)
		Translated from ZETF 82 1007.		
KENNEY	62	PR 126 736	+Shephard, Gall	(KNTY)
SAMIOS	62	PRL 9 139	+Bachman, Lea+	(BNL, CUNY, COLU, KNTY)
XUONG	62	PR 128 1849	+Lynch	(LRL)
ANDERSON	61	PRL 6 365	+Bang, Burke, Carmony, Schmitz	(LRL)
ERWIN	61	PRL 6 628	+March, Walker, West	(WISC)

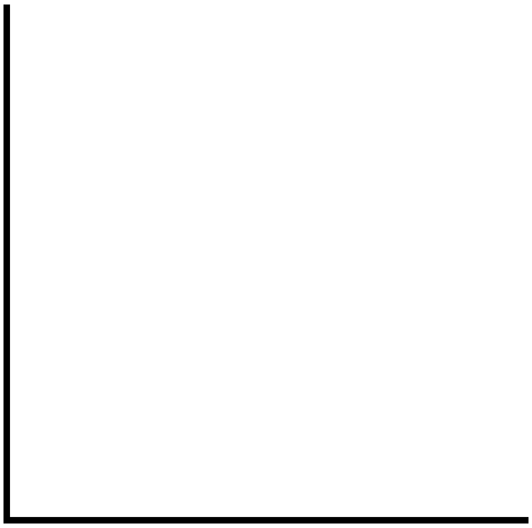
$\omega(782)$

$I^G(J^{PC}) = 0^-(1^{--})$

$\omega(782)$ MASS

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	COMMENT
781.94±0.12 OUR AVERAGE	Error includes scale factor of 1.5. See the ideogram below.				
781.96±0.17±0.80	11k	AMSLER	94C	CBAR	0.0 $\overline{p}p \to \omega\eta\pi^0$
782.08±0.36±0.82	3463	AMSLER	94C	CBAR	0.0 $\overline{p}p \to \omega\eta\pi^0$
781.96±0.13±0.17	15k	AMSLER	93B	CBAR	0.0$\overline{p}p \to \omega\pi^0\pi^0$
782.4 ±0.2	270k	WEIDENAUER	93	ASTE	$\overline{p}p \to 2\pi^+2\pi^-\pi^0$
781.78±0.10		BARKOV	87	CMD	$e^+e^- \to \pi^+\pi^-\pi^0$
782.2 ±0.4	1488	KURDADZE	83B	OLYA	$e^+e^- \to \pi^+\pi^-\pi^0$
782.4 ±0.5	7000	[1] KEYNE	76	CNTR	$\pi^-p \to \omega n$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
783.3 ±0.4		CORDIER	80	WIRE	$e^+e^- \to \pi^+\pi^-\pi^0$
782.5 ±0.8	33260	ROOS	80	RVUE	0.0–3.6 $\overline{p}p$
782.6 ±0.8	3000	BENKHEIRI	79	OMEG	9–12 $\pi^\pm p$
781.8 ±0.6	1430	COOPER	78B	HBC	0.7–0.8 $\overline{p}p \to 5\pi$
782.7 ±0.9	535	VANAPEL...	78	HBC	7.2 $\overline{p}p \to \overline{p}p\omega$
783.5 ±0.8	2100	GESSAROLI	77	HBC	11 $\pi^-p \to \omega n$
782.5 ±0.8	418	AGUILAR-...	72B	HBC	3.9,4.6 K^-p
783.4 ±1.0	248	BIZZARRI	71	HBC	0.0 $p\overline{p} \to K^+K^-\omega$
781.0 ±0.6	510	BIZZARRI	71	HBC	0.0 $p\overline{p} \to K_1K_1\omega$
783.7 ±1.0	3583	[2] COYNE	71	HBC	3.7 $\pi^+p \to p\pi^+\pi^+\pi^-\pi^0$
784.1 ±1.2	750	ABRAMOVI...	70	HBC	3.9 π^-p
783.2 ±1.6		[3] BIGGS	70B	CNTR	<4.1 $\gamma C \to \pi^+\pi^-C$
782.4 ±0.5	2400	BIZZARRI	69	HBC	0.0 $\overline{p}p$

[1] Observed by threshold-crossing technique. Mass resolution = 4.8 MeV FWHM.
[2] From best-resolution sample of COYNE 71.
[3] From ω-ρ interference in the $\pi^+\pi^-$ mass spectrum assuming ω width 12.6 MeV.



$\omega(782)$ mass (MeV)

$\omega(782)$ WIDTH

VALUE (MeV)	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
8.43±0.10 OUR AVERAGE					
8.4 ±0.1		[4] AULCHENKO	87	ND	$e^+e^- \rightarrow \pi^+\pi^-\pi^0$
8.30±0.40		BARKOV	87	CMD	$e^+e^- \rightarrow \pi^+\pi^-\pi^0$
9.8 ±0.9	1488	KURDADZE	83B	OLYA	$e^+e \rightarrow \pi^+\pi^-\pi^0$
9.0 ±0.8		CORDIER	80	WIRE	$e^+e^- \rightarrow \pi^+\pi^-\pi^0$
9.1 ±0.8		BENAKSAS	72B	OSPK	e^+e^-
• • • We do not use the following data for averages, fits, limits, etc. • • •					
12.0 ±2.0	1430	COOPER	78B	HBC	0.7–0.8 $\overline{p}p \rightarrow 5\pi$
9.4 ±2.5	2100	GESSAROLI	77	HBC	11 $\pi^-p \rightarrow \omega n$
10.22±0.43	20000	[5] KEYNE	76	CNTR	$\pi^-p \rightarrow \omega n$
13.3 ±2	418	AGUILAR-...	72B	HBC	3.9,4.6 K^-p
10.5 ±1.5		BORENSTEIN	72	HBC	2.18 K^-p
7.70±0.9 ±1.15	940	BROWN	72	MMS	2.5 $\pi^-p \rightarrow n$MM
10.3 ±1.4	510	BIZZARRI	71	HBC	0.0 $p\overline{p} \rightarrow K_1K_1\omega$
12.8 ±3.0	248	BIZZARRI	71	HBC	0.0 $p\overline{p} \rightarrow K^+K^-\omega$
9.5 ±1.0	3583	COYNE	71	HBC	3.7 $\pi^+p \rightarrow p\pi^+\pi^+\pi^-\pi^0$

[4] Relativistic Breit-Wigner includes radiative corrections.
[5] Observed by threshold-crossing technique. Mass resolution = 4.8 MeV FWHM.

$\omega(782)$ DECAY MODES

	Mode	Fraction (Γ_i/Γ)	Confidence level
Γ_1	$\pi^+\pi^-\pi^0$	(88.8 ±0.7) %	
Γ_2	$\pi^0\gamma$	(8.5 ±0.5) %	
Γ_3	$\pi^+\pi^-$	(2.21±0.30) %	
Γ_4	neutrals (excluding $\pi^0\gamma$)	(5.3 $^{+8.7}_{-3.5}$) $\times 10^{-3}$	
Γ_5	$\eta\gamma$	(8.3 ±2.1) $\times 10^{-4}$	
Γ_6	$\pi^0e^+e^-$	(5.9 ±1.9) $\times 10^{-4}$	
Γ_7	$\pi^0\mu^+\mu^-$	(9.6 ±2.3) $\times 10^{-5}$	

Γ_8	$e^+ e^-$			$(7.15\pm0.19)\times10^{-5}$	
Γ_9	$\pi^+\pi^-\pi^0\pi^0$		<	2 %	90%
Γ_{10}	$\pi^+\pi^-\gamma$		<	3.6×10^{-3}	95%
Γ_{11}	$\pi^+\pi^-\pi^+\pi^-$		<	1×10^{-3}	90%
Γ_{12}	$\pi^0\pi^0\gamma$			$(7.2 \pm2.5)\times10^{-5}$	
Γ_{13}	$\mu^+\mu^-$		<	1.8×10^{-4}	90%
Γ_{14}	3γ		<	8×10^{-4}	90%

Charge conjugation (C)

Γ_{15}	$\eta\pi^0$	C	<	1×10^{-3}	90%
Γ_{16}	$3\pi^0$	C	<	1.5×10^{-3}	90%

CONSTRAINED FIT INFORMATION

An overall fit to 6 branching ratios uses 20 measurements and one constraint to determine 4 parameters. The overall fit has a χ^2 = 10.3 for 17 degrees of freedom.

The following *off-diagonal* array elements are the correlation coefficients $\langle\delta x_i \delta x_j\rangle/(\delta x_i\cdot\delta x_j)$, in percent, from the fit to 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	13		
x_3	−39	−5	
x_4	−74	−68	−1
	x_1	x_2	x_3

ω(782) PARTIAL WIDTHS

$\Gamma(e^+e^-)$ — Γ_8

VALUE (keV)	*DOCUMENT ID*
0.60±0.02 OUR EVALUATION	

ω(782) BRANCHING RATIOS

$\Gamma(\text{neutrals})/\Gamma(\pi^+\pi^-\pi^0)$ — $(\Gamma_2+\Gamma_4)/\Gamma_1$

VALUE	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
0.102±0.008 OUR FIT					
$0.103^{+0.011}_{-0.010}$ OUR AVERAGE					
0.15 ±0.04	46	AGUILAR-...	72B	HBC	3.9,4.6 $K^- p$
0.10 ±0.03	19	BARASH	67B	HBC	0.0 $\overline{p}p$
0.134±0.026	850	DIGIUGNO	66B	CNTR	1.4 $\pi^- p$
0.097±0.016	348	FLATTE	66	HBC	1.4 – 1.7 $K^- p \to \Lambda$MM
$0.06\ ^{+0.05}_{-0.02}$		JAMES	66	HBC	2.1 $\pi^+ p$
0.08 ±0.03	35	KRAEMER	64	DBC	1.2 $\pi^+ d$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.11 ±0.02	20	BUSCHBECK	63	HBC	1.5 $K^- p$

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

See also $\Gamma(\pi^+\pi^-)/\Gamma_{\text{total}}$.

VALUE	*DOCUMENT ID*		*TECN*	*COMMENT*
0.0249±0.0035 OUR FIT				
0.026 ±0.005 OUR AVERAGE				
$0.021\ ^{+0.028}_{-0.009}$	[6] RATCLIFF	72	ASPK	15 $\pi^- p \to n2\pi$
0.028 ±0.006	BEHREND	71	ASPK	Photoproduction
$0.022\ ^{+0.009}_{-0.01}$	[7] ROOS	70	RVUE	

[6] Significant interference effect observed. NB of $\omega \to 3\pi$ comes from an extrapolation.
[7] ROOS 70 combines ABRAMOVICH 70 and BIZZARRI 70.

$\Gamma(\pi^0\gamma)/\Gamma(\pi^+\pi^-\pi^0)$ — Γ_2/Γ_1

VALUE	DOCUMENT ID		TECN	COMMENT
0.096±0.006 OUR FIT				
0.096±0.006 OUR AVERAGE				
0.099±0.007	DOLINSKY	89	ND	$e^+e^- \rightarrow \pi^0\gamma$
0.084±0.013	KEYNE	76	CNTR	$\pi^- p \rightarrow \omega n$
0.109±0.025	BENAKSAS	72C	OSPK	e^+e^-
0.081±0.020	BALDIN	71	HLBC	2.9 $\pi^+ p$
0.13 ±0.04	JACQUET	69B	HLBC	

$\Gamma(\pi^+\pi^-\gamma)/\Gamma(\pi^+\pi^-\pi^0)$ — Γ_{10}/Γ_1

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<0.066	90	KALBFLEISCH	75	HBC	2.18 $K^- p \rightarrow \Lambda\pi^+\pi^-\gamma$
<0.05	90	FLATTE	66	HBC	1.2 – 1.7 $K^- p \rightarrow \Lambda\pi^+\pi^-\gamma$

$\Gamma(\pi^+\pi^-\gamma)/\Gamma_{total}$ — Γ_{10}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.0036	95	WEIDENAUER	90	ASTE	$p\overline{p} \rightarrow \pi^+\pi^-\pi^+\pi^-\gamma$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<0.004	95	BITYUKOV	88B	SPEC	32 $\pi^- p \rightarrow \pi^+\pi^-\gamma X$

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

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<1 × 10^−3	90	KURDADZE	88	OLYA	$e^+e^- \rightarrow \pi^+\pi^-\pi^+\pi^-$

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

VALUE (units 10^{-2})	CL%	DOCUMENT ID		TECN	COMMENT
<2	90	KURDADZE	86	OLYA	$e^+e^- \rightarrow \pi^+\pi^-\pi^0\pi^0$

$\Gamma(\mu^+\mu^-)/\Gamma(\pi^+\pi^-\pi^0)$ — Γ_{13}/Γ_1

VALUE (units 10^{-3})	CL%	DOCUMENT ID		TECN	COMMENT
<0.2	90	WILSON	69	OSPK	12 π^- C → Fe
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<1.7	74	FLATTE	66	HBC	1.2 – 1.7 $K^- p \rightarrow \Lambda\mu^+\mu^-$
<1.2		BARBARO-...	65	HBC	2.7 $K^- p$

$\Gamma(\pi^0\pi^0\gamma)/\Gamma(\pi^0\gamma)$ — Γ_{12}/Γ_2

VALUE	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
0.00085±0.00029		40 ± 14	ALDE	94B	GAM2	$\pi^- p \rightarrow \pi^0\pi^0\gamma n$
• • • We do not use the following data for averages, fits, limits, etc. • • •						
< 0.005	90		DOLINSKY	89	ND	$e^+e^- \rightarrow \pi^0\pi^0\gamma$
< 0.18	95		KEYNE	76	CNTR	$\pi^- p \rightarrow \omega n$
< 0.15	90		BENAKSAS	72C	OSPK	e^+e^-
< 0.14			BALDIN	71	HLBC	2.9 $\pi^+ p$
< 0.1	90		BARMIN	64	HLBC	1.3–2.8 $\pi^- p$

$\Gamma(\eta\pi^0)/\Gamma_{total}$ — Γ_{15}/Γ

Violates C conservation.

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.001	90	ALDE	94B	GAM2	38$\pi^- p \rightarrow \eta\pi^0 n$

$[\Gamma(\eta\gamma)+\Gamma(\eta\pi^0)]/\Gamma(\pi^+\pi^-\pi^0)$ — $(\Gamma_5+\Gamma_{15})/\Gamma_1$

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.016	90	[8] FLATTE	66	HBC	1.2 – 1.7 $K^- p \rightarrow \Lambda\pi^+\pi^-$ MM
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<0.045	95	JACQUET	69B	HLBC	

[8] Restated by us usingBR($\eta \rightarrow$ $charged modes$)=(29.2)%.

$\Gamma(\text{neutrals})/\Gamma(\text{charged particles})$ — $(\Gamma_2+\Gamma_4)/(\Gamma_1+\Gamma_3)$

VALUE	DOCUMENT ID		TECN	COMMENT
0.099±0.008 OUR FIT				
0.124±0.021	FELDMAN	67C	OSPK	1.2 $\pi^- p$

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

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.00045	90	DOLINSKY	89	ND	$e^+e^- \rightarrow \pi^0\pi^0\gamma$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<0.08	95	JACQUET	69B	HLBC	

$\Gamma(\eta\gamma)/\Gamma(\pi^0\gamma)$ — Γ_5/Γ_2

VALUE	DOCUMENT ID		TECN	COMMENT
0.0098±0.0024	ALDE	94	GAM2	$38\pi^- p \rightarrow \omega n$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.0082±0.0033	[9] DOLINSKY	89	ND	$e^+e^- \rightarrow \eta\gamma$
0.039 ±0.007	[10] DOLINSKY	89	ND	e^+e^-
0.010 ±0.045	APEL	72B	OSPK	4–8 $\pi^- p \rightarrow n3\gamma$

[9] Solution corresponding to constructive ω-ρ interference. The quark model predicts a relative decay phase of zero.
[10] Solution corresponding to destructive ρ-ω interference.

$\Gamma(\pi^0\mu^+\mu^-)/\Gamma_{\text{total}}$ — Γ_7/Γ

VALUE (units 10^{-4})	DOCUMENT ID		TECN	COMMENT
0.96±0.23	DZHELYADIN	81B	CNTR	25–33 $\pi^- p \rightarrow \omega n$

$\Gamma(\pi^0 e^+e^-)/\Gamma_{\text{total}}$ — Γ_6/Γ

VALUE (units 10^{-4})	EVTS	DOCUMENT ID		TECN	COMMENT
5.9±1.9	43	DOLINSKY	88	ND	$e^+e^- \rightarrow \pi^0 e^+e^-$

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

VALUE (units 10^{-4})	EVTS	DOCUMENT ID		TECN	COMMENT
0.715±0.019 OUR AVERAGE					
0.714±0.036		DOLINSKY	89	ND	$e^+e^- \rightarrow \pi^+\pi^-\pi^0$
0.72 ±0.03		BARKOV	87	CMD	$e^+e^- \rightarrow \pi^+\pi^-\pi^0$
0.66 ±0.05		KURDADZE	84	OLYA	$e^+e^- \rightarrow$ hadrons
0.675±0.069		CORDIER	80	WIRE	$e^+e^- \rightarrow 3\pi$
0.83 ±0.10		BENAKSAS	72B	OSPK	$e^+e^- \rightarrow 3\pi$
0.77 ±0.06		[11] AUGUSTIN	69D	OSPK	$e^+e^- \rightarrow 2\pi$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.64 ±0.04	1488	[12] KURDADZE	83B	OLYA	$e^+e^- \rightarrow \pi^+\pi^-\pi^0$
0.65 ±0.13	33	[13] ASTVACAT...	68	OSPK	Assume SU(3)+mixing

[11] Rescaled by us to correspond to ω width 8.4 MeV.
[12] Superseded by KURDADZE 84.
[13] Not resolved from ρ decay. Error statistical only.

$\Gamma(\text{neutrals})/\Gamma_{\text{total}}$ — $(\Gamma_2+\Gamma_4)/\Gamma$

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.090±0.006 OUR FIT					
0.081±0.011 OUR AVERAGE					
0.075±0.025		BIZZARRI	71	HBC	0.0 $p\overline{p}$
0.079±0.019		DEINET	69B	OSPK	1.5 $\pi^- p$
0.084±0.015		BOLLINI	68C	CNTR	2.1 $\pi^- p$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.073±0.018	42	BASILE	72B	CNTR	1.67 $\pi^- p$

$\Gamma(\pi^+\pi^-)/\Gamma_{\text{total}}$ — Γ_3/Γ

See also $\Gamma(\pi^+\pi^-)/\Gamma(\pi^+\pi^-\pi^0)$.

VALUE	DOCUMENT ID		TECN	COMMENT
0.0221±0.0030 OUR FIT				
0.021 ±0.004 OUR AVERAGE				
0.023 ±0.005	BARKOV	85	OLYA	e^+e^-
0.016 $^{+0.009}_{-0.007}$	QUENZER	78	CNTR	e^+e^-

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

0.010 ±0.001	[14] WICKLUND	78	ASPK	3,4,6 $\pi^{\pm} N$
0.0122±0.0030	ALVENSLEBEN	71C	CNTR	Photoproduction
$0.013^{+0.012}_{-0.009}$	MOFFEIT	71	HBC	2.8,4.7 γp
$0.0080^{+0.0028}_{-0.002}$	[15] BIGGS	70B	CNTR	4.2 $\gamma C \rightarrow \pi^+ \pi^- C$

[14] From a model-dependent analysis assuming complete coherence.
[15] Re-evaluated under $\Gamma(\pi^+\pi^-)/\Gamma(\pi^+\pi^-\pi^0)$ by BEHREND 71 using more accurate $\omega \rightarrow \rho$ photoproduction cross-section ratio.

$\Gamma(\pi^0\pi^0\gamma)/\Gamma(\text{neutrals})$ — $\Gamma_{12}/(\Gamma_2+\Gamma_4)$

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.22±0.07		[16] DAKIN	72	OSPK	1.4 $\pi^- p \rightarrow n$MM
<0.19	90	DEINET	69B	OSPK	

[16] See $\Gamma(\pi^0\gamma)/\Gamma(\text{neutrals})$.

$\Gamma(\pi^0\gamma)/\Gamma(\text{neutrals})$ — $\Gamma_2/(\Gamma_2+\Gamma_4)$

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.78±0.07		[17] DAKIN	72	OSPK	1.4 $\pi^- p \rightarrow n$MM
>0.81	90	DEINET	69B	OSPK	

[17] Error statistical only. Authors obtain good fit also assuming $\pi^0\gamma$ as the only neutral decay.

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

VALUE (units 10^{-4})	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
8.3±2.1	ALDE	94	GAM2	$38\pi^- p \rightarrow \omega n$
7.3±2.9	[18] DOLINSKY	89	ND	$e^+e^- \rightarrow \eta\gamma$
35 ±5	[19] DOLINSKY	89	ND	$e^+e^- \rightarrow \eta\gamma$
$3.0^{+2.5}_{-1.8}$	[18] ANDREWS	77	CNTR	6.7–10 γCu
29.0±7.0	[19] ANDREWS	77	CNTR	6.7–10 γCu

[18] Solution corresponding to constructive ω-ρ interference. The quark model predicts a relative decay phase of zero.
[19] Solution corresponding to destructive ω-ρ interference.

$\Gamma(\pi^0\mu^+\mu^-)/\Gamma(\mu^+\mu^-)$ — Γ_7/Γ_{13}

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
1.2±0.6	30	[20] DZHELYADIN	79	CNTR	25–33 $\pi^- p$

[20] Superseded by DZHELYADIN 81B result above.

$\Gamma(\pi^+\pi^-\pi^0)/\Gamma_{\text{total}}$ — Γ_1/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
0.8942±0.0062	DOLINSKY	89	ND	$e^+e^- \rightarrow \pi^+\pi^-\pi^0$

$\Gamma(3\pi^0)/\Gamma_{\text{total}}$ — Γ_{16}/Γ

Violates C conservation.

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.0015	90	ALDE	94B	GAM2	$38\pi^- p \rightarrow 3\pi^0 n$

$\Gamma(3\gamma)/\Gamma_{\text{total}}$ — Γ_{14}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.0008	90	ALDE	94B	GAM2	$38\pi^- p \rightarrow 3\gamma n$

$\omega(782)$ REFERENCES

ALDE	94	ZPHY C61 35	+Binon+	(SERP, LAPP, LANL, BELG, BRUX, CERN)
ALDE	94B	PL B340 122	+Binon, Boutemeur+	(SERP, BELG, LANL, LAPP, MONT)
AMSLER	94C	PL B327 425	+Armstrong+	(Crystal Barrel Collab.)
AMSLER	93B	PL B311 362	+Armstrong, Augustin+	(Crystal Barrel Collab.)
WEIDENAUER	93	ZPHY C59 387	+Duch+	(ASTERIX Collab.)
WEIDENAUER	90	ZPHY C47 353	+Duch, Heel, Kalinowsky+	(ASTERIX Collab.)
DOLINSKY	89	ZPHY C42 511	+Druzhinin, Dubrovin, Golubev+	(NOVO)
BITYUKOV	88B	SJNP 47 800	+Borisov, Viktorov, Golovkin+	(SERP)
		Translated from YAF 47 1258.		
DOLINSKY	88	SJNP 48 277	+Druzhinin, Dubrovin, Golubev+	(NOVO)
		Translated from YAF 48 442.		
KURDADZE	88	JETPL 47 512	+Leltchouk, Pakhtusova, Sidorov+	(NOVO)
		Translated from ZETFP 47 432.		
AULCHENKO	87	PL B186 432	+Dolinsky, Druzhinin, Dubrovin+	(NOVO)
BARKOV	87	JETPL 46 164	+Vasserman, Vorobev, Ivanov	(NOVO)
		Translated from ZETFP 46 132.		
KURDADZE	86	JETPL 43 643	+Lelchuk, Pakhtusova, Sidorov, Skrinskii+	(NOVO)
		Translated from ZETFP 43 497.		
BARKOV	85	NP B256 365	+Chilingarov, Eidelman, Khazin, Lelchuk+	(NOVO)
KURDADZE	84	IYF 84-7 Preprint	+Leltchouk, Pakhtusova, Sidorov+	(NOVO)
KURDADZE	83B	JETPL 36 274	+Pakhtusova, Sidorov+	(NOVO)
		Translated from ZETFP 36 221.		
DZHELYADIN	81B	PL 102B 296	+Golovkin, Konstantinov+	(SERP)
CORDIER	80	NP B172 13	+Delcourt, Eschstruth, Fulda+	(LALO)
ROOS	80	LNC 27 321	+Pellinen	(HELS)
BENKHEIRI	79	NP B150 268	+Eisenstein+	(EPOL, CERN, CDEF, LALO)
DZHELYADIN	79	PL 84B 143	+Golovkin, Gritsuk+	(SERP)
COOPER	78B	NP B146 1	+Ganguli+	(TATA, CERN, CDEF, MADR)
QUENZER	78	PL 76B 512	+Ribes, Rumpf, Bertrand, Bizot, Chase+	(LALO)
VANAPEL...	78	NP B133 245	VanApeldoorn, Grundeman, Harting+	(ZEEM)
WICKLUND	78	PR D17 1197	+Ayres, Diebold, Greene, Kramer, Pawlicki	(ANL)
ANDREWS	77	PRL 38 198	+Fukushima, Harvey, Lobkowicz, May+	(ROCH)
GESSAROLI	77	NP B126 382	+	(BGNA, FIRZ, GENO, MILA, OXF, PAVI)
KEYNE	76	PR D14 28	+Binnie, Carr, Debenham, Garbutt+	(LOIC, SHMP)
Also	73B	PR D8 2789	Binnie, Carr, Debenham, Duane+	(LOIC, SHMP)
KALBFLEISCH	75	PR D11 987	+Strand, Chapman	(BNL, MICH)
AGUILAR-...	72B	PR D6 29	Aguilar-Benitez, Chung, Eisner, Samios	(BNL)
APEL	72B	PL 41B 234	+Auslander, Muller, Bertolucci+	(KARLK, KARLE, PISA)
BASILE	72B	Phil. Conf. 153	+Bollini, Broglin, Dalpiaz, Frabetti+	(CERN)
BENAKSAS	72B	PL 42B 507	+Cosme, Jean-Marie, Jullian	(ORSAY)
BENAKSAS	72C	PL 42B 511	+Cosme, Jean-Marie, Jullian, Laplanche+	(ORSAY)
BORENSTEIN	72	PR D5 1559	+Danburg, Kalbfleisch+	(BNL, MICH)
BROWN	72	PL 42B 117	+Downing, Holloway, Huld, Bernstein+	(ILL, ILLC)
DAKIN	72	PR D6 2321	+Hauser, Kreisler, Mischke	(PRIN)
RATCLIFF	72	PL 38B 345	+Bulos, Carnegie, Kluge, Leith, Lynch+	(SLAC)
ALVENSLEBEN	71C	PRL 27 888	+Becker, Busza, Chen, Cohen+	(DESY)
BALDIN	71	SJNP 13 758	+Yergakov, Trebukhovsky, Shishov	(ITEP)
		Translated from YAF 13 1318.		
BEHREND	71	PRL 27 61	+Lee, Nordberg, Wehmann+	(ROCH, CORN, FNAL)
BIZZARRI	71	NP B27 140	+Montanet, Nilsson, D'Andlau+	(CERN, CDEF)
COYNE	71	NP B32 333	+Butler, Fang-Landau, MacNaughton	(LRL)
MOFFEIT	71	NP B29 349	+Bingham, Fretter+	(LRL, UCB, SLAC, TUFTS)
ABRAMOVI...	70	NP B20 209	Abramovich, Blumenfeld, Bruyant+	(CERN)
BIGGS	70B	PRL 24 1201	+Clifft, Gabathuler, Kitching, Rand	(DARE)
BIZZARRI	70	PRL 25 1385	+Ciapetti, Dore, Gaspero, Guidoni+	(ROMA, SYRA)
ROOS	70	DNPL/R7 173		(CERN)
Proc. Daresbury Study Weekend No. 1.				
AUGUSTIN	69D	PL 28B 513	+Benaksas, Buon, Gracco, Haissinski+	(ORSAY)
BIZZARRI	69	NP B14 169	+Foster, Gavillet, Montanet+	(CERN, CDEF)
DEINET	69B	PL 30B 426	+Menzione, Muller, Buniatov+	(KARL, CERN)
JACQUET	69B	NC 63A 743	+Nguyen-Khac, Haatuft, Halsteinslid	(EPOL, BERG)
WILSON	69	Private Comm.		(HARV)
Also	69	PR 178 2095	Wehmann+	(HARV, CASE, SLAC, CORN, MCGI)
ASTVACAT...	68	PL 27B 45	Astvacaturov, Azimov, Baldin+	(JINR, MOSU)
BOLLINI	68C	NC 56A 531	+Buhler, Dalpiaz, Massam+	(CERN, BGNA, STRB)
BARASH	67B	PR 156 1399	+Kirsch, Miller, Tan	(COLU)
FELDMAN	67C	PR 159 1219	+Frati, Gleeson, Halpern, Nussbaum+	(PENN)
DIGIUGNO	66B	NC 44A 1272	+Peruzzi, Troise+	(NAPL, FRAS, TRST)
FLATTE	66	PR 145 1050	+Huwe, Murray, Button-Shafer, Solmitz+	(LRL)
JAMES	66	PR 142 896	+Kraybill	(YALE, BNL)
BARBARO-...	65	PRL 14 279	Barbaro-Galtieri, Tripp	(LRL)
BARMIN	64	JETP 18 1289	+Dolgolenko, Krestnikov+	(ITEP)
		Translated from ZETF 45 1879.		
KRAEMER	64	PR 136B 496	+Madansky, Fields+	(JHU, NWES, WOOD)
BUSCHBECK	63	Siena Conf. 1 166	+Czapp+	(VIEN, CERN, ANIK)

OTHER RELATED PAPERS

DOLINSKY	86	PL B174 453	+Druzhinin, Dubrovin, Eidelman+	(NOVO)
KURDADZE	83	JETPL 37 733	+Lelchuk, Pakhtusova+	(NOVO)
		Translated from ZETFP 37 613.		
ALFF-...	62B	PRL 9 325	Alff-Steinberger, Berley, Colley+	(COLU, RUTG)
ARMENTEROS	62	CERN Conf. 90	+Budde+	(CERN, CDEF, EPOL)
STEVENSON	62	PR 125 687	+Alvarez, Maglich, Rosenfeld	(LRL)
MAGLICH	61	PRL 7 178	+Alvarez, Rosenfeld, Stevenson	(LRL)
PEVSNER	61	PRL 7 421	+Kraemer, Nussbaum, Richardson+	(JHU)
XUONG	61	PRL 7 327	+Lynch	(LRL)

$\eta'(958)$

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

Our latest mini-review on this particle can be found in the 1984 edition. See also the mini-review under non-$q\overline{q}$ candidates. (See the index for the page number.)

$\eta'(958)$ MASS

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	COMMENT
957.77±0.14 OUR AVERAGE					
959 ±1	630±50	BELADIDZE	92C	VES	36 π^- Be $\rightarrow$ $\pi^- \eta' \eta$ Be
958 ±1	340	ARMSTRONG	91B	OMEG	300 $pp \rightarrow pp\eta\pi^+\pi^-$
958.2 ±0.4	622	AUGUSTIN	90	DM2	$J/\psi \rightarrow \gamma\eta\pi^+\pi^-$
957.8 ±0.2	2420	AUGUSTIN	90	DM2	$J/\psi \rightarrow \gamma\gamma\pi^+\pi^-$
956.3 ±1.0	143±12	GIDAL	87	MRK2	$e^+e^- \rightarrow e^+e^-\eta\pi^+\pi^-$
957.46±0.33		DUANE	74	MMS	$\pi^- p \rightarrow n$MM
958.2 ±0.5	1414	DANBURG	73	HBC	2.2 $K^- p \rightarrow \Lambda X^0$
958 ±1	400	JACOBS	73	HBC	2.9 $K^- p \rightarrow \Lambda X^0$
956.1 ±1.1	3415	BASILE	71	CNTR	1.6 $\pi^- p \rightarrow nX^0$
957.4 ±1.4	535	BASILE	71	CNTR	1.6 $\pi^- p \rightarrow nX^0$
957 ±1		RITTENBERG	69	HBC	1.7–2.7 $K^- p$

$\eta'(958)$ WIDTH

We include direct measurements of the $\eta'(958)$ total width and $\gamma\gamma$ partial width together with the measured branching ratios in the fit for the partial decay rates.

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	CHG	COMMENT
0.201±0.016 OUR FIT	Error includes scale factor of 1.3.					
0.28 ±0.10	1000	BINNIE	79	MMS	0	$\pi^- p \rightarrow n$MM

$\eta'(958)$ DECAY MODES

	Mode	Fraction (Γ_i/Γ)	Scale factor/ Confidence level
Γ_1	$\pi^+\pi^-\eta$	(43.7 ±1.5) %	S=1.1
Γ_2	$\rho^0\gamma$	(30.2 ±1.3) %	S=1.1
Γ_3	$\pi^0\pi^0\eta$	(20.8 ±1.3) %	S=1.2
Γ_4	$\omega\gamma$	(3.02±0.30) %	
Γ_5	$\gamma\gamma$	(2.12±0.13) %	S=1.2
Γ_6	$3\pi^0$	(1.55±0.26) $\times 10^{-3}$	
Γ_7	$\mu^+\mu^-\gamma$	(1.04±0.26) $\times 10^{-4}$	
Γ_8	$\pi^+\pi^-\pi^0$	$<$ 5 %	CL=90%
Γ_9	$\pi^0\rho^0$	$<$ 4 %	CL=90%
Γ_{10}	$\pi^+\pi^-$	$<$ 2 %	CL=90%
Γ_{11}	$\pi^0 e^+e^-$	$<$ 1.3 %	CL=90%
Γ_{12}	ηe^+e^-	$<$ 1.1 %	CL=90%
Γ_{13}	$\pi^+\pi^+\pi^-\pi^-$	$<$ 1 %	CL=90%
Γ_{14}	$\pi^+\pi^+\pi^-\pi^-$ neutrals	$<$ 1 %	CL=95%
Γ_{15}	$\pi^+\pi^+\pi^-\pi^-\pi^0$	$<$ 1 %	CL=90%
Γ_{16}	6π	$<$ 1 %	CL=90%
Γ_{17}	$\pi^+\pi^-e^+e^-$	$<$ 6 $\times 10^{-3}$	CL=90%
Γ_{18}	$\pi^0\pi^0$	$<$ 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}	3γ	$<$ 1.0 $\times 10^{-4}$	CL=90%
Γ_{22}	$\mu^+\mu^-\pi^0$	$<$ 6.0 $\times 10^{-5}$	CL=90%
Γ_{23}	$\mu^+\mu^-\eta$	$<$ 1.5 $\times 10^{-5}$	CL=90%
Γ_{24}	$\pi^+\pi^-\gamma$ (including $\rho^0\gamma$)		
Γ_{25}	e^+e^-	$<$ 2.1 $\times 10^{-7}$	CL=90%

*CITATION: L. Montanet et al., Physical Review D50, 1173 (1994) and 1995 off-year partial update for the 1996 edition (URL: http://pdg.lbl.gov/)

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 45 measurements and one constraint to determine 7 parameters. The overall fit has a $\chi^2 = 33.4$ for 39 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	−49					
x_3	−63	−35				
x_4	−27	−25	34			
x_5	−22	−13	27	8		
x_6	−23	−13	36	12	10	
Γ	35	−11	−21	−3	−83	−7
	x_1	x_2	x_3	x_4	x_5	x_6

	Mode	Rate (MeV)	Scale factor
Γ_1	$\pi^+\pi^-\eta$	0.088 ±0.009	1.2
Γ_2	$\rho^0\gamma$	0.061 ±0.005	1.3
Γ_3	$\pi^0\pi^0\eta$	0.042 ±0.004	1.5
Γ_4	$\omega\gamma$	0.0061 ±0.0008	1.2
Γ_5	$\gamma\gamma$	0.00426±0.00019	1.1
Γ_6	$3\pi^0$	(3.1 ±0.6) $\times 10^{-4}$	1.1

η'(958) PARTIAL WIDTHS

$\Gamma(\gamma\gamma)$ — Γ_5

VALUE (keV)	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
4.26±0.19 OUR FIT	Error includes scale factor of 1.1.				
4.34±0.25 OUR AVERAGE					
4.53±0.29±0.51	266±17	KARCH	92	CBAL	$e^+e^- \rightarrow e^+e^-\eta\pi^0\pi^0$
3.62±0.14±0.48		[1] BEHREND	91	CELL	$e^+e^- \rightarrow e^+e^-\eta'(958)$
4.6 ±1.1 ±0.6	23	BARU	90	MD1	$e^+e^- \rightarrow e^+e^-\pi^+\pi^-\gamma$
4.57±0.25±0.44		BUTLER	90	MRK2	$e^+e^- \rightarrow e^+e^-\eta'(958)$
4.94±0.23±0.72	547	[2] ROE	90	ASP	$e^+e^- \rightarrow e^+e^-2\gamma$
3.8 ±0.7 ±0.6	34	AIHARA	88C	TPC	$e^+e^- \rightarrow e^+e^-\eta\pi^+\pi^-$
4.8 ±0.5 ±0.5	136±14	[2] 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±12	[3] GIDAL	87	MRK2	$e^+e^- \rightarrow e^+e^-\eta\pi^+\pi^-$
4.0 ±0.9		[4] BARTEL	85E	JADE	$e^+e^- \rightarrow e^+e^-2\gamma$

[1] Using B($\eta' \rightarrow \rho(770)\gamma$) = (30.1 ± 1.4)%.
[2] Using B($\eta' \rightarrow \gamma\gamma$) = (2.17 ± 0.17)%.
[3] Superseded by BUTLER 90.
[4] 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.

$\Gamma(\gamma\gamma) \times \Gamma(\rho^0\gamma)/\Gamma_{\text{total}}$ — $\Gamma_5\Gamma_2/\Gamma$

VALUE (keV)	EVTS	DOCUMENT ID		TECN	COMMENT
1.29±0.06 OUR FIT Error includes scale factor of 1.2.					
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±30	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±16.5	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	$e^+e^- \to e^+e^-\rho\gamma$

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

VALUE (keV)	DOCUMENT ID		TECN	COMMENT
0.88±0.07 OUR FIT Error includes scale factor of 1.1.				
0.93±0.06±0.11	[5] 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	[6] KARCH	90	CBAL	$e^+e^- \to e^+e^-\eta\pi^0\pi^0$
1.00±0.08±0.10	[5,6] ANTREASYAN	87	CBAL	$e^+e^- \to e^+e^-\eta\pi^0\pi^0$

[5] Using BR($\eta \to 2\gamma$)=(38.9 ± 0.5)%.
[6] Superseded by KARCH 92.

$\eta'(958)$ α PARAMETER

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

VALUE	DOCUMENT ID		TECN	COMMENT
−0.058±0.013	[7] 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	[7] KALBFLEISCH	74	RVUE	$\eta' \to \eta\pi^+\pi^-$

[7] May not necessarily be the same for $\eta' \to \eta\pi^+\pi^-$ and $\eta' \to \eta\pi^0\pi^0$.

$\eta'(958)$ BRANCHING RATIOS

$\Gamma(\pi^+\pi^-\eta(\text{neutral decay}))/\Gamma_{\text{total}}$ — $0.709\Gamma_1/\Gamma$

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.310±0.011 OUR FIT Error includes scale factor of 1.1.					
0.314±0.026	281	RITTENBERG	69	HBC	1.7–2.7 K^-p

$\Gamma(\pi^+\pi^-\text{neutrals})/\Gamma_{\text{total}}$ — $(0.709\Gamma_1+0.291\Gamma_3+0.9\Gamma_4)/\Gamma$

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.398±0.009 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 $K^-p \to \Lambda\pi^+\pi^-$ neutrals
0.35 ±0.06	33	BADIER	65B	HBC	3 K^-p

$\Gamma(\pi^+\pi^-\eta(\text{charged decay}))/\Gamma_{\text{total}}$ — $0.291\Gamma_1/\Gamma$

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.127±0.004 OUR FIT Error includes scale factor of 1.1.					
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 $K^-p \to \Lambda\pi^+\pi^-\pi^+\pi^-\pi^0$
0.07 ±0.04	7	BADIER	65B	HBC	3 K^-p

$[\Gamma(\pi^0\pi^0\eta(\text{charged decay})) + \Gamma(\omega(\text{charged decay})\gamma)]/\Gamma_{total}$ — $(0.291\Gamma_3+0.9\Gamma_4)/\Gamma$

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
0.088±0.005 OUR FIT Error includes scale factor of 1.2.				
0.045±0.029	42	RITTENBERG 69	HBC	1.7–2.7 $K^- p$

$\Gamma(\text{neutrals})/\Gamma_{total}$ — $(0.709\Gamma_3+0.09\Gamma_4+\Gamma_5)/\Gamma$

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
0.171±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 $\pi^- p \rightarrow n X^0$
0.189±0.026	123	RITTENBERG 69	HBC	1.7–2.7 $K^- p$

$\Gamma(\rho^0\gamma)/\Gamma_{total}$ — Γ_2/Γ

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
0.302±0.013 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 $K^- p \rightarrow \Lambda\pi^+\pi^-\gamma$
0.34 ±0.09	35	BADIER 65B	HBC	3 $K^- p$

$\Gamma(\rho^0\gamma)/\Gamma(\pi\pi\eta)$ — $\Gamma_2/(\Gamma_1+\Gamma_3)$

VALUE	DOCUMENT ID	TECN	COMMENT
0.468±0.029 OUR FIT Error includes scale factor of 1.1.			
0.31 ±0.15	DAVIS 68	HBC	5.5 $K^- p$

$\Gamma(\pi^0 e^+ e^-)/\Gamma_{total}$ — Γ_{11}/Γ

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<0.013	90	RITTENBERG 65	HBC	2.7 $K^- p$

$\Gamma(\eta e^+ e^-)/\Gamma_{total}$ — Γ_{12}/Γ

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<0.011	90	RITTENBERG 65	HBC	2.7 $K^- p$

$\Gamma(\pi^0\rho^0)/\Gamma_{total}$ — Γ_9/Γ

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

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

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<0.006	90	RITTENBERG 65	HBC	2.7 $K^- p$

$\Gamma(6\pi)/\Gamma_{total}$ — Γ_{16}/Γ

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<0.01	90	LONDON 66	HBC	Compilation

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

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
0.069±0.008 OUR FIT Error includes scale factor of 1.1.				
0.068±0.013	68	ZANFINO 77	ASPK	8.4 $\pi^- p$

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

VALUE	DOCUMENT ID	TECN	COMMENT
0.447±0.028 OUR FIT Error includes scale factor of 1.1.			
0.25 ±0.14	DAUBER 64	HBC	1.95 $K^- p$

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

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
0.0212±0.0013 OUR FIT Error includes scale factor of 1.2.				
0.0196±0.0015 OUR AVERAGE				
0.0200±0.0018		[8] STANTON 80	SPEC	8.45 $\pi^- p \rightarrow n\pi^+\pi^- 2\gamma$
0.025 ±0.007		DUANE 74	MMS	$\pi^- p \rightarrow n$MM
0.0171±0.0033	68	DALPIAZ 72	CNTR	1.6 $\pi^- p \rightarrow n X^0$
0.020 $^{+0.008}_{-0.006}$	31	HARVEY 71	OSPK	3.65 $\pi^- p \rightarrow n X^0$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.018 ±0.002	6000	[9] APEL 79	NICE	15–40 $\pi^- p \rightarrow n 2\gamma$

[8] Includes APEL 79 result.
[9] Data is included in STANTON 80 evaluation.

$\Gamma(e^+e^-)/\Gamma_{total}$ — Γ_{25}/Γ

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

$\Gamma(\pi^+\pi^-)/\Gamma_{total}$ — Γ_{10}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.02	90	RITTENBERG	69	HBC	1.7–2.7 K^-p
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<0.08	95	DANBURG	73	HBC	2.2 $K^-p \rightarrow \Lambda X^0$

$\Gamma(\pi^+\pi^-\pi^0)/\Gamma_{total}$ — Γ_8/Γ

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

$\Gamma(\pi^+\pi^+\pi^-\pi^-\text{neutrals})/\Gamma_{total}$ — Γ_{14}/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

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

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

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

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

$\Gamma(\rho^0\gamma)/\Gamma(\pi^+\pi^-\gamma(\text{including}\,\rho^0\gamma))$ — Γ_2/Γ_{24}

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
1.15 ± 0.10	473	DANBURG	73	HBC	2.2 $K^-p \rightarrow \Lambda X^0$
1.01 ± 0.15	137	JACOBS	73	HBC	2.9 $K^-p \rightarrow \Lambda X^0$
0.94 ± 0.20		AGUILAR-...	70D	HBC	3.9–4.6 K^-p

$\Gamma(\pi^0\pi^0\eta(3\pi^0\,\text{decay}))/\Gamma_{total}$ — $0.319\Gamma_3/\Gamma$

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.066 ± 0.004 OUR FIT Error includes scale factor of 1.2.					
$0.11\ \pm0.06$	4	BENSINGER	70	DBC	2.2 π^+d

$\Gamma(\rho^0\gamma)/\Gamma(\pi^+\pi^-\eta(\text{neutral decay}))$ — $\Gamma_2/0.709\Gamma_1$

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.97 ± 0.07 OUR FIT Error includes scale factor of 1.1.					
1.01 ± 0.09 OUR AVERAGE					
1.07 ± 0.17		BELADIDZE	92C	VES	36 $\pi^-\text{Be} \rightarrow \pi^-\eta'\eta\,\text{Be}$
0.92 ± 0.14	473	DANBURG	73	HBC	2.2 $K^-p \rightarrow \Lambda X^0$
1.11 ± 0.18	192	JACOBS	73	HBC	2.9 $K^-p \rightarrow \Lambda X^0$

$\Gamma(\gamma\gamma)/\Gamma(\pi^0\pi^0\eta(\text{neutral decay}))$ — $\Gamma_5/0.709\Gamma_3$

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.144 ± 0.010 OUR FIT Error includes scale factor of 1.6.					
0.188 ± 0.058	16	APEL	72	OSPK	3.8 $\pi^-p \rightarrow nX^0$

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

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

$\Gamma(\mu^+\mu^-\eta)/\Gamma_{total}$ — Γ_{23}/Γ

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

$\Gamma(\mu^+\mu^-\pi^0)/\Gamma_{total}$ — Γ_{22}/Γ

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

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

VALUE (units 10^{-4})	DOCUMENT ID		TECN	COMMENT
74±12 OUR FIT				
74±12 OUR AVERAGE				
74±15	ALDE	87B	GAM2	38 $\pi^- p \rightarrow n6\gamma$
75±18	BINON	84	GAM2	30–40 $\pi^- p \rightarrow n6\gamma$

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

VALUE	DOCUMENT ID		TECN	COMMENT
0.102±0.007 OUR FIT Error includes scale factor of 1.6.				
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 $\pi^- p \rightarrow n2\gamma$

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

VALUE	DOCUMENT ID		TECN	COMMENT
0.145±0.014 OUR FIT				
0.147±0.016	ALDE	87B	GAM2	38 $\pi^- p \rightarrow n4\gamma$

$\Gamma(3\gamma)/\Gamma(\pi^0\pi^0\eta)$ — Γ_{21}/Γ_3

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

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

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

$\Gamma(\pi^0\pi^0)/\Gamma(\pi^0\pi^0\eta)$ — Γ_{18}/Γ_3

VALUE (units 10^{-4})	CL%	DOCUMENT ID		TECN	COMMENT
<45	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 $\pi^- p \rightarrow n8\gamma$

$\eta'(958)$ *C*-NONCONSERVING DECAY PARAMETER

See the note on η decay parameters in the Stable Particle Full 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 $K^- p$

$\eta'(958)$ REFERENCES

AMSLER	93	ZPHY C58 175	+Armstrong, Augustin+	(Crystal Barrel Collab.)
BELADIDZE	92C	SJNP 55 1535	+Bityukov, Borisov	(VES Collab.)
		Translated from YAF 55 2748.		
KARCH	92	ZPHY C54 33	+Antreasyan, Bartels+	(Crystal Ball Collab.)
ARMSTRONG	91B	ZPHY C52 389	+Barnes+	(ATHU, BARI, BIRM, CERN, CDEF)
BEHREND	91	ZPHY C49 401	+Criegee, Field, Franke+	(CELLO Collab.)
AUGUSTIN	90	PR D42 10	+Cosme+	(DM2 Collab.)
BARU	90	ZPHY C48 581	+Blinov, Blinov+	(MD-1 Collab.)
BUTLER	90	PR D42 1368	+Boyer+	(Mark II Collab.)
KARCH	90	PL B249 353	+Antreasyan, Bartels+	(Crystal Ball Collab.)
ROE	90	PR D41 17	+Bartha, Burke, Garbincius+	(ASP Collab.)
AIHARA	88C	PR D38 1	+Alston-Garnjost+	(TPC-2γ Collab.)
VOROBYEV	88	SJNP 48 273	+Golubev, Dolinsky, Druzhinin+	(NOVO)
		Translated from YAF 48 436.		

WILLIAMS	88	PR D38 1365	+Antreasyan, Bartels, Besset+	(Crystal Ball Collab.)
AIHARA	87	PR D35 2650	+Alston-Garnjost+	(TPC-2γ Collab.) JP
ALBRECHT	87B	PL B199 457	+Andam, Binder+	(ARGUS Collab.)
ALDE	87B	ZPHY C36 603	+Binon, Bricman+	(LANL, BELG, SERP, LAPP)
ANTREASYAN	87	PR D36 2633	+Bartels, Besset+	(Crystal Ball Collab.)
GIDAL	87	PRL 59 2012	+Boyer, Butler, Cords, Abrams+	(LBL, SLAC, HARV)
ALDE	86	PL B177 115	+Binon, Bricman+	(SERP, BELG, LANL, LAPP)
BARTEL	85E	PL 160B 421	+Becker, Cords, Felst+	(JADE Collab.)
ALTHOFF	84E	PL 147B 487	+Braunschweig, Kirschfink, Luebelsmeyer+	(TASSO Collab.)
BERGER	84B	PL 142B 125		(PLUTO Collab.)
BINON	84	PL 140B 264	+Donskov, Duteil+	(SERP, BELG, LAPP, CERN)
BEHREND	83B	PL 125B 518	+D'Agostini+	(CELLO Collab.)
Also	82C	PL 114B 378	Behrend, Chen, Fenner, Field+	(CELLO Collab.)
JENNI	83	PR D27 1031	+Burke, Telnov, Abrams, Blocker+	(SLAC, LBL)
BARTEL	82B	PL 113B 190	+Cords+	(JADE Collab.)
DZHELYADIN	81	PL 105B 239	+Golovkin, Konstantinov, Kubarovski+	(SERP)
STANTON	80	PL 92 B 353	+Edwards, Legacey+	(OSU, CARL, MCGI, TNTO)
VIKTOROV	80	SJNP 32 520	+Golovkin, Dzhelyadin, Zaitsev, Mukhin+	(SERP)
		Translated from YAF 32 1005.		
APEL	79	PL 83B 131	+Augenstein, Bertolucci	(KARLK, KARLE, PISA, SERP, WIEN)
BINNIE	79	PL 83B 141	+Carr, Debenham, Jones, Karami, Keyne+	(LOIC)
ZANFINO	77	PRL 38 930	+Brockman+	(CARL, MCGI, OHIO, TNTO)
GRIGORIAN	75	NP B91 232	+Ladage, Mellema, Rudnick+	(UCLA)
KALBFLEISCH	75	PR D11 987	+Strand, Chapman	(BNL, MICH)
DUANE	74	PRL 32 425	+Binnie, Camilleri, Carr+	(LOIC, SHMP)
KALBFLEISCH	74	PR D10 916		(BNL)
DANBURG	73	PR D8 3744	+Kalbfleisch, Borenstein, Chapman+	(BNL, MICH) JP
JACOBS	73	PR D8 18	+Chang, Gauthier+	(BRAN, UMD, SYRA, TUFTS) JP
APEL	72	PL 40B 680	+Auslander, Muller, Bertolucci+	(KARLK, KARLE, PISA)
DALPIAZ	72	PL 42B 377	+Frabetti, Massam, Navarria, Zichichi	(CERN)
BASILE	71	NC 3A 371	+Bollini, Dalpiaz, Frabetti+	(CERN, BGNA, STRB)
HARVEY	71	PRL 27 885	+Marquit, Peterson, Rhoades+	(MINN, MICH)
AGUILAR-...	70D	PRL 25 1635	Aguilar-Benitez, Bassano, Samios, Barnes+	(BNL)
BENSINGER	70	PL 33B 505	+Erwin, Thompson, Walker	(WISC)
RITTENBERG	69	Thesis UCRL 18863		(LRL) I
DAVIS	68	PL 27B 532	+Ammar, Mott, Dagan, Derrick+	(NWES, ANL)
LONDON	66	PR 143 1034	+Rau, Goldberg, Lichtman+	(BNL, SYRA) IJP
BADIER	65B	PL 17 337	+Demoulin, Barloutaud+	(EPOL, SACL, AMST)
RITTENBERG	65	PRL 15 556	+Kalbfleisch	(LRL, BNL)
DAUBER	64	PRL 13 449	+Slater, Smith, Stork, Ticho	(UCLA) JP
Also	64B	Dubna Conf. 1 418	Dauber, Slater, Smith, Stork, Ticho	(UCLA)

OTHER RELATED PAPERS

GENOVESE	94	ZPHY C61 425	+Lichtenberg, Pedrazzi	(TORI, IND)
BENAYOUN	93	ZPHY 58 31	+Feindt, Girone+	(CDEF, CERN, BARI)
KAMAL	92	PL B284 421	+Xu	(ALBE)
BICKERSTAFF	82	ZPHY C16 171	+McKellar	(MELB)
KIENZLE	65	PL 19 438	+Maglich, Levrat, Lefebvres+	(CERN)
TRILLING	65	PL 19 427	+Brown, Goldhaber, Kadyk, Scanio	(LRL)
GOLDBERG	64	PRL 12 546	+Gundzik, Lichtman, Connolly, Hart+	(SYRA, BNL)
GOLDBERG	64B	PRL 13 249	+Gundzik, Leitner, Connolly, Hart+	(SYRA, BNL)
KALBFLEISCH	64	PRL 12 527	+Alvarez, Barbaro-Galtieri+	(LRL) JP
KALBFLEISCH	64B	PRL 13 349	+Dahl, Rittenberg	(LRL) JP

$f_0(980)$
was $S(975)$

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

For early work using Breit-Wigner or scattering length parametrization in fits to the $K\overline{K}$ mass spectrum, see reference section and our 1972 edition.

See also the mini-review under $f_0(1300)$ and the non-$q\overline{q}$ candidates. (See the index for the page number.)

$f_0(980)$ MASS

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
980 ±10 OUR ESTIMATE				
• • • We do not use the following data for averages, fits, limits, etc. • • •				
983	[1] BUGG	94	RVUE	$\overline{p}p \rightarrow \eta 2\pi^0$
988	[2] ZOU	94B	RVUE	
988 ±10	[3] MORGAN	93	RVUE	$\pi\pi(K\overline{K}) \rightarrow \pi\pi(K\overline{K})$, $J/\psi \rightarrow \phi\pi\pi(K\overline{K})$, $D_s \rightarrow \pi(\pi\pi)$
971.1± 4.0	[4] AGUILAR-...	91	EHS	400pp
979 ± 4	[5] ARMSTRONG	91	OMEG	300 $pp \rightarrow pp\pi\pi$, $ppKK$
956 ±12	BREAKSTONE	90	SFM	$pp \rightarrow pp\pi^+\pi^-$
959.4± 6.5	[4] AUGUSTIN	89	DM2	$J/\psi \rightarrow \omega\pi^+\pi^-$
978 ± 9	[4] ABACHI	86B	HRS	$e^+e^- \rightarrow \pi^+\pi^- X$
$985.0^{+9.0}_{-39.0}$	ETKIN	82B	MPS	$23\ \pi^- p \rightarrow n2K^0_S$

985	[6] TORNQVIST	82	RVUE	
974 ± 4	[5] GIDAL	81	MRK2	$J/\psi \to \pi^+\pi^- X$
975	[6] ACHASOV	80	RVUE	
986 ±10	[5] AGUILAR-...	78	HBC	$0.7\ \overline{p}p \to K^0_S K^0_S$
969 ± 5	[5] LEEPER	77	ASPK	$2\text{–}2.4\ \pi^- p \to \pi^+\pi^- n$, $K^+K^- n$
987 ± 7	[5] BINNIE	73	CNTR	$\pi^- p \to n$MM
1012 ± 6	[7] GRAYER	73	ASPK	$17\ \pi^- p \to \pi^+\pi^- n$
1007 ±20	[7] HYAMS	73	ASPK	$17\ \pi^- p \to \pi^+\pi^- n$
997 ± 6	[7] PROTOPOP...	73	HBC	$7\ \pi^+ p \to \pi^+ p \pi^+ \pi^-$

[1] On sheet II in a 2 pole solution. The other pole is found on sheet III at $(996-103i)$ MeV.
[2] On sheet II in a 2 pole solution. The other pole is found on sheet III at $(797-185i)$ MeV and can be interpreted as a shadow pole.
[3] On sheet II in a 2 pole solution. The other pole is found on sheet III at $(978-28i)$ MeV.
[4] From invariant mass fit.
[5] From coupled channel analysis.
[6] Coupled channel analysis with finite width corrections.
[7] Included in AGUILAR-BENITEZ 78 fit.

$f_0(980)$ WIDTH

Width determination very model dependent. Peak width is about 50 MeV, but decay width can be much larger.

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
40 to 400 OUR ESTIMATE				
• • • We do not use the following data for averages, fits, limits, etc. • • •				
74	[8] BUGG	94	RVUE	$\overline{p}p \to \eta 2\pi^0$
46	[9] ZOU	94B	RVUE	
48 ± 12	[10] MORGAN	93	RVUE	$\pi\pi(K\overline{K}) \to \pi\pi(K\overline{K})$, $J/\psi \to \phi\pi\pi(K\overline{K})$, $D_s \to \pi(\pi\pi)$
37.4 ± 10.6	[11] AGUILAR-...	91	EHS	$400pp$
72 ± 8	[12] ARMSTRONG	91	OMEG	$300\ pp \to pp\pi\pi$, $ppKK$
110 ± 30	BREAKSTONE	90	SFM	$pp \to pp\pi^+\pi^-$
29 ± 13	[11] ABACHI	86B	HRS	$e^+e^- \to \pi^+\pi^- X$
120 ±281 ±20	ETKIN	82B	MPS	$23\ \pi^- p \to n2K^0_S$
~ 400	[13] TORNQVIST	82	RVUE	
28 ± 10	[12] GIDAL	81	MRK2	$J/\psi \to \pi^+\pi^- X$
70 to 300	[14] ACHASOV	80	RVUE	
100 ± 80	[15] AGUILAR-...	78	HBC	$0.7\ \overline{p}p \to K^0_S K^0_S$
30 ± 8	[12] LEEPER	77	ASPK	$2\text{–}2.4\ \pi^- p \to \pi^+\pi^- n$, $K^+K^- n$
48 ± 14	[12] BINNIE	73	CNTR	$\pi^- p \to n$MM
32 ± 10	[16] GRAYER	73	ASPK	$17\ \pi^- p \to \pi^+\pi^- n$
30 ± 10	[16] HYAMS	73	ASPK	$17\ \pi^- p \to \pi^+\pi^- n$
54 ± 16	[16] PROTOPOP...	73	HBC	$7\ \pi^+ p \to \pi^+ p \pi^+ \pi^-$

[8] On sheet II in a 2 pole solution. The other pole is found on sheet III at $(996-103i)$ MeV.
[9] On sheet II in a 2 pole solution. The other pole is found on sheet III at $(797-185i)$ MeV and can be interpreted as a shadow pole.
[10] On sheet II in a 2 pole solution. The other pole is found on sheet III at $(978-28i)$ MeV.
[11] From invariant mass fit.
[12] From coupled channel analysis.
[13] Total Breit-Wigner width in coupled channel analysis, but peak width in $\pi\pi$ 50 MeV.
[14] Coupled channel analysis with finite width corrections.
[15] From coupled channel fit to the HYAMS 73 and PROTOPOPESCU 73 data. With a simultaneous fit to the $\pi\pi$ phase-shifts, inelasticity and to the $K^0_S K^0_S$ invariant mass.
[16] Included in AGUILAR-BENITEZ 78 fit.

$f_0(980)$ DECAY MODES

	Mode	Fraction (Γ_i/Γ)	Confidence level
Γ_1	$\pi\pi$	(78.1 ± 2.4) %	
Γ_2	$K\overline{K}$	(21.9 ± 2.4) %	
Γ_3	$\gamma\gamma$	$(1.19 \pm 0.33) \times 10^{-5}$	
Γ_4	e^+e^-	$< 3 \times 10^{-7}$	90%

CONSTRAINED FIT INFORMATION

An overall fit to a branching ratio uses 3 measurements and one constraint to determine 2 parameters. The overall fit has a $\chi^2 = 2.0$ for 2 degrees of freedom.

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

x_2	−100
	x_1

$f_0(980)$ PARTIAL WIDTHS

$\Gamma(\gamma\gamma)$ — Γ_3

VALUE (keV)	EVTS	DOCUMENT ID		TECN	COMMENT
0.56±0.11 OUR AVERAGE					
0.63±0.14		[17] MORGAN	90	RVUE	$\gamma\gamma \to \pi^+\pi^-, \pi^0\pi^0$
0.42±0.06±0.18	60 ± 8	[18] OEST	90	JADE	$e^+e^- \to e^+e^-\pi^0\pi^0$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.29±0.07±0.12		[19,20] BOYER	90	MRK2	$e^+e^- \to e^+e^-\pi^+\pi^-$
0.31±0.14±0.09		[19,20] MARSISKE	90	CBAL	$e^+e^- \to e^+e^-\pi^0\pi^0$

[17] From amplitude analysis of BOYER 90 and MARSISKE 90, data corresponds to resonance parameters $m = 989$ MeV, $\Gamma = 61$ MeV.
[18] OEST 90 quote systematic errors $^{+0.08}_{-0.18}$. We use ±0.18.
[19] From analysis allowing arbitrary background unconstrained by unitarity.
[20] Data included in MORGAN 90 analysis.

$\Gamma(e^+e^-)$ — Γ_4

VALUE (eV)	CL%	DOCUMENT ID		TECN	COMMENT
<8.4	90	VOROBYEV	88	ND	$e^+e^- \to \pi^0\pi^0$

$f_0(980)$ BRANCHING RATIOS

$\Gamma(\pi\pi)/[\Gamma(\pi\pi)+\Gamma(K\overline{K})]$ — $\Gamma_1/(\Gamma_1+\Gamma_2)$

VALUE	DOCUMENT ID		TECN	COMMENT
0.781±0.024 OUR FIT				
$0.781^{+0.027}_{-0.023}$ OUR AVERAGE				
0.67 ±0.09	[21] LOVERRE	80	HBC	$4\ \pi^- p \to n2K^0_S$
0.81 $^{+0.09}_{-0.04}$	[21] CASON	78	STRC	$7\ \pi^- p \to n2K^0_S$
0.78 ±0.03	[21] WETZEL	76	OSPK	$8.9\ \pi^- p \to n2K^0_S$

[21] Measure $\pi\pi$ elasticity assuming two resonances coupled to the $\pi\pi$ and $K\overline{K}$ channels only.

$f_0(980)$ REFERENCES

BUGG	94	PR D50 4412	+Anisovich+	(LOQM)
ZOU	94B	PR D50 591	+Bugg	(LOQM)
MORGAN	93	PR D48 1185	+Pennington	(RAL, DURH)
AGUILAR-...	91	ZPHY C50 405	Aguilar-Benitez, Allison, Batalor+	(LEBC-EHS Collab.)
ARMSTRONG	91	ZPHY C51 351	+Benayoun+	(ATHU, BARI, BIRM, CERN, CDEF)
BOYER	90	PR D42 1350	+Butler+	(Mark II Collab.)
BREAKSTONE	90	ZPHY C48 569	+	(ISU, BGNA, CERN, DORT, HEIDH, WARS)
MARSISKE	90	PR D41 3324	+Antreasyan+	(Crystal Ball Collab.)
MORGAN	90	ZPHY C48 623	+Pennington	(RAL, DURH)
OEST	90	ZPHY C47 343	+Olsson+	(JADE Collab.)
AUGUSTIN	89	NP B320 1	+Cosme	(DM2 Collab.)
VOROBYEV	88	SJNP 48 273 Translated from YAF 48 436.	+Golubev, Dolinsky, Druzhinin+	(NOVO)
ABACHI	86B	PRL 57 1990	+Derrick, Blockus+	(PURD, ANL, IND, MICH, LBL)
ETKIN	82B	PR D25 1786	+Foley, Lai+	(BNL, CUNY, TUFTS, VAND)
TORNQVIST	82	PRL 49 624		(HELS)
GIDAL	81	PL 107B 153	+Goldhaber, Guy, Millikan, Abrams+	(SLAC, LBL)
ACHASOV	80	SJNP 32 566 Translated from YAF 32 1098.	+Devyanin, Shestakov	(NOVO)

LOVERRE	80	ZPHY C6 187	+Armenteros, Dionisi+	(CERN, CDEF, MADR, STOH) IJP
AGUILAR-...	78	NP B140 73	Aguilar-Benitez, Cerrada+	(MADR, BOMB, CERN+)
CASON	78	PRL 41 271	+Baumbaugh, Bishop, Biswas+	(NDAM, ANL)
LEEPER	77	PR D16 2054	+Buttram, Crawley, Duke, Lamb, Peterson	(ISU)
WETZEL	76	NP B115 208	+Freudenreich, Beusch+	(ETH, CERN, LOIC)
BINNIE	73	PRL 31 1534	+Carr, Debenham, Duane, Garbutt+	(LOIC, SHMP)
GRAYER	73	Tallahassee	+Hyams, Jones, Blum, Dietl, Koch+	(CERN, MPIM)
HYAMS	73	NP B64 134	+Jones, Weilhammer, Blum, Dietl+	(CERN, MPIM)
PROTOPOP...	73	PR D7 1279	Protopopescu, Alston-Garnjost, Galtieri, Flatte+	(LBL)

OTHER RELATED PAPERS

AU	87	PR D35 1633	+Morgan, Pennington	(DURH, RAL)
AKESSON	86	NP B264 154	+Albrow, Almehed+	(Axial Field Spec. Collab.)
MENNESSIER	83	ZPHY C16 241		(MONP)
BARBER	82	ZPHY C12 1	+Dainton, Brodbeck, Brookes+	(DARE, LANC, SHEF)
ETKIN	82C	PR D25 2446	+Foley, Lai+	(BNL, CUNY, TUFTS, VAND)
BIGI	62	CERN Conf. 247	+Brandt, Carrara+	(CERN)
BINGHAM	62	CERN Conf. 240	+Bloch+	(EPOL, CERN)
ERWIN	62	PRL 9 34	+Hoyer, March, Walker, Wangler	(WISC, BNL)
WANG	61	JETP 13 323	+Veksler, Vrana+	(JINR)
		Translated from ZETF 40 464.		

$a_0(980)$
was $\delta(980)$

$I^G(J^{PC}) = 1^-(0^{++})$

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$a_0(980)$ MASS

VALUE (MeV)	*DOCUMENT ID*
983.5±0.9 OUR AVERAGE	Includes data from the 2 datablocks that follow this one.

$\eta\pi$ FINAL STATE ONLY

The data in this block is included in the average printed for a previous datablock.

VALUE (MeV)	*EVTS*	*DOCUMENT ID*		*TECN*	*CHG*	*COMMENT*
983.7 ± 0.9 OUR AVERAGE						
984.45± 1.23±0.34		AMSLER	94C	CBAR		0.0 $\overline{p}p \rightarrow \omega\eta\pi^0$
982 ± 2		[1] AMSLER	92	CBAR		0.0 $\overline{p}p \rightarrow \eta\eta\pi^0$
984 ± 4	1040	[1] ARMSTRONG	91B	OMEG	±	300 $pp \rightarrow pp\eta\pi^+\pi^-$
976 ± 6		ATKINSON	84E	OMEG	±	25–55 $\gamma p \rightarrow \eta\pi n$
986 ± 3	500	[2] EVANGELISTA	81	OMEG	±	12 $\pi^- p \rightarrow \eta\pi^+\pi^-\pi^- p$
990.0 ± 7.0	145	[2] GURTU	79	HBC	±	4.2 $K^- p \rightarrow \Lambda\eta 2\pi$
977.0 ± 7.0		GRASSLER	77	HBC	−	16 $\pi^\mp p \rightarrow p\eta 3\pi$
972 ±10	150	DEFOIX	72	HBC	±	0.7 $\overline{p}p \rightarrow 7\pi$
• • • We do not use the following data for averages, fits, limits, etc. • • •						
980 ±11	47	CONFORTO	78	OSPK	−	4.5 $\pi^- p \rightarrow pX^-$
978.0 ±16.0	50	CORDEN	78	OMEG	±	12–15 $\pi^- p \rightarrow n\eta 2\pi$
989.0 ± 4.0	70	WELLS	75	HBC	−	3.1–6 $K^- p \rightarrow \Lambda\eta 2\pi$
970.0 ±15.0	20	BARNES	69C	HBC	−	4–5 $K^- p \rightarrow \Lambda\eta 2\pi$
980 ±10		CAMPBELL	69	DBC	±	2.7 $\pi^+ d$
980.0 ±10.0	15	MILLER	69B	HBC	−	4.5 $K^- N \rightarrow \eta\pi\Lambda$
980.0 ±10.0	30	AMMAR	68	HBC	±	5.5 $K^- p \rightarrow \Lambda\eta 2\pi$

[1] From a single Breit-Wigner fit.
[2] From $f_1(1285)$ decay.

$K\overline{K}$ ONLY

The data in this block is included in the average printed for a previous datablock.

VALUE (MeV)	*EVTS*	*DOCUMENT ID*		*TECN*	*CHG*	*COMMENT*
976 ± 6	316	DEBILLY	80	HBC	±	1.2–2 $\overline{p}p \rightarrow f_1(1285)\omega$
• • • We do not use the following data for averages, fits, limits, etc. • • •						
1016 ±10	100	[3] ASTIER	67	HBC	±	0.0 $\overline{p}p$
1003.3± 7.0	143	[4] ROSENFELD	65	RVUE	±	

[3] ASTIER 67 includes data of BARLOW 67, CONFORTO 67, ARMENTEROS 65.
[4] Plus systematic errors.

$a_0(980)$ WIDTH

$\eta\pi$ FINAL STATE ONLY

Width determination very model dependent. Peak width is about 60 MeV, but decay width can be much larger.

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	CHG	COMMENT
50 to 300 OUR ESTIMATE						
• • • We do not use the following data for averages, fits, limits, etc. • • •						
$54.12 \pm 0.34 \pm 0.12$		AMSLER	94C	CBAR		$0.0\ \overline{p}p \rightarrow \omega\eta\pi^0$
54 ± 10		[5] AMSLER	92	CBAR		$0.0\ \overline{p}p \rightarrow \eta\eta\pi^0$
95 ± 14	1040	[5] ARMSTRONG	91B	OMEG	$\pm$	$300\ pp \rightarrow pp\eta\pi^+\pi^-$
62 ± 15	500	[6] EVANGELISTA	81	OMEG	$\pm$	$12\ \pi^- p \rightarrow \eta\pi^+\pi^-\pi^- p$
60.0 ± 20.0	145	[6] GURTU	79	HBC	$\pm$	$4.2\ K^- p \rightarrow \Lambda\eta 2\pi$
$60 {+50 \atop -30}$	47	CONFORTO	78	OSPK	$-$	$4.5\ \pi^- p \rightarrow pX^-$
$86.0 {+60.0 \atop -50.0}$	50	CORDEN	78	OMEG	$\pm$	$12\text{–}15\ \pi^- p \rightarrow n\eta 2\pi$
44.0 ± 22.0		GRASSLER	77	HBC	$-$	$16\ \pi^\mp p \rightarrow p\eta 3\pi$
80 to 300		[7] FLATTE	76	RVUE	$-$	$4.2\ K^- p \rightarrow \Lambda\eta 2\pi$
$16.0 {+25.0 \atop -16.0}$	70	WELLS	75	HBC	$-$	$3.1\text{–}6\ K^- p \rightarrow \Lambda\eta 2\pi$
30 ± 5	150	DEFOIX	72	HBC	$\pm$	$0.7\ \overline{p}p \rightarrow 7\pi$
40 ± 15		CAMPBELL	69	DBC	$\pm$	$2.7\ \pi^+ d$
60.0 ± 30.0	15	MILLER	69B	HBC	$-$	$4.5\ K^- N \rightarrow \eta\pi\Lambda$
80.0 ± 30.0	30	AMMAR	68	HBC	$\pm$	$5.5\ K^- p \rightarrow \Lambda\eta 2\pi$

[5] From a single Breit-Wigner fit.
[6] From $f_1(1285)$ decay.
[7] Using a two-channel resonance parametrization of GAY 76B data.

$K\overline{K}$ ONLY

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	CHG
• • • We do not use the following data for averages, fits, limits, etc. • • •					
~ 25	100	[8] ASTIER	67	HBC	$\pm$
57.0 ± 13.0	143	[9] ROSENFELD	65	RVUE	$\pm$

[8] ASTIER 67 includes data of BARLOW 67, CONFORTO 67, ARMENTEROS 65.
[9] Plus systematic errors.

$a_0(980)$ DECAY MODES

	Mode	Fraction (Γ_i/Γ)
Γ_1	$\eta\pi$	dominant
Γ_2	$K\overline{K}$	seen
Γ_3	$\rho\pi$	
Γ_4	$\pi\eta'(958)$	
Γ_5	$\gamma\gamma$	seen
Γ_6	e^+e^-	

$a_0(980)$ $\Gamma(i)\Gamma(\gamma\gamma)/\Gamma(\text{total})$

$\Gamma(\eta\pi) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$ — $\Gamma_1\Gamma_5/\Gamma$

VALUE (keV)	EVTS	DOCUMENT ID		TECN	COMMENT
$0.24^{+0.08}_{-0.07}$ OUR AVERAGE					
$0.28 \pm 0.04 \pm 0.10$	44 ± 7	OEST	90	JADE	$e^+e^- \rightarrow e^+e^-\pi^0\eta$
$0.19 \pm 0.07^{+0.10}_{-0.07}$		ANTREASYAN	86	CBAL	$e^+e^- \rightarrow e^+e^-\pi^0\eta$

$\Gamma(\eta\pi) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$ — $\Gamma_1\Gamma_6/\Gamma$

VALUE (eV)	CL%	DOCUMENT ID		TECN	COMMENT
<1.5	90	VOROBYEV	88	ND	$e^+e^- \rightarrow \pi^0\eta$

$a_0(980)$ BRANCHING RATIOS

$\Gamma(K\overline{K})/\Gamma(\eta\pi)$ — Γ_2/Γ_1

VALUE	DOCUMENT ID		TECN	CHG	COMMENT
1.16±0.18	[10] BUGG	94	RVUE		$\overline{p}p \rightarrow \eta\eta\pi^0$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.7 ±0.3	[11] CORDEN	78	OMEG		12–15 $\pi^- p \rightarrow n\eta 2\pi$
0.25±0.08	[11] DEFOIX	72	HBC	±	0.7 $\overline{p} \rightarrow 7\pi$

[10] BUGG 94 uses AMSLER 94C data.
[11] From the decay of $f_1(1285)$.

$\Gamma(\rho\pi)/\Gamma(\eta\pi)$ — Γ_3/Γ_1

VALUE	CL%	DOCUMENT ID		TECN	CHG	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •						
<0.25	70	AMMAR	70	HBC	±	4.1,5.5 $K^- p \rightarrow \Lambda\eta 2\pi$

$a_0(980)$ REFERENCES

AMSLER	94C	PL B327 425	+Armstrong+	(Crystal Barrel Collab.)
BUGG	94	PR D50 4412	+Anisovich+	(LOQM)
AMSLER	92	PL B291 347	+Augustin, Baker+	(Crystal Barrel Collab.)
ARMSTRONG	91B	ZPHY C52 389	+Barnes+	(ATHU, BARI, BIRM, CERN, CDEF)
OEST	90	ZPHY C47 343	+Olsson+	(JADE Collab.)
VOROBYEV	88	SJNP 48 273	+Golubev, Dolinsky, Druzhinin+	(NOVO)
		Translated from YAF 48 436.		
ANTREASYAN	86	PR D33 1847	+Aschman, Besset, Bienlein+	(Crystal Ball Collab.)
ATKINSON	84E	PL 138B 459	+	(BONN, CERN, GLAS, LANC, MCHS, CURIN+)
EVANGELISTA	81	NP B178 197	+	(BARI, BONN, CERN, DARE, LIVP+)
DEBILLY	80	NP B176 1	+Briand, Duboc, Levy+	(CURIN, LAUS, NEUC, GLAS)
GURTU	79	NP B151 181	+Gavillet, Blokzijl+	(CERN, ZEEM, NIJM, OXF)
CONFORTO	78	LNC 23 419	+Conforto, Key+	(RHEL, TNTO, CHIC, FNAL+)
CORDEN	78	NP B144 253	+Corbett, Alexander+	(BIRM, RHEL, TELA, LOWC)
GRASSLER	77	NP B121 189	+	(AACH3, BERL, BONN, CERN, CRAC, HEIDH+)
FLATTE	76	PL 63B 224		(CERN)
GAY	76B	PL 63B 220	+Chaloupka, Blokzijl, Heinen+	(CERN, AMST, NIJM) JP
WELLS	75	NP B101 333	+Radojicic, Roscoe, Lyons	(OXF)
DEFOIX	72	NP B44 125	+Nascimento, Bizzarri+	(CDEF, CERN)
AMMAR	70	PR D2 430	+Kropac, Davis+	(KANS, NWES, ANL, WISC)
BARNES	69C	PRL 23 610	+Chung, Eisner, Bassano, Goldberg+	(BNL, SYRA)
CAMPBELL	69	PRL 22 1204	+Lichtman, Loeffler+	(PURD)
MILLER	69B	PL 29B 255	+Kramer, Carmony+	(PURD)
Also	69	PR 188 2011	Yen, Ammann, Carmony, Elsner+	(PURD)
AMMAR	68	PRL 21 1832	+Davis, Kropac, Derrick, Fields+	(NWES, ANL)
ASTIER	67	PL 25B 294	+Montanet, Baubillier, Duboc+	(CDEF, CERN, IRAD)
Includes data of BARLOW 67, CONFORTO 67, and ARMENTEROS 65.				
BARLOW	67	NC 50A 701	+Lillestol, Montanet+	(CERN, CDEF, IRAD, LIVP)
CONFORTO	67	NP B3 469	+Marechal+	(CERN, CDEF, IPNP, LIVP)
ARMENTEROS	65	PL 17 344	+Edwards, Jacobsen+	(CERN, CDEF)
ROSENFELD	65	Oxford Conf. 58		(LRL)

OTHER RELATED PAPERS

TORNQVIST	90	NPBPS 21,196		(HELS)
WEINSTEIN	89	UTPT 89 03	+Isgur	(TNTO)
ACHASOV	88B	ZPHY C41 309	+Shestakov	(NOVO)
WEINSTEIN	83B	PR D27 588	+Isgur	(TNTO)
TORNQVIST	82	PRL 49 624		(HELS)
BRAMON	80	PL 93B 65	+Masso	(BARC)
TURKOT	63	Siena Conf. 1 661	+Collins, Fujii, Kemp+	(BNL, PITT)

$\phi(1020)$

$I^G(J^{PC}) = 0^-(1^{--})$

ϕ(1020) MASS

We average mass and width values only when the systematic errors have been evaluated.

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	COMMENT
1019.413±0.008 OUR AVERAGE					
1019.7 ±0.3	2012	DAVENPORT	86	MPSF	400 $pA \rightarrow 4KX$
1019.411±0.008	642k	[1] DIJKSTRA	86	SPEC	100–200 $\pi^\pm$, $\overline{p}$, p, $K^\pm$, on Be
1019.7 ±0.1 ±0.1	5079	ALBRECHT	85D	ARG	10 $e^+e^- \rightarrow K^+K^-X$
1019.3 ±0.1	1500	ARENTON	82	AEMS	11.8 polar. $pp \rightarrow KK$
1019.67 ±0.17	25080	[2] PELLINEN	82	RVUE	
1019.54 ±0.12	1100	BARKOV	79B	EMUL	$e^+e^- \rightarrow K^+K^-$
1019.52 ±0.13	3681	BUKIN	78C	OLYA	$e^+e^- \rightarrow$ hadrons
• • • We do not use the following data for averages, fits, limits, etc. • • •					
1019.8 ±0.7		ARMSTRONG	86	OMEG	85 $\pi^+/pp \rightarrow \pi^+/p4Kp$
1020.1 ±0.11	5526	[3] ATKINSON	86	OMEG	20–70 γp
1019.7 ±1.0		BEBEK	86	CLEO	$e^+e^- \rightarrow \Upsilon(4S)$
1020.9 ±0.2		[3] FRAME	86	OMEG	13 $K^+p \rightarrow \phi K^+p$
1021.0 ±0.2		[3] ARMSTRONG	83B	OMEG	18.5 $K^-p \rightarrow K^-K^+\Lambda$
1020.0 ±0.5		[3] ARMSTRONG	83B	OMEG	18.5 $K^-p \rightarrow K^-K^+\Lambda$
1019.7 ±0.3		[3] BARATE	83	GOLI	190 π^- Be $\rightarrow 2\mu X$
1019.8 ±0.2 ±0.5	766	IVANOV	81	OLYA	1–1.4 $e^+e^- \rightarrow K^+K^-$
1019.4 ±0.5	337	COOPER	78B	HBC	0.7–0.8 $\overline{p}p \rightarrow K^0_S K^0_L \pi^+\pi^-$
1020.0 ±1.0	383	[3] BALDI	77	CNTR	10 $\pi^-p \rightarrow \pi^-\phi p$
1018.9 ±0.6	800	COHEN	77	ASPK	6 $\pi^\pm N \rightarrow K^+K^-N$
1019.7 ±0.5	454	KALBFLEISCH	76	HBC	2.18 $K^-p \rightarrow \Lambda K\overline{K}$
1019.4 ±0.8	984	BESCH	74	CNTR	2 $\gamma p \rightarrow pK^+K^-$
1020.3 ±0.4	100	BALLAM	73	HBC	2.8–9.3 γp
1019.4 ±0.7		BINNIE	73B	CNTR	$\pi^-p \rightarrow \phi n$
1019.6 ±0.5	120	[4] AGUILAR-...	72B	HBC	3.9,4.6 $K^-p \rightarrow \Lambda K^+K^-$
1019.9 ±0.5	100	[4] AGUILAR-...	72B	HBC	3.9,4.6 $K^-p \rightarrow K^-pK^+K^-$
1020.4 ±0.5	131	COLLEY	72	HBC	10 $K^+p \rightarrow K^+p\phi$
1019.9 ±0.3	410	STOTTLE...	71	HBC	2.9 $K^-p \rightarrow \Sigma/\Lambda K\overline{K}$

[1] Weighted and scaled average of 12 measurements of DIJKSTRA 86.
[2] PELLINEN 82 review includes AKERLOF 77, DAUM 81, BALDI 77, AYRES 74, DEGROOT 74.
[3] Systematic errors not evaluated.
[4] Mass errors enlarged by us to $\Gamma/\sqrt{N}$; see the note with the $K^*(892)$ mass.

*CITATION: L. Montanet et al., Physical Review D50, 1173 (1994) and 1995 off-year partial update for the 1996 edition (URL: http://pdg.lbl.gov/)

$\phi(1020)$ WIDTH

We average mass and width values only when the systematic errors have been evalutated.

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	COMMENT
4.43±0.06 OUR FIT					
4.43±0.06 OUR AVERAGE					
4.45±0.06	271k	DIJKSTRA	86	SPEC	100 π^- Be
4.5 ±0.7	1500	ARENTON	82	AEMS	11.8 polar. $pp \rightarrow KK$
4.2 ±0.6	766	[5] IVANOV	81	OLYA	1–1.4 $e^+e^- \rightarrow K^+K^-$
4.3 ±0.6		[5] CORDIER	80	WIRE	$e^+e^- \rightarrow \pi^+\pi^-\pi^0$
4.58±0.55	1100	[5] BARKOV	79B	EMUL	$e^+e^- \rightarrow K^+K^-$
4.36±0.29	3681	[5] BUKIN	78C	OLYA	$e^+e^- \rightarrow$ hadrons
4.4 ±0.6	984	[5] BESCH	74	CNTR	$2\gamma p \rightarrow pK^+K^-$
4.67±0.72	681	[5] BALAKIN	71	OSPK	$e^+e^- \rightarrow$ hadrons
4.09±0.29		BIZOT	70	OSPK	$e^+e^- \rightarrow$ hadrons
• • • We do not use the following data for averages, fits, limits, etc. • • •					
4.08±0.14	13714	KURDADZE	84	OLYA	$e^+e^- \rightarrow$ hadrons
3.6 ±0.8	337	[5] COOPER	78B	HBC	0.7–0.8 $\overline{p}p \rightarrow K^0_S K^0_L \pi^+\pi^-$
4.5 ±0.50	1300	[5,6] AKERLOF	77	SPEC	400 pA $\rightarrow K^+K^-$X
4.5 ±0.8	500	[5,6] AYRES	74	ASPK	3–6 $\pi^- p \rightarrow K^+K^- n$, $K^- p \rightarrow K^+K^- \Lambda/\Sigma^0$
3.81±0.37		COSME	74B	OSPK	$e^+e^- \rightarrow K^0_L K^0_S$
3.8 ±0.7	454	[5] BORENSTEIN	72	HBC	2.18 $K^- p \rightarrow K\overline{K}n$

[5] Width errors enlarged by us to $4\Gamma/\sqrt{N}$; see the note with the $K^*(892)$ mass.
[6] Systematic errors not evaluated.

$\phi(1020)$ DECAY MODES

	Mode	Fraction (Γ_i/Γ)	Scale factor/ Confidence level
Γ_1	K^+K^-	(49.1 ±0.9) %	S=1.3
Γ_2	$K^0_L K^0_S$	(34.3 ±0.7) %	S=1.2
Γ_3	$\rho\pi$	(12.9 ±0.7) %	
Γ_4	$\pi^+\pi^-\pi^0$	(2.5 ±0.9) %	S=1.1
Γ_5	$\eta\gamma$	(1.28±0.06) %	S=1.2
Γ_6	$\pi^0\gamma$	(1.31±0.13) $\times 10^{-3}$	
Γ_7	e^+e^-	(3.09±0.07) $\times 10^{-4}$	
Γ_8	$\mu^+\mu^-$	(2.48±0.34) $\times 10^{-4}$	
Γ_9	ηe^+e^-	(1.3 $^{+0.8}_{-0.6}$) $\times 10^{-4}$	
Γ_{10}	$\pi^+\pi^-$	(8 $^{+5}_{-4}$) $\times 10^{-5}$	S=1.5
Γ_{11}	$\omega\gamma$	< 5 %	CL=84%
Γ_{12}	$\rho\gamma$	< 2 %	CL=84%
Γ_{13}	$\pi^+\pi^-\gamma$	< 7 $\times 10^{-3}$	CL=90%
Γ_{14}	$f_0(980)\gamma$	< 2 $\times 10^{-3}$	CL=90%
Γ_{15}	$\pi^0\pi^0\gamma$	< 1 $\times 10^{-3}$	CL=90%
Γ_{16}	$\pi^+\pi^-\pi^+\pi^-$	< 8.7 $\times 10^{-4}$	CL=90%
Γ_{17}	$\eta'(958)\gamma$	< 4.1 $\times 10^{-4}$	CL=90%
Γ_{18}	$\pi^+\pi^+\pi^-\pi^-\pi^0$	< 1.5 $\times 10^{-4}$	CL=95%
Γ_{19}	$\pi^0 e^+e^-$	< 1.2 $\times 10^{-4}$	CL=90%
Γ_{20}	$\pi^0\eta\gamma$	< 2.5 $\times 10^{-3}$	CL=90%
Γ_{21}	$a_0(980)\gamma$	< 5 $\times 10^{-3}$	CL=90%

*CITATION: L. Montanet et al., Physical Review D50, 1173 (1994) and 1995 off-year partial update for the 1996 edition (URL: http://pdg.lbl.gov/)

CONSTRAINED FIT INFORMATION

An overall fit to the total width, a partial width, and 9 branching ratios uses 38 measurements and one constraint to determine 6 parameters. The overall fit has a χ^2 = 27.1 for 33 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	−70				
x_3	0	0			
x_4	−39	−10	−75		
x_5	−5	−2	0	0	
Γ	0	0	−24	18	0
	x_1	x_2	x_3	x_4	x_5

	Mode	Rate (MeV)	Scale factor
Γ_1	K^+K^-	2.17 ±0.05	1.2
Γ_2	$K^0_L K^0_S$	1.52 ±0.04	1.1
Γ_3	$\rho\pi$	0.570 ±0.030	
Γ_4	$\pi^+\pi^-\pi^0$	0.11 ±0.04	1.1
Γ_5	$\eta\gamma$	0.0569±0.0029	1.2

ϕ(1020) PARTIAL WIDTHS

$\Gamma(\rho\pi)$ — Γ_3

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
0.570±0.030 OUR FIT				
0.57 ±0.03	JULLIAN	76	OSPK	e^+e^-

$\Gamma(e^+e^-)$ — Γ_7

VALUE (keV)	*DOCUMENT ID*
1.37±0.05 OUR EVALUATION	

ϕ(1020) BRANCHING RATIOS

$\Gamma(K^+K^-)/\Gamma_{\text{total}}$ — Γ_1/Γ

VALUE	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
0.491±0.009 OUR FIT	Error includes scale factor of 1.3.				
0.496±0.019 OUR AVERAGE					
0.44 ±0.05	321	KALBFLEISCH	76	HBC	2.18 $K^-p \rightarrow \Lambda K^+K^-$
0.49 ±0.06	270	DEGROOT	74	HBC	4.2 $K^-p \rightarrow \Lambda\phi$
0.540±0.034	565	BALAKIN	71	OSPK	$e^+e^- \rightarrow K^+K^-$
0.486±0.044		CHATELUS	71	OSPK	e^+e^-
0.48 ±0.04	252	LINDSEY	66	HBC	2.1–2.7 $K^-p \rightarrow \Lambda K^+K^-$

$\Gamma(K^0_L K^0_S)/\Gamma_{\text{total}}$ — Γ_2/Γ

VALUE	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
0.343±0.007 OUR FIT	Error includes scale factor of 1.2.				
0.333±0.009 OUR AVERAGE					
0.326±0.035		DOLINSKY	91	ND	$e^+e^- \rightarrow K^0_L K^0_S$
0.310±0.024		DRUZHININ	84	ND	$e^+e^- \rightarrow K^0_L K^0_S$
0.338±0.010		KURDADZE	84	OLYA	$e^+e^- \rightarrow K^0_L K^0_S$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.27 ±0.03	133	KALBFLEISCH	76	HBC	2.18 $K^-p \rightarrow \Lambda K^0_L K^0_S$
0.257±0.030	95	BALAKIN	71	OSPK	$e^+e^- \rightarrow K^0_L K^0_S$
0.40 ±0.04	167	LINDSEY	66	HBC	2.1–2.7 $K^-p \rightarrow \Lambda K^0_L K^0_S$

$\left[\Gamma(\rho\pi)+\Gamma(\pi^+\pi^-\pi^0)\right]/\Gamma_{total}$ $(\Gamma_3+\Gamma_4)/\Gamma$

VALUE	DOCUMENT ID		TECN	COMMENT
0.153±0.006 OUR FIT Error includes scale factor of 1.3.				
0.148±0.006 OUR AVERAGE Error includes scale factor of 1.1.				
0.143±0.007	DOLINSKY	91	ND	$e^+e^- \rightarrow \pi^+\pi^-\pi^0$
0.155±0.008	KURDADZE	84	OLYA	$e^+e^- \rightarrow \pi^+\pi^-\pi^0$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.139±0.007	[7] PARROUR	76B	OSPK	e^+e^-

[7] Using total width 4.1 MeV. The $\rho\pi$ to 3π mode is more than 80%. at the 90% confidence level.

$\Gamma(K^0_L K^0_S)/\Gamma(K\overline{K})$ $\Gamma_2/(\Gamma_1+\Gamma_2)$

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.411±0.008 OUR FIT Error includes scale factor of 1.2.					
0.45 ±0.04 OUR AVERAGE					
0.44 ±0.07		LONDON	66	HBC	2.24 $K^-p \rightarrow \Lambda K\overline{K}$
0.48 ±0.07	52	BADIER	65B	HBC	3 K^-p
0.40 ±0.10	34	SCHLEIN	63	HBC	1.95 $K^-p \rightarrow \Lambda K\overline{K}$

$\left[\Gamma(\rho\pi)+\Gamma(\pi^+\pi^-\pi^0)\right]/\Gamma(K\overline{K})$ $(\Gamma_3+\Gamma_4)/(\Gamma_1+\Gamma_2)$

VALUE	DOCUMENT ID		TECN	COMMENT
0.184±0.009 OUR FIT Error includes scale factor of 1.3.				
0.24 ±0.04 OUR AVERAGE				
0.237±0.039	CERRADA	77B	HBC	4.2 $K^-p \rightarrow \Lambda 3\pi$
0.30 ±0.15	LONDON	66	HBC	2.24 $K^-p \rightarrow \Lambda\pi^+\pi^-\pi^0$

$\left[\Gamma(\rho\pi)+\Gamma(\pi^+\pi^-\pi^0)\right]/\Gamma(K^0_L K^0_S)$ $(\Gamma_3+\Gamma_4)/\Gamma_2$

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.447±0.021 OUR FIT Error includes scale factor of 1.3.					
0.51 ±0.05 OUR AVERAGE					
0.56 ±0.07	3681	BUKIN	78C	OLYA	$e^+e^- \rightarrow K^0_L K^0_S$, $\pi^+\pi^-\pi^0$
0.47 ±0.06	516	COSME	74	OSPK	$e^+e^- \rightarrow \pi^+\pi^-\pi^0$

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

VALUE (units 10^{-4})	DOCUMENT ID		TECN	COMMENT
2.48±0.34 OUR AVERAGE				
2.69±0.46	[8] HAYES	71	CNTR	8.3,9.8 γC $\rightarrow \mu^+\mu^-$X
2.17±0.60	[8] EARLES	70	CNTR	6.0 γC $\rightarrow \mu^+\mu^-$X
2.34±1.01	MOY	69	CNTR	5.0 γC $\rightarrow \mu^+\mu^-$X

[8] Neglecting interference between resonance and continuum.

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

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.0128±0.0006 OUR FIT Error includes scale factor of 1.2.					
0.0128±0.0007 OUR AVERAGE Error includes scale factor of 1.2.					
0.0130±0.0006		[9] DRUZHININ	84	ND	$e^+e^- \rightarrow 3\gamma$
0.014 ±0.002		[10] DRUZHININ	84	ND	$e^+e^- \rightarrow 6\gamma$
0.0088±0.0020	290	KURDADZE	83C	OLYA	$e^+e^- \rightarrow 3\gamma$
0.0135±0.0029		ANDREWS	77	CNTR	6.7–10 γCu
0.015 ±0.004	54	[9] COSME	76	OSPK	e^+e^-

[9] From 2γ decay mode of η.
[10] From $3\pi^0$ decay mode of η.

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

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.007	90	COSME	74	OSPK	$e^+e^- \rightarrow \pi^+\pi^-\gamma$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<0.06	90	KALBFLEISCH	75	HBC	2.18 $K^-p \rightarrow \Lambda\pi^+\pi^-\gamma$
<0.04	99	LINDSEY	65	HBC	2.1–2.7 $K^-p \rightarrow \Lambda\pi^+\pi^-$ neutrals

$\Gamma(\omega\gamma)/\Gamma_{total}$ Γ_{11}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.05	84	LINDSEY	66	HBC	2.1–2.7 $K^-p \rightarrow \Lambda\pi^+\pi^-$ neutrals

$\Gamma(\rho\gamma)/\Gamma_{\text{total}}$ — Γ_{12}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.02	84	LINDSEY	66	HBC	2.1–2.7 $K^- p \rightarrow \Lambda\pi^+\pi^-$ neutrals

$\Gamma(e^+e^-)/\Gamma_{\text{total}}$ — Γ_7/Γ

VALUE (units 10^{-4})	EVTS	DOCUMENT ID		TECN	COMMENT
3.09±0.07 OUR AVERAGE					
3.05±0.12	13714	KURDADZE	84	OLYA	$e^+e^- \rightarrow$ hadrons
3.00±0.21	3681	BUKIN	78C	OLYA	$e^+e^- \rightarrow$ hadrons
3.10±0.14		[11] PARROUR	76	OSPK	e^+e^-
3.3 ±0.3		COSME	74	OSPK	$e^+e^- \rightarrow$ hadrons
2.81±0.25	681	BALAKIN	71	OSPK	$e^+e^- \rightarrow$ hadrons
3.50±0.27		CHATELUS	71	OSPK	e^+e^-

[11] Using total width 4.2 MeV. They detect 3π mode and observe significant interference with ω tail. This is accounted for in the result quoted above.

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

VALUE (units 10^{-3})	EVTS	DOCUMENT ID		TECN	COMMENT
1.31±0.13 OUR AVERAGE					
1.30±0.13		DRUZHININ	84	ND	$e^+e^- \rightarrow 3\gamma$
1.4 ±0.5	32	COSME	76	OSPK	e^+e^-

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

VALUE (units 10^{-4})	CL%	DOCUMENT ID		TECN	COMMENT
$0.8^{+0.5}_{-0.4}$ OUR AVERAGE Error includes scale factor of 1.5.					
$0.63^{+0.37}_{-0.28}$		[12] GOLUBEV	86	ND	$e^+e^- \rightarrow \pi^+\pi^-$
$1.94^{+1.03}_{-0.81}$		[12] VASSERMAN	81	OLYA	e^+e^-
<6.6	95	BUKIN	78B	OLYA	$e^+e^- \rightarrow \pi^+\pi^-$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<4.0	95	JULLIAN	76	OSPK	e^+e^-
<2.7	95	ALVENSLEBEN	72	CNTR	6.7 $\gamma C \rightarrow C\pi^+\pi^-$

[12] Using $\Gamma(e^+e^-)/\Gamma_{\text{total}} = 3.1 \times 10^{-4}$.

$\Gamma(K^0_L K^0_S)/\Gamma(K^+K^-)$ — Γ_2/Γ_1

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.699±0.024 OUR FIT Error includes scale factor of 1.2.					
0.740±0.031 OUR AVERAGE					
0.70 ±0.06	2732	BUKIN	78C	OLYA	$e^+e^- \rightarrow K^0_L K^0_S$
0.82 ±0.08		LOSTY	78	HBC	4.2 $K^- p \rightarrow \phi$ hyperon
0.71 ±0.05		LAVEN	77	HBC	10 $K^- p \rightarrow K^+K^-\Lambda$
0.71 ±0.08		LYONS	77	HBC	3–4 $K^- p \rightarrow \Lambda\phi$
0.89 ±0.10	144	AGUILAR-...	72B	HBC	3.9,4.6 $K^- p$

$[\Gamma(\rho\pi) + \Gamma(\pi^+\pi^-\pi^0)]/\Gamma(K^+K^-)$ — $(\Gamma_3+\Gamma_4)/\Gamma_1$

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.313±0.016 OUR FIT Error includes scale factor of 1.3.					
0.28 ±0.09	34	AGUILAR-...	72B	HBC	3.9,4.6 $K^- p$

$\Gamma(\eta e^+e^-)/\Gamma_{\text{total}}$ — Γ_9/Γ

VALUE (units 10^{-4})	EVTS	DOCUMENT ID		TECN	COMMENT
$1.3^{+0.8}_{-0.6}$	7	GOLUBEV	85	ND	$e^+e^- \rightarrow \gamma\gamma e^+e^-$

$\Gamma(\eta'(958)\gamma)/\Gamma_{\text{total}}$ — Γ_{17}/Γ

VALUE (units 10^{-4})	CL%	DOCUMENT ID		TECN	COMMENT
<4.1	90	DRUZHININ	87	ND	$e^+e^- \rightarrow \gamma\eta\pi^+\pi^-$

$\Gamma(\pi^0\pi^0\gamma)/\Gamma_{\text{total}}$ — Γ_{15}/Γ

VALUE (units 10^{-3})	CL%	DOCUMENT ID		TECN	COMMENT
<1	90	DRUZHININ	87	ND	$e^+e^- \rightarrow 5\gamma$

$\Gamma(\pi^+\pi^+\pi^-\pi^-\pi^0)/\Gamma_{total}$ — Γ_{18}/Γ

VALUE (units 10^{-4})	CL%	DOCUMENT ID		TECN	COMMENT
<1.5	95	BARKOV	88	CMD	$e^+e^- \rightarrow \pi^+\pi^-\pi^+\pi^-\pi^0$

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

VALUE (units 10^{-4})	CL%	DOCUMENT ID		TECN	COMMENT
<8.7	90	CORDIER	79	WIRE	$e^+e^- \rightarrow 4\pi$

$\Gamma(f_0(980)\gamma)/\Gamma_{total}$ — Γ_{14}/Γ

VALUE (units 10^{-3})	CL%	DOCUMENT ID		TECN	COMMENT
<2	90	DRUZHININ	87	ND	$e^+e^- \rightarrow \pi^0\pi^0\gamma$

$\Gamma(\pi^0 e^+ e^-)/\Gamma_{total}$ — Γ_{19}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<1.2 \times 10^{-4}$	90	DOLINSKY	88	ND	$e^+e^- \rightarrow \pi^0 e^+e^-$

$\Gamma(\pi^0\eta\gamma)/\Gamma_{total}$ — Γ_{20}/Γ

VALUE (units 10^{-3})	CL%	DOCUMENT ID		TECN	COMMENT
<2.5	90	DOLINSKY	91	ND	$e^+e^- \rightarrow \pi^0\eta\gamma$

$\Gamma(a_0(980)\gamma)/\Gamma_{total}$ — Γ_{21}/Γ

VALUE (units 10^{-3})	CL%	DOCUMENT ID		TECN	COMMENT
<5	90	DOLINSKY	91	ND	$e^+e^- \rightarrow \pi^0\eta\gamma$

$\phi(1020)$ REFERENCES

DOLINSKY 91 PRPL 202 99 +Druzhinin, Dubrovin+ (NOVO)
BARKOV 88 SJNP 47 248 +Vasserman, Vorobyev, Ivanov+ (NOVO)
Translated from YAF 47 393.
DOLINSKY 88 SJNP 48 277 +Druzhinin, Dubrovin, Golubev+ (NOVO)
Translated from YAF 48 442.
DRUZHININ 87 ZPHY C37 1 +Dubrovin, Eidelman, Golubev+ (NOVO)
ARMSTRONG 86 PL 166B 245 +Bloodworth, Carney+ (ATHU, BARI, BIRM, CERN)
ATKINSON 86 ZPHY C30 521 + (BONN, CERN, GLAS, LANC, MCHS, CURIN+)
BEBEK 86 PRL 56 1893 +Berkelman, Blucher, Cassel+ (CLEO Collab.)
DAVENPORT 86 PR 33 2519 (TUFTS, ARIZ, FNAL, FSU, NDAM, VAND)
DIJKSTRA 86 ZPHY C31 375 +Bailey+ (ANIK, BRIS, CERN, CRAC, MPIM, RAL)
FRAME 86 NP B276 667 +Hughes, Lynch, Minto, McFadzean+ (GLAS)
GOLUBEV 86 SJNP 44 409 +Druzhinin, Ivanchenko, Perevedentsev+ (NOVO)
Translated from YAF 44 633.
ALBRECHT 85D PL 153B 343 +Drescher, Binder, Drews+ (ARGUS Collab.)
GOLUBEV 85 SJNP 41 756 +Druzhinin, Ivanchenko, Peryshkin+ (NOVO)
Translated from YAF 41 1183.
DRUZHININ 84 PL 144B 136 +Golubev, Ivanchenko, Peryshkin+ (NOVO)
KURDADZE 84 IYF 84-7 Preprint +Leltchouk, Pakhtusova, Sidorov+ (NOVO)
ARMSTRONG 83B NP B224 193 + (BARI, BIRM, CERN, MILA, CURIN+)
BARATE 83 PL 121B 449 +Bareyre, Bonamy+ (SACL, LOIC, SHMP, IND)
KURDADZE 83C JETPL 38 366 +Lelchuk, Root+ (NOVO)
Translated from ZETFP 38 306.
ARENTON 82 PR D25 2241 +Ayres, Diebold, May, Swallow+ (ANL, ILL)
PELLINEN 82 PS 25 599 +Roos (HELS)
DAUM 81 PL 100B 439 +Bardsley+ (AMST, BRIS, CERN, CRAC, MPIM+)
IVANOV 81 PL 107B 297 +Kurdadze, Lelchuk, Sidorov, Skrinsky+ (NOVO)
Also 82 Private Comm. Eidelman (NOVO)
VASSERMAN 81 PL 99B 62 +Kurdadze, Sidorov, Skrinsky+ (NOVO)
CORDIER 80 NP B172 13 +Delcourt, Eschstruth, Fulda+ (LALO)
BARKOV 79B IYF 79-93 Preprint +Zolotorev, Makarina, Mishakova+ (NOVO)
CORDIER 79 PL 81B 389 +Delcourt, Eschstruth, Fulda+ (LALO)
BUKIN 78B SJNP 27 521 +Kurdadze, Sidorov, Skrinsky+ (NOVO)
Translated from YAF 27 985.
BUKIN 78C SJNP 27 516 +Kurdadze, Serednyakov, Sidorov+ (NOVO)
Translated from YAF 27 976.
COOPER 78B NP B146 1 +Ganguli+ (TATA, CERN, CDEF, MADR)
LOSTY 78 NP B133 38 +Holmgren, Blokzijl+ (CERN, AMST, NIJM, OXF)
AKERLOF 77 PRL 39 861 +Alley, Bintinger, Ditzler+ (FNAL, MICH, PURD)
ANDREWS 77 PRL 38 198 +Fukushima, Harvey, Lobkowicz, May+ (ROCH)
BALDI 77 PL 68B 381 +Bohringer, Dorsaz, Hungerbuhler+ (GEVA)
CERRADA 77B NP B126 241 +Blockzijl, Heinen+ (AMST, CERN, NIJM, OXF)
COHEN 77 PRL 38 269 +Ayres, Diebold, Kramer, Pawlicki, Wicklund (ANL)
LAVEN 77 NP B127 43 +Otter, Klein+ (AACH3, BERL, CERN, LOIC, WIEN)
LYONS 77 NP B125 207 +Cooper, Clark (OXF)
COSME 76 PL 63B 352 +Courau, Dudelzak, Grelaud, Jean-Marie+ (ORSAY)
JULLIAN 76 Tbilisi 2 B19 (ORSAY)
KALBFLEISCH 76 PR D13 22 +Strand, Chapman (BNL, MICH)
PARROUR 76 PL 63B 357 +Grelaud, Cosme, Courau, Dudelzak+ (ORSAY)

PARROUR	76B	PL 63B 362	+Grelaud, Cosme, Courau, Dudelzak+	(ORSAY)
KALBFLEISCH	75	PR D11 987	+Strand, Chapman	(BNL, MICH)
AYRES	74	PRL 32 1463	+Diebold, Greene, Kramer, Levine+	(ANL)
BESCH	74	NP B70 257	+Hartmann, Kose, Krautschneider, Paul+	(BONN)
COSME	74	PL 48B 155	+Jean-Marie, Jullian, Laplanche+	(ORSAY)
COSME	74B	PL 48B 159	+Jean-Marie, Jullian, Laplanche+	(ORSAY)
DEGROOT	74	NP B74 77	+Hoogland, Jongejans, Metzger+	(AMST, NIJM)
BALLAM	73	PR D7 3150	+Chadwick, Eisenberg, Bingham+	(SLAC, LBL)
BINNIE	73B	PR D8 2789	+Carr, Debenham, Duane+	(LOIC, SHMP)
AGUILAR-...	72B	PR D6 29	Aguilar-Benitez, Chung, Eisner, Samios	(BNL)
ALVENSLEBEN	72	PRL 28 66	+Becker, Biggs, Binkley+	(MIT, DESY)
BORENSTEIN	72	PR D5 1559	+Danburg, Kalbfleisch+	(BNL, MICH)
COLLEY	72	NP B50 1	+Jobes, Riddiford, Griffiths+	(BIRM, GLAS)
BALAKIN	71	PL 34B 328	+Budker, Pakhtusova, Sidorov, Skrinsky+	(NOVO)
CHATELUS	71	Thesis LAL 1247		(STRB)
Also	70	PL 32 416	Bizot, Buon, Chatelus, Jeanjean+	(ORSAY)
HAYES	71	PR D4 899	+Imlay, Joseph, Keizer, Stein	(CORN)
STOTTLE...	71	Thesis ORO 2504 170	Stottlemyer	(UMD)
BIZOT	70	PL 32 416	+Buon, Chatelus, Jeanjean+	(ORSAY)
Also	69	Liverpool Sym. 69	Perez-y-Jorba	
EARLES	70	PRL 25 1312	+Faissler, Gettner, Lutz, Moy, Tang+	(NEAS)
MOY	69	Thesis		(NEAS)
LINDSEY	66	PR 147 913	+Smith	(LRL)
LONDON	66	PR 143 1034	+Rau, Goldberg, Lichtman+	(BNL, SYRA) IGJPC
BADIER	65B	PL 17 337	+Demoulin, Barloutaud+	(EPOL, SACL, AMST)
LINDSEY	65	PRL 15 221	+Smith	(LRL)
LINDSEY 65 data included in LINDSEY 66.				
SCHLEIN	63	PRL 10 368	+Slater, Smith, Stork, Ticho	(UCLA) IGJP

OTHER RELATED PAPERS

KAMAL	92	PL B284 421	+Xu	(ALBE)
GEORGIO...	85	PL 152B 428	Georgiopoulos+	(TUFTS, ARIZ, FNAL, FSU, NDAM+)
ARMENTEROS	63B	Siena Conf. 2 70	+Edwards, Astier+	(CERN, CDEF)
GELFAND	63B	PRL 11 438	+Miller, Nussbaum, Kirsch+	(COLU, RUTG)
BERTANZA	62	PRL 9 180	+Brisson, Connolly, Hart+	(BNL, SYRA)

$h_1(1170)$

$I^G(J^{PC}) = 0^-(1^{+-})$

$h_1(1170)$ MASS

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*CHG*	*COMMENT*
1170±20 OUR ESTIMATE					
• • • We do not use the following data for averages, fits, limits, etc. • • •					
1168± 4	ANDO	92	SPEC		8 $\pi^- p \to \pi^+ \pi^- \pi^0 n$
1166± 5±3	[1] ANDO	92	SPEC		8 $\pi^- p \to \pi^+ \pi^- \pi^0 n$
1190±60	[2] DANKOWY...	81	SPEC	0	8 $\pi p \to 3\pi n$

[1] Average and spread of values using 2 variants of the model of BOWLER 75.
[2] Uses the model of BOWLER 75.

$h_1(1170)$ WIDTH

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*CHG*	*COMMENT*
360±40 OUR ESTIMATE					
• • • We do not use the following data for averages, fits, limits, etc. • • •					
345± 6	ANDO	92	SPEC		8 $\pi^- p \to \pi^+ \pi^- \pi^0 n$
375± 6±34	[3] ANDO	92	SPEC		8 $\pi^- p \to \pi^+ \pi^- \pi^0 n$
320±50	[4] DANKOWY...	81	SPEC	0	8 $\pi p \to 3\pi n$

[3] Average and spread of values using 2 variants of the model of BOWLER 75.
[4] Uses the model of BOWLER 75.

$h_1(1170)$ DECAY MODES

	Mode	Fraction (Γ_i/Γ)
Γ_1	$\rho\pi$	seen

$h_1(1170)$ BRANCHING RATIOS

$\Gamma(\rho\pi)/\Gamma_{total}$ **Γ_1/Γ**

VALUE	DOCUMENT ID		TECN	COMMENT
seen	ATKINSON	84	OMEG	20–70 $\gamma p \to \pi^+\pi^-\pi^0 p$
seen	DANKOWY...	81	SPEC	8 $\pi p \to 3\pi n$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
seen	ANDO	92	SPEC	8 $\pi^- p \to \pi^+\pi^-\pi^0 n$

$h_1(1170)$ REFERENCES

ANDO	92	PL B291 496	+Imai+	(KEK, KYOT, NIRS, SAGA, INUS, AKIT)
ATKINSON	84	NP B231 15	+	(BONN, CERN, GLAS, LANC, MCHS, CURIN+)
DANKOWY...	81	PRL 46 580	Dankowych+	(TNTO, BNL, CARL, MCGI, OHIO)
BOWLER	75	NP B97 227	+Game, Aitchison, Dainton	(OXFTP, DARE)

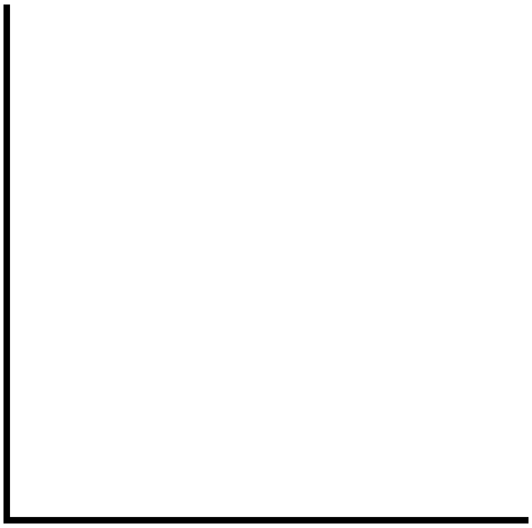
$b_1(1235)$

$I^G(J^{PC}) = 1^+(1^{+-})$

$b_1(1235)$ MASS

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	CHG	COMMENT
1231 ±10 OUR ESTIMATE		This is only an educated guess; the error given is larger than the error on the average of the published values.				
1230.9± 3.1 OUR AVERAGE		Error includes scale factor of 1.6. See the ideogram below.				
1225 ± 5		WEIDENAUER	93	ASTE		$\bar{p}p \to 2\pi^+ 2\pi^- \pi^0$
1235 ±15		ALDE	92C	GAM2		38,100 $\pi^- p \to \omega\pi^0 n$
1236 ±16		FUKUI	91	SPEC		8.95 $\pi^- p \to \omega\pi^0 n$
1222 ± 6		ATKINSON	84E	OMEG	±	25–55 $\gamma p \to \omega\pi X$
1237 ± 7		ATKINSON	84E	OMEG	0	25–55 $\gamma p \to \omega\pi X$
1239 ± 5		EVANGELISTA	81	OMEG	−	12 $\pi^- p \to \omega\pi p$
1251.0± 8.0	450	GESSAROLI	77	HBC	−	11 $\pi^- p \to \pi^-\omega p$
1245.0±11.0	890	FLATTE	76C	HBC	−	4.2 $K^- p \to \pi^-\omega\Sigma^+$
1222 ± 4	1400	CHALOUPKA	74	HBC	−	3.9 $\pi^- p$
1220 ± 7	600	KARSHON	74B	HBC	+	4.9 $\pi^+ p$
1243 ± 6	1163	[1] OTT	72B	HBC	+	7.1 $\pi^+ p$
• • • We do not use the following data for averages, fits, limits, etc. • • •						
1311 ±10		[2] TAKAMATSU	90	SPEC	0	8 $\pi^- p \to \eta\rho n$
1190 ±10		AUGUSTIN	89	DM2	±	$e^+e^- \to 5\pi$
1213 ± 5		ATKINSON	84C	OMEG	0	20–70 γp
1271 ±11		COLLICK	84	SPEC	+	200 $\pi^+ Z \to Z\pi\omega$

[1] From fit of the mass spectrum.
[2] Breit–Wigner fitting of PWA of $\eta\pi\pi$ system.



$b_1(1235)$ mass (MeV)

$b_1(1235)$ WIDTH

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	CHG	COMMENT
142 ± 8 OUR AVERAGE		Error includes scale factor of 1.1.				
113 ±12		WEIDENAUER	93	ASTE		$\overline{p}p \to 2\pi^+ 2\pi^- \pi^0$
160 ±30		ALDE	92C	GAM2		38,100 $\pi^- p \to \omega \pi^0 n$
151 ±31		FUKUI	91	SPEC		8.95 $\pi^- p \to \omega \pi^0 n$
170 ±15		EVANGELISTA	81	OMEG	−	12 $\pi^- p \to \omega \pi p$
170.0±50.0	225	BALTAY	78B	HBC	+	15 $\pi^+ p \to p 4\pi$
155.0±32.0	450	GESSAROLI	77	HBC	−	11 $\pi^- p \to \pi^- \omega p$
182.0±45.0	890	FLATTE	76C	HBC	−	4.2 $K^- p \to \pi^- \omega \Sigma^+$
135 ±20	1400	CHALOUPKA	74	HBC	−	3.9 $\pi^- p$
156 ±22	600	KARSHON	74B	HBC	+	4.9 $\pi^+ p$
134 $^{+23}_{-26}$	1163	[3] OTT	72B	HBC	+	7.1 $\pi^+ p$
• • • We do not use the following data for averages, fits, limits, etc. • • •						
126 ±10		[4] TAKAMATSU	90	SPEC	0	8 $\pi^- p \to \eta \rho n$
210 ±19		AUGUSTIN	89	DM2	±	$e^+ e^- \to 5\pi$
231 ±14		ATKINSON	84C	OMEG	0	20–70 γp
232 ±29		COLLICK	84	SPEC	+	200 $\pi^+ Z \to Z \pi \omega$

[3] From fit of the mass spectrum.
[4] Breit–Wigner fitting of PWA of $\eta \pi \pi$ system.

$b_1(1235)$ DECAY MODES

	Mode	Fraction (Γ_i/Γ)	Confidence level
Γ_1	$\omega \pi$ [D/S amplitude ratio = 0.26 ± 0.04]	dominant	
Γ_2	$\pi^\pm \gamma$	$(1.6 \pm 0.4) \times 10^{-3}$	
Γ_3	$\eta \rho$	seen	
Γ_4	$\pi^+ \pi^+ \pi^- \pi^0$	< 50 %	84%

Γ_5	$(K\overline{K})^{\pm}\pi^0$	$<$ 8	%	90%
Γ_6	$K^0_S K^0_L \pi^{\pm}$	$<$ 6	%	90%
Γ_7	$K^0_S K^0_S \pi^{\pm}$	$<$ 2	%	90%
Γ_8	$\pi\phi$	$<$ 1.5	%	84%

$b_1(1235)$ PARTIAL WIDTHS

$\Gamma(\pi^{\pm}\gamma)$ — Γ_2

VALUE (keV)	DOCUMENT ID		TECN	CHG	COMMENT
230.0±60.0	COLLICK	84	SPEC	+	200 $\pi^+ Z \rightarrow Z\pi\omega$

$b_1(1235)$ D-wave/S-wave AMPLITUDE RATIO IN DECAY OF $b_1(1235) \rightarrow \omega\pi$

VALUE	EVTS	DOCUMENT ID		TECN	CHG	COMMENT
0.260±0.035 OUR AVERAGE						
0.235±0.047		ATKINSON	84C	OMEG		20–70 γp
0.4 $^{+0.1}_{-0.1}$		GESSAROLI	77	HBC	−	11 $\pi^- p \rightarrow \pi^-\omega p$
0.21 ±0.08		CHUNG	75B	HBC	+	7.1 $\pi^+ p$
0.3 ±0.1		CHALOUPKA	74	HBC	−	3.9–7.5 $\pi^- p$
0.35 ±0.25	600	KARSHON	74B	HBC	+	4.9 $\pi^+ p$

$b_1(1235)$ BRANCHING RATIOS

$\Gamma(\eta\rho)/\Gamma(\omega\pi)$ — Γ_3/Γ_1

VALUE	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
seen	TAKAMATSU	90	SPEC	
<0.10	ATKINSON	84D	OMEG	20–70 γp

$\Gamma(\pi^+\pi^+\pi^-\pi^0)/\Gamma(\omega\pi)$ — Γ_4/Γ_1

VALUE	DOCUMENT ID		TECN	CHG	COMMENT
<0.5	ABOLINS	63	HBC	+	3.5 $\pi^+ p$

$\Gamma((K\overline{K})^{\pm}\pi^0)/\Gamma(\omega\pi)$ — Γ_5/Γ_1

VALUE	CL%	DOCUMENT ID		TECN	CHG	COMMENT
<0.08	90	BALTAY	67	HBC	±	0.0 $\overline{p}p$

$\Gamma(K^0_S K^0_L \pi^{\pm})/\Gamma(\omega\pi)$ — Γ_6/Γ_1

VALUE	CL%	DOCUMENT ID		TECN	CHG	COMMENT
<0.06	90	BALTAY	67	HBC	±	0.0 $\overline{p}p$

$\Gamma(K^0_S K^0_S \pi^{\pm})/\Gamma(\omega\pi)$ — Γ_7/Γ_1

VALUE	CL%	DOCUMENT ID		TECN	CHG	COMMENT
<0.02	90	BALTAY	67	HBC	±	0.0 $\overline{p}p$

$\Gamma(\pi\phi)/\Gamma(\omega\pi)$ — Γ_8/Γ_1

VALUE	CL%	DOCUMENT ID		TECN	CHG	COMMENT
<0.015		DAHL	67	HBC		1.6–4.2 $\pi^- p$
• • • We do not use the following data for averages, fits, limits, etc. • • •						
<0.04	95	BIZZARRI	69	HBC	±	0.0 $\overline{p}p$

$b_1(1235)$ REFERENCES

WEIDENAUER 93 ZPHY C59 387 +Duch+ (ASTERIX Collab.)
ALDE 92C ZPHY C54 553 +Bellazzini+ (SERP, BELG, LANL, LAPP, PISA, KEK)
FUKUI 91 PL B257 241 +Horikawa+ (SUGI, NAGO, KEK, KYOT, MIYA)
TAKAMATSU 90 Hadron 89 Conf. p 71 +Ando+ (KEK)
AUGUSTIN 89 NP B320 1 +Cosme (DM2 Collab.)
ATKINSON 84C NP B243 1 + (BONN, CERN, GLAS, LANC, MCHS, CURIN+)JP
ATKINSON 84D NP B242 269 + (BONN, CERN, GLAS, LANC, MCHS, CURIN+)
ATKINSON 84E PL 138B 459 + (BONN, CERN, GLAS, LANC, MCHS, CURIN+)
COLLICK 84 PRL 53 2374 +Heppelmann, Berg+ (MINN, ROCH, FNAL)
EVANGELISTA 81 NP B178 197 + (BARI, BONN, CERN, DARE, LIVP+)
BALTAY 78B PR D17 62 +Cautis, Cohen, Csorna+ (COLU, BING)

GESSAROLI 77 NP B126 382 + (BGNA, FIRZ, GENO, MILA, OXF, PAVI) JP
FLATTE 76C PL 64B 225 +Gay, Blokzijl, Metzger+ (CERN, AMST, NIJM, OXF) JP
CHUNG 75B PR D11 2426 +Protopopescu, Lynch, Flatte+ (BNL, LBL, UCSC) JP
CHALOUPKA 74 PL 51B 407 +Ferrando, Losty, Montanet (CERN) JP
KARSHON 74B PR D10 3608 +Mikenberg, Eisenberg, Pitluck, Ronat+ (REHO) JP
OTT 72B Thesis LBL-1547 (LBL) JP
BIZZARRI 69 NP B14 169 +Foster, Gavillet, Montanet+ (CERN, CDEF)
BALTAY 67 PRL 18 93 +Franzini, Severiens, Yeh, Zanello (COLU)
DAHL 67 PR 163 1377 +Hardy, Hess, Kirz, Miller (LRL)
ABOLINS 63 PRL 11 381 +Lander, Mehlhop, Nguyen, Yager (UCSD)

OTHER RELATED PAPERS

BRAU 88 PR D37 2379 +Franek+ (SLAC Hybrid Facility Photon Collab.) JP
ATKINSON 84C NP B243 1 + (BONN, CERN, GLAS, LANC, MCHS, CURIN+) JP
GOLDHABER 65 PRL 15 118 +Goldhaber, Kadyk, Shen (LRL)
CARMONY 64 PRL 12 254 +Lander, Rindfleisch, Xuong, Yager (UCB) JP
BONDAR 63B PL 5 209 +Dodd+ (AACH, BIRM, HAMB, LOIC, MPIM)

$a_1(1260)$

$I^G(J^{PC}) = 1^-(1^{++})$

MINIREVIEW GOES HERE

$a_1(1260)$ MASS

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*CHG*	*COMMENT*
1230 ±40 OUR ESTIMATE					
• • • We do not use the following data for averages, fits, limits, etc. • • •					
1211 ± 7	ALBRECHT	93C	ARG		$\tau^+ \to \pi^+\pi^+\pi^-\nu$
1121 ± 8	[1] ANDO	92	SPEC		$8\ \pi^- p \to \pi^+\pi^-\pi^0 n$
1242 ±37	[2] IVANOV	91	RVUE		$\tau \to \pi^+\pi^+\pi^-\nu$
1260 ±14	[3] IVANOV	91	RVUE		$\tau \to \pi^+\pi^+\pi^-\nu$
1250 ± 9	[4] IVANOV	91	RVUE		$\tau \to \pi^+\pi^+\pi^-\nu$
1208 ±15	ARMSTRONG	90	OMEG	0	$300.0 pp \to pp\pi^+\pi^-\pi^0$
1220 ±15	[5] ISGUR	89	RVUE		$\tau^+ \to \pi^+\pi^+\pi^-\nu$
1260 ±25	[6] BOWLER	88	RVUE		
1166 ±18 ±11	BAND	87	MAC		$\tau^+ \to \pi^+\pi^+\pi^-\nu$
1164 ±41 ±23	BAND	87	MAC		$\tau^+ \to \pi^+\pi^0\pi^0\nu$
1250 ±40	[5] TORNQVIST	87	RVUE		
1046 ±11	ALBRECHT	86B	ARG		$\tau^+ \to \pi^+\pi^+\pi^-\nu$
1056 ±20 ±15	RUCKSTUHL	86	DLCO		$\tau^+ \to \pi^+\pi^+\pi^-\nu$
1194 ±14 ±10	SCHMIDKE	86	MRK2		$\tau^+ \to \pi^+\pi^+\pi^-\nu$
1240.0±80.0	[7] DANKOWY...	81	SPEC	0	$8.45\ \pi^- p \to n 3\pi$
1280.0±30.0	[7] DAUM	81B	CNTR		$63,94\ \pi^- p \to p 3\pi$
1041.0±13.0	[8] GAVILLET	77	HBC	+	$4.2\ K^- p \to \Sigma 3\pi$

[1] Average and spread of values using 2 variants of the model of BOWLER 75.
[2] Reanalysis of RUCKSTUHL 86.
[3] Reanalysis of SCHMIDKE 86.
[4] Reanalysis of ALBRECHT 86B.
[5] From a combined reanalysis of ALBRECHT 86B, SCHMIDKE 86, and RUCKSTUHL 86.
[6] From a combined reanalysis of ALBRECHT 86B and DAUM 81B.
[7] Uses the model of BOWLER 75.
[8] Produced in K^- backward scattering.

$a_1(1260)$ WIDTH

VALUE (MeV)	*DOCUMENT ID*	*TECN*	*CHG*	*COMMENT*
~ 400 OUR ESTIMATE				
• • • We do not use the following data for averages, fits, limits, etc. • • •				

446 ± 21	ALBRECHT	93C	ARG		$\tau^+ \to \pi^+\pi^+\pi^-\nu$
239 ± 11	ANDO	92	SPEC		8 $\pi^- p \to \pi^+\pi^-\pi^0 n$
266 ± 13 ± 4	[9] ANDO	92	SPEC		8 $\pi^- p \to \pi^+\pi^-\pi^0 n$
465 $^{+228}_{-143}$	[10] IVANOV	91	RVUE		$\tau \to \pi^+\pi^+\pi^-\nu$
298 $^{+40}_{-34}$	[11] IVANOV	91	RVUE		$\tau \to \pi^+\pi^+\pi^-\nu$
488 ± 32	[12] IVANOV	91	RVUE		$\tau \to \pi^+\pi^+\pi^-\nu$
430 ± 50	ARMSTRONG	90	OMEG	0	300.0$pp \to pp\pi^+\pi^-\pi^0$
420 ± 40	[13] ISGUR	89	RVUE		$\tau^+ \to \pi^+\pi^+\pi^-\nu$
396 ± 43	[14] BOWLER	88	RVUE		
405 ± 75 ±25	BAND	87	MAC		$\tau^+ \to \pi^+\pi^+\pi^-\nu$
419 ±108 ±57	BAND	87	MAC		$\tau^+ \to \pi^+\pi^0\pi^0\nu$
521 ± 27	ALBRECHT	86B	ARG		$\tau^+ \to \pi^+\pi^+\pi^-\nu$
476 $^{+132}_{-120}$ ±54	RUCKSTUHL	86	DLCO		$\tau^+ \to \pi^+\pi^+\pi^-\nu$
462 ± 56 ±30	SCHMIDKE	86	MRK2		$\tau^+ \to \pi^+\pi^+\pi^-\nu$
380.0±100.0	[15] DANKOWY...	81	SPEC	0	8.45 $\pi^- p \to n 3\pi$
300.0± 50.0	[15] DAUM	81B	CNTR		63,94 $\pi^- p \to p 3\pi$
230.0± 50.0	[16] GAVILLET	77	HBC	+	4.2 $K^- p \to \Sigma 3\pi$

[9] Average and spread of values using 2 variants of the model of BOWLER 75.
[10] Reanalysis of RUCKSTUHL 86.
[11] Reanalysis of SCHMIDKE 86.
[12] Reanalysis of ALBRECHT 86B.
[13] From a combined reanalysis of ALBRECHT 86B, SCHMIDKE 86, and RUCKSTUHL 86.
[14] From a combined reanalysis of ALBRECHT 86B and DAUM 81B.
[15] Uses the model of BOWLER 75.
[16] Produced in K^- backward scattering.

$a_1(1260)$ DECAY MODES

	Mode	Fraction (Γ_i/Γ)	Confidence level
Γ_1	$\rho\pi$	dominant	
Γ_2	$\pi\gamma$	seen	
Γ_3	$\pi(\pi\pi)_{S\text{-wave}}$	[a] <0.7 %	90%

[a] This is only an educated guess; the error given is larger than the error on the average of the published values.

$a_1(1260)$ PARTIAL WIDTHS

$\Gamma(\pi\gamma)$ Γ_2

VALUE (keV)	DOCUMENT ID		TECN	COMMENT
640.0±246.0	ZIELINSKI	84C	SPEC	200 $\pi^+ Z \to Z 3\pi$

$a_1(1260)$ BRANCHING RATIOS

$\Gamma(\pi(\pi\pi)_{S\text{-wave}})/\Gamma(\rho\pi)$ Γ_3/Γ_1

VALUE	DOCUMENT ID		TECN
0.003 ±0.003	[17] LONGACRE	82	RVUE

[17] Uses multichannel Aitchison-Bowler model (BOWLER 75). Uses data from GAVILLET 77, DAUM 80, and DANKOWYCH 81.

$a_1(1260)$ REFERENCES

ALBRECHT	93C	ZPHY C58 61	+Ehrlichmann, Hamacher+	(ARGUS Collab.)
ANDO	92	PL B291 496	+Imai+	(KEK, KYOT, NIRS, SAGA, INUS, AKIT)
IVANOV	91	ZPHY C49 563	+Osipov, Volkov	(JINR)
ARMSTRONG	90	ZPHY C48 213	+Benayoun, Beusch	(WA76 Collab.)
ISGUR	89	PR D39 1357	+Morningstar, Reader	(TNTO)
BOWLER	88	PL B209 99		(OXF)
BAND	87	PL B198 297	+Camporesi, Chadwick, Delfino+	(MAC Collab.)
TORNQVIST	87	ZPHY C36 695		(HELS)
ALBRECHT	86B	ZPHY C33 7	+Donker, Gabriel, Edwards+	(ARGUS Collab.)
RUCKSTUHL	86	PRL 56 2132	+Stroynowski, Atwood, Barish+	(DELCO Collab.)
SCHMIDKE	86	PRL 57 527	+Abrams, Matteuzzi, Amidei+	(Mark II Collab.)
ZIELINSKI	84C	PRL 52 1195	+Berg, Chandlee, Cihangir+	(ROCH, MINN, FNAL)
LONGACRE	82	PR D26 83		(BNL)
DANKOWY...	81	PRL 46 580	Dankowych+	(TNTO, BNL, CARL, MCGI, OHIO)
DAUM	81B	NP B182 269	+Hertzberger+	(AMST, CERN, CRAC, MPIM, OXF+)
DAUM	80	PL 89B 281	+Hertzberger+	(AMST, CERN, CRAC, MPIM, OXF+) JP
GAVILLET	77	PL 69B 119	+Blockzijl, Engelen+	(AMST, CERN, NIJM, OXF) JP
BOWLER	75	NP B97 227	+Game, Aitchison, Dainton	(OXFTP, DARE)

OTHER RELATED PAPERS

IIZUKA	89	PR D39 3357	+Koibuchi, Masuda	(NAGO, IBAR, TSUK)
TORNQVIST	87	ZPHY C36 695		(HELS)
BOWLER	86	PL B182 400		(OXF)
ADERHOLZ	64	PL 10 226	+	(AACH3, BERL, BIRM, BONN, DESY, HAMB+)
GOLDHABER	64	PRL 12 336	+Brown, Kadyk, Shen+	(LRL, UCB)
LANDER	64	PRL 13 346A	+Abolins, Carmony, Hendricks, Xuong+	(UCSD) JP
BELLINI	63	NC 29 896	+Fiorini, Herz, Negri, Ratti	(MILA)

$f_2(1270)$

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

See also minireview under non-$q\overline{q}$ candidates.

$f_2(1270)$ MASS

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	COMMENT
1275 ± 5 OUR ESTIMATE					
1274.8± 1.2 OUR AVERAGE					
1272 ± 8		PROKOSHKIN	94	GAM2	38 $\pi^- p \to \pi^0 \pi^0 n$
1269.7± 5.2	5730	AUGUSTIN	89	DM2	$e^+ e^- \to 5\pi$
1283 ± 8	400± 50	[1] ALDE	87	GAM4	100 $\pi^- p \to 4\pi^0 n$
1274 ± 5		[1] AUGUSTIN	87	DM2	$J/\psi \to \gamma \pi^+ \pi^-$
1283 ± 6		[2] LONGACRE	86	MPS	22 $\pi^- p \to n 2 K^0_S$
1276 ± 7		COURAU	84	DLCO	$e^+ e^- \to e^+ e^- \pi^+ \pi^-$
1273.3± 2.3		[3] CHABAUD	83	ASPK	17 $\pi^- p$ polarized
1280 ± 4		[4] CASON	82	STRC	8 $\pi^+ p \to p \pi^+ 2\pi^0$
1281 ± 7	11600± 1000	GIDAL	81	MRK2	J/ψ decay
1282 ± 5		[5] CORDEN	79	OMEG	12–15 $\pi^- p \to n 2\pi$
1269 ± 4	10k	APEL	75	NICE	40 $\pi^- p \to n 2\pi^0$
1272 ± 4	4600	ENGLER	74	DBC	6 $\pi^+ n \to \pi^+ \pi^- p$
1277 ± 4	5300	FLATTE	71	HBC	7.0 $\pi^+ p$
1273 ± 8		[1] 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. • • •					
1281 ± 6		ADAMO	91	OBLX	$\overline{n} p \to \pi^+ \pi^+ \pi^-$
1262 ±11		AGUILAR-...	91	EHS	400 $p p$
1275 ±10		AKER	91	CBAR	0.0 $\overline{p} p \to 3\pi^0$
1220 ±10		BREAKSTONE	90	SFM	$p p \to p p \pi^+ \pi^-$
1288 ±12		ABACHI	86B	HRS	$e^+ e^- \to \pi^+ \pi^- X$
1284 ±30	3k	BINON	83	GAM2	38 $\pi^- p \to n 2\eta$
1280 ±20	3k	APEL	82	CNTR	25 $\pi^- p \to n 2\pi^0$
1284 ±10	16000	DEUTSCH...	76	HBC	16 $\pi^+ p$
1258 ±10	600	TAKAHASHI	72	HBC	8 $\pi^- p \to n 2\pi$
1275 ±13		ARMENISE	70	HBC	9 $\pi^+ n \to p \pi^+ \pi^-$
1261 ± 5	1960	[1] ARMENISE	68	DBC	5.1 $\pi^+ n \to p \pi^+ MM^-$
1270 ±10	360	[1] ARMENISE	68	DBC	5.1 $\pi^+ n \to p \pi^0 MM$
1268 ± 6		[6] JOHNSON	68	HBC	3.7–4.2 $\pi^- p$
1276 ±11		RABIN	67	HBC	8.5 $\pi^+ p$

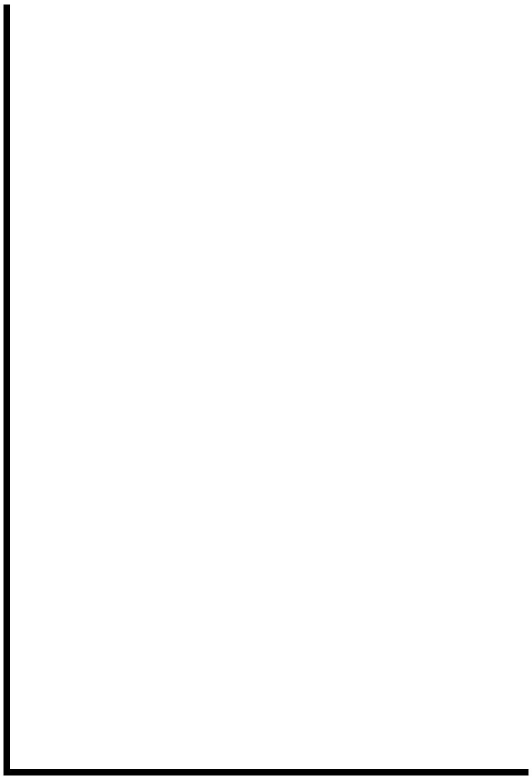
[1] Mass errors enlarged by us to $\Gamma/\sqrt{N}$; see the note with the $K^*(892)$ mass.

[2] From a partial-wave analysis of data using a K-matrix formalism with 5 poles.
[3] From an energy-independent partial-wave analysis.
[4] From an amplitude analysis of $\pi^+\pi^- \rightarrow \pi^0\pi^0$ scattering data.
[5] From an amplitude analysis of $\pi^+\pi^- \rightarrow \pi^+\pi^-$ scattering data.
[6] JOHNSON 68 includes BONDAR 63, LEE 64, DERADO 65, EISNER 67.

f_2(1270) WIDTH

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	COMMENT
185 ±20 OUR ESTIMATE					
185.4± 2.8 OUR FIT Error includes scale factor of 1.5.					
$184.5^{+4.4}_{-2.7}$ OUR AVERAGE Error includes scale factor of 1.7. See the ideogram below.					
192 ± 5		PROKOSHKIN	94	GAM2	$38\ \pi^- p \rightarrow \pi^0\pi^0 n$
180 ±24		AGUILAR-...	91	EHS	$400 p p$
169 ± 9	5730	[7] AUGUSTIN	89	DM2	$e^+e^- \rightarrow 5\pi$
150 ±30	400±50	[7] ALDE	87	GAM4	$100\ \pi^- p \rightarrow 4\pi^0 n$
$186\ ^{+9}_{-2}$		[8] LONGACRE	86	MPS	$22\ \pi^- p \rightarrow n 2 K^0_S$
$179.2^{+6.9}_{-6.6}$		[9] CHABAUD	83	ASPK	$17\ \pi^- p$ polarized
160 ±11		DENNEY	83	LASS	$10\ \pi^+ N$
196 ±10	3k	APEL	82	CNTR	$25\ \pi^- p \rightarrow n 2\pi^0$
152 ± 9		[10] CASON	82	STRC	$8\ \pi^+ p \rightarrow p \pi^+ 2\pi^0$
186 ±27	11600±1000	GIDAL	81	MRK2	J/ψ decay
216 ±13		[11] CORDEN	79	OMEG	12–15 $\pi^- p \rightarrow n 2\pi$
190 ±10	10k	APEL	75	NICE	$40\ \pi^- p \rightarrow n 2\pi^0$
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		[7] STUNTEBECK	70	HBC	$8\ \pi^- p$, $5.4\ \pi^+ d$
216 ±20	1960	[7] ARMENISE	68	DBC	$5.1\ \pi^+ n \rightarrow p \pi^+ MM^-$
128 ±27		[7] BOESEBECK	68	HBC	$8\ \pi^+ p$
176 ±21		[7,12] JOHNSON	68	HBC	3.7–4.2 $\pi^- p$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
206 ±19		ADAMO	91	OBLX	$\overline{n} p \rightarrow \pi^+\pi^+\pi^-$
200 ±10		AKER	91	CBAR	$0.0\ \overline{p} p \rightarrow 3\pi^0$
240 ±40	3k	BINON	83	GAM2	$38\ \pi^- p \rightarrow n 2\eta$
187 ±30	650	[7] ANTIPOV	77	CIBS	$25\ \pi^- p \rightarrow p 3\pi$
225 ±38	16000	DEUTSCH...	76	HBC	$16\ \pi^+ p$
166 ±28	600	[7] TAKAHASHI	72	HBC	$8\ \pi^- p \rightarrow n 2\pi$
173 ±53		[7] ARMENISE	70	HBC	$9\ \pi^+ n \rightarrow p \pi^+\pi^-$
155 ±17		RABIN	67	HBC	$8.5\ \pi^+ p$

[7] Width errors enlarged by us to $4\Gamma/\sqrt{N}$; see the note with the $K^*(892)$ mass.
[8] From a partial-wave analysis of data using a K-matrix formalism with 5 poles.
[9] From an energy-independent partial-wave analysis.
[10] From an amplitude analysis of $\pi^+\pi^- \rightarrow \pi^0\pi^0$ scattering data.
[11] From an amplitude analysis of $\pi^+\pi^- \rightarrow \pi^+\pi^-$ scattering data.
[12] JOHNSON 68 includes BONDAR 63, LEE 64, DERADO 65, EISNER 67.



$f_2(1270)$ width (MeV)

$f_2(1270)$ DECAY MODES

	Mode	Fraction (Γ_i/Γ)	Scale factor/ Confidence level
Γ_1	$\pi\pi$	$(84.7\ ^{+2.6}_{-1.2})$ %	S=1.3
Γ_2	$\pi^+\pi^-2\pi^0$	$(\ 7.2\ ^{+1.4}_{-2.9})$ %	S=1.3
Γ_3	$K\overline{K}$	$(\ 4.6\ \pm 0.5\ )$ %	S=2.8
Γ_4	$2\pi^+2\pi^-$	$(\ 2.8\ \pm 0.4\ )$ %	S=1.2
Γ_5	$\eta\eta$	$(\ 4.5\ \pm 1.0\ ) \times 10^{-3}$	S=2.4
Γ_6	$4\pi^0$	$(\ 3.0\ \pm 1.0\ ) \times 10^{-3}$	
Γ_7	$\gamma\gamma$	$(\ 1.32^{+0.18}_{-0.16}) \times 10^{-5}$	
Γ_8	$\eta\pi\pi$	$< 8 \times 10^{-3}$	CL=95%
Γ_9	$K^0K^-\pi^+ +$ c.c.	$< 3.4 \times 10^{-3}$	CL=95%
Γ_{10}	e^+e^-	$< 9 \times 10^{-9}$	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 38 measurements and one constraint to determine 8 parameters. The overall fit has a $\chi^2 = 69.8$ for 31 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	−92						
x_3	11	−38					
x_4	11	−36	1				
x_5	2	−9	0	0			
x_6	0	−7	0	0	0		
x_7	8	−3	−15	1	0	0	
Γ	−80	74	−12	−9	−3	0	−10
	x_1	x_2	x_3	x_4	x_5	x_6	x_7

	Mode	Rate (MeV)	Scale factor
Γ_1	$\pi\pi$	$156.9\ ^{+3.7}_{-1.3}$	
Γ_2	$\pi^+\pi^-2\pi^0$	$13.3\ ^{+2.8}_{-5.4}$	1.3
Γ_3	$K\overline{K}$	$8.6\ \pm 0.8$	2.9
Γ_4	$2\pi^+2\pi^-$	$5.2\ \pm 0.7$	1.2
Γ_5	$\eta\eta$	$0.83\ \pm 0.18$	2.4
Γ_6	$4\pi^0$	$0.55\ \pm 0.19$	
Γ_7	$\gamma\gamma$	$0.00244\ ^{+0.00032}_{-0.00029}$	

$f_2(1270)$ PARTIAL WIDTHS

$\Gamma(\pi\pi)$ Γ_1

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
$156.9^{+3.7}_{-1.3}$ OUR FIT				
$157.0^{+6.0}_{-1.0}$	[13] LONGACRE	86	MPS	22 $\pi^- p \to n 2K^0_S$

$\Gamma(K\overline{K})$ Γ_3

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
8.6 ±0.8 OUR FIT Error includes scale factor of 2.9.				
$9.0\ ^{+0.7}_{-0.3}$	[13] LONGACRE	86	MPS	22 $\pi^- p \to n 2K^0_S$

$\Gamma(\eta\eta)$ Γ_5

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
0.83±0.18 OUR FIT Error includes scale factor of 2.4.				
1.0 ±0.1	[13] LONGACRE	86	MPS	22 $\pi^- p \to n 2K^0_S$

$\Gamma(\gamma\gamma)$ Γ_7

The value of this width depends on the theoretical model used. Unitarised models with scalars give values clustering around $\simeq 2.6$; without an S-wave contribution, values are systematically higher (typically around 3). Since it is used to average results obtained with variety of models, we prefer to quote our own estimate.

VALUE (keV)	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
2.8 ±0.4 OUR ESTIMATE					
$2.44^{+0.32}_{-0.29}$ OUR FIT					
$2.58\pm0.13^{+0.36}_{-0.27}$		[14] BEHREND	92	CELL	$e^+e^- \to e^+e^-\pi^+\pi^-$

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

$3.10\pm0.35\pm0.35$		[15] BLINOV	92	MD1	$e^+e^- \to e^+e^-\pi^+\pi^-$
$2.27\pm0.47\pm0.11$		ADACHI	90D	TOPZ	$e^+e^- \to e^+e^-\pi^+\pi^-$
$3.15\pm0.04\pm0.39$		BOYER	90	MRK2	$e^+e^- \to e^+e^-\pi^+\pi^-$
$3.19\pm0.16^{+0.29}_{-0.28}$		MARSISKE	90	CBAL	$e^+e^- \to e^+e^-\pi^0\pi^0$
2.35 ± 0.65		[16] MORGAN	90	RVUE	$\gamma\gamma \to \pi^+\pi^-, \pi^0\pi^0$
$3.19\pm0.09^{+0.22}_{-0.38}$	2177	OEST	90	JADE	$e^+e^- \to e^+e^-\pi^0\pi^0$
$3.2\ \pm0.1\ \pm0.4$		[17] AIHARA	86B	TPC	$e^+e^- \to e^+e^-\pi^+\pi^-$
$2.5\ \pm0.1\ \pm0.5$		BEHREND	84B	CELL	$e^+e^- \to e^+e^-\pi^+\pi^-$
$2.85\pm0.25\pm0.5$		[18] BERGER	84	PLUT	$e^+e^- \to e^+e^-2\pi$
$2.70\pm0.05\pm0.20$		COURAU	84	DLCO	$e^+e^- \to e^+e^-\pi^+\pi^-$
$2.52\pm0.13\pm0.38$		[19] SMITH	84C	MRK2	$e^+e^- \to e^+e^-\pi^+\pi^-$
$2.3\ \pm0.2\ \pm0.5$		FRAZER	83	JADE	$e^+e^- \to e^+e^-\pi^+\pi^-$
$2.7\ \pm0.2\ \pm0.6$		EDWARDS	82F	CBAL	$e^+e^- \to e^+e^-2\pi^0$
$2.9\ ^{+0.6}_{-0.4}\ \pm0.6$		[20] EDWARDS	82F	CBAL	$e^+e^- \to e^+e^-2\pi^0$
$3.2\ \pm0.2\ \pm0.6$		BRANDELIK	81B	TASS	$e^+e^- \to e^+e^-\pi^+\pi^-$
$3.6\ \pm0.3\ \pm0.5$		ROUSSARIE	81	MRK2	$e^+e^- \to e^+e^-\pi^+\pi^-$
$2.3\ \pm0.8$		[21] BERGER	80B	PLUT	e^+e^-

$\Gamma(e^+e^-)$ Γ_{10}

VALUE (eV)	CL%	DOCUMENT ID		TECN	COMMENT
<1.7	90	VOROBYEV	88	ND	$e^+e^- \to \pi^0\pi^0$

[13] From a partial-wave analysis of data using a K-matrix formalism with 5 poles.
[14] Using a unitarized model with scalars.
[15] Using the unitarized model of LYTH 85.
[16] 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 $f_0(1300)$: $\Gamma(f_2) + 1/4\ \Gamma(f^0) = 3.6 \pm 0.3$ KeV.
[17] Radiative corrections modify the partial widths; for instance the COURAU 84 value becomes 2.66 ± 0.21 in the calculation of LANDRO 86.
[18] Using the MENNESSIER 83 model.
[19] Superseded by BOYER 90.
[20] If helicity = 2 assumption is not made.
[21] Using mass, width and B($f_2(1270) \to 2\pi$) from PDG 78.

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

$\Gamma(K\overline{K}) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$ $\Gamma_3\Gamma_7/\Gamma$

VALUE (keV)	DOCUMENT ID		TECN	COMMENT
$0.113^{+0.016}_{-0.015}$ OUR FIT Error includes scale factor of 1.1.				
$0.091\pm0.007\pm0.027$	[22] ALBRECHT	90G	ARG	$e^+e^- \to e^+e^-K^+K^-$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
$0.104\pm0.007\pm0.072$	[23] ALBRECHT	90G	ARG	$e^+e^- \to e^+e^-K^+K^-$

[22] Using an incoherent background.
[23] Using a coherent background.

$f_2(1270)$ BRANCHING RATIOS

$\Gamma(\pi\pi)/\Gamma_{\text{total}}$ Γ_1/Γ

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
$0.847^{+0.026}_{-0.012}$ OUR FIT Error includes scale factor of 1.3.					
0.837 ± 0.020 OUR AVERAGE					
0.849 ± 0.025		CHABAUD	83	ASPK	17 π^-p polarized
$0.85\ \pm0.05$	250	BEAUPRE	71	HBC	8 $\pi^+p \to \Delta^{++}f_2$
$0.8\ \ \pm0.04$	600	OH	70	HBC	1.26 $\pi^-p \to \pi^+\pi^-n$

$\Gamma(\pi^+\pi^-2\pi^0)/\Gamma(\pi\pi)$ — Γ_2/Γ_1

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
$0.085^{+0.018}_{-0.036}$ OUR FIT Error includes scale factor of 1.3.					
0.15 ±0.06	600	EISENBERG	74	HBC	$4.9\ \pi^+ p \rightarrow \Delta^{++} f_2$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.07		EMMS	75D	DBC	$4\ \pi^+ n \rightarrow p f_2$

$\Gamma(K\overline{K})/\Gamma(\pi\pi)$ — 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
0.055±0.006 OUR FIT Error includes scale factor of 2.8.					
$0.040^{+0.005}_{-0.006}$ OUR AVERAGE					
$0.037^{+0.008}_{-0.021}$		ETKIN	82B	MPS	$23\ \pi^- p \rightarrow n 2K^0_S$
0.045±0.009		CHABAUD	81	ASPK	$17\ \pi^- p$ polarized
0.039±0.008		LOVERRE	80	HBC	$4\ \pi^- p \rightarrow K\overline{K}N$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.036±0.005		[24] COSTA...	80	OMEG	$1\text{–}2.2\ \pi^- p \rightarrow K^+K^- n$
0.030±0.005		[25] MARTIN	79	RVUE	
0.027±0.009		[26] POLYCHRO...	79	STRC	$7\ \pi^- p \rightarrow n 2K^0_S$
0.025±0.015		EMMS	75D	DBC	$4\ \pi^+ n \rightarrow p f_2$
0.031±0.012	20	ADERHOLZ	69	HBC	$8\ \pi^+ p \rightarrow K^+K^-\pi^+ p$

[24] Re-evaluated by CHABAUD 83.
[25] Includes PAWLICKI 77 data.
[26] Takes into account the $f_2(1270)$-$f_2'(1525)$ interference.

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

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
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	$1.26\ \pi^- p \rightarrow \pi^+\pi^- n$

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

VALUE (units 10^{-3})	DOCUMENT ID		TECN	COMMENT
4.5±1.0 OUR FIT Error includes scale factor of 2.4.				
3.1±0.8 OUR AVERAGE Error includes scale factor of 1.3.				
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
• • • 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	$4.9\ \pi^+ p \rightarrow \Delta^{++} f_2$

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

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

$\Gamma(\eta\pi\pi)/\Gamma(\pi\pi)$ — Γ_8/Γ_1

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.010	95	EMMS	75D	DBC	$4\ \pi^+ n \rightarrow p f_2$

$\Gamma(K^0 K^- \pi^+ + \text{c.c.})/\Gamma(\pi\pi)$ **Γ_9/Γ_1**

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<0.004	95	EMMS 75D	DBC	$4\ \pi^+ n \rightarrow\ p f_2$

$f_2(1270)$ REFERENCES

PROKOSHKIN	94	SPD 39 420	+Kondashov	(SERP)
BEHREND	92	ZPHY C56 381		(CELLO Collab.)
BLINOV	92	ZPHY C53 33	+Bondar, Bukin+	(NOVO)
ADAMO	91	Hadron 91 Conf.	+Agnello, Balestra+	(OBELIX Collab.)
AGUILAR-...	91	ZPHY C50 405	Aguilar-Benitez, Allison, Batalor+	(LEBC-EHS Collab.)
AKER	91	PL B260 249	+Amsler, Peters+	(Crystal Barrel Collab.)
ADACHI	90D	PL B234 185	+Doser+	(TOPAZ Collab.)
ALBRECHT	90G	ZPHY C48 183	+Ehrlichmann, Harder+	(ARGUS Collab.)
BOYER	90	PR D42 1350	+Butler+	(Mark II Collab.)
BREAKSTONE	90	ZPHY C48 569	+	(ISU, BGNA, CERN, DORT, HEIDH, WARS)
MARSISKE	90	PR D41 3324	+Antreasyan+	(Crystal Ball Collab.)
MORGAN	90	ZPHY C48 623	+Pennington	(RAL, DURH)
OEST	90	ZPHY C47 343	+Olsson+	(JADE Collab.)
AUGUSTIN	89	NP B320 1	+Cosme	(DM2 Collab.)
VOROBYEV	88	SJNP 48 273	+Golubev, Dolinsky, Druzhinin+	(NOVO)
		Translated from YAF 48 436.		
ALDE	87	PL B198 286	+Binon, Bricman+	(LANL, BRUX, SERP, LAPP)
AUGUSTIN	87	ZPHY C36 369	+Cosme+	(LALO, CLER, FRAS, PADO)
ABACHI	86B	PRL 57 1990	+Derrick, Blockus+	(PURD, ANL, IND, MICH, LBL)
AIHARA	86B	PRL 57 404	+Alston-Garnjost+	(TPC-2γ Collab.)
ALDE	86D	NP B269 485	+Binon, Bricman+	(BELG, LAPP, SERP, CERN)
LANDRO	86	PL B172 445	+Mork, Olsen	(UTRO)
LONGACRE	86	PL B177 223	+Etkin+	(BNL, BRAN, CUNY, DUKE, NDAM)
LYTH	85	JPG 11 459		
BEHREND	84B	ZPHY C23 223	+Fenner, Schachter, Schroeder+	(CELLO Collab.)
BERGER	84	ZPHY C26 199	+Klovning, Burger+	(PLUTO Collab.)
COURAU	84	PL 147B 227	+Johnson, Sherman, Atwood, Baillon+	(CIT, SLAC)
SMITH	84C	PR D30 851	+Burke, Abrams, Blocker, Levi+	(SLAC, LBL, HARV)
BINON	83	NC 78A 313	+Donskov, Duteil+	(BELG, LAPP, SERP, CERN)
Also	83B	SJNP 38 561	Binon, Gouanere+	(BELG, LAPP, SERP, CERN)
		Translated from YAF 38 934.		
CHABAUD	83	NP B223 1	+Gorlich, Cerrada+	(CERN, CRAC, MPIM)
DENNEY	83	PR D28 2726	+Cranley, Firestone, Chapman+	(IOWA, MICH)
FRAZER	83	Aachen Conf.		(UCSD)
MENNESSIER	83	ZPHY C16 241		(MONP)
APEL	82	NP B201 197	+Augenstein+	(KARLK, KARLE, PISA, SERP, WIEN, CERN)
CASON	82	PRL 48 1316	+Biswas, Baumbaugh, Bishop+	(NDAM, ANL)
EDWARDS	82F	PL 110B 82	+Partridge, Peck+	(CIT, HARV, PRIN, STAN, SLAC)
ETKIN	82B	PR D25 1786	+Foley, Lai+	(BNL, CUNY, TUFTS, VAND)
BRANDELIK	81B	ZPHY C10 117	+Boerner+	(TASSO Collab.)
CHABAUD	81	APP B12 575	+Niczyporuk, Becker+	(CERN, CRAC, MPIM)
GIDAL	81	PL 107B 153	+Goldhaber, Guy, Millikan, Abrams+	(SLAC, LBL)
ROUSSARIE	81	PL 105B 304	+Burke, Abrams, Alam+	(SLAC, LBL)
BERGER	80B	PL 94B 254	+Genzer+	(PLUTO Collab.)
COSTA...	80	NP B175 402	Costa De Beauregard+	(BARI, BONN, CERN+)
LOVERRE	80	ZPHY C6 187	+Armenteros, Dionisi+	(CERN, CDEF, MADR, STOH)
CORDEN	79	NP B157 250	+Dowell, Garvey+	(BIRM, RHEL, TELA, LOWC)
MARTIN	79	NP B158 520	+Ozmutlu	(DURH)
POLYCHRO...	79	PR D19 1317	Polychronakos, Cason, Bishop+	(NDAM, ANL)
PDG	78	PL 75B	Bricman+	
ANTIPOV	77	NP B119 45	+Busnello, Damgaard, Kienzle+	(SERP, GEVA)
PAWLICKI	77	PR D15 3196	+Ayres, Cohen, Diebold, Kramer, Wicklund	(ANL)
DEUTSCH...	76	NP B103 426	Deutschmann+	(AACH3, BERL, BONN, CERN+)
APEL	75	PL 57B 398	+Augenstein+	(KARLK, KARLE, PISA, SERP, WIEN, CERN)
EMMS	75D	NP B96 155	+Kinson, Stacey, Votruba+	(BIRM, DURH, RHEL)
EISENBERG	74	PL 52B 239	+Engler, Haber, Karshon+	(REHO)
ENGLER	74	PR D10 2070	+Kraemer, Toaff, Weisser, Diaz+	(CMU, CASE)
LOUIE	74	PL 48B 385	+Alitti, Gandois, Chaloupka+	(SACL, CERN)
ANDERSON	73	PRL 31 562	+Engler, Kraemer, Toaff, Diaz+	(CMU, CASE)
TAKAHASHI	72	PR D6 1266	+Barish+	(TOHOK, PENN, NDAM, ANL)
BEAUPRE	71	NP B28 77	+Deutschmann, Graessler+	(AACH, BERL, CERN)
FLATTE	71	PL 34B 551	+Alston-Garnjost, Barbaro-Galtieri+	(LBL)
ARMENISE	70	LNC 4 199	+Ghidini, Foring, Cartacci+	(BARI, BGNA, FIRZ)
OH	70	PR D1 2494	+Garfinkel, Morse, Walker, Prentice	(WISC, TNTO) JP
STUNTEBECK	70	PL 32B 391	+Kenney, Deery, Biswas, Cason+	(NDAM)
ADERHOLZ	69	NP B11 259	+Bartsch+	(AACH3, BERL, CERN, JAGL, WARS)
ARMENISE	68	NC 54A 999	+Ghidini, Forino+	(BARI, BGNA, FIRZ, ORSAY)
ASCOLI	68D	PRL 21 1712	+Crawley, Mortara+	(ILL)
BOESEBECK	68	NP B4 501	+Deutschmann+	(AACH, BERL, CERN)
JOHNSON	68	PR 176 1651	+Poirier, Biswas, Gutay+	(NDAM, PURD, SLAC)
EISNER	67	PR 164 1699	+Johnson, Klein, Peters, Sahni, Yen+	(PURD)
RABIN	67	Thesis		(RUTG)
DERADO	65	PRL 14 872	+Kenney, Poirier, Shephard	(NDAM)
LEE	64	PRL 12 342	+Roe, Sinclair, VanderVelde	(MICH)
BONDAR	63	PL 5 153	+	(AACH, BIRM, BONN, DESY, LOIC, MPIM)

$f_1(1285)$

$I^G(J^{PC}) = 0^+(1^{++})$

See also minireview under non-$q\overline{q}$ candidates.

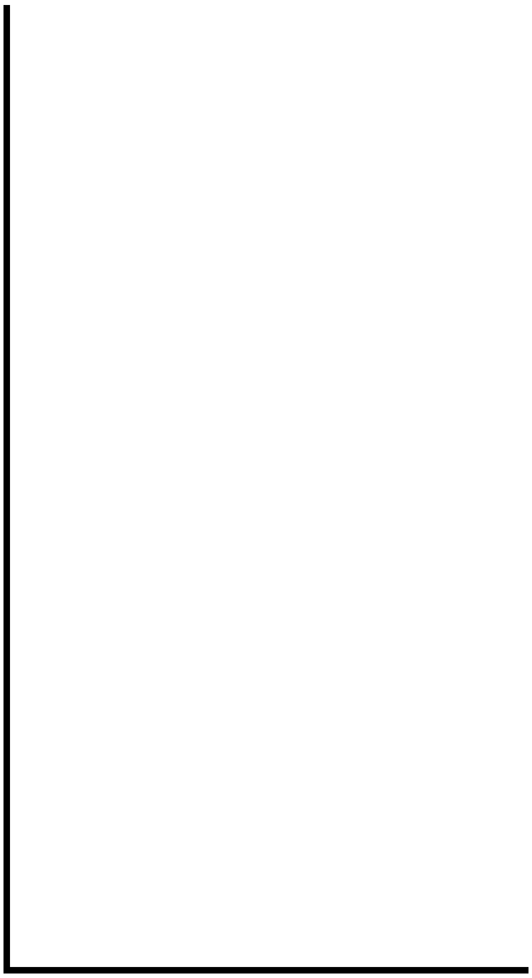
$f_1(1285)$ MASS

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	CHG	COMMENT
1282 ± 5 OUR ESTIMATE						
1282.1± 0.6 OUR AVERAGE		Error includes scale factor of 1.6. See the ideogram below.				
1280 ± 2		ABATZIS	94	OMEG		450 $pp \to pp2(\pi^+\pi^-)$
1282.2± 1.5		LEE	94	MPS2		18 $\pi^- p \to K^+\overline{K}^0 2\pi^- p$
1282 ± 4		ARMSTRONG	93C	SPEC		$\overline{p}p \to \pi^0\eta\eta \to 6\gamma$
1270 ± 6 ±10		ARMSTRONG	92C	OMEG		300 $pp \to pp\pi^+\pi^-\gamma$
1279 ± 5		FUKUI	91C	SPEC		8.95 $\pi^- p \to \eta\pi^+\pi^- n$
1278 ± 2	140± 12	ARMSTRONG	89	OMEG		300 $pp \to K\overline{K}\pi pp$
1281 ± 1		ARMSTRONG	89E	OMEG		300 $pp \to pp2(\pi^+\pi^-)$
1278 ± 2		ARMSTRONG	89G	OMEG		85 $\pi^+ p \to 4\pi\pi p$, $pp \to 4\pi pp$
1280.1± 2.1	60 ± 20	RATH	89	MPS		21.4 $\pi^- p \to K^0_S K^0_S \pi^0 n$
1285 ± 1	4750± 100	[1] BIRMAN	88	MPS		8 $\pi^- p \to K^+\overline{K}^0\pi^- n$
1280 ± 1	504± 84	BITYUKOV	88	SPEC		32.5 $\pi^- p \to K^+K^-\pi^0 n$
1279 ± 6 ±10	16 ± 6	BECKER	87	MRK3		$e^+e^- \to \phi K\overline{K}\pi$
1286 ± 9		GIDAL	87	MRK2		$e^+e^- \to e^+e^-\eta\pi^+\pi^-$
1280 ± 4		ANDO	86	SPEC		8 $\pi^- p \to n\eta\pi^+\pi^-$
1277.0± 2.0	420	REEVES	86	SPEC		6.6 $p\overline{p} \to KK\pi X$
1285.0± 2.0		CHUNG	85	SPEC		8 $\pi^- p \to NK\overline{K}\pi$
1279.0± 2.0	604	ARMSTRONG	84	OMEG		85 $\pi^+ p \to K\overline{K}\pi\pi p$, $pp \to K\overline{K}\pi pp$
1287.0± 5.0	353	BITUKOV	84	SPEC		32 $\pi^- p \to K^+K^-\pi^0 n$
1286.0± 1.0		CHAUVAT	84	SPEC		ISR 31.5 pp
1278 ± 4		EVANGELISTA	81	OMEG		12 $\pi^- p \to \eta\pi^+\pi^-\pi^- p$
1275.0± 6.0	31	BROMBERG	80	SPEC		100 $\pi^- p \to K\overline{K}\pi X$
1283.0± 3.0	103	DIONISI	80	HBC		4 $\pi^- p \to K\overline{K}\pi n$
1288.0± 9.0	200	GURTU	79	HBC		4.2 $K^- p \to n\eta 2\pi$
1295.0±12.0	85	CORDEN	78	OMEG		12–15 $\pi^- p \to n5\pi$
1282.0± 2.0	320	NACASCH	78	HBC		0.7,0.76 $\overline{p}p \to K\overline{K}3\pi$
1279.0± 5.0	210	GRASSLER	77	HBC		16 $\pi^\mp p$
1292 ±10	150	DEFOIX	72	HBC		0.7 $\overline{p}p \to 7\pi$
1286 ± 3	180	DUBOC	72	HBC		1.2 $\overline{p}p \to 2K4\pi$
1303.0± 8.0		BARDADIN-...	71	HBC		8 $\pi^+ p \to p6\pi$
1283.0± 6.0		BOESEBECK	71	HBC		16.0 $\pi p \to p5\pi$
1270.0±10.0		CAMPBELL	69	DBC		2.7 $\pi^+ d$
1285 ± 7		LORSTAD	69	HBC		0.7 $\overline{p}p$, 4,5-body
1290 ± 7		D'ANDLAU	68	HBC		1.2 $\overline{p}p$, 5–6 body
1283.0± 5.0		DAHL	67	HBC		1.6–4.2 $\pi^- p$

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

1264 ± 8		AUGUSTIN	90	DM2		$J/\psi \to \gamma\eta\pi^+\pi^-$
1284 ± 4		TAKAMATSU	90	SPEC	0	8 $\pi^- p \to K\overline{K}\pi n$
~ 1279		[2] TORNQVIST	82B	RVUE		
~ 1275.0	46	[3] STANTON	79	CNTR		8.5 $\pi^- p \to n 2\gamma 2\pi$
1271.0±10.0	34	CORDEN	78	OMEG		12–15 $\pi^- p \to K^+ K^- \pi n$
1280 ± 3	500	[4] THUN	72	MMS		13.4 $\pi^- p$

[1] From partial wave analysis of $K^+\overline{K}^0\pi^-$ system.
[2] From a unitarized quark-model calculation.
[3] From phase shift analysis of $\eta\pi^+\pi^-$ system.
[4] Seen in the missing mass spectrum.



$f_1(1285)$ mass (MeV)

$f_1(1285)$ WIDTH

Only experiments giving width error less than 20 MeV are kept for averaging.

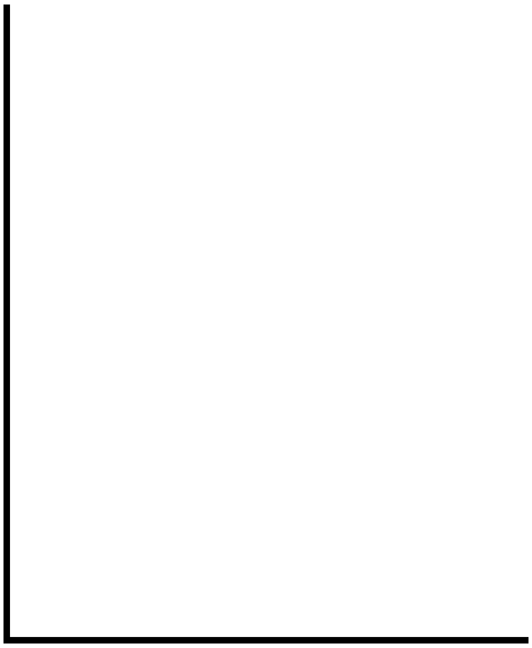
VALUE (MeV)	*CL%*	*EVTS*	*DOCUMENT ID*		*TECN*	*CHG*	*COMMENT*
24 ± 3 OUR ESTIMATE							
25.1± 1.3 OUR AVERAGE			Error includes scale factor of 1.3. See the ideogram below.				
40 ± 5			ABATZIS	94	OMEG		450 $pp \to pp 2(\pi^+\pi^-)$

29.0± 4.1			LEE	94	MPS2	18 $\pi^- p \rightarrow K^+ \overline{K}^0 2\pi^- p$
25 ± 4		140±12	ARMSTRONG	89	OMEG	300 $pp \rightarrow K\overline{K}\pi pp$
31 ± 5			ARMSTRONG	89E	OMEG	300 $pp \rightarrow pp2(\pi^+\pi^-)$
41 ±12			ARMSTRONG	89G	OMEG	85 $\pi^+ p \rightarrow 4\pi\pi p$, $pp \rightarrow 4\pi pp$
17.9±10.9		60 ± 20	RATH	89	MPS	21.4 $\pi^- p \rightarrow K^0_S K^0_S \pi^0 n$
22 ± 2		4750±100	[5] BIRMAN	88	MPS	8 $\pi^- p \rightarrow K^+ \overline{K}^0 \pi^- n$
25 ± 4		504±84	BITYUKOV	88	SPEC	32.5 $\pi^- p \rightarrow K^+ K^- \pi^0 n$
14 $^{+20}_{-14}$ ±10		16 ± 6	BECKER	87	MRK3	$e^+ e^- \rightarrow \phi K\overline{K}\pi$
19 ± 5			ANDO	86	SPEC	8 $\pi^- p \rightarrow n\eta\pi^+\pi^-$
32.0± 8.0		420	REEVES	86	SPEC	6.6 $p\overline{p} \rightarrow KK\pi X$
22.0± 2.0			CHUNG	85	SPEC	8 $\pi^- p \rightarrow NK\overline{K}\pi$
32.0± 3.0		604	ARMSTRONG	84	OMEG	85 $\pi^+ p \rightarrow K\overline{K}\pi\pi p$, $pp \rightarrow K\overline{K}\pi pp$
24.0± 3.0			CHAUVAT	84	SPEC	ISR 31.5 pp
26 ±12			EVANGELISTA	81	OMEG	12 $\pi^- p \rightarrow \eta\pi^+\pi^-\pi^- p$
29.0±10.0		103	DIONISI	80	HBC	4 $\pi^- p \rightarrow K\overline{K}\pi n$
25.0±15.0		200	GURTU	79	HBC	4.2 $K^- p \rightarrow n\eta 2\pi$
28.3± 6.7		320	NACASCH	78	HBC	0.7,0.76 $\overline{p}p \rightarrow K\overline{K}3\pi$
24.0±18.0		210	GRASSLER	77	HBC	16 $\pi^{\mp} p$
10.0±10.0			BOESEBECK	71	HBC	16.0 $\pi p \rightarrow p5\pi$
30.0±15.0			CAMPBELL	69	DBC	2.7 $\pi^+ d$

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

44 ±20			AUGUSTIN	90	DM2		$J/\psi \rightarrow \gamma\eta\pi^+\pi^-$
22 ± 5			TAKAMATSU	90	SPEC	0	8 $\pi^- p \rightarrow K\overline{K}\pi n$
<20	90		TAKAMATSU	90	SPEC	0	8.95 $\pi^- p \rightarrow \eta\pi^+\pi^- n$
~ 10.0			[6] STANTON	79	CNTR		8.5 $\pi^- p \rightarrow n2\gamma 2\pi$
28 ± 5		150	[7] DEFOIX	72	HBC		0.7 $\overline{p}p \rightarrow 7\pi$
46 ± 9		180	[7] DUBOC	72	HBC		1.2 $\overline{p}p \rightarrow 2K4\pi$
37 ± 5		500	[8] THUN	72	MMS		13.4 $\pi^- p$
60 ±15			[7] LORSTAD	69	HBC		0.7 $\overline{p}p$, 4,5-body
35.0±10.0			[7] DAHL	67	HBC		1.6–4.2 $\pi^- p$

[5] From partial wave analysis of $K^+\overline{K}^0\pi^-$ system.
[6] From phase shift analysis of $\eta\pi^+\pi^-$ system.
[7] Resolution is not unfolded.
[8] Seen in the missing mass spectrum.



$f_1(1285)$ width (MeV)

$f_1(1285)$ DECAY MODES

	Mode	Fraction (Γ_i/Γ)	Scale factor/ Confidence level
Γ_1	4π	(29 ± 6) %	
Γ_2	$\pi^0\pi^0\pi^+\pi^-$	$(15\ ^{+9}_{-8})$ %	S=1.1
Γ_3	$2\pi^+2\pi^-$	(15 ± 6) %	
Γ_4	$\rho^0\pi^+\pi^-$	dominates $2\pi^+2\pi^-$	
Γ_5	$4\pi^0$	$< 7 \times 10^{-4}$	CL=90%
Γ_6	$\eta\pi\pi$	(54 ± 15) %	
Γ_7	$a_0(980)\pi$ [ignoring $a_0(980) \to K\overline{K}$]	(44 ± 7) %	S=1.1
Γ_8	$\eta\pi\pi$ [excluding $a_0(980)\pi$]	$(10\ ^{+7}_{-6})$ %	S=1.1
Γ_9	$K\overline{K}\pi$	(9.7 ± 1.6) %	S=1.2
Γ_{10}	$K\overline{K}^*(892)$	not seen	
Γ_{11}	$\gamma\rho^0$	(6.6 ± 1.3) %	S=1.5
Γ_{12}	$\phi\gamma$	$(8.0 \pm 3.1) \times 10^{-4}$	
Γ_{13}	$\gamma\gamma^*$		
Γ_{14}	$\gamma\gamma$		

CONSTRAINED FIT INFORMATION

An overall fit to 7 branching ratios uses 13 measurements and one constraint to determine 6 parameters. The overall fit has a $\chi^2 = 11.4$ for 8 degrees of freedom.

The following *off-diagonal* array elements are the correlation coefficients $\left\langle \delta x_i \delta x_j \right\rangle/(\delta x_i \cdot \delta x_j)$, in percent, from the fit to 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_3	−87				
x_7	−33	13			
x_8	−4	−5	−78		
x_9	46	−19	−38	−12	
x_{11}	−59	45	30	−11	−41
	x_2	x_3	x_7	x_8	x_9

$f_1(1285)$ $\Gamma(i)\Gamma(\gamma\gamma)/\Gamma(\text{total})$

$\Gamma(\eta\pi\pi) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$ — $\Gamma_6\Gamma_{14}/\Gamma = (\Gamma_7+\Gamma_8)\Gamma_{14}/\Gamma$

VALUE (keV)	*CL%*	*DOCUMENT ID*		*TECN*	*COMMENT*
<0.62	95	GIDAL	87	MRK2	$e^+e^- \to e^+e^-\eta\pi^+\pi^-$

$\Gamma(\eta\pi\pi) \times \Gamma(\gamma\gamma^*)/\Gamma_{\text{total}}$ — $\Gamma_6\Gamma_{13}/\Gamma = (\Gamma_7+\Gamma_8)\Gamma_{13}/\Gamma$

VALUE (keV)	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
1.4 ±0.4 OUR AVERAGE Error includes scale factor of 1.4.					
1.18±0.25±0.20	26	[9,10] AIHARA	88B	TPC	$e^+e^- \to e^+e^-\eta\pi^+\pi^-$
2.30±0.61±0.42		[9,11] GIDAL	87	MRK2	$e^+e^- \to e^+e^-\eta\pi^+\pi^-$

[9] Assuming a ρ-pole form factor.
[10] Published value multiplied by $\eta\pi\pi$ branching ratio 0.49.
[11] Published value divided by 2 and multiplied by the $\eta\pi\pi$ branching ratio 0.49.

$f_1(1285)$ BRANCHING RATIOS

$\Gamma(K\overline{K}\pi)/\Gamma(4\pi)$ — $\Gamma_9/\Gamma_1 = \Gamma_9/(\Gamma_2+\Gamma_3)$

VALUE	*DOCUMENT ID*		*TECN*	*COMMENT*
0.33±0.04 OUR FIT Error includes scale factor of 1.2.				
0.32±0.04 OUR AVERAGE Error includes scale factor of 1.2.				
0.28±0.05	[12] ARMSTRONG	89E	OMEG	300 $pp \to ppf_1(1285)$
0.37±0.03±0.05	[13] ARMSTRONG	89G	OMEG	85 $\pi p \to 4\pi X$

[12] Assuming $\rho\pi\pi$ and $a_0(980)\pi$ intermediate states.
[13] 4π consistent with being entirely $\rho\pi\pi$.

$\Gamma(K\overline{K}\pi)/\Gamma(\eta\pi\pi)$ — $\Gamma_9/\Gamma_6 = \Gamma_9/(\Gamma_7+\Gamma_8)$

VALUE	*DOCUMENT ID*		*TECN*	*COMMENT*
0.18±0.04 OUR FIT Error includes scale factor of 1.1.				
0.23±0.06 OUR AVERAGE Error includes scale factor of 1.2.				
0.42±0.15	GURTU	79	HBC	4.2 K^-p
0.5 ±0.2	CORDEN	78	OMEG	12–15 π^-p
0.20±0.08	[14] DEFOIX	72	HBC	0.7 $\overline{p}p \to 7\pi$
0.16±0.08	CAMPBELL	69	DBC	2.7 π^+d

[14] $K\overline{K}$ system characterized by the $I = 1$ threshold enhancement. (See under $a_0(980)$).

$\Gamma(a_0(980)\pi$ [ignoring $a_0(980) \to K\overline{K}$]$)/\Gamma(\eta\pi\pi)$ — $\Gamma_7/\Gamma_6 = \Gamma_7/(\Gamma_7+\Gamma_8)$

VALUE	*DOCUMENT ID*		*TECN*	*COMMENT*
0.82±0.12 OUR FIT Error includes scale factor of 1.1.				
$0.69^{+0.13}_{-0.12}$ OUR AVERAGE				
0.72±0.15	GURTU	79	HBC	4.2 K^-p
0.6 $^{+0.3}_{-0.2}$	CORDEN	78	OMEG	12–15 π^-p
• • • We do not use the following data for averages, fits, limits, etc. • • •				
1.0 ±0.3	GRASSLER	77	HBC	16 $\pi^{\mp}p$

$\Gamma(4\pi)/\Gamma(\eta\pi\pi)$ — $\Gamma_1/\Gamma_6 = (\Gamma_2+\Gamma_3)/(\Gamma_7+\Gamma_8)$

VALUE	DOCUMENT ID		TECN	COMMENT
0.54±0.12 OUR FIT Error includes scale factor of 1.1.				
0.41±0.14 OUR AVERAGE				
0.37±0.11±0.11	BOLTON	92	MRK3	$J/\psi \to \gamma f_1(1285)$
0.64±0.40	GURTU	79	HBC	4.2 $K^- p$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.93±0.30	[15] GRASSLER	77	HBC	16 $\pi^\mp p$

[15] Assuming $\rho\pi\pi$ and $a_0(980)\pi$ intermediate states.

$\Gamma(K\overline{K}^*(892))/\Gamma_{total}$ — Γ_{10}/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
not seen	NACASCH	78	HBC	0.7,0.76 $\overline{p}p \to K\overline{K}3\pi$

$\Gamma(\rho^0\pi^+\pi^-)/\Gamma(2\pi^+2\pi^-)$ — Γ_4/Γ_3

VALUE	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
1.0±0.4	GRASSLER	77	HBC	16 GeV $\pi^\pm p$

$\Gamma(4\pi^0)/\Gamma_{total}$ — Γ_5/Γ

VALUE (units 10^{-4})	CL%	DOCUMENT ID		TECN	COMMENT
<7	90	ALDE	87	GAM4	100 $\pi^- p \to 4\pi^0 n$

$\Gamma(\phi\gamma)/\Gamma(K\overline{K}\pi)$ — Γ_{12}/Γ_9

VALUE (units 10^{-2})	EVTS	DOCUMENT ID		TECN	COMMENT
0.82±0.21±0.20	19	BITYUKOV	88	SPEC	32.5 $\pi^- p \to K^+K^-\pi^0 n$

$\Gamma(\gamma\rho^0)/\Gamma(K\overline{K}\pi)$ — Γ_{11}/Γ_9

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
>0.035	90	[16] COFFMAN	90	MRK3	$J/\psi \to \gamma\gamma\pi^+\pi^-$

[16] Using B($J/\psi \to \gamma f_1(1285) \to \gamma\gamma\rho^0$)=0.25 × 10^{-4} and B($J/\psi \to \gamma f_1(1285) \to \gamma K\overline{K}\pi$)=< 0.72 × 10^{-3}.

$\Gamma(\gamma\rho^0)/\Gamma(2\pi^+2\pi^-)$ — Γ_{11}/Γ_3

VALUE	DOCUMENT ID		TECN	COMMENT
0.45±0.18 OUR FIT				
0.45±0.18	[17] COFFMAN	90	MRK3	$J/\psi \to \gamma\gamma\pi^+\pi^-$

[17] Using B($J/\psi \to \gamma f_1(1285) \to \gamma\gamma\rho^0$)=0.25 × 10^{-4} and B($J/\psi \to \gamma f_1(1285) \to \gamma 2\pi^+ 2\pi^-$)=0.55 × 10^{-4} given by MIR 88.

$\Gamma(\gamma\rho^0)/\Gamma(a_0(980)\pi$ [ignoring $a_0(980) \to K\overline{K}$]) — Γ_{11}/Γ_7

VALUE	DOCUMENT ID		TECN	COMMENT
0.15±0.04 OUR FIT Error includes scale factor of 1.6.				
0.10±0.03±0.02	[18] BURCHELL	91	MRK3	$J/\psi \to \gamma\eta\pi^+\pi^-$

[18] Uses a result from COFFMAN 90, and includes an unknown branching ratio for $a_0(980) \to \eta\pi$.

$\Gamma(\gamma\rho^0)/\Gamma_{total}$ — Γ_{11}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<0.05	95	BITYUKOV	91B	SPEC	32 $\pi^- p \to \pi^+\pi^-\gamma n$

$\Gamma(\eta\pi\pi)/\Gamma(\gamma\rho^0)$ — $\Gamma_6/\Gamma_{11} = (\Gamma_7+\Gamma_8)/\Gamma_{11}$

VALUE	DOCUMENT ID		TECN	COMMENT
8.2±1.6 OUR FIT Error includes scale factor of 1.8.				
7.5±1.0	[19] ARMSTRONG	92C	OMEG	300 $pp \to pp\pi^+\pi^-\gamma$, $pp\eta\pi^+\pi^-$

[19] Published value multiplied by 1.5.

$f_1(1285)$ REFERENCES

ABATZIS	94	PL B324 509	+Antinori, Barberis+	(ATHU, BARI, BIRM, CERN, JINR)
LEE	94	PL B323 227	+Chung, Kirk+	(BNL, IND, KYUN, MASD, RICE)
ARMSTRONG	93C	PL B307 394	+Bettoni+	(FNAL, FERR, GENO, UCI, NWES+)
ARMSTRONG	92C	ZPHY C54 371	+Barnes, Benayoun+	(ATHU, BARI, BIRM, CERN, CDEF)
BOLTON	92	PL B278 495	+Brown, Bunnell+	(Mark III Collab.)
BITYUKOV	91B	SJNP 54 318	+Borisov, Viktorov+	(SERP)
		Translated from YAF 54 529.		
BURCHELL	91	NP B21 132 (suppl)		(Mark III Collab.)
FUKUI	91C	PL B267 293	+	(SUGI, NAGO, KEK, KYOT, MIYA, AKIT)
AUGUSTIN	90	PR D42 10	+Cosme+	(DM2 Collab.)
COFFMAN	90	PR D41 1410	+De Jongh+	(Mark III Collab.)
TAKAMATSU	90	Hadron 89 Conf. p 71	+Ando+	(KEK)
ARMSTRONG	89	PL B221 216	+Benayoun+	(CERN, CDEF, BIRM, BARI, ATHU, CURIN+) JPC
ARMSTRONG	89E	PL B228 536	+Benayoun	(ATHU, BARI, BIRM, CERN, CDEF, CURIN+)
ARMSTRONG	89G	ZPHY C43 55	+Bloodworth+	(CERN, BIRM, BARI, ATHU, CURIN+)
RATH	89	PR D40 693	+Cason+	(NDAM, BRAN, BNL, CUNY, DUKE)
AIHARA	88B	PL B209 107	+Alston-Garnjost+	(TPC-2γ Collab.)
BIRMAN	88	PRL 61 1557	+Chung, Peaslee+	(BNL, FSU, IND, MASD) JP
BITYUKOV	88	PL B203 327	+Borisov, Dorofeev+	(SERP)
MIR	88	Photon-Photon 88 Conf., 126		(Mark III Collab.)
ALDE	87	PL B198 286	+Binon, Bricman+	(LANL, BRUX, SERP, LAPP)
BECKER	87	PRL 59 186	+Blaylock, Bolton, Brown+	(Mark III Collab.)
GIDAL	87	PRL 59 2012	+Boyer, Butler, Cords, Abrams+	(LBL, SLAC, HARV)
ANDO	86	PRL 57 1296	+Imai+	(KEK, KYOT, NIRS, SAGA, INUS, TSUK+) IJP
REEVES	86	PR 34 1960	+Chung, Crittenden+	(FLOR, BNL, IND, MASD) JP
CHUNG	85	PRL 55 779	+Fernow, Boehnlein+	(BNL, FLOR, IND, MASD) JP
ARMSTRONG	84	PL 146B 273	+Bloodworth, Burns+	(ATHU, BARI, BIRM, CERN) JP
BITUKOV	84	PL 144B 133	+Dorofeev, Dzhelyadin, Golovkin, Kulik+	(SERP)
CHAUVAT	84	PL 148B 382	+Meritet, Bonino+	(CERN, CLER, UCLA, SACL)
TORNQVIST	82B	NP B203 268		(HELS)
EVANGELISTA	81	NP B178 197	+	(BARI, BONN, CERN, DARE, LIVP+)
BROMBERG	80	PR D22 1513	+Haggerty, Abrams, Dzierba	(CIT, FNAL, ILLC, IND)
DIONISI	80	NP B169 1	+Gavillet+	(CERN, MADR, CDEF, STOH)
GURTU	79	NP B151 181	+Gavillet, Blokzijl+	(CERN, ZEEM, NIJM, OXF)
STANTON	79	PRL 42 346	+Brockman+	(OSU, CARL, MCGI, TNTO) JP
CORDEN	78	NP B144 253	+Corbett, Alexander+	(BIRM, RHEL, TELA, LOWC) JP
NACASCH	78	NP B135 203	+Defoix, Dobrzynski+	(PARIS, MADR, CERN)
GRASSLER	77	NP B121 189	+	(AACH3, BERL, BONN, CERN, CRAC, HEIDH+)
DEFOIX	72	NP B44 125	+Nascimento, Bizzarri+	(CDEF, CERN)
DUBOC	72	NP B46 429	+Goldberg, Makowski, Donald+	(PARIS, LIVP)
THUN	72	PRL 28 1733	+Blieden, Finocchiaro, Bowen+	(STON, NEAS)
BARDADIN-...	71	PR D4 2711	Bardadin-Otwinowska, Hofmokl+	(WARS)
BOESEBECK	71	PL 34B 659		(AACH, BERL, BONN, CERN, CRAC, HEID, WARS)
CAMPBELL	69	PRL 22 1204	+Lichtman, Loeffler+	(PURD)
LORSTAD	69	NP B14 63	+D'Andlau, Astier+	(CDEF, CERN) JP
D'ANDLAU	68	NP B5 693	+Astier, Barlow+	(CDEF, CERN, IRAD, LIVP) IJP
DAHL	67	PR 163 1377	+Hardy, Hess, Kirz, Miller	(LRL) IJP

OTHER RELATED PAPERS

AIHARA	88C	PR D38 1	+Alston-Garnjost+	(TPC-2γ Collab.) JPC
ASTON	85	PR D32 2255	+Carnegie, Dunwoodie+	(SLAC, CARL, CNRC)
ATKINSON	84E	PL 138B 459	+	(BONN, CERN, GLAS, LANC, MCHS, CURIN+)
GAVILLET	82	ZPHY C16 119	+Armenteros+	(CERN, CDEF, PADO, ROMA)
D'ANDLAU	65	PL 17 347	+Barlow, Adamson+	(CDEF, CERN, IRAD, LIVP)
MILLER	65	PRL 14 1074	+Chung, Dahl, Hess, Hardy, Kirz+	(LRL, UCB)

$\eta(1295)$

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

See also the mini-review under non-$q\overline{q}$ candidates. (See the index for the page number.)

$\eta(1295)$ MASS

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
1295±4	FUKUI	91C	SPEC	8.95 $\pi^- p \to \eta\pi^+\pi^- n$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
~ 1275	STANTON	79	CNTR	8.4 $\pi^- p \to n\eta 2\pi$

$\eta(1295)$ WIDTH

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
53±6	FUKUI	91C	SPEC	8.95 $\pi^- p \to \eta\pi^+\pi^- n$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
~ 70	STANTON	79	CNTR	8.4 $\pi^- p \to n\eta 2\pi$

*CITATION: L. Montanet et al., Physical Review D50, 1173 (1994) and 1995 off-year partial update for the 1996 edition (URL: http://pdg.lbl.gov/)

$\eta(1295)$ DECAY MODES

	Mode	Fraction (Γ_i/Γ)
Γ_1	$\eta\pi^+\pi^-$	seen
Γ_2	$a_0(980)\pi$	seen
Γ_3	$\gamma\gamma$	

$\eta(1295)$ $\Gamma(i)\Gamma(\gamma\gamma)/\Gamma(\text{total})$

$\Gamma(\eta\pi^+\pi^-) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$ — $\Gamma_1\Gamma_3/\Gamma$

VALUE (keV)	CL%	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<0.6	90	AIHARA	88C	TPC	$e^+e^- \rightarrow e^+e^-\eta\pi^+\pi^-$
<0.3		ANTREASYAN	87	CBAL	$e^+e^- \rightarrow e^+e^-\eta\pi\pi$

$\eta(1295)$ BRANCHING RATIOS

$\Gamma(a_0(980)\pi)/\Gamma_{\text{total}}$ — Γ_2/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
seen	BIRMAN	88	MPS	$8\ \pi^- p \rightarrow K^+\overline{K}^0\pi^- n$
large	ANDO	86	SPEC	$8\ \pi^- p \rightarrow n\eta\pi^+\pi^-$
large	STANTON	79	CNTR	$8.4\ \pi^- p \rightarrow n\eta 2\pi$

$\eta(1295)$ REFERENCES

FUKUI	91C	PL B267 293	+	(SUGI, NAGO, KEK, KYOT, MIYA, AKIT)
AIHARA	88C	PR D38 1	+Alston-Garnjost+	(TPC-2γ Collab.)
BIRMAN	88	PRL 61 1557	+Chung, Peaslee+	(BNL, FSU, IND, MASD) JP
ANTREASYAN	87	PR D36 2633	+Bartels, Besset+	(Crystal Ball Collab.)
ANDO	86	PRL 57 1296	+Imai+	(KEK, KYOT, NIRS, SAGA, INUS, TSUK+) IJP
STANTON	79	PRL 42 346	+Brockman+	(OSU, CARL, MCGI, TNTO) JP

$f_0(1300)$
was $f_0(1400)$
was $\epsilon(1200)$

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

We list here all claims for highly elastic $\pi\pi$ S-wave resonances.

MINIREVIEW GOES HERE

$f_0(1300)$ MASS

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
1000-1500 OUR ESTIMATE				
• • • We do not use the following data for averages, fits, limits, etc. • • •				
$\simeq 1000$	[1] MORGAN	93	RVUE	
1472 ± 12	ARMSTRONG	91	OMEG	$300\ pp \rightarrow pp\pi\pi$, $ppKK$
1440 ± 20	CHEN	91	MRK3	$J/\psi \rightarrow \gamma\pi^+\pi^-$, $\gamma K\overline{K}$
1275 ± 20	BREAKSTONE	90	SFM	$62\ pp \rightarrow pp\pi^+\pi^-$
1440 ± 50	BOLONKIN	88	SPEC	$40\ \pi^- p \rightarrow K^0_S K^0_S n$
1420 ± 20	AKESSON	86	SPEC	$63\ pp \rightarrow pp\pi^+\pi^-$
1220 ± 40	ALDE	86D	GAM4	$100\ \pi^- p \rightarrow n2\eta$
$1463\pm\ 9$	ETKIN	82B	MPS	$23\ \pi^- p \rightarrow n2K^0_S$
~ 1237	TORNQVIST	82	RVUE	
1425 ± 15	WICKLUND	80	SPEC	$6\ \pi N \rightarrow K^+K^-N$
~ 1300	POLYCHRO...	79	STRC	$7\ \pi^- p \rightarrow n2K^0_S$
1256	FROGGATT	77	RVUE	$\pi^+\pi^-$ channel

[1] Combining new data on $f_0(980)$ production in J/ψ and D_s decays with earlier information on central production and elastic $\pi\pi$, $K\overline{K}$ processes.

$f_0(1300)$ WIDTH

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
150 to 400 OUR ESTIMATE				
• • • We do not use the following data for averages, fits, limits, etc. • • •				
$\simeq 700$	[2] MORGAN	93	RVUE	
195 ± 33	ARMSTRONG	91	OMEG	$300\ pp \rightarrow pp\pi\pi, ppKK$
160 ± 40	CHEN	91	MRK3	$J/\psi \rightarrow \gamma\pi^+\pi^-, \gamma K\overline{K}$
285 ± 60	BREAKSTONE	90	SFM	$62\ pp \rightarrow pp\pi^+\pi^-$
250 ± 80	BOLONKIN	88	SPEC	$40\ \pi^- p \rightarrow K^0_S K^0_S n$
460 ± 50	AKESSON	86	SPEC	$63\ pp \rightarrow pp\pi^+\pi^-$
320 ± 40	ALDE	86D	GAM4	$100\ \pi^- p \rightarrow n2\eta$
~ 1400	TORNQVIST	82	RVUE	
160 ± 30	WICKLUND	80	SPEC	$6\ \pi N \rightarrow K^+K^-N$
~ 150	POLYCHRO...	79	STRC	$7\ \pi^- p \rightarrow n2K^0_S$
~ 400	[3] FROGGATT	77	RVUE	$\pi^+\pi^-$ channel

[2] Combining new data on $f_0(980)$ production in J/ψ and D_s decays with earlier information on central production and elastic $\pi\pi$, $K\overline{K}$ processes.

[3] Width defined as distance between 45 and 135° phase shift.

$f_0(1300)$ DECAY MODES

	Mode	Fraction (Γ_i/Γ)
Γ_1	$\pi\pi$	$(93.6^{+1.9}_{-1.5})$ %
Γ_2	$K\overline{K}$	(7.5 ± 0.9) %
Γ_3	$\eta\eta$	seen
Γ_4	$\gamma\gamma$	seen
Γ_5	e^+e^-	not seen

$f_0(1300)$ PARTIAL WIDTHS

$\Gamma(\gamma\gamma)$ — Γ_4

VALUE (keV)	DOCUMENT ID		TECN	COMMENT
5.4 ± 2.3	[4] MORGAN	90	RVUE	$\gamma\gamma \rightarrow \pi^+\pi^-, \pi^0\pi^0$

[4] Error includes spread of different solutions. Authors report strong correlation with $\gamma\gamma$ width of $f_2(1270)$.

$\Gamma(e^+e^-)$ — Γ_5

VALUE (eV)	CL%	DOCUMENT ID		TECN	COMMENT
<20	90	VOROBYEV	88	ND	$e^+e^- \rightarrow \pi^0\pi^0$

$f_0(1300)$ BRANCHING RATIOS

$\Gamma(\pi\pi)/\Gamma_{total}$ — Γ_1/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
$0.936^{+0.019}_{-0.015}$	GORLICH	80	ASPK	$17,18\ \pi^- p$ polarized
• • • We do not use the following data for averages, fits, limits, etc. • • •				
~ 0.93	TORNQVIST	82	RVUE	
0.93	LOVERRE	80	HBC	$4\ \pi^- p \rightarrow K\overline{K}N$
0.73	HYAMS	75	ASPK	$17.2\ \pi^- p \rightarrow n\pi^+\pi^-$

$\Gamma(K\overline{K})/\Gamma(\pi\pi)$ — Γ_2/Γ_1

VALUE	DOCUMENT ID		TECN	COMMENT
0.08 ± 0.01	COSTA...	80	OMEG	$10\ \pi^- p \rightarrow K^+K^-n$

$\Gamma(\eta\eta)/\Gamma_{total}$ — Γ_3/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
0.02	ALDE	86D	GAM4	$100\ \pi^- p \rightarrow n2\eta$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
seen	BINON	83	GAM2	$38\ \pi^- p \rightarrow 2\eta n$

f_0(1300) REFERENCES

MORGAN	93	PR D48 1185	+Pennington	(RAL, DURH)
Also	93C	NC A Conf. Suppl.	Morgan	(RAL)
ARMSTRONG	91	ZPHY C51 351	+Benayoun+	(ATHU, BARI, BIRM, CERN, CDEF)
CHEN	91	Hadron 91 Conf.		(Mark III Collab.)
SLAC-PUB-5669				
BREAKSTONE	90	ZPHY C48 569	+	(ISU, BGNA, CERN, DORT, HEIDH, WARS)
MORGAN	90	ZPHY C48 623	+Pennington	(RAL, DURH)
BOLONKIN	88	NP B309 426	+Bloshenko, Gorin+	(ITEP, SERP)
VOROBYEV	88	SJNP 48 273	+Golubev, Dolinsky, Druzhinin+	(NOVO)
		Translated from YAF 48 436.		
AKESSON	86	NP B264 154	+Albrow, Almehed+	(Axial Field Spec. Collab.)
ALDE	86D	NP B269 485	+Binon, Bricman+	(BELG, LAPP, SERP, CERN)
BINON	83	NC 78A 313	+Donskov, Duteil+	(BELG, LAPP, SERP, CERN)
ETKIN	82B	PR D25 1786	+Foley, Lai+	(BNL, CUNY, TUFTS, VAND)
TORNQVIST	82	PRL 49 624		(HELS)
COSTA...	80	NP B175 402	Costa De Beauregard+	(BARI, BONN, CERN+)
GORLICH	80	NP B174 16	+Niczyporuk+	(CRAC, MPIM, CERN, ZEEM)
LOVERRE	80	ZPHY C6 187	+Armenteros, Dionisi+	(CERN, CDEF, MADR, STOH) IJP
WICKLUND	80	PRL 45 1469	+Ayres, Cohen, Diebold, Pawlicki	(ANL)
POLYCHRO...	79	PR D19 1317	Polychronakos, Cason, Bishop+	(NDAM, ANL) IJP
FROGGATT	77	NP B129 89	+Petersen	(GLAS, NORD)
HYAMS	75	NP B100 205	+Jones, Weilhammer, Blum, Dietl+	(CERN, MPIM)

OTHER RELATED PAPERS

ACHASOV	94	PR D49 5779	+Shestakov	(NOVI)
AMSLER	94	PL B322 431	+Armstrong+	(Crystal Barrel Collab.)
ANISOVICH	94	PL B323 233	+Armstrong+	(Crystal Barrel Collab.)
ADAMO	93	NP A558 13C	+Agnello+	(OBELIX Collab.)
GASPERO	93	NP A562 407		(ROMAI)
SVEC	92	PR D45 55	+de Lesquen, van Rossum	(MCGI, SACL)
SVEC	92B	PR D45 1518	+de Lesquen, van Rossum	(MCGI, SACL)
SVEC	92C	PR D46 949	+de Lesquen, van Rossum	(MCGI, SACL)
MORGAN	91	PL B258 444	+Pennington	(RAL, DURH)
WEINSTEIN	89	UTPT 89 03	+Isgur	(TNTO)
ALDE	88	PL B201 160	+Bellazzini, Binon+	(SERP, BELG, LANL, LAPP, PISA)
AU	87	PR D35 1633	+Morgan, Pennington	(DURH, RAL)
ACHASOV	84	ZPHY C22 53	+Devyanin, Shestakov	(NOVO)
CASON	83	PR D28 1586	+Cannata, Baumbaugh, Bishop+	(NDAM, ANL)
WEINSTEIN	83B	PR D27 588	+Isgur	(TNTO)
BECKER	79	NP B151 46	+Blanar, Blum+	(MPIM, CERN, ZEEM, CRAC)
BECKER	79B	NP B150 301	+Blanar, Blum+	(MPIM, CERN, ZEEM, CRAC)
CORDEN	79	NP B157 250	+Dowell, Garvey+	(BIRM, RHEL, TELA, LOWC) JP
CASON	76	PRL 36 1485	+Polychronakos, Bishop, Biswas+	(NDAM, ANL) IJ
WETZEL	76	NP B115 208	+Freudenreich, Beusch+	(ETH, CERN, LOIC)
ESTABROOKS	74	NP B79 301	+Martin	(DURH)
GRAYER	74	NP B75 189	+Hyams, Blum, Dietl+	(CERN, MPIM)
HYAMS	73	NP B64 134	+Jones, Weilhammer, Blum, Dietl+	(CERN, MPIM)

$\pi(1300)$

$I^G(J^{PC}) = 1^-(0^{-+})$

π(1300) MASS

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
1300 ±100 OUR ESTIMATE				
• • • We do not use the following data for averages, fits, limits, etc. • • •				
1190 ± 30	ZIELINSKI	84	SPEC	200 $\pi^+ Z \to Z 3\pi$
1240 ± 30	BELLINI	82	SPEC	40 $\pi^- A \to A 3\pi$
1273.0 ± 50.0	[1] AARON	81	RVUE	
1342 ± 20	BONESINI	81	OMEG	12 $\pi^- p \to p 3\pi$
~ 1400	DAUM	81B	SPEC	63,94 $\pi^- p$

[1] Uses multichannel Aitchison-Bowler model (BOWLER 75). Uses data from DAUM 80 and DANKOWYCH 81.

π(1300) WIDTH

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
200 to 600 OUR ESTIMATE				
• • • We do not use the following data for averages, fits, limits, etc. • • •				
440 ± 80	ZIELINSKI	84	SPEC	200 $\pi^+ Z \to Z 3\pi$
360 ± 120	BELLINI	82	SPEC	40 $\pi^- A \to A 3\pi$
580.0 ± 100.0	[2] AARON	81	RVUE	
220 ± 70	BONESINI	81	OMEG	12 $\pi^- p \to p 3\pi$
~ 600	DAUM	81B	SPEC	63,94 $\pi^- p$

[2] Uses multichannel Aitchison-Bowler model (BOWLER 75). Uses data from DAUM 80 and DANKOWYCH 81.

$\pi(1300)$ DECAY MODES

	Mode	Fraction (Γ_i/Γ)
Γ_1	$\rho\pi$	seen
Γ_2	$\pi(\pi\pi)_{S\text{-wave}}$	seen
Γ_3	$f_0(1300)\pi$	

$\pi(1300)$ BRANCHING RATIOS

$\Gamma(\pi(\pi\pi)_{S\text{-wave}})/\Gamma(\rho\pi)$ — Γ_2/Γ_1

VALUE	DOCUMENT ID		TECN
• • • We do not use the following data for averages, fits, limits, etc. • • •			
2.12	[3] AARON	81	RVUE

[3] Uses multichannel Aitchison-Bowler model (BOWLER 75). Uses data from DAUM 80 and DANKOWYCH 81.

$\pi(1300)$ REFERENCES

ZIELINSKI	84	PR D30 1855	+Berg, Chandlee, Cihangir+	(ROCH, MINN, FNAL)
BELLINI	82	PRL 48 1697	+Frabetti, Ivanshin, Litkin+	(MILA, BGNA, JINR)
AARON	81	PR D24 1207	+Longacre	(NEAS, BNL)
BONESINI	81	PL 103B 75	+Donald+	(MILA, LIVP, DARE, CERN, BARI, BONN)
DANKOWY...	81	PRL 46 580	Dankowych+	(TNTO, BNL, CARL, MCGI, OHIO)
DAUM	81B	NP B182 269	+Hertzberger+	(AMST, CERN, CRAC, MPIM, OXF+)
DAUM	80	PL 89B 281	+Hertzberger+	(AMST, CERN, CRAC, MPIM, OXF+)
BOWLER	75	NP B97 227	+Game, Aitchison, Dainton	(OXFTP, DARE)

$a_2(1320)$

$I^G(J^{PC}) = 1^-(2^{++})$

$a_2(1320)$ MASS

3π AND $K^\pm K^0_S$ MODES

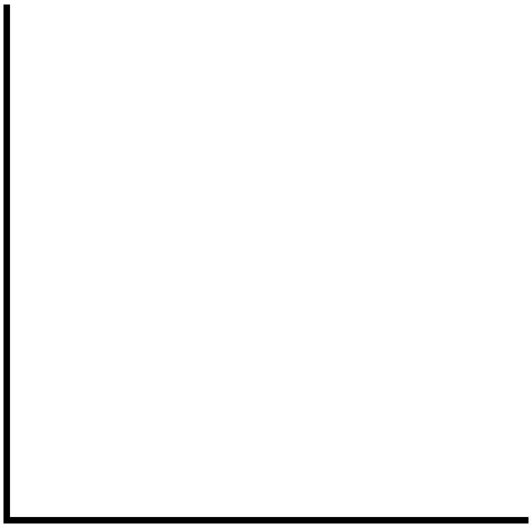
VALUE (MeV)	DOCUMENT ID
1318.4±0.6 OUR AVERAGE	Includes data from the 4 datablocks that follow this one. Error includes scale factor of 1.1.

3π MODE

The data in this block is included in the average printed for a previous datablock.

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	CHG	COMMENT
1318.5± 1.6 OUR AVERAGE		Error includes scale factor of 1.3. See the ideogram below.				
1315 ±15 ±2		[1] AMSLER	94D	CBAR		0.0 $\overline{p}p \to \pi^0\pi^0\eta$
1310 ± 5		ARMSTRONG	90	OMEG	0	300.0 $pp \to pp\pi^+\pi^-\pi^0$
1323.8± 2.3	4022	AUGUSTIN	89	DM2	±	$J/\psi \to \rho^\pm a_2^\mp$
1320.6± 3.1	3562	AUGUSTIN	89	DM2	0	$J/\psi \to \rho^0 a_2^0$
1317.0± 2.0	25000	[2] DAUM	80C	SPEC	−	63,94 $\pi^- p \to 3\pi p$
1320.0±10.0	1097	[2] BALTAY	78B	HBC	+0	15 $\pi^+ p \to p4\pi$
1306.0± 8.0		FERRERSORIA	78	OMEG	−	9 $\pi^- p \to p3\pi$
1318 ± 7	1600	[2] EMMS	75	DBC	0	4 $\pi^+ n \to p(3\pi)^0$
1315 ± 5		[2] ANTIPOV	73C	CNTR	−	25,40 $\pi^- p \to p\eta\pi^-$
1306 ± 9	1580	CHALOUPKA	73	HBC	−	3.9 $\pi^- p$
• • • We do not use the following data for averages, fits, limits, etc. • • •						
1305 ±14		CONDO	93	SHF		$\gamma p \to \eta\pi^+\pi^+\pi^-$
1310 ± 2		[2] EVANGELISTA	81	OMEG	−	12 $\pi^- p \to 3\pi p$
1343.0±11.0	490	BALTAY	78B	HBC	0	15 $\pi^+ p \to \Delta 3\pi$
1309 ± 5	5000	BINNIE	71	MMS	−	$\pi^- p$ near a_2 threshold
1299.0± 6.0	28000	BOWEN	71	MMS	−	5 $\pi^- p$
1300 ± 6.0	24000	BOWEN	71	MMS	+	5 $\pi^+ p$
1309.0± 4.0	17000	BOWEN	71	MMS	−	7 $\pi^- p$
1306.0± 4.0	941	ALSTON-...	70	HBC	+	7.0 $\pi^+ p \to 3\pi p$

[1] The systematic error of 2 MeV corresponds to the spread of solutions.
[2] From a fit to $J^P = 2^+$ $\rho\pi$ partial wave.



$a_2(1320)$ mass, 3π mode (MeV)

$K^{\pm}K^0_S$ MODE

VALUE (MeV)	EVTS		DOCUMENT ID		TECN	CHG	COMMENT
The data in this block is included in the average printed for a previous datablock.							
1318.1± 0.7 OUR AVERAGE							
1319.0± 5.0	4700	[3,4]	CLELAND	82B	SPEC	+	50 $\pi^+ p \rightarrow K^0_S K^+ p$
1324.0± 6.0	5200	[3,4]	CLELAND	82B	SPEC	−	50 $\pi^- p \rightarrow K^0_S K^- p$
1320.0± 2.0	4000		CHABAUD	80	SPEC	−	17 $\pi^- A \rightarrow K^0_S K^- A$
1312.0± 4.0	11000		CHABAUD	78	SPEC	−	9.8 $\pi^- p \rightarrow K^- K^0_S p$
1316.0± 2.0	4730		CHABAUD	78	SPEC	−	18.8 $\pi^- p \rightarrow K^- K^0_S p$
1318 ± 1		[3,5]	MARTIN	78D	SPEC	−	10 $\pi^- p \rightarrow K^0_S K^- p$
1320.0± 2.0	2724		MARGULIE	76	SPEC	−	23 $\pi^- p \rightarrow K^- K^0_S p$
1313.0± 4.0	730		FOLEY	72	CNTR	−	20.3 $\pi^- p \rightarrow K^- K^0_S p$
1319.0± 3.0	1500	[5]	GRAYER	71	ASPK	−	17.2 $\pi^- p \rightarrow K^- K^0_S p$
• • • We do not use the following data for averages, fits, limits, etc. • • •							
1330.0±11.0	1000	[3,4]	CLELAND	82B	SPEC	+	30 $\pi^+ p \rightarrow K^0_S K^+ p$
1324.0± 5.0	350		HYAMS	78	ASPK	+	12.7 $\pi^+ p \rightarrow K^+ K^0_S p$

[3] From a fit to $J^P = 2^+$ partial wave.
[4] Number of events evaluated by us.
[5] Systematic error in mass scale subtracted.

$\eta\pi$ MODE

VALUE (MeV)	EVTS		DOCUMENT ID		TECN	CHG	COMMENT
The data in this block is included in the average printed for a previous datablock.							
1320.1±2.0 OUR AVERAGE							
1325.1±5.1			AOYAGI	93	BKEI		$\pi^- p \rightarrow \eta\pi^- p$
1324 ±5			ARMSTRONG	93C	SPEC	0	$\overline{p}p \rightarrow \pi^0\eta\eta \rightarrow 6\gamma$
1317.7±1.4±2.0			BELADIDZE	93	VES		$37\pi^- N \rightarrow \eta\pi^- N$
1323 ±8	1000	[6]	KEY	73	OSPK	−	6 $\pi^- p \rightarrow p\pi^-\eta$

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

1336.2±1.7	2561	DELFOSSE	81	SPEC	+	$\pi^\pm p \to p\pi^\pm\eta$
1330.7±2.4	1653	DELFOSSE	81	SPEC	−	$\pi^\pm p \to p\pi^\pm\eta$
1324 ±8	6200	[6,7] CONFORTO	73	OSPK	−	$6\ \pi^- p \to p\mathrm{MM}^-$

[6] Error includes 5 MeV systematic mass-scale error.
[7] Missing mass with enriched MMS = $\eta\pi^-$, $\eta = 2\gamma$.

$\eta'\pi$ MODE

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
The data in this block is included in the average printed for a previous datablock.				
1327.0±10.7	BELADIDZE	93	VES	$37\pi^- N \to \eta'\pi^- N$

$a_2(1320)$ WIDTH

3π MODE

VALUE (MeV)	*EVTS*	*DOCUMENT ID*		*TECN*	*CHG*	*COMMENT*
105.6± 1.9 OUR AVERAGE	Error includes scale factor of 1.1.					
112 ± 3 ±2		[8] AMSLER	94D	CBAR		$0.0\ \overline{p}p \to \pi^0\pi^0\eta$
120 ±10		ARMSTRONG	90	OMEG	0	$300.0 pp \to pp\pi^+\pi^-\pi^0$
107.0± 9.7	4022	AUGUSTIN	89	DM2	±	$J/\psi \to \rho^\pm a_2^\mp$
118.5±12.5	3562	AUGUSTIN	89	DM2	0	$J/\psi \to \rho^0 a_2^0$
97 ± 5		[9] EVANGELISTA	81	OMEG	−	$12\ \pi^- p \to 3\pi p$
96.0± 9.0	25000	[9] DAUM	80C	SPEC	−	$63{,}94\ \pi^- p \to 3\pi p$
110.0±15.0	1097	[9] BALTAY	78B	HBC	+0	$15\ \pi^+ p \to p4\pi$
112 ±18	1600	[9] EMMS	75	DBC	0	$4\ \pi^+ n \to p(3\pi)^0$
122 ±14	1200	[9,10] WAGNER	75	HBC	0	$7\ \pi^+ p \to \Delta^{++}(3\pi)^0$
115 ±15		[9] ANTIPOV	73C	CNTR	−	$25{,}40\ \pi^- p \to p\eta\pi^-$
99 ±15	1580	CHALOUPKA	73	HBC	−	$3.9\ \pi^- p$
105.0± 5.0	28000	BOWEN	71	MMS	−	$5\ \pi^- p$
99.0± 5.0	24000	BOWEN	71	MMS	+	$5\ \pi^+ p$
103.0± 5.0	17000	BOWEN	71	MMS	−	$7\ \pi^- p$
• • • We do not use the following data for averages, fits, limits, etc. • • •						
120 ±40		CONDO	93	SHF		$\gamma p \to \eta\pi^+\pi^+\pi^-$
115.0±14.0	490	BALTAY	78B	HBC	0	$15\ \pi^+ p \to \Delta 3\pi$
72 ±16	5000	BINNIE	71	MMS	−	$\pi^- p$ near a_2 threshold
79.0±12.0	941	ALSTON-...	70	HBC	+	$7.0\ \pi^+ p \to 3\pi p$

[8] The systematic error of 2 MeV corresponds to the spread of solutions.
[9] From a fit to $J^P = 2^+\ \rho\pi$ partial wave.
[10] Width errors enlarged by us to $4\Gamma/\sqrt{N}$; see the note with the $K^*(892)$ mass.

$K^\pm K^0_S$ AND $\eta\pi$ MODES

VALUE (MeV)	*DOCUMENT ID*
107 ±5 OUR ESTIMATE	
110.1±1.9 OUR AVERAGE	Includes data from the 2 datablocks that follow this one.

$K^\pm K^0_S$ MODE

VALUE (MeV)	*EVTS*	*DOCUMENT ID*		*TECN*	*CHG*	*COMMENT*
The data in this block is included in the average printed for a previous datablock.						
109.8± 2.4 OUR AVERAGE						
112.0±20.0	4700	[11,12] CLELAND	82B	SPEC	+	$50\ \pi^+ p \to K^0_S K^+ p$
120.0±25.0	5200	[11,12] CLELAND	82B	SPEC	−	$50\ \pi^- p \to K^0_S K^- p$
106.0± 4.0	4000	CHABAUD	80	SPEC	−	$17\ \pi^- \mathrm{A} \to K^0_S K^- \mathrm{A}$
126.0±11.0	11000	CHABAUD	78	SPEC	−	$9.8\ \pi^- p \to K^- K^0_S p$
101.0± 8.0	4730	CHABAUD	78	SPEC	−	$18.8\ \pi^- p \to K^- K^0_S p$

113 ± 4		[11,13] MARTIN	78D	SPEC	−	10 $\pi^- p \to K^0_S K^- p$
105.0 ± 8.0	2724	[13] MARGULIE	76	SPEC	−	23 $\pi^- p \to K^- K^0_S p$
113.0 ± 19.0	730	FOLEY	72	CNTR	−	20.3 $\pi^- p \to K^- K^0_S p$
123.0 ± 13.0	1500	[13] GRAYER	71	ASPK	−	17.2 $\pi^- p \to K^- K^0_S p$
• • • We do not use the following data for averages, fits, limits, etc. • • •						
121.0 ± 51.0	1000	[11,12] CLELAND	82B	SPEC	+	30 $\pi^+ p \to K^0_S K^+ p$
110.0 ± 18.0	350	HYAMS	78	ASPK	+	12.7 $\pi^+ p \to K^+ K^0_S p$

[11] From a fit to $J^P = 2^+$ partial wave.
[12] Number of events evaluated by us.
[13] Width errors enlarged by us to $4\Gamma/\sqrt{N}$; see the note with the $K^*(892)$ mass.

$\eta\pi$ MODE

VALUE (MeV)	*EVTS*	*DOCUMENT ID*		*TECN*	*CHG*	*COMMENT*
The data in this block is included in the average printed for a previous datablock.						
110.9 ± 3.3 OUR AVERAGE						
118 ± 10		ARMSTRONG	93C	SPEC	0	$\bar{p} p \to \pi^0 \eta\eta \to 6\gamma$
103 ± 6 ± 3		BELADIDZE	93	VES		$37 \pi^- N \to \eta\pi^- N$
112.2 ± 5.7	2561	DELFOSSE	81	SPEC	+	$\pi^\pm p \to p \pi^\pm \eta$
116.6 ± 7.7	1653	DELFOSSE	81	SPEC	−	$\pi^\pm p \to p \pi^\pm \eta$
108 ± 9	1000	KEY	73	OSPK	−	6 $\pi^- p \to p \pi^- \eta$
• • • We do not use the following data for averages, fits, limits, etc. • • •						
104 ± 9	6200	[14] CONFORTO	73	OSPK	−	6 $\pi^- p \to p MM^-$

[14] Model dependent.

$\eta'\pi$ MODE

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
106 ± 32	BELADIDZE	93	VES	$37 \pi^- N \to \eta' \pi^- N$

$a_2(1320)$ DECAY MODES

	Mode	Fraction (Γ_i/Γ)	Scale factor/ Confidence level
Γ_1	$\rho\pi$	(70.1 ± 2.7) %	S=1.2
Γ_2	$\eta\pi$	(14.5 ± 1.2) %	
Γ_3	$\omega\pi\pi$	(10.6 ± 3.2) %	S=1.3
Γ_4	$K\overline{K}$	(4.9 ± 0.8) %	
Γ_5	$\eta'(958)\pi$	$(5.7 \pm 1.1) \times 10^{-3}$	
Γ_6	$\pi^\pm\gamma$	$(2.8 \pm 0.6) \times 10^{-3}$	
Γ_7	$\gamma\gamma$	$(9.7 \pm 1.0) \times 10^{-6}$	
Γ_8	$\pi^+\pi^-\pi^-$	< 8 %	CL=90%
Γ_9	e^+e^-	$< 2.3 \times 10^{-7}$	CL=90%

CONSTRAINED FIT INFORMATION

An overall fit to 5 branching ratios uses 18 measurements and one constraint to determine 4 parameters. The overall fit has a $\chi^2 =$ 9.3 for 15 degrees of freedom.

The following *off-diagonal* array elements are the correlation coefficients $\langle \delta x_i \delta x_j \rangle / (\delta x_i \cdot \delta x_j)$, in percent, from the fit to 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	10		
x_3	−89	−46	
x_4	−1	−2	−24
	x_1	x_2	x_3

$a_2(1320)$ PARTIAL WIDTHS

$\Gamma(\pi^\pm\gamma)$ — Γ_6

VALUE (keV)	DOCUMENT ID		TECN	CHG	COMMENT
295± 60	CIHANGIR	82	SPEC	+	200 π^+ A
• • • We do not use the following data for averages, fits, limits, etc. • • •					
461±110	[14] MAY	77	SPEC	±	9.7 γA

$\Gamma(\gamma\gamma)$ — Γ_7

VALUE (keV)	EVTS	DOCUMENT ID		TECN	CHG	COMMENT
1.04±0.09 OUR AVERAGE						
1.26±0.26±0.18	36	BARU	90	MD1		$e^+e^- \to e^+e^-\pi^+\pi^-\pi^0$
1.00±0.07±0.15	415	BEHREND	90C	CELL	0	$e^+e^- \to e^+e^-\pi^+\pi^-\pi^0$
1.03±0.13±0.21		BUTLER	90	MRK2		$e^+e^- \to e^+e^-\pi^+\pi^-\pi^0$
1.01±0.14±0.22	85	OEST	90	JADE		$e^+e^- \to e^+e^-\pi^0\eta$
0.90±0.27±0.15	56	[15] ALTHOFF	86	TASS	0	$e^+e^- \to e^+e^-3\pi$
1.14±0.20±0.26		[16] ANTREASYAN	86	CBAL	0	$e^+e^- \to e^+e^-\pi^0\eta$
1.06±0.18±0.19		BERGER	84C	PLUT	0	$e^+e^- \to e^+e^-3\pi$
• • • We do not use the following data for averages, fits, limits, etc. • • •						
$0.81\pm0.19^{+0.42}_{-0.11}$	35	[15] BEHREND	83B	CELL	0	$e^+e^- \to e^+e^-3\pi$
0.84±0.07±0.15		[15] FRAZER	83	JADE	0	$e^+e^- \to e^+e^-3\pi$
0.77±0.18±0.27	22	[16] EDWARDS	82F	CBAL	0	$e^+e^- \to e^+e^-\pi^0\eta$

[15] From $\rho\pi$ decay mode.
[16] From $\eta\pi^0$ decay mode.

$\Gamma(e^+e^-)$ — Γ_9

VALUE (eV)	CL%	DOCUMENT ID		TECN	COMMENT
<25	90	VOROBYEV	88	ND	$e^+e^- \to \pi^0\eta$

$a_2(1320)$ $\Gamma(i)\Gamma(\gamma\gamma)/\Gamma(\text{total})$

$\Gamma(K\overline{K}) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$ — $\Gamma_4\Gamma_7/\Gamma$

VALUE (keV)	DOCUMENT ID		TECN	COMMENT
0.126±0.007±0.028	[17] ALBRECHT	90G	ARG	$e^+e^- \to e^+e^-K^+K^-$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.081±0.006±0.027	[18] ALBRECHT	90G	ARG	$e^+e^- \to e^+e^-K^+K^-$

[17] Using an incoherent background.
[18] Using a coherent background.

$a_2(1320)$ BRANCHING RATIOS

$\Gamma(K\overline{K})/\Gamma(\rho\pi)$ — Γ_4/Γ_1

VALUE	EVTS	DOCUMENT ID		TECN	CHG	COMMENT
0.070±0.012 OUR FIT						
0.078±0.017		CHABAUD	78	RVUE		
• • • We do not use the following data for averages, fits, limits, etc. • • •						
0.056±0.014	50	[19] CHALOUPKA	73	HBC	−	3.9 π^-p
0.097±0.018	113	[19] ALSTON-...	71	HBC	+	7.0 π^+p
0.06 ±0.03		[19] ABRAMOVI...	70B	HBC	−	3.93 π^-p
0.054±0.022		[19] CHUNG	68	HBC	−	3.2 π^-p

[19] Included in CHABAUD 78 review.

$\Gamma(\eta\pi)/[\Gamma(\rho\pi)+\Gamma(\eta\pi)+\Gamma(K\overline{K})]$ — $\Gamma_2/(\Gamma_1+\Gamma_2+\Gamma_4)$

VALUE	EVTS	DOCUMENT ID		TECN	CHG	COMMENT
0.162±0.012 OUR FIT						
0.140±0.028 OUR AVERAGE						
0.13 ±0.04		ESPIGAT	72	HBC	±	0.0 $\overline{p}p$
0.15 ±0.04	34	BARNHAM	71	HBC	+	3.7 π^+p

$\Gamma(\eta\pi)/\Gamma(\rho\pi)$ — Γ_2/Γ_1

VALUE	EVTS	DOCUMENT ID		TECN	CHG	COMMENT
0.207±0.018 OUR FIT						
0.213±0.020 OUR AVERAGE						
0.18 ±0.05		FORINO	76	HBC		11 $\pi^- p$
0.22 ±0.05	52	ANTIPOV	73	CNTR	$-$	40 $\pi^- p$
0.211±0.044	149	CHALOUPKA	73	HBC	$-$	3.9 $\pi^- p$
0.246±0.042	167	ALSTON-...	71	HBC	$+$	7.0 $\pi^+ p$
0.25 ±0.09	15	BOECKMANN	70	HBC	$+$	5.0 $\pi^+ p$
0.23 ±0.08	22	ASCOLI	68	HBC	$-$	5 $\pi^- p$
0.12 ±0.08		CHUNG	68	HBC	$-$	3.2 $\pi^- p$
0.22 ±0.09		CONTE	67	HBC	$-$	11.0 $\pi^- p$

$\Gamma(\eta'(958)\pi)/\Gamma_{\text{total}}$ — Γ_5/Γ

VALUE	CL%	DOCUMENT ID		TECN	CHG	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •						
<0.006	95	ALDE	92B	GAM2		38,100 $\pi^- p \to \eta' \pi^0 n$
<0.02	97	BARNHAM	71	HBC	$+$	3.7 $\pi^+ p$
0.004±0.004		BOESEBECK	68	HBC	$+$	8 $\pi^+ p$

$\Gamma(\eta'(958)\pi)/\Gamma(\rho\pi)$ — Γ_5/Γ_1

VALUE	CL%	DOCUMENT ID		TECN	CHG	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •						
<0.011	90	EISENSTEIN	73	HBC	$-$	5 $\pi^- p$
<0.04		ALSTON-...	71	HBC	$+$	7.0 $\pi^+ p$
$0.04\ ^{+0.03}_{-0.04}$		BOECKMANN	70	HBC	0	5.0 $\pi^+ p$

$\Gamma(K\overline{K})/[\Gamma(\rho\pi)+\Gamma(\eta\pi)+\Gamma(K\overline{K})]$ — $\Gamma_4/(\Gamma_1+\Gamma_2+\Gamma_4)$

VALUE	EVTS	DOCUMENT ID		TECN	CHG	COMMENT
0.054±0.009 OUR FIT						
0.048±0.012 OUR AVERAGE						
0.05 ±0.02		TOET	73	HBC	$+$	5 $\pi^+ p$
0.09 ±0.04		TOET	73	HBC	0	5 $\pi^+ p$
0.03 ±0.02	8	DAMERI	72	HBC	$-$	11 $\pi^- p$
0.06 ±0.03	17	BARNHAM	71	HBC	$+$	3.7 $\pi^+ p$
• • • We do not use the following data for averages, fits, limits, etc. • • •						
0.020±0.004		[20] ESPIGAT	72	HBC	$\pm$	0.0 $\overline{p}p$

[20] Not averaged because of discrepancy between masses from $K\overline{K}$ and $\rho\pi$ modes.

$\Gamma(\pi^+\pi^-\pi^-)/\Gamma(\rho\pi)$ — Γ_8/Γ_1

VALUE	CL%	DOCUMENT ID		TECN	CHG	COMMENT
<0.12	90	ABRAMOVI...	70B	HBC	$-$	3.93 $\pi^- p$

$\Gamma(\pi^\pm\gamma)/\Gamma_{\text{total}}$ — Γ_6/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
$0.005^{+0.005}_{-0.003}$	[21] EISENBERG	72	HBC	4.3,5.25,7.5 γp

[21] Pion-exchange model used in this estimation.

$\Gamma(\omega\pi\pi)/\Gamma(\rho\pi)$ — Γ_3/Γ_1

VALUE	EVTS	DOCUMENT ID		TECN	CHG	COMMENT
0.15±0.05 OUR FIT Error includes scale factor of 1.3.						
0.15±0.05 OUR AVERAGE Error includes scale factor of 1.3. See the ideogram below.						
0.28±0.09	60	DIAZ	74	DBC	0	6 $\pi^+ n$
0.18±0.08		[22] KARSHON	74	HBC		Avg. of above two
0.10±0.05	279	CHALOUPKA	73	HBC	$-$	3.9 $\pi^- p$

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

0.29±0.08	140	[22] KARSHON	74	HBC	0	4.9 $\pi^+ p$
0.10±0.04	60	[22] KARSHON	74	HBC	+	4.9 $\pi^+ p$
0.19±0.08		DEFOIX	73	HBC	0	0.7 $\overline{p}p$

[22] KARSHON 74 suggest an additional $I = 0$ state strongly coupled to $\omega\pi\pi$ which could explain discrepancies in branching ratios and masses. We use a central value and a systematic spread.

$\Gamma\left(\omega\pi\pi\right)/\Gamma\left(\rho\pi\right)$

$\Gamma\left(\eta'(958)\pi\right)/\Gamma\left(\eta\pi\right)$ Γ_5/Γ_2

VALUE	DOCUMENT ID		TECN	COMMENT
0.040±0.007 OUR AVERAGE				
0.047±0.010±0.004	[23] BELADIDZE	93	VES	$37\pi^- N \rightarrow a_2^- N$
0.034±0.008±0.005	BELADIDZE	92	VES	$36\pi^- C \rightarrow a_2^- C$

[23] Using B($\eta' \rightarrow \pi^+\pi^-\eta$) = 0.441, B($\eta \rightarrow \gamma\gamma$) = 0.389 and B($\eta \rightarrow \pi^+\pi^-\pi^0$) = 0.236.

$a_2(1320)$ REFERENCES

AMSLER	94D	PL B333 277	+Anisovich+	(Crystal Barrel Collab.)
AOYAGI	93	PL B314 246	+Fukui, Hasegawa+	(BKEI Collab.)
ARMSTRONG	93C	PL B307 394	+Bettoni+	(FNAL, FERR, GENO, UCI, NWES+)
BELADIDZE	93	PL 313 276	+Berdnikov, Bityukov+	(VES Collab.)
CONDO	93	PR D48 3045	+Handler, Bugg+	(SLAC Hybrid Collab.)
ALDE	92B	ZPHY C54 549	+Binon+	(SERP, BELG, LANL, LAPP, PISA, KEK)
BELADIDZE	92	ZPHY C54 235	+Bityukov, Borisov+	(VES Collab.)
ALBRECHT	90G	ZPHY C48 183	+Ehrlichmann, Harder+	(ARGUS Collab.)
ARMSTRONG	90	ZPHY C48 213	+Benayoun, Beusch	(WA76 Collab.)
BARU	90	ZPHY C48 581	+Blinov, Blinov+	(MD-1 Collab.)
BEHREND	90C	ZPHY C46 583	+Criegee+	(CELLO Collab.)
BUTLER	90	PR D42 1368	+Boyer+	(Mark II Collab.)
OEST	90	ZPHY C47 343	+Olsson+	(JADE Collab.)
AUGUSTIN	89	NP B320 1	+Cosme	(DM2 Collab.)
VOROBYEV	88	SJNP 48 273	+Golubev, Dolinsky, Druzhinin+	(NOVO)
		Translated from YAF 48 436.		
ALTHOFF	86	ZPHY C31 537	+Boch, Foster, Bernardi+	(TASSO Collab.)
ANTREASYAN	86	PR D33 1847	+Aschman, Besset, Bienlein+	(Crystal Ball Collab.)
BERGER	84C	PL 149B 427	+Klovning, Burger+	(PLUTO Collab.)
BEHREND	83B	PL 125B 518	+D'Agostini+	(CELLO Collab.)
FRAZER	83	Aachen Conf.		(UCSD)
CIHANGIR	82	PL 117B 123	+Berg, Biel, Chandlee+	(FNAL, MINN, ROCH)
CLELAND	82B	NP B208 228	+Delfosse, Dorsaz, Gloor	(DURH, GEVA, LAUS, PITT)
EDWARDS	82F	PL 110B 82	+Partridge, Peck+	(CIT, HARV, PRIN, STAN, SLAC)
DELFOSSE	81	NP B183 349	+Guisan, Martin, Muhlemann, Weill+	(GEVA, LAUS)
EVANGELISTA	81	NP B178 197	+	(BARI, BONN, CERN, DARE, LIVP+)
CHABAUD	80	NP B175 189	+Hyams, Papadopoulou+	(CERN, MPIM, AMST)
DAUM	80C	PL 89B 276	+Hertzberger+	(AMST, CERN, CRAC, MPIM, OXF+) JP
BALTAY	78B	PR D17 62	+Cautis, Cohen, Csorna+	(COLU, BING)
CHABAUD	78	NP B145 349	+Hyams, Jones, Weilhammer, Blum+	(CERN, MPIM)
FERRERSORIA	78	PL 74B 287	+Treille+	(ORSAY, CERN, CDEF, EPOL)
HYAMS	78	NP B146 303	+Jones, Weilhammer, Blum+	(CERN, MPIM, ATEN)

MARTIN	78D	PL 74B 417	+Ozmutlu, Baldi, Bohringer, Dorsaz+	(DURH, GEVA) JP
MAY	77	PR D16 1983	+Abramson, Andrews, Busnello+	(ROCH, CORN)
FORINO	76	NC 35A 465	+Gessaroli+	(BGNA, FIRZ, GENO, MILA, OXF, PAVI)
MARGULIE	76	PR D14 667	+Kramer, Foley, Love, Lindenbaum+	(BNL, CUNY)
EMMS	75	PL 58B 117	+Jones, Kinson, Stacey, Bell+	(BIRM, DURH, RHEL) JP
WAGNER	75	PL 58B 201	+Tabak, Chew	(LBL) JP
DIAZ	74	PRL 32 260	+Dibianca, Fickinger, Anderson+	(CASE, CMU)
KARSHON	74	PRL 32 852	+Mikenberg, Pitluck, Eisenberg, Ronat+	(REHO)
ANTIPOV	73	NP B63 175	+Ascoli, Busnello, Focacci+	(CERN, SERP) JP
ANTIPOV	73C	NP B63 153	+Ascoli, Busnello, Focacci+	(CERN, SERP) JP
CHALOUPKA	73	PL 44B 211	+Dobrzynski, Ferrando, Losty+	(CERN)
CONFORTO	73	PL 45B 154	+Mobley, Key+	(EFI, FNAL, TNTO, WISC)
DEFOIX	73	PL 43B 141	+Dobrzynski, Espigat, Nascimento+	(CDEF)
EISENSTEIN	73	PR D7 278	+Schultz, Ascoli, Ioffredo+	(ILL)
KEY	73	PRL 30 503	+Conforto, Mobley+	(TNTO, EFI, FNAL, WISC)
TOET	73	NP B63 248	+Thuan, Major+	(NIJM, BONN, DURH, TORI)
DAMERI	72	NC 9A 1	+Borzatta, Goussu+	(GENO, MILA, SACL)
EISENBERG	72	PR D5 15	+Ballam, Dagan+	(REHO, SLAC, TELA)
ESPIGAT	72	NP B36 93	+Ghesquiere, Lillestol, Montanet	(CERN, CDEF)
FOLEY	72	PR D6 747	+Love, Ozaki, Platner, Lindenbaum+	(BNL, CUNY)
ALSTON-...	71	PL 34B 156	Alston-Garnjost, Barbaro, Buhl, Derenzo+	(LRL)
BARNHAM	71	PRL 26 1494	+Abrams, Butler, Coyne, Goldhaber, Hall+	(LBL)
BINNIE	71	PL 36B 257	+Camilleri, Duane, Faruqi, Burton+	(LOIC, SHMP)
BOWEN	71	PRL 26 1663	+Earles, Faissler, Blieden+	(NEAS, STON)
GRAYER	71	PL 34B 333	+Hyams, Jones, Schlein, Blum+	(CERN, MPIM)
ABRAMOVI...	70B	NP B23 466	Abramovich, Blumenfeld, Bruyant+	(CERN) JP
ALSTON-...	70	PL 33B 607	Alston-Garnjost, Barbaro, Buhl, Derenzo+	(LRL)
BOECKMANN	70	NP B16 221	+Major+	(BONN, DURH, NIJM, EPOL, TORI)
ASCOLI	68	PRL 20 1321	+Crawley, Mortara, Shapiro, Bridges+	(ILL) JP
BOESEBECK	68	NP B4 501	+Deutschmann+	(AACH, BERL, CERN)
CHUNG	68	PR 165 1491	+Dahl, Kirz, Miller	(LRL)
CONTE	67	NC 51A 175	+Tomasini, Cords+	(GENO, HAMB, MILA, SACL)

OTHER RELATED PAPERS

JENNI	83	PR D27 1031	+Burke, Telnov, Abrams, Blocker+	(SLAC, LBL)
BEHREND	82C	PL 114B 378	+Chen, Fenner, Field+	(CELLO Collab.)
ABOLINS	65	Athens Conf.	+Carmony, Lander, Xuong, Yager	(UCSD) I
ADERHOLZ	65	PR 138B 897		(AACH3, BERL, BIRM, BONN, HAMB, LOIC, MPIM)
ALITTI	65	PL 15 69	+Baton, Deler, Crussard+	(SACL, BGNA) JP
CHUNG	65	PRL 15 325	+Dahl, Hardy, Hess, Jacobs, Kirz	(LRL)
FORINO	65B	PL 19 68	+Gessaroli+	(BGNA, BARI, FIRZ, ORSAY, SACL)
LEFEBVRES	65	PL 19 434	+Levrat+	(CERN Missing Mass Spect. Collab.)
SEIDLITZ	65	PRL 15 217	+Dahl, Miller	(LRL)
ADERHOLZ	64	PL 10 226	+	(AACH3, BERL, BIRM, BONN, DESY, HAMB+)
CHUNG	64	PRL 12 621	+Dahl, Hardy, Hess, Kalbfleisch, Kirz	(LRL)
GOLDHABER	64B	Dubna Conf. 1 480	+Goldhaber, O'Halloran, Shen	(LRL)
Also	64	PRL 12 336	Goldhaber, Brown, Kadyk, Shen+	(LRL, UCB)
LANDER	64	PRL 13 346A	+Abolins, Carmony, Hendricks, Xuong+	(UCSD)

$f_0(1370)$

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

OMITTED FROM SUMMARY TABLE

We list here all claims compatible with high $\pi\pi$ S-wave inelasticity. See also minireviews under $f_0(1300)$ and non-$q\overline{q}$ candidates.

$f_0(1370)$ MASS

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
1365^{+20}_{-55}	[1] ANISOVICH	94	CBAR	$0.0\ \overline{p}p \rightarrow 3\pi^0, \pi^0\eta\eta$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
1374 ± 38	AMSLER	94	CBAR	$0.0\ \overline{p}p \rightarrow \pi^+\pi^-3\pi^0$
1335 ± 40	[2] BUGG	94	RVUE	$\overline{p}p \rightarrow 3\pi^0, \eta\eta\pi^0, \eta\pi^0\pi^0$
1345 ± 12	ADAMO	93	OBLX	$\overline{n}p \rightarrow 3\pi^+2\pi^-$
1430 ± 25	AMSLER	93C	CBAR	$0.0\ \overline{p}p \rightarrow \pi^0\eta\eta$
1386 ± 30	GASPERO	93	DBC	$0.0\ \overline{p}n \rightarrow 2\pi^+3\pi^-$
1440 ± 20	CHEN	91	MRK3	$J/\psi \rightarrow \gamma\pi^+\pi^-, \gamma K\overline{K}$
1440 ± 50	BOLONKIN	88	SPEC	$40\ \pi^-p \rightarrow K^0_S K^0_S n$
$1463\pm\ 9$	ETKIN	82B	MPS	$23\ \pi^-p \rightarrow n2K^0_S$

[1] From a simultaneous analysis of the annihilations $\overline{p}p \rightarrow 3\pi^0, \pi^0\eta\eta$. Supersedes AMSLER 93C.

[2] Reanalysis of ANISOVICH 94 data.

$f_0(1370)$ WIDTH

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
268± 70	[3] ANISOVICH	94	CBAR	0.0 $\overline{p}p \rightarrow 3\pi^0, \pi^0\eta\eta$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
375± 61	AMSLER	94	CBAR	0.0 $\overline{p}p \rightarrow \pi^+\pi^-3\pi^0$
255^{+60}_{-40}	[4] BUGG	94	RVUE	$\overline{p}p \rightarrow 3\pi^0$, $\eta\eta\pi^0$, $\eta\pi^0\pi^0$
398± 26	ADAMO	93	OBLX	$\overline{n}p \rightarrow 3\pi^+2\pi^-$
250± 50	AMSLER	93C	CBAR	0.0 $\overline{p}p \rightarrow \pi^0\eta\eta$
310± 50	GASPERO	93	DBC	0.0 $\overline{p}n \rightarrow 2\pi^+3\pi^-$
160± 40	CHEN	91	MRK3	$J/\psi \rightarrow \gamma\pi^+\pi^-$, $\gamma K\overline{K}$
250± 80	BOLONKIN	88	SPEC	40 $\pi^-p \rightarrow K^0_S K^0_S n$
118^{+138}_{-16}	ETKIN	82B	MPS	23 $\pi^-p \rightarrow n2K^0_S$

[3] From a simultaneous analysis of the annihilations $\overline{p}p \rightarrow 3\pi^0, \pi^0\eta\eta$. Supersedes AMSLER 93C.
[4] Reanalysis of ANISOVICH 94 data.

$f_0(1370)$ DECAY MODES

	Mode	Fraction (Γ_i/Γ)	Confidence level
Γ_1	$\pi\pi$	<12 %	
Γ_2	4π	>72 %	95%
Γ_3	$4\pi^0$		
Γ_4	$2\pi^+2\pi^-$		
Γ_5	$\pi^+\pi^-2\pi^0$		
Γ_6	6π		
Γ_7	$\eta\eta$	seen	
Γ_8	$\eta\eta'$		
Γ_9	2ω		
Γ_{10}	$K\overline{K}X$		

$f_0(1370)$ BRANCHING RATIOS

$\Gamma(\pi\pi)/\Gamma_{total}$ — Γ_1/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
<0.12	[5] GASPERO	93	RVUE	0.0 $\overline{p}n \rightarrow$ hadrons

[5] Based on GASPERO 93 and private communications from M. Gaspero.

$\Gamma(4\pi)/\Gamma_{total}$ — $\Gamma_2/\Gamma = (\Gamma_3+\Gamma_4+\Gamma_5)/\Gamma$

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
>0.72	95	[6] GASPERO	93	RVUE	0.0 $\overline{p}n \rightarrow$ hadrons

[6] Based on model-dependent evaluation by GASPERO 93 and private communications from M. Gaspero.

$\Gamma(2\pi^+2\pi^-)/\Gamma(4\pi)$ — $\Gamma_4/\Gamma_2 = \Gamma_4/(\Gamma_3+\Gamma_4+\Gamma_5)$

VALUE	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.420±0.014	[7] GASPERO	93	RVUE	0.0 $\overline{p}n \rightarrow 2\pi^+3\pi^-$

[7] Based on model-dependent evaluation by GASPERO 93.

$\Gamma(\pi^+\pi^-2\pi^0)/\Gamma(4\pi)$ — $\Gamma_5/\Gamma_2 = \Gamma_5/(\Gamma_3+\Gamma_4+\Gamma_5)$

VALUE	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.512±0.019	[8] GASPERO	93	RVUE	0.0 $\overline{p}n \rightarrow$ hadrons

[8] Based on model-dependent evaluation by GASPERO 93.

$\Gamma(\eta\eta)/\Gamma_{total}$ — Γ_7/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
seen	AMSLER	92	CBAR	0.0 $\overline{p}p \rightarrow \eta\eta\pi^0$

$f_0(1370)$ REFERENCES

AMSLER	94	PL B322 431	+Armstrong+	(Crystal Barrel Collab.) JPC
ANISOVICH	94	PL B323 233	+Armstrong+	(Crystal Barrel Collab.) JPC
BUGG	94	PR D50 4412	+Anisovich+	(LOQM)
ADAMO	93	NP A558 13C	+Agnello+	(OBELIX Collab.) JPC
AMSLER	93C	NP A558 3C	+Augustin+	(Crystal Barrel Collab.) JPC
GASPERO	93	NP A562 407		(ROMAI) JPC
AMSLER	92	PL B291 347	+Augustin, Baker+	(Crystal Barrel Collab.)
CHEN	91	Hadron 91 Conf.		(Mark III Collab.)
SLAC-PUB-5669				
BOLONKIN	88	NP B309 426	+Bloshenko, Gorin+	(ITEP, SERP)
ETKIN	82B	PR D25 1786	+Foley, Lai+	(BNL, CUNY, TUFTS, VAND)

OTHER RELATED PAPERS

BRIDGES	86	PRL 56 211	+Brown+	(BLSU, BNL, CASE, COLU, UMD, SYRA)
BRIDGES	86B	PRL 56 215	+Daftari, Kalogeropoulos, Debbe+	(SYRA, CASE)
BRIDGES	86C	PRL 57 1534	+Daftari, Kalogeropoulos+	(SYRA)
BETTINI	66	NC 42A 695	+Cresti, Limentani, Bertanza, Bigi+	(PADO, PISA)

$h_1(1380)$

$I^G(J^{PC}) = ?^-(1^{+?})$

OMITTED FROM SUMMARY TABLE

Seen in partial-wave analysis of the $K^0_S K^{\pm}\pi^{\mp}$ system. Evidence for $K^*\overline{K} + \overline{K}^* K$ decays (ASTON 88C). Needs confirmation.

$h_1(1380)$ MASS

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
1380±20	ASTON	88C	LASS	11 $K^- p \to K^0_S K^{\pm}\pi^{\mp}\Lambda$

$h_1(1380)$ WIDTH

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
80±30	ASTON	88C	LASS	11 $K^- p \to K^0_S K^{\pm}\pi^{\mp}\Lambda$

$h_1(1380)$ DECAY MODES

	Mode
Γ_1	$K\overline{K}^*(892) + c.c.$

$h_1(1380)$ REFERENCES

ASTON	88C	PL B201 573	+Awaji, Bienz+	(SLAC, NAGO, CINC, INUS)

$\hat{\rho}(1405)$

$I^G(J^{PC}) = 1^-(1^{-+})$

OMITTED FROM SUMMARY TABLE

Seen by ALDE 88B in $\pi^- p \to \eta \pi^0 n$ amplitude analysis. Needs confirmation.

See also the mini-review under non-$q\overline{q}$ candidates. (See the index for the page number.)

$\hat{\rho}(1405)$ MASS

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*CHG*	*COMMENT*
1406 ±20	[1] ALDE	88B	GAM4	0	100 $\pi^- p \to \eta \pi^0 n$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
1323.1± 4.6	AOYAGI	93	BKEI		$\pi^- p \to \eta \pi^- p$

[1] Seen in the P_0-wave intensity of the $\eta \pi^0$ system.

$\hat{\rho}(1405)$ WIDTH

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*CHG*	*COMMENT*
180 ±20	[2] ALDE	88B	GAM4	0	100 $\pi^- p \to \eta \pi^0 n$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
143.2±12.5	AOYAGI	93	BKEI		$\pi^- p \to \eta \pi^- p$

[2] Seen in the P_0-wave intensity of the $\eta \pi^0$ system.

$\hat{\rho}(1405)$ DECAY MODES

	Mode	Fraction (Γ_i/Γ)
Γ_1	$\eta \pi^0$	seen
Γ_2	$\eta \pi^-$	
Γ_3	$\rho \pi$	not seen
Γ_4	$\eta' \pi$	

$\hat{\rho}(1405)$ BRANCHING RATIOS

$\Gamma(\eta \pi^0)/\Gamma_{total}$ — Γ_1/Γ

VALUE	*DOCUMENT ID*		*TECN*	*CHG*	*COMMENT*
seen	[3] ALDE	88B	GAM4	0	100 $\pi^- p \to \eta \pi^0 n$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
not seen	[4] BUGG	94	RVUE		$\overline{p} p \to \eta 2\pi^0$
not seen	[5] APEL	81	NICE	0	40 $\pi^- p \to \eta \pi^0 n$

[3] Seen in the P_0-wave intensity of the $\eta \pi^0$ system.
[4] Using Crystal Barrel data.
[5] A general fit allowing S, D, and P waves (including m=0) is not done because of limited statistics.

$\Gamma(\eta \pi^-)/\Gamma_{total}$ — Γ_2/Γ

VALUE	*DOCUMENT ID*		*TECN*	*COMMENT*
• • • We do not use the following data for averages, fits, limits, etc. • • •				
possibly seen	AOYAGI	93	BKEI	$\pi^- p \to \eta \pi^- p$

$\Gamma(\rho \pi)/\Gamma_{total}$ — Γ_3/Γ

VALUE	*DOCUMENT ID*		*COMMENT*
not seen	[6] ZIELINSKI	86	200 π^+ Cu,Pb $\to \pi^+ \pi^+ \pi^-$ X

[6] A general fit allowing S, D, and P waves (including m=0) is not done because of limited statistics.

$\Gamma(\eta'\pi)/\Gamma(\eta\pi^0)$ Γ_4/Γ_1

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
<0.80	95	BOUTEMEUR 90	GAM4	100 $\pi^- p \rightarrow 4\gamma n$

$\hat{\rho}(1405)$ REFERENCES

BUGG	94	PR D50 4412	+Anisovich+	(LOQM)
AOYAGI	93	PL B314 246	+Fukui, Hasegawa+	(BKEI Collab.)
BOUTEMEUR	90	Hadron 89 Conf. p 119	+Poulet	(SERP, BELG, LANL, LAPP, PISA, KEK)
ALDE	88B	PL B205 397	+Binon, Boutemeur+	(SERP, BELG, LANL, LAPP) IGJPC
ZIELINSKI	86	Berkeley HEP 1 736	+Berg+	(ROCH, MINN, FNAL)
APEL	81	NP B193 269	+Augenstein, Bertolucci, Donskov+	(SERP, CERN)

OTHER RELATED PAPERS

KALASHNIK...	94	ZPHY C62 323	Kalashnikova	(ITEP)
IDDIR	88	PL B205 564	+Le Yaouanc, Ono+	(ORSAY, TOKY)
TUAN	88	PL B213 537	+Ferbel, Dalitz	(HAWA, ROCH, OXFTP)
ZIELINSKI	87	ZPHY C34 255		(ROCH)
ZIELINSKI	86	Berkeley HEP 1 736	+Berg+	(ROCH, MINN, FNAL)

$f_1(1420)$

$I^G(J^{PC}) = 0^+(1^{++})$

See also minireview under non-$q\overline{q}$ candidates.

MINIREVIEW GOES HERE

$f_1(1420)$ MASS

PRODUCED IN $p\overline{p}$ ANNIHILATION

VALUE (MeV)	EVTS	DOCUMENT ID	TECN	COMMENT
1414.9± 3.5 OUR AVERAGE		Error includes scale factor of 1.2.		
1417.5± 4		NACASCH 78	HBC	0.7,0.76 $\overline{p}p$
1398 ±10	170	DEFOIX 72	HBC	0.7 $\overline{p}p \rightarrow 7\pi$
1406 ± 7	280	DUBOC 72	HBC	1.2 $\overline{p}p \rightarrow 2K4\pi$
1420 ± 7	310	LORSTAD 69	HBC	0.7 $\overline{p}p$
1423.0±10.0		FRENCH 67	HBC	3–4 $\overline{p}p$

PRODUCED IN OTHER REACTIONS

VALUE (MeV)	EVTS	DOCUMENT ID	TECN	COMMENT
1426.8± 2.3 OUR AVERAGE		Error includes scale factor of 1.3. See the ideogram below.		
1430 ± 4		[1] ARMSTRONG 92E	OMEG	85,300 $\pi^+ p$, $pp \rightarrow \pi^+ p$, $pp(K\overline{K}\pi)$
1462 ±20		[2] AUGUSTIN 92	DM2	$J/\psi \rightarrow \gamma K\overline{K}\pi$
1443 $^{+7}_{-6}$ $^{+3}_{-2}$	1100	BAI 90C	MRK3	$J/\psi \rightarrow \gamma K^0_S K^\pm \pi^\mp$
1425 ±10	17	BEHREND 89	CELL	$\gamma\gamma \rightarrow K^0_S K^\pm \pi^\mp$
1442 ± $5.0^{+10.0}_{-17.0}$	111^{+31}_{-26}	BECKER 87	MRK3	e^+e^-, $\omega K\overline{K}\pi$
1423 ± 4		GIDAL 87B	MRK2	$e^+e^- \rightarrow e^+e^- K\overline{K}\pi$
1417.0±13.0	13	AIHARA 86C	TPC	$e^+e^- \rightarrow e^+e^- K\overline{K}\pi$
1422.0± 3.0		CHAUVAT 84	SPEC	ISR 31.5 pp
1440.0±10.0		[3] BROMBERG 80	SPEC	100 $\pi^- p \rightarrow K\overline{K}\pi X$
1426.0± 6.0	221	DIONISI 80	HBC	4 $\pi^- p \rightarrow K\overline{K}\pi n$
1420 ±20		DAHL 67	HBC	1.6–4.2 $\pi^- p$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
1429 ± 3	389±27	ARMSTRONG 89	OMEG	300 $pp \rightarrow K\overline{K}\pi pp$
1425.0± 2.0	1520	ARMSTRONG 84	OMEG	85 $\pi^+ p$, $pp \rightarrow (\pi^+, p)(K\overline{K}\pi)p$

[1] This result supersedes ARMSTRONG 84, ARMSTRONG 89.

[2] From fit to the $K^*(892)K$ 1^{++} partial wave.

[3] Mass error increased to account for $a_0(980)$ mass cut uncertainties.

$f_1(1420)$ mass (MeV)

$f_1(1420)$ WIDTH

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	COMMENT
52 ± 4 OUR AVERAGE					
58 ±10		[4] ARMSTRONG	92E	OMEG	85,300 $\pi^+ p$, $pp \to \pi^+ p$, $pp(K\overline{K}\pi)$
129 ±41		[5] AUGUSTIN	92	DM2	$J/\psi \to \gamma K\overline{K}\pi$
68 $^{+29}_{-18}$ $^{+8}_{-9}$	1100	BAI	90C	MRK3	$J/\psi \to \gamma K^0_S K^\pm \pi^\mp$
42 ±22	17	BEHREND	89	CELL	$\gamma\gamma \to K^0_S K^\pm \pi^\mp$
40 $^{+17}_{-13}$ ±5	111^{+31}_{-26}	BECKER	87	MRK3	$e^+ e^- \to \omega K\overline{K}\pi$
$35.0^{+47.0}_{-20.0}$	13	AIHARA	86C	TPC	$e^+ e^- \to e^+ e^- K\overline{K}\pi$
47.0±10.0		CHAUVAT	84	SPEC	ISR 31.5 pp
62.0±14.0		BROMBERG	80	SPEC	100 $\pi^- p \to K\overline{K}\pi X$
40.0±15.0	221	DIONISI	80	HBC	4 $\pi^- p \to K\overline{K}\pi n$
53 ±20.0		NACASCH	78	HBC	0.7,0.76 $\overline{p}p$
50 ±10	170	DEFOIX	72	HBC	0.7 $\overline{p}p \to 7\pi$
50 ±12	280	DUBOC	72	HBC	1.2 $\overline{p}p \to 2K4\pi$
60 ±20	310	LORSTAD	69	HBC	0.7 $\overline{p}p$
60.0±20.0		DAHL	67	HBC	1.6–4.2 $\pi^- p$
45 ±20		FRENCH	67	HBC	3–4 $\overline{p}p$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
58 ± 8	389± 27	ARMSTRONG	89	OMEG	300 $pp \to K\overline{K}\pi pp$
62.0± 5.0	1520	ARMSTRONG	84	OMEG	85 $\pi^+ p$, $pp \to (\pi^+, p)(K\overline{K}\pi)p$

[4] This result supersedes ARMSTRONG 84, ARMSTRONG 89.
[5] From fit to the $K^*(892)K$ 1^{++} partial wave.

$f_1(1420)$ DECAY MODES

	Mode	Fraction (Γ_i/Γ)
Γ_1	$K\overline{K}\pi$	dominant
Γ_2	$\eta\pi\pi$	possibly seen
Γ_3	$a_0(980)\pi$	
Γ_4	$\pi\pi\rho$	

Γ_5	$K\overline{K}^*(892)+$ c.c.
Γ_6	4π
Γ_7	$\gamma\gamma^*$
Γ_8	$\rho^0\gamma$

$f_1(1420)$ $\Gamma(i)\Gamma(\gamma\gamma)/\Gamma(\text{total})$

$\Gamma(K\overline{K}\pi) \times \Gamma(\gamma\gamma^*)/\Gamma_{\text{total}}$ — $\Gamma_1\Gamma_7/\Gamma$

VALUE (keV)	CL%	DOCUMENT ID		TECN	COMMENT
1.7±0.4 OUR AVERAGE					
3.0±0.9±0.7		[6,7] BEHREND	89	CELL	$e^+e^- \rightarrow e^+e^- K^0_S K\pi$
$2.3^{+1.0}_{-0.9}$±0.8		HILL	89	JADE	$e^+e^- \rightarrow e^+e^- K^\pm K^0_S \pi^\mp$
1.3±0.5±0.3		AIHARA	88B	TPC	$e^+e^- \rightarrow e^+e^- K^\pm K^0_S \pi^\mp$
1.6±0.7±0.3		[6,8] GIDAL	87B	MRK2	$e^+e^- \rightarrow e^+e^- K\overline{K}\pi$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<8.0	95	JENNI	83	MRK2	$e^+e^- \rightarrow e^+e^- K\overline{K}\pi$

[6] Assume a ρ-pole form factor.
[7] A ϕ - pole form factor gives considerably smaller widths.
[8] Published value divided by 2.

$f_1(1420)$ BRANCHING RATIOS

$\Gamma(K\overline{K}^*(892)+\text{c.c.})/\Gamma(K\overline{K}\pi)$ — Γ_5/Γ_1

VALUE	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.76±0.06	BROMBERG	80	SPEC	100 $\pi^- p \rightarrow K\overline{K}\pi X$
0.86±0.12	DIONISI	80	HBC	4 $\pi^- p \rightarrow K\overline{K}\pi n$

$\Gamma(\pi\pi\rho)/\Gamma(K\overline{K}\pi)$ — Γ_4/Γ_1

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<0.3	95	CORDEN	78	OMEG	12–15 $\pi^- p$
<2.0		DAHL	67	HBC	1.6–4.2 $\pi^- p$

$\Gamma(\eta\pi\pi)/\Gamma(K\overline{K}\pi)$ — Γ_2/Γ_1

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.1	95	ARMSTRONG	91B	OMEG	300 $pp \rightarrow pp\eta\pi^+\pi^-$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
1.35±0.75		KOPKE	89	MRK3	$J/\psi \rightarrow \omega\eta\pi\pi(K\overline{K}\pi)$
<0.6	90	GIDAL	87	MRK2	$e^+e^- \rightarrow e^+e^- \eta\pi^+\pi^-$
<0.5	95	CORDEN	78	OMEG	12–15 $\pi^- p$
1.5 ±0.8		DEFOIX	72	HBC	0.7 $\overline{p}p$

$\Gamma(a_0(980)\pi)/\Gamma(\eta\pi\pi)$ — Γ_3/Γ_2

VALUE	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
not seen in either mode	ANDO	86	SPEC	8 $\pi^- p$
not seen in either mode	CORDEN	78	OMEG	12–15 $\pi^- p$
0.4±0.2	DEFOIX	72	HBC	0.7 $\overline{p}p \rightarrow 7\pi$

$\Gamma(4\pi)/\Gamma(K\overline{K}^*(892)+\text{c.c.})$ — Γ_6/Γ_5

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<0.90	95	DIONISI	80	HBC	4 $\pi^- p$

$\Gamma(K\overline{K}\pi)/[\Gamma(a_0(980)\pi)+\Gamma(K\overline{K}^*(892)+\text{c.c.})]$ — $\Gamma_1/(\Gamma_3+\Gamma_5)$

VALUE	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.65±0.27	[9] DIONISI	80	HBC	4 $\pi^- p$

[9] Calculated using $\Gamma(K\overline{K})/\Gamma(\eta\pi) = 0.24 \pm 0.07$ for $a_0(980)$ fractions.

$\Gamma(a_0(980)\pi)/\Gamma(K\overline{K}^*(892)+\text{c.c.})$ — Γ_3/Γ_5

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
<0.04	68	ARMSTRONG 84	OMEG	85 $\pi^+ p$

$\Gamma(4\pi)/\Gamma(K\overline{K}\pi)$ — Γ_6/Γ_1

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<0.62	95	ARMSTRONG 89G	OMEG	85 $\pi p \rightarrow 4\pi X$

$\Gamma(\rho^0\gamma)/\Gamma_{total}$ — Γ_8/Γ

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<0.08	95	[10] ARMSTRONG 92C	SPEC	300 $pp \rightarrow pp\pi^+\pi^-\gamma$

[10] Using the data on the $\overline{K}K\pi$ mode from ARMSTRONG 89.

$f_1(1420)$ REFERENCES

ARMSTRONG 92C ZPHY C54 371 +Barnes, Benayoun+ (ATHU, BARI, BIRM, CERN, CDEF)
ARMSTRONG 92E ZPHY 56 29 +Benayoun+ (ATHU, BARI, BIRM, CERN, CDEF) JPC
AUGUSTIN 92 PR D46 1951 +Cosme (DM2 Collab.)
ARMSTRONG 91B ZPHY C52 389 +Barnes+ (ATHU, BARI, BIRM, CERN, CDEF)
BAI 90C PRL 65 2507 +Blaylock+ (Mark III Collab.)
ARMSTRONG 89 PL B221 216 +Benayoun+ (CERN, CDEF, BIRM, BARI, ATHU, CURIN+) JPC
ARMSTRONG 89G ZPHY C43 55 +Bloodworth+ (CERN, BIRM, BARI, ATHU, CURIN+)
BEHREND 89 ZPHY C42 367 +Criegee+ (CELLO Collab.)
HILL 89 ZPHY C42 355 +Olsson+ (JADE Collab.) JP
KOPKE 89 PRPL 174 67 +Wermes+ (CERN)
AIHARA 88B PL B209 107 +Alston-Garnjost+ (TPC-2γ Collab.)
BECKER 87 PRL 59 186 +Blaylock, Bolton, Brown+ (Mark III Collab.) JP
GIDAL 87 PRL 59 2012 +Boyer, Butler, Cords, Abrams+ (LBL, SLAC, HARV)
GIDAL 87B PRL 59 2016 +Boyer, Butler, Cords, Abrams+ (LBL, SLAC, HARV)
AIHARA 86C PRL 57 2500 +Alston-Garnjost+ (TPC-2γ Collab.) JP
ANDO 86 PRL 57 1296 +Imai+ (KEK, KYOT, NIRS, SAGA, INUS, TSUK+)
ARMSTRONG 84 PL 146B 273 +Bloodworth, Burns+ (ATHU, BARI, BIRM, CERN) JP
CHAUVAT 84 PL 148B 382 +Meritet, Bonino+ (CERN, CLER, UCLA, SACL)
JENNI 83 PR D27 1031 +Burke, Telnov, Abrams, Blocker+ (SLAC, LBL)
BROMBERG 80 PR D22 1513 +Haggerty, Abrams, Dzierba (CIT, FNAL, ILLC, IND)
DIONISI 80 NP B169 1 +Gavillet+ (CERN, MADR, CDEF, STOH) IJP
CORDEN 78 NP B144 253 +Corbett, Alexander+ (BIRM, RHEL, TELA, LOWC)
NACASCH 78 NP B135 203 +Defoix, Dobrzynski+ (PARIS, MADR, CERN)
DEFOIX 72 NP B44 125 +Nascimento, Bizzarri+ (CDEF, CERN)
DUBOC 72 NP B46 429 +Goldberg, Makowski, Donald+ (PARIS, LIVP)
LORSTAD 69 NP B14 63 +D'Andlau, Astier+ (CDEF, CERN) JP
DAHL 67 PR 163 1377 +Hardy, Hess, Kirz, Miller (LRL) IJP
Also 65 PRL 14 1074 Miller, Chung, Dahl, Hess, Hardy, Kirz+ (LRL, UCB)
FRENCH 67 NC 52A 438 +Kinson, McDonald, Riddiford+ (CERN, BIRM)

OTHER RELATED PAPERS

CALDWELL 90 Hadron 89 Conf. p 127 (UCSB)
ISHIDA 89 PTP 82 119 +Oda, Sawazaki, Yamada (NIHO)
AIHARA 88C PR D38 1 +Alston-Garnjost+ (TPC-2γ Collab.) JPC
BITYUKOV 88 PL B203 327 +Borisov, Dorofeev+ (SERP)
PROTOPOP... 87B Hadron 87 Conf. Protopopescu, Chung (BNL)

$\omega(1420)$

$I^G(J^{PC}) = 0^-(1^{--})$

See also $\omega(1600)$.

$\omega(1420)$ MASS

VALUE (MeV)	EVTS	DOCUMENT ID	TECN	COMMENT
1419±31	315	[1] ANTONELLI 92	DM2	1.34–2.4 $e^+e^- \rightarrow \rho\pi$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
1440±70		[2] DONNACHIE 91	RVUE	

[1] From a fit to two Breit-Wigner functions interfering between them and with the ω,ϕ tails with fixed (+,−,+) phases.

[2] Using data published later by ANTONELLI 92.

$\omega(1420)$ WIDTH

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	COMMENT
174±59	315	[3] ANTONELLI	92	DM2	1.34–2.4 $e^+e^- \rightarrow \rho\pi$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
240±70		[4] DONNACHIE	91	RVUE	

[3] From a fit to two Breit-Wigner functions interfering between them and with the ω,ϕ tails with fixed (+,−,+) phases.

[4] Using data published later by ANTONELLI 92.

$\omega(1420)$ DECAY MODES

	Mode	Fraction (Γ_i/Γ)
Γ_1	$\rho\pi$	dominant
Γ_2	$\omega\pi\pi$	
Γ_3	e^+e^-	

$\omega(1420)$ $\Gamma(i)\Gamma(e^+e^-)/\Gamma(\text{total})$

$\Gamma(\rho\pi) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$ — $\Gamma_1\Gamma_3/\Gamma$

VALUE (eV)	EVTS	DOCUMENT ID		TECN	COMMENT
81±31	315	[5] ANTONELLI	92	DM2	1.34–2.4 $e^+e^- \rightarrow \rho\pi$

[5] From a fit to two Breit-Wigner functions interfering between them and with the ω,ϕ tails with fixed (+,−,+) phases.

$\omega(1420)$ REFERENCES

ANTONELLI 92 ZPHY C56 15 +Baldini+ (DM2 Collab.)
DONNACHIE 91 ZPHY C51 689 +Clegg (MCHS, LANC)

OTHER RELATED PAPERS

ATKINSON 87 ZPHY C34 157 + (BONN, CERN, GLAS, LANC, MCHS, CURIN)
ATKINSON 84 NP B231 15 + (BONN, CERN, GLAS, LANC, MCHS, CURIN+)
ATKINSON 83B PL 127B 132 + (BONN, CERN, GLAS, LANC, MCHS, CURIN+)

$f_2(1430)$

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

OMITTED FROM SUMMARY TABLE

This entry lists nearby peaks observed in the D wave of the $K\overline{K}$ and $\pi^+\pi^-$ systems.

$f_2(1430)$ MASS

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
≈ 1430 OUR ESTIMATE				
• • • We do not use the following data for averages, fits, limits, etc. • • •				
1421 ± 5	AUGUSTIN	87	DM2	$J/\psi \rightarrow \gamma\pi^+\pi^-$
1480.0±50.0	AKESSON	86	SPEC	$pp \rightarrow pp\pi^+\pi^-$
$1436.0^{+26.0}_{-16.0}$	DAUM	84	CNTR	17–18 $\pi^- p \rightarrow K^+K^- n$
1412.0± 3.0	DAUM	84	CNTR	63 $\pi^- p \rightarrow K^0_S K^0_S n$, $K^+K^- n$
$1439.0^{+5.0}_{-6.0}$	[1] BEUSCH	67	OSPK	5,7,12 $\pi^- p \rightarrow K^0_S K^0_S n$

[1] Not seen by WETZEL 76.

f_2(1430) WIDTH

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
30 ± 9	AUGUSTIN	87	DM2	$J/\psi \to \gamma\pi^+\pi^-$
150.0±40.0	AKESSON	86	SPEC	$pp \to pp\pi^+\pi^-$
$81.0^{+56.0}_{-29.0}$	DAUM	84	CNTR	17–18 $\pi^- p \to K^+K^- n$
14.0± 6.0	DAUM	84	CNTR	63 $\pi^- p \to K^0_S K^0_S n$, $K^+K^- n$
$43.0^{+17.0}_{-18.0}$	[2] BEUSCH	67	OSPK	5,7,12 $\pi^- p \to K^0_S K^0_S n$

[2] Not seen by WETZEL 76.

f_2(1430) DECAY MODES

	Mode
Γ_1	$K\overline{K}$
Γ_2	$\pi\pi$

f_2(1430) REFERENCES

AUGUSTIN	87	ZPHY C36 369	+Cosme+	(LALO, CLER, FRAS, PADO)
AKESSON	86	NP B264 154	+Albrow, Almehed+	(Axial Field Spec. Collab.)
DAUM	84	ZPHY C23 339	+Hertzberger+	(AMST, CERN, CRAC, MPIM, OXF+) JP
WETZEL	76	NP B115 208	+Freudenreich, Beusch+	(ETH, CERN, LOIC)
BEUSCH	67	PL 25B 357	+Fischer, Gobbi, Astbury+	(ETH, CERN)

η(1440)
was ι(1440)

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

See also the mini-review under non-$q\overline{q}$ candidates. (See the index for the page number.)

MINIREVIEW GOES HERE

η(1440) MASS

VALUE (MeV)	DOCUMENT ID
1420±20 OUR ESTIMATE	This is only an educated guess; the error given is larger than the error on the average of the published values.

$\eta\pi\pi$ MODE

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	COMMENT
1399± 4 OUR AVERAGE					
1400± 6		[1] BURCHELL	91	MRK3	$J/\psi \to \gamma\eta\pi^+\pi^-$
1398± 6	261± 24	[2] AUGUSTIN	90	DM2	$J/\psi \to \gamma\eta\pi^+\pi^-$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
1385±15		[1] BEHREND	92	CELL	$J/\psi \to \gamma\eta\pi^+\pi^-$
1388± 4		FUKUI	91C	SPEC	8.95 $\pi^- p \to \eta\pi^+\pi^- n$
1420± 5		ANDO	86	SPEC	8 $\pi^- p \to n\eta\pi^+\pi^-$

[1] From fit to the $a_0(980)\pi$ 0^{-+} partial wave.
[2] Best fit with a single Breit Wigner.

$\pi\pi\gamma$ MODE

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
1401±18	[3,4] AUGUSTIN	90	DM2	$J/\psi \to \pi^+\pi^-\gamma\gamma$
1440±20	[4] COFFMAN	90	MRK3	$J/\psi \to \pi^+\pi^- 2\gamma$

[3] Best fit with a single Breit Wigner.
[4] This peak in the $\gamma\rho$ channel may not be related to the $\eta(1440)$.

4π MODE

VALUE (MeV)	EVTS	DOCUMENT ID	TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
1489±12	3270	[5] BISELLO	89B DM2	$J/\psi \to 4\pi\gamma$

[5] Estimated by us from various fits.

$K\overline{K}\pi$ MODE

VALUE (MeV)	EVTS	DOCUMENT ID	TECN	COMMENT
1419.8± 1.0 OUR AVERAGE	Error includes scale factor of 1.2.			
1421 ±14		[6] AUGUSTIN	92 DM2	$J/\psi \to \gamma K\overline{K}\pi$
1416 ± 8 $^{+7}_{-5}$	700	[7] BAI	90C MRK3	$J/\psi \to \gamma K^0_S K^\pm \pi^\mp$
1413 ± 8	500	DUCH	89 ASTE	$\overline{p}p \to \pi^+\pi^- K^\pm \pi^\mp K^0$
1419 ± 1	8800±200	[8,9] BIRMAN	88 MPS	$8\ \pi^- p \to K^+ \overline{K}^0 \pi^- n$
1424 ± 3	620	[9,10] REEVES	86 SPEC	$6.6\ p\overline{p} \to K\overline{K}\pi X$
1421 ± 2		CHUNG	85 SPEC	$8\ \pi^- p \to K\overline{K}\pi n$
1425 ± 7	800	[9,11] BAILLON	67 HBC	$0.0\ \overline{p}p \to K\overline{K}\pi\pi\pi$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
1459 ± 5		[8] AUGUSTIN	92 DM2	$J/\psi \to \gamma K\overline{K}\pi$
1445 ± 8	693±30	[9] AUGUSTIN	90 DM2	$J/\psi \to \gamma K^0_S K^\pm \pi^\mp$
1433 ± 8	296±20	[9] AUGUSTIN	90 DM2	$J/\psi \to \gamma K^+ K^- \pi^0$
1490 $^{+14}_{-8}$ $^{+3}_{-16}$	1100	[6] BAI	90C MRK3	$J/\psi \to \gamma K^0_S K^\pm \pi^\mp$
1443 ± 5		[6] TAKAMATSU	90 SPEC	$8\ \pi^- p \to nK^*(892)K$
1424 ± 4		TAKAMATSU	90 SPEC	$8\ \pi^- p \to nK^0_S K^\pm \pi^\mp$
1475 ± 4		[12] RATH	89 MPS	$21.4\ \pi^- p \to nK^0_S K^0_S \pi^0$
1452.8± 6.8	170±15	[9] RATH	89 MPS	$21.4\ \pi^- p \to K^0_S K^0_S \pi^0 n$
1412.8± 5.4		RATH	89 MPS	$21.4\ \pi^- p \to nK^0_S K^0_S \pi^0$
1454 ± 3		WISNIEWSKI	87 MRK3	$J/\psi \to K\overline{K}\pi\gamma$
1440 $^{+20}_{-15}$	174	EDWARDS	82E CBAL	$J/\psi \to \gamma K^+ K^- \pi^0$
1440 $^{+10}_{-15}$		SCHARRE	80 MRK2	$J/\psi \to \gamma K^0_S K^\pm \pi^\mp$

[6] From fit to the $K^*(892)K$ 0^{-+} partial wave.
[7] From fit to the $a_0(980)\pi$ 1^{++} partial wave. cannot rule out a $a_0(980)\pi$ 1^{++} partial wave.
[8] From fit to the $a_0(980)\pi$ 0^{-+} partial wave.
[9] Best fit with a single Breit Wigner.
[10] From fit of the 0^{-+} partial wave , mainly $a_0(980)\pi$.
[11] From best fit of 0^{-+} partial wave , 50% $K^*(892)K$, 50% $a_0(980)\pi$.
[12] From fit to the $a_0(980)\pi$ 0^{-+} partial wave , but $a_0(980)\pi$ 1^{++} cannot be excluded. The fit is also consistent with one resonance at 1453 MeV.

$\eta(1440)$ WIDTH

VALUE (MeV)	DOCUMENT ID
60±30 OUR ESTIMATE	This is only an educated guess; the error given is larger than the error on the average of the published values.

$\eta\pi\pi$ MODE

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
50± 8 OUR AVERAGE			
46±13	[13] BURCHELL	91 MRK3	$J/\psi \to \gamma\eta\pi^+\pi^-$
53±11	[14] AUGUSTIN	90 DM2	$J/\psi \to \gamma\eta\pi^+\pi^-$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
∼ 50	[14] BEHREND	92 CELL	$J/\psi \to \gamma\eta\pi^+\pi^-$
59± 4	FUKUI	91C SPEC	$8.95\ \pi^- p \to \eta\pi^+\pi^- n$
31± 7	ANDO	86 SPEC	$8\ \pi^- p \to n\eta\pi^+\pi^-$

[13] From fit to the $a_0(980)\pi$ 0^{-+} partial wave.
[14] From $\eta\pi^+\pi^-$ mass distribution - mainly $a_0(980)\pi$ - no spin–parity determination available.

$\pi\pi\gamma$ MODE

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
174±44	AUGUSTIN	90	DM2	$J/\psi \to \pi^+\pi^-\gamma\gamma$
60±30	[15] COFFMAN	90	MRK3	$J/\psi \to \pi^+\pi^- 2\gamma$

[15] This peak in the $\gamma\rho$ channel may not be related to the $\eta(1440)$.

4π MODE

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
144±13	3270	[16] BISELLO	89B	DM2	$J/\psi \to 4\pi\gamma$

[16] Estimated by us from various fits.

$K\overline{K}\pi$ MODE

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	COMMENT
66.0± 1.9 OUR AVERAGE					
63 ±18		AUGUSTIN	92	DM2	$J/\psi \to \gamma K\overline{K}\pi$
91 $^{+67}_{-31}$ $^{+15}_{-38}$		BAI	90C	MRK3	$J/\psi \to \gamma K^0_S K^\pm \pi^\mp$
62 ±16	500	DUCH	89	ASTE	$\overline{p}p \to K\overline{K}\pi\pi\pi$
66 ± 2	8800±200	BIRMAN	88	MPS	$8\ \pi^- p \to K^+\overline{K}^0\pi^- n$
60 ±10	620	[17] REEVES	86	SPEC	$6.6\ p\overline{p} \to KK\pi X$
60 ±10		CHUNG	85	SPEC	$8\ \pi^- p \to K\overline{K}\pi n$
80 ±10	800	[18] BAILLON	67	HBC	$0.0\ \overline{p}p \to K\overline{K}\pi\pi$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
75 ± 9		[19] AUGUSTIN	92	DM2	$J/\psi \to \gamma K\overline{K}\pi$
75 ± 9	693±30	[19] AUGUSTIN	90	DM2	$J/\psi \to \gamma K^0_S K^\pm \pi^\mp$
93 ±14	296±20	AUGUSTIN	90	DM2	$J/\psi \to \gamma K^+ K^- \pi^0$
105 ±10	693±30	AUGUSTIN	90	DM2	$J/\psi \to \gamma K^0_S K^\pm \pi^\mp$
54 $^{+37}_{-21}$ $^{+13}_{-24}$		[20] BAI	90C	MRK3	$J/\psi \to \gamma K^0_S K^\pm \pi^\mp$
59 ± 4		[20] TAKAMATSU	90	SPEC	$9\ \pi^- p \to n\eta\pi^+\pi^-$
82 ± 8		TAKAMATSU	90	SPEC	$8\ \pi^- p \to nK^0_S K^\pm \pi^\mp$
57 ± 8		TAKAMATSU	90	SPEC	$8\ \pi^- p \to nK^*(892)K$
51 ±13		[21] RATH	89	MPS	$21.4\ \pi^- p \to nK^0_S K^0_S \pi^0$
99.9±11.4	170±15	[22] RATH	89	MPS	$21.4\ \pi^- p \to K^0_S K^0_S \pi^0 n$
19 ± 7		RATH	89	MPS	$21.4\ \pi^- p \to nK^0_S K^0_S \pi^0$
160 ±11		WISNIEWSKI	87	MRK3	$J/\psi \to K\overline{K}\pi\gamma$
55 $^{+20}_{-30}$	174	EDWARDS	82E	CBAL	$J/\psi \to \gamma K^+ K^- \pi^0$
50 $^{+30}_{-20}$		SCHARRE	80	MRK2	$J/\psi \to \gamma K^0_S K^\pm \pi^\mp$

[17] From best fit to 0^{-+} partial wave , 50% $K^*(892)K$, 50% $a_0(980)\pi$.
[18] From fit to the 0^{-+} partial wave , mainly $a_0(980)\pi$.
[19] From fit to the $a_0(980)\pi$ 0^{-+} partial wave.
[20] From fit to the $K^*(892)K$ 0^{-+} partial wave.
[21] From fit to the $a_0(980)\pi$ 0^{-+} partial wave , but $a_0(980)\pi$ 1^{++} cannot be excluded. The fit is also consistent with one resonance at 1453 MeV.
[22] Best fit with a single Breit Wigner.

$\eta(1440)$ DECAY MODES

	Mode	Fraction (Γ_i/Γ)
Γ_1	$K\overline{K}\pi$	seen
Γ_2	$\eta\pi\pi$	seen
Γ_3	$a_0(980)\pi$	seen
Γ_4	$\pi\pi\rho$	
Γ_5	$K\overline{K}^*(892)$+ c.c.	
Γ_6	4π	seen
Γ_7	$\gamma\gamma$	
Γ_8	$\rho^0\gamma$	

$\eta(1440)$ $\Gamma(i)\Gamma(\gamma\gamma)/\Gamma(\text{total})$

$\Gamma(K\overline{K}\pi) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$ — $\Gamma_1\Gamma_7/\Gamma$

VALUE (keV)	CL%	DOCUMENT ID		TECN	COMMENT
<1.2	95	BEHREND	89	CELL	$\gamma\gamma \rightarrow K^0_S K^\pm \pi^\mp$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<1.6	95	AIHARA	86D	TPC	$e^+ e^- \rightarrow e^+ e^- K^0_S K^\pm \pi^\mp$
<2.2	95	ALTHOFF	85B	TASS	$e^+ e^- \rightarrow e^+ e^- K\overline{K}\pi$
<8.0	95	JENNI	83	MRK2	$e^+ e^- \rightarrow e^+ e^- K\overline{K}\pi$

$\Gamma(\eta\pi\pi) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$ — $\Gamma_2\Gamma_7/\Gamma$

VALUE (keV)	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
<0.3	ANTREASYAN	87	CBAL	$e^+ e^- \rightarrow e^+ e^- \eta\pi\pi$

$\Gamma(\rho^0\gamma) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$ — $\Gamma_8\Gamma_7/\Gamma$

VALUE (keV)	CL%	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<1.5	95	ALTHOFF	84E	TASS	$e^+ e^- \rightarrow e^+ e^- \pi^+ \pi^- \gamma$

$\eta(1440)$ BRANCHING RATIOS

$\Gamma(\eta\pi\pi)/\Gamma(K\overline{K}\pi)$ — Γ_2/Γ_1

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<0.5	90	EDWARDS	83B	CBAL	$J/\psi \rightarrow \eta\pi\pi\gamma$
<1.1	90	SCHARRE	80	MRK2	$J/\psi \rightarrow \eta\pi\pi\gamma$
<1.5	95	FOSTER	68B	HBC	$0.0\ \overline{p}p$

$\Gamma(a_0(980)\pi)/\Gamma(K\overline{K}\pi)$ — Γ_3/Γ_1

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
~ 0.8	500	[23] DUCH	89	ASTE	$\overline{p}p \rightarrow \pi^+ \pi^- K^\pm \pi^\mp K^0$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
~ 0.75		[23] REEVES	86	SPEC	$6.6\ p\overline{p} \rightarrow K K \pi X$

[23] Assuming that the $a_0(980)$ decays only into $K\overline{K}$.

$\Gamma(K\overline{K}^*(892)+\text{c.c.})/\Gamma(K\overline{K}\pi)$ — Γ_5/Γ_1

VALUE	DOCUMENT ID		TECN	COMMENT
0.50±0.10	BAILLON	67	HBC	$0.0\ \overline{p}p \rightarrow K\overline{K}\pi\pi\pi$

$\Gamma(K\overline{K}^*(892)+\text{c.c.})/\left[\Gamma(a_0(980)\pi) + \Gamma(K\overline{K}^*(892)+\text{c.c.})\right]$ — $\Gamma_5/(\Gamma_3+\Gamma_5)$

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<0.25	90	EDWARDS	82E	CBAL	$J/\psi \rightarrow K^+ K^- \pi^0 \gamma$

$\Gamma(\rho^0\gamma)/\Gamma(K\overline{K}\pi)$ — Γ_8/Γ_1

VALUE	DOCUMENT ID		TECN	COMMENT
0.0152±0.0038	[24] COFFMAN	90	MRK3	$J/\psi \rightarrow \gamma\gamma\pi^+\pi^-$

[24] Using B($J/\psi \rightarrow \gamma\eta(1440) \rightarrow \gamma K\overline{K}\pi$)=$4.2 \times 10^{-3}$ and B($J/\psi \rightarrow \gamma\eta(1440) \rightarrow \gamma\gamma\rho^0$)=$6.4 \times 10^{-5}$ and assuming that the $\gamma\rho^0$ signal does not come from the $f_1(1420)$.

$\eta(1440)$ REFERENCES

AUGUSTIN	92	PR D46 1951	+Cosme	(DM2 Collab.)
BEHREND	92	ZPHY C56 381		(CELLO Collab.)
BURCHELL	91	NP B21 132 (suppl)		(Mark III Collab.)
FUKUI	91C	PL B267 293	+	(SUGI, NAGO, KEK, KYOT, MIYA, AKIT)
AUGUSTIN	90	PR D42 10	+Cosme+	(DM2 Collab.)
BAI	90C	PRL 65 2507	+Blaylock+	(Mark III Collab.)
COFFMAN	90	PR D41 1410	+De Jongh+	(Mark III Collab.)
TAKAMATSU	90	Hadron 89 Conf. p 71	+Ando+	(KEK)
BEHREND	89	ZPHY C42 367	+Criegee+	(CELLO Collab.)
BISELLO	89B	PR D39 701	Busetto+	(DM2 Collab.)
DUCH	89	ZPHY 45 223	+Heel, Bailey+	(ASTERIX Collab.) JP
RATH	89	PR D40 693	+Cason+	(NDAM, BRAN, BNL, CUNY, DUKE)
BIRMAN	88	PRL 61 1557	+Chung, Peaslee+	(BNL, FSU, IND, MASD) JP
ANTREASYAN	87	PR D36 2633	+Bartels, Besset+	(Crystal Ball Collab.)
WISNIEWSKI	87	Hadron 87 Conf.		(Mark III Collab.)
AIHARA	86D	PRL 57 51	+Alston-Garnjost+	(TPC-2γ Collab.)
ANDO	86	PRL 57 1296	+Imai+	(KEK, KYOT, NIRS, SAGA, INUS, TSUK+) IJP
REEVES	86	PR 34 1960	+Chung, Crittenden+	(FLOR, BNL, IND, MASD) JP
ALTHOFF	85B	ZPHY C29 189	+Braunschweig, Kirschfink+	(TASSO Collab.)
CHUNG	85	PRL 55 779	+Fernow, Boehnlein+	(BNL, FLOR, IND, MASD) JP
ALTHOFF	84E	PL 147B 487	+Braunschweig, Kirschfink, Luebelsmeyer+	(TASSO Collab.)
EDWARDS	83B	PRL 51 859	+Partridge, Peck+	(CIT, HARV, PRIN, STAN, SLAC)
JENNI	83	PR D27 1031	+Burke, Telnov, Abrams, Blocker+	(SLAC, LBL)
EDWARDS	82E	PRL 49 259	+Partridge, Peck+	(CIT, HARV, PRIN, STAN, SLAC)
Also	83	PRL 50 219	Edwards, Partridge+	(CIT, HARV, PRIN, STAN+)
SCHARRE	80	PL 97B 329	+Trilling, Abrams, Alam, Blocker+	(SLAC, LBL)
FOSTER	68B	NP B8 174	+Gavillet, Labrosse, Montanet+	(CERN, CDEF)
BAILLON	67	NC 50A 393	+Edwards, D'Andlau, Astier+	(CERN, CDEF, IRAD)

OTHER RELATED PAPERS

GENOVESE	94	ZPHY C61 425	+Lichtenberg, Pedrazzi	(TORI, IND)
AHMAD	89	NP B (PROC.)8 50	+Amsler, Auld+	(ASTERIX Collab.)
ARMSTRONG	89	PL B221 216	+Benayoun+	(CERN, CDEF, BIRM, BARI, ATHU, CURIN+)
ZIEMINSKA	88	AIP Conf.		(IND)
ARMSTRONG	87	ZPHY C34 23	+Bloodworth+	(CERN, BIRM, BARI, ATHU, CURIN+)
ASTON	87	NP B292 693	+Awaji, D'Amore+	(SLAC, NAGO, CINC, INUS)
PROTOPOP...	87B	Hadron 87 Conf.	Protopopescu, Chung	(BNL)
TOKI	87	Hadron 87 Conf.		(SLAC)
ARMSTRONG	84	PL 146B 273	+Bloodworth, Burns+	(ATHU, BARI, BIRM, CERN)
DIONISI	80	NP B169 1	+Gavillet+	(CERN, MADR, CDEF, STOH)
DEFOIX	72	NP B44 125	+Nascimento, Bizzarri+	(CDEF, CERN)
DUBOC	72	NP B46 429	+Goldberg, Makowski, Donald+	(PARIS, LIVP)
LORSTAD	69	NP B14 63	+D'Andlau, Astier+	(CDEF, CERN)

$a_0(1450)$

$I^G(J^{PC}) = 1^-(0^{++})$

OMITTED FROM SUMMARY TABLE

Observed by AMSLER 94D from a partial-wave analysis of the $\pi\eta$ system.

$a_0(1450)$ MASS

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
1450±40	AMSLER	94D	CBAR	0.0 $\overline{p}p \to \pi^0\pi^0\eta$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
1435±40	[1] BUGG	94	RVUE	$\overline{p}p \to \eta 2\pi^0$

[1] Reanalysis of AMSLER 94C data.

$a_0(1450)$ WIDTH

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
270±40	AMSLER	94D	CBAR	0.0 $\overline{p}p \to \pi^0\pi^0\eta$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
270±40	[1] BUGG	94	RVUE	$\overline{p}p \to \eta 2\pi^0$

$a_0(1450)$ DECAY MODES

	Mode	Fraction (Γ_i/Γ)
Γ_1	$\pi\eta$	seen

$a_0(1450)$ REFERENCES

AMSLER	94C	PL B327 425	+Armstrong+	(Crystal Barrel Collab.)
AMSLER	94D	PL B333 277	+Anisovich+	(Crystal Barrel Collab.) IGJPC
BUGG	94	PR D50 4412	+Anisovich+	(LOQM)

$\rho(1450)$

$I^G(J^{PC}) = 1^+(1^{--})$

See the mini-review under the $\rho(1700)$.

ρ(1450) MASS

VALUE (MeV)	*DOCUMENT ID*
1465±25 OUR ESTIMATE	This is only an educated guess; the error given is larger than the error on the average of the published values.
1449± 8 OUR AVERAGE	Includes data from the 4 datablocks that follow this one.

MIXED MODES

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
The data in this block is included in the average printed for a previous datablock.				
• • • We do not use the following data for averages, fits, limits, etc. • • •				
1265.5±75.3	DUBNICKA	89	RVUE	$e^+e^- \rightarrow \pi^+\pi^-$

$\eta\rho^0$ MODE

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
The data in this block is included in the average printed for a previous datablock.				
1470±20	ANTONELLI	88	DM2	$e^+e^- \rightarrow \eta\pi^+\pi^-$
1446±10	FUKUI	88	SPEC	8.95 $\pi^- p \rightarrow \eta\pi^+\pi^- n$

$\pi^+\pi^-$ MODE

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
The data in this block is included in the average printed for a previous datablock.				
1424±25	BISELLO	89	DM2	$e^+e^- \rightarrow \pi^+\pi^-$

$\omega\pi$ MODE

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
The data in this block is included in the average printed for a previous datablock.				
1463±25	[1] DONNACHIE	91	RVUE	
• • • We do not use the following data for averages, fits, limits, etc. • • •				
1250	[2] ASTON	80C	OMEG	20–70 $\gamma p \rightarrow \omega\pi^0 p$
1290±40	[2] BARBER	80C	SPEC	3–5 $\gamma p \rightarrow \omega\pi^0 p$

[1] Using data from BISELLO 91B, DOLINSKY 86 and ALBRECHT 87L.
[2] Not separated from $b_1(1235)$, not pure $J^P = 1^-$ effect.

$\phi\pi$ MODE

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*CHG*	*COMMENT*
• • • We do not use the following data for averages, fits, limits, etc. • • •					
1480±40	[3] BITYUKOV	87	SPEC	0	32.5 $\pi^- p \rightarrow \phi\pi^0 n$

[3] See the minireview for $\rho(1700)$ and ACHASOV 88 for a non-exotic interpretation. DONNACHIE 91 suggests this is a different particle.

ρ(1450) WIDTH

VALUE (MeV)	*DOCUMENT ID*
310±60 OUR ESTIMATE	This is only an educated guess; the error given is larger than the error on the average of the published values.

$\omega\pi$ MODE

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
The data in this block is included in the average printed for a previous datablock.				
311± 62	[4] DONNACHIE	91	RVUE	
• • • We do not use the following data for averages, fits, limits, etc. • • •				
300	[5] ASTON	80C	OMEG	20–70 $\gamma p \rightarrow \omega\pi^0 p$
320±100	[5] BARBER	80C	SPEC	3–5 $\gamma p \rightarrow \omega\pi^0 p$

[4] Using data from BISELLO 91B, DOLINSKY 86 and ALBRECHT 87L.
[5] Not separated from $b_1(1235)$, not pure $J^P = 1^-$ effect.

MIXED MODES

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
391.0±70.0	DUBNICKA	89	RVUE	$e^+ e^- \to \pi^+ \pi^-$

$\eta \rho^0$ MODE

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
230±30	ANTONELLI	88	DM2	$e^+ e^- \to \eta \pi^+ \pi^-$
60±15	FUKUI	88	SPEC	8.95 $\pi^- p \to \eta \pi^+ \pi^- n$

$\pi^+ \pi^-$ MODE

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
269±31	BISELLO	89	DM2	$e^+ e^- \to \pi^+ \pi^-$

$\phi \pi$ MODE

VALUE (MeV)	DOCUMENT ID		TECN	CHG	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
130±60	[6] BITYUKOV	87	SPEC	0	32.5 $\pi^- p \to \phi \pi^0 n$

[6] See the minireview for $\rho(1700)$ and ACHASOV 88 for a non-exotic interpretation. DONNACHIE 91 suggests this is a different particle.

$\rho(1450)$ DECAY MODES

	Mode	Fraction (Γ_i/Γ)	Confidence level
Γ_1	$\pi \pi$	seen	
Γ_2	4π	seen	
Γ_3	$e^+ e^-$	seen	
Γ_4	$\eta \rho$	<4 %	
Γ_5	$\omega \pi$	<2.0 %	95%
Γ_6	$\phi \pi$	<1 %	
Γ_7	$K \overline{K}$	$<1.6 \times 10^{-3}$	95%

$\rho(1450)$ $\Gamma(i)\Gamma(e^+ e^-)/\Gamma(\text{total})$

$\Gamma(\pi \pi) \times \Gamma(e^+ e^-)/\Gamma_{\text{total}}$ — $\Gamma_1 \Gamma_3/\Gamma$

VALUE (keV)	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.12	[7] DIEKMAN	88	RVUE	$e^+ e^- \to \pi^+ \pi^-$

[7] Using total width = 235 MeV.

$\Gamma(\eta \rho) \times \Gamma(e^+ e^-)/\Gamma_{\text{total}}$ — $\Gamma_4 \Gamma_3/\Gamma$

VALUE (eV)	DOCUMENT ID		TECN	COMMENT
91±19	ANTONELLI	88	DM2	$e^+ e^- \to \eta \pi^+ \pi^-$

$\Gamma(\phi \pi) \times \Gamma(e^+ e^-)/\Gamma_{\text{total}}$ — $\Gamma_6 \Gamma_3/\Gamma$

VALUE (eV)	CL%	DOCUMENT ID		TECN	COMMENT
<70	90	[8] AULCHENKO	87B	ND	$e^+ e^- \to K^0_S K^0_L \pi^0$

[8] Using mass 1480 ± 40 MeV and total width 130 ± 60 MeV of BITYUKOV 87.

$\rho(1450)$ BRANCHING RATIOS

$\Gamma(\eta \rho)/\Gamma_{\text{total}}$ — Γ_4/Γ

VALUE	DOCUMENT ID		TECN
<0.04	DONNACHIE	87B	RVUE

$\Gamma(\phi \pi)/\Gamma(\omega \pi)$ — Γ_6/Γ_5

VALUE	CL%	DOCUMENT ID		TECN	CHG	COMMENT
>0.5	95	BITYUKOV	87	SPEC	0	32.5 $\pi^- p \to \phi \pi^0 n$

$\Gamma(\omega\pi)/\Gamma(4\pi)$ Γ_5/Γ_2

VALUE	DOCUMENT ID		TECN
<0.14	CLEGG	88	RVUE

$\Gamma(\eta\rho)/\Gamma(\omega\pi)$ Γ_4/Γ_5

VALUE	DOCUMENT ID		TECN	COMMENT
~ 0.24	[9] DONNACHIE	91	RVUE	
• • • We do not use the following data for averages, fits, limits, etc. • • •				
>2	FUKUI	91	SPEC	8.95 $\pi^- p \rightarrow \omega\pi^0 n$

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

VALUE	DOCUMENT ID		TECN
~ 0.21	[9] DONNACHIE	91	RVUE

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

VALUE	DOCUMENT ID		TECN
~ 0.24	[9] DONNACHIE	91	RVUE

$\Gamma(\phi\pi)/\Gamma_{total}$ Γ_6/Γ

VALUE	DOCUMENT ID		TECN
<0.01	[9] DONNACHIE	91	RVUE

$\Gamma(K\overline{K})/\Gamma(\omega\pi)$ Γ_7/Γ_5

VALUE	DOCUMENT ID		TECN
<0.08	[9] DONNACHIE	91	RVUE

[9] Using data from BISELLO 91B, DOLINSKY 86 and ALBRECHT 87L.

$\rho(1450)$ REFERENCES

BISELLO	91B	NP B21 111 (suppl)		(DM2 Collab.)
DONNACHIE	91	ZPHY C51 689	+Clegg	(MCHS, LANC)
FUKUI	91	PL B257 241	+Horikawa+	(SUGI, NAGO, KEK, KYOT, MIYA)
BISELLO	89	PL B220 321	+Busetto+	(DM2 Collab.)
DUBNICKA	89	JPG 15 1349	+Martinovic+	(JINR, SLOV)
ACHASOV	88	PL B207 199	+Kozhevnikov	(NOVO)
ANTONELLI	88	PL B212 133	+Baldini+	(DM2 Collab.)
CLEGG	88	ZPHY C40 313	+Donnachie	(MCHS, LANC)
DIEKMAN	88	PRPL 159 101		(BONN)
FUKUI	88	PL B202 441	+Horikawa+	(SUGI, NAGO, KEK, KYOT, MIYA)
ALBRECHT	87L	PL B185 223	+Binder, Boeckmann, Glaser+	(ARGUS Collab.)
AULCHENKO	87B	JETPL 45 145	+Dolinsky, Druzhinin, Dubrovin+	(NOVO)
		Translated from ZETFP 45 118.		
BITYUKOV	87	PL B188 383	+Dzhelyadin, Dorofeev, Golovkin+	(SERP)
DONNACHIE	87B	ZPHY C34 257	+Clegg	(MCHS, LANC)
DOLINSKY	86	PL B174 453	+Druzhinin, Dubrovin, Eidelman+	(NOVO)
ASTON	80C	PL 92B 211		(BONN, CERN, EPOL, GLAS, LANC, MCHS+)
BARBER	80C	ZPHY C4 169	+Dainton, Brodbeck, Brookes+	(DARE, LANC, SHEF)

OTHER RELATED PAPERS

MURADOV	94	PAN 57 864		(BAKU)
LANDSBERG	92	SJNP 55 1051		(SERP)
		Translated from YAF 55 1896.		
BRAU	88	PR D37 2379	+Franek+	(SLAC Hybrid Facility Photon Collab.)
ASTON	87	NP B292 693	+Awaji, D'Amore+	(SLAC, NAGO, CINC, INUS)
KURDADZE	86	JETPL 43 643	+Lelchuk, Pakhtusova, Sidorov, Skrinskii+	(NOVO)
		Translated from ZETFP 43 497.		
BARKOV	85	NP B256 365	+Chilingarov, Eidelman, Khazin, Lelchuk+	(NOVO)
BISELLO	85	LAL 85-15	+Augustin, Ajaltouni+	(PADO, LALO, CLER, FRAS)
ABE	84B	PRL 53 751	+Bacon, Ballam+	(SLAC Hybrid Facility Photon Collab.)
ATKINSON	84C	NP B243 1	+	(BONN, CERN, GLAS, LANC, MCHS, CURIN+)
CORDIER	82	PL 109B 129	+Bisello, Bizot, Buon, Delcourt	(LALO)
KILLIAN	80	PR D21 3005	+Treadwell, Ahrens, Berkelman, Cassel+	(CORN)
COSME	76	PL 63B 352	+Courau, Dudelzak, Grelaud, Jean-Marie+	(ORSAY)
BINGHAM	72B	PL 41B 635	+Rabin, Rosenfeld, Smadja+	(LBL, UCB, SLAC)
FRENKIEL	72	NP B47 61	+Ghesquiere, Lillestol, Chung+	(CDEF, CERN)
LAYSSAC	71	NC 6A 134	+Renard	(MONP)

$f_1(1510)$

$I^G(J^{PC}) = 0^+(1^{++})$

See also minireview under non-$q\overline{q}$ candidates.

$f_1(1510)$ MASS

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	COMMENT
1512 ± 4	600±200	[1] BIRMAN	88	MPS	$8\ \pi^- p \to K^+ \overline{K}^0 \pi^- n$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
~ 1525		[2] BAUER	93B		$\gamma\gamma^* \to \pi^+\pi^-\pi^0\pi^0$
1530 ±10		ASTON	88C	LASS	$11\ K^- p \to K^0_S K^\pm \pi^\mp \Lambda$
1526.0± 6.0	271	GAVILLET	82	HBC	$4.2\ K^- p \to \Lambda K K \pi$

[1] From partial wave analysis of $K^+ \overline{K}^0 \pi^-$ state.
[2] Possibly a different resonance than that seen in $K\overline{K}\pi$, isospin and spin uncertain.

$f_1(1510)$ WIDTH

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	COMMENT
35 ±15	600±200	[3] BIRMAN	88	MPS	$8\ \pi^- p \to K^+ \overline{K}^0 \pi^- n$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
100 ±40		ASTON	88C	LASS	$11\ K^- p \to K^0_S K^\pm \pi^\mp \Lambda$
107.0±15.0	271	GAVILLET	82	HBC	$4.2\ K^- p \to \Lambda K K \pi$

[3] From partial wave analysis of $K^+ \overline{K}^0 \pi^-$ state.

$f_1(1510)$ DECAY MODES

	Mode	Fraction (Γ_i/Γ)
Γ_1	$K\overline{K}^*(892)$+ c.c.	seen

$f_1(1510)$ REFERENCES

BAUER	93B	PR D48 3976	+Belcinski, Berg, Bingham+	(SLAC)
ASTON	88C	PL B201 573	+Awaji, Bienz+	(SLAC, NAGO, CINC, INUS) JP
BIRMAN	88	PRL 61 1557	+Chung, Peaslee+	(BNL, FSU, IND, MASD) JP
GAVILLET	82	ZPHY C16 119	+Armenteros+	(CERN, CDEF, PADO, ROMA)

$f_2(1520)$

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

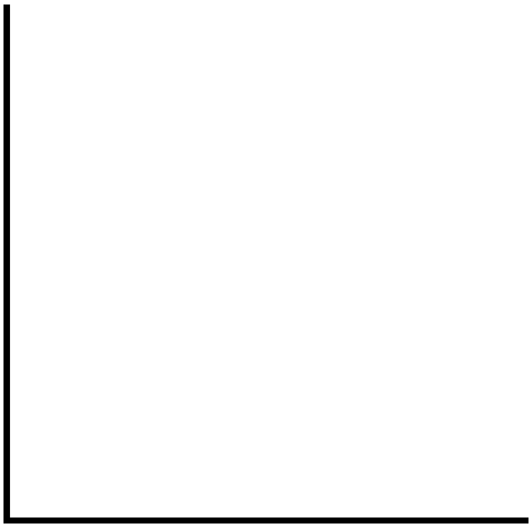
OMITTED FROM SUMMARY TABLE

Seen in antiproton-nucleon annihilation at rest. See also minireview under non-$q\overline{q}$ candidates. Needs confirmation.

$f_2(1520)$ MASS

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	CHG	COMMENT
1510± 8 OUR AVERAGE Error includes scale factor of 1.8. See the ideogram below.						
1502± 9		[1] ADAMO	93	OBLX		$\overline{n} p \to \pi^+\pi^+\pi^-$
1488±10		ARMSTRONG	93C	SPEC		$\overline{p} p \to \pi^0 \eta\eta \to 6\gamma$
1508±10		ARMSTRONG	93D	SPEC		$\overline{p} p \to 3\pi^0 \to 6\gamma$
1525±10		ARMSTRONG	93D	SPEC		$\overline{p} p \to \eta\pi^0\pi^0 \to 6\gamma$
1515±10		AKER	91	CBAR		$0.0\ \overline{p} p \to 3\pi^0$
1565±20		MAY	90	ASTE		$\overline{p} p \to \pi^+\pi^-\pi^0$
• • • We do not use the following data for averages, fits, limits, etc. • • •						
1566^{+80}_{-50}		[2] ANISOVICH	94	CBAR		$0.0\ \overline{p} p \to 3\pi^0, \eta\eta\pi^0$
1527± 5	435±45	[3] GRAY	83	DBC	0	$0.0\ \overline{p} N \to 3\pi$

[1] Supersedes ADAMO 92.
[2] From a simultanious analysis of the annihilations $\overline{p}p \rightarrow 3\pi^0, \pi^0\eta\eta$ including AKER 91 data.
[3] No fit of the Dalitz plot has been made. J=0 is cautiously suggested, but J=2 is not excluded.



$f_2(1520)$ mass (MeV)

$f_2(1520)$ WIDTH

VALUE (MeV)	*EVTS*	*DOCUMENT ID*		*TECN*	*CHG*	*COMMENT*
120± 5 OUR AVERAGE						
130±10		[4] ADAMO	93	OBLX		$\overline{n}p \rightarrow \pi^+\pi^+\pi^-$
148±27		ARMSTRONG	93C	SPEC		$\overline{p}p \rightarrow \pi^0\eta\eta \rightarrow 6\gamma$
103±15		ARMSTRONG	93D	SPEC		$\overline{p}p \rightarrow 3\pi^0 \rightarrow 6\gamma$
111±10		ARMSTRONG	93D	SPEC		$\overline{p}p \rightarrow \eta\pi^0\pi^0 \rightarrow 6\gamma$
120±10		AKER	91	CBAR		0.0 $\overline{p}p \rightarrow 3\pi^0$
170±40		MAY	90	ASTE		$\overline{p}p \rightarrow \pi^+\pi^-\pi^0$
• • • We do not use the following data for averages, fits, limits, etc. • • •						
166^{+80}_{-20}		[5] ANISOVICH	94	CBAR		0.0 $\overline{p}p \rightarrow 3\pi^0, \eta\eta\pi^0$
101±19	435±45	[6,7] GRAY	83	DBC	0	0.0 $\overline{p}N \rightarrow 3\pi$

[4] Supersedes ADAMO 92.
[5] From a simultanious analysis of the annihilations $\overline{p}p \rightarrow 3\pi^0, \pi^0\eta\eta$ including AKER 91 data.
[6] No fit of the Dalitz plot has been made.
[7] Width error enlarged by us to $4\Gamma/N^{1/2}$.

$f_2(1520)$ DECAY MODES

	Mode	Fraction (Γ_i/Γ)
Γ_1	$\pi^+\pi^-$	seen
Γ_2	$\rho^0\rho^0$	
Γ_3	$\pi^0\pi^0$	
Γ_4	$2\pi^+2\pi^-$	
Γ_5	$\eta\eta$	

$f_2(1520)$ BRANCHING RATIOS

$\Gamma(\pi^+\pi^-)/\Gamma_{total}$ — Γ_1/Γ

VALUE	DOCUMENT ID		TECN	CHG	COMMENT
seen	MAY	89	ASTE		$\overline{p}p \rightarrow \pi^+\pi^-\pi^0$
seen	GRAY	83	DBC	0	0.0 $\overline{p}N \rightarrow 3\pi$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
not seen	[8] ANISOVICH	94B	RVUE		$\overline{p}p \rightarrow \pi^+\pi^-\pi^0$

[8] ANISOVICH 94B is from a reanalysis of MAY 90.

$\Gamma(\pi^+\pi^-)/\Gamma(\rho^0\rho^0)$ — Γ_1/Γ_2

VALUE	DOCUMENT ID		TECN	CHG	COMMENT
0.042±0.013	BRIDGES	86B	DBC	0	$\overline{p}N \rightarrow 3\pi^- 2\pi^+$

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

VALUE	DOCUMENT ID		TECN	COMMENT
seen	AKER	91	CBAR	0.0 $\overline{p}p \rightarrow 3\pi^0$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
not seen	[9] ANISOVICH	94B	RVUE	0.0 $\overline{p}p \rightarrow 3\pi^0$

[9] ANISOVICH 94B is from a reanalysis of AKER 91.

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

VALUE	DOCUMENT ID		TECN	COMMENT
0.024±0.005±0.012	ARMSTRONG	93C	SPEC	$\overline{p}p \rightarrow \pi^0\eta\eta \rightarrow 6\gamma$

$f_2(1520)$ REFERENCES

ANISOVICH	94	PL B323 233	+Armstrong+	(Crystal Barrel Collab.)
ANISOVICH	94B	PR D50 1972	+Bugg+	(LOQM)
ADAMO	93	NP A558 13C	+Agnello+	(OBELIX Collab.)
ARMSTRONG	93C	PL B307 394	+Bettoni+	(FNAL, FERR, GENO, UCI, NWES+)
ARMSTRONG	93D	PL B307 399	+Bettoni+	(FNAL, FERR, GENO, UCI, NWES+)
ADAMO	92	PL B287 368	+Agnello, Balestra+	(OBELIX Collab.)
AKER	91	PL B260 249	+Amsler, Peters+	(Crystal Barrel Collab.)
MAY	90	ZPHY C46 203	+Duch, Heel+	(ASTERIX Collab.)
MAY	89	PL B225 450	+Duch, Heel+	(ASTERIX Collab.) IJP
BRIDGES	86B	PRL 56 215	+Daftari, Kalogeropoulos, Debbe+	(SYRA, CASE)
GRAY	83	PR D27 307	+Kalogeropoulos, Nandy, Roy, Zenone	(SYRA)

$f_2'(1525)$

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

See also the mini-review under non-$q\overline{q}$ candidates. (See the index for the page number.)

$f_2'(1525)$ MASS

VALUE (MeV)	DOCUMENT ID
1525±5 OUR ESTIMATE	This is only an educated guess; the error given is larger than the error on the average of the published values.

PRODUCED BY PION BEAM

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
1547^{+10}_{-2}		[1] LONGACRE	86	MPS	22 $\pi^- p \rightarrow K^0_S K^0_S n$
1496^{+9}_{-8}		[2] CHABAUD	81	ASPK	6 $\pi^- p \rightarrow K^+ K^- n$
1497^{+8}_{-9}		CHABAUD	81	ASPK	18.4 $\pi^- p \rightarrow K^+ K^- n$
1492±29		GORLICH	80	ASPK	17 $\pi^- p$ polarized $\rightarrow K^+ K^- n$
1502±25		[3] CORDEN	79	OMEG	12–15 $\pi^- p \rightarrow \pi^+\pi^- n$
1480	14	CRENNELL	66	HBC	6.0 $\pi^- p \rightarrow K^0_S K^0_S n$

*CITATION: L. Montanet et al., Physical Review D50, 1173 (1994) and 1995 off-year partial update for the 1996 edition (URL: http://pdg.lbl.gov/)

PRODUCED BY $K^{\pm}$ BEAM

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	COMMENT
1524.5±1.4 OUR AVERAGE		Includes data from the datablock that follows this one. Error includes scale factor of 1.1.			
1526.8±4.3		ASTON	88D	LASS	11 $K^- p \to K^0_S K^0_S \Lambda$
1529 ±3		ARMSTRONG	83B	OMEG	18.5 $K^- p \to K^- K^+ \Lambda$
1521 ±6	650	AGUILAR-...	81B	HBC	4.2 $K^- p \to \Lambda K^+ K^-$
1521 ±3	572	ALHARRAN	81	HBC	8.25 $K^- p \to \Lambda K \overline{K}$
1522 ±6	123	BARREIRO	77	HBC	4.15 $K^- p \to \Lambda K^0_S K^0_S$
1528 ±7	166	EVANGELISTA	77	OMEG	10 $K^- p \to K^+ K^- (\Lambda, \Sigma)$
1527 ±3	120	BRANDENB...	76C	ASPK	13 $K^- p \to K^+ K^- (\Lambda, \Sigma)$
1519 ±7	100	AGUILAR-...	72B	HBC	3.9,4.6 $K^- p \to K \overline{K} (\Lambda, \Sigma)$

PRODUCED IN $e^+ e^-$ ANNIHILATION

The data in this block is included in the average printed for a previous datablock.

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
1519 ± 5 OUR AVERAGE	Error includes scale factor of 1.1.			
1531.6±10.0	AUGUSTIN	88	DM2	$J/\psi \to \gamma K^+ K^-$
1515 ± 5	[4] FALVARD	88	DM2	$J/\psi \to \phi K^+ K^-$
1525 ±10 ±10	BALTRUSAIT...	87	MRK3	$J/\psi \to \gamma K^+ K^-$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
1496 ± 2	[5] FALVARD	88	DM2	$J/\psi \to \phi K^+ K^-$

[1] From a partial-wave analysis of data using a K-matrix formalism with 5 poles.
[2] CHABAUD 81 is a reanalysis of PAWLICKI 77 data.
[3] From an amplitude analysis where the $f'_2(1525)$ width and elasticity are in complete disagreement with the values obtained from $K\overline{K}$ channel, making the solution dubious.
[4] From an analysis ignoring interference with $f_J(1710)$.
[5] From an analysis including interference with $f_J(1710)$.

$f'_2(1525)$ WIDTH

VALUE (MeV)	DOCUMENT ID		COMMENT
76±10 OUR ESTIMATE	This is only an educated guess; the error given is larger than the error on the average of the published values.		
85± 5 OUR FIT			
76±10	PDG	90	For fitting

PRODUCED BY PION BEAM

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
108^{+5}_{-2}	[6] LONGACRE	86	MPS	22 $\pi^- p \to K^0_S K^0_S n$
69^{+22}_{-16}	[7] CHABAUD	81	ASPK	6 $\pi^- p \to K^+ K^- n$
137^{+23}_{-21}	CHABAUD	81	ASPK	18.4 $\pi^- p \to K^+ K^- n$
150^{+83}_{-50}	GORLICH	80	ASPK	17 $\pi^- p$ polarized $\to K^+ K^- n$
165±42	[8] CORDEN	79	OMEG	12–15 $\pi^- p \to \pi^+ \pi^- n$
92^{+39}_{-22}	[9] POLYCHRO...	79	STRC	7 $\pi^- p \to n K^0_S K^0_S$

PRODUCED BY $K^{\pm}$ BEAM

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	COMMENT
78± 5 OUR AVERAGE		Includes data from the datablock that follows this one.			
90±12		ASTON	88D	LASS	11 $K^- p \to K^0_S K^0_S \Lambda$
83±15		ARMSTRONG	83B	OMEG	18.5 $K^- p \to K^- K^+ \Lambda$
85±16	650	AGUILAR-...	81B	HBC	4.2 $K^- p \to \Lambda K^+ K^-$
80^{+14}_{-11}	572	ALHARRAN	81	HBC	8.25 $K^- p \to \Lambda K \overline{K}$
72±25	166	EVANGELISTA	77	OMEG	10 $K^- p \to K^+ K^- (\Lambda, \Sigma)$
69±22	100	AGUILAR-...	72B	HBC	3.9,4.6 $K^- p \to K \overline{K} (\Lambda, \Sigma)$
• • • We do not use the following data for averages, fits, limits, etc. • • •					

62^{+19}_{-14}	123	BARREIRO	77	HBC	$4.15\ K^- p \to \Lambda K^0_S K^0_S$
61 ± 8	120	BRANDENB...	76C	ASPK	$13\ K^- p \to K^+ K^- (\Lambda, \Sigma)$

PRODUCED IN $e^+ e^-$ ANNIHILATION

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
The data in this block is included in the average printed for a previous datablock.				
67± 9 OUR AVERAGE				
103 ± 30	AUGUSTIN	88	DM2	$J/\psi \to \gamma K^+ K^-$
62 ± 10	[10] FALVARD	88	DM2	$J/\psi \to \phi K^+ K^-$
85 ± 35	BALTRUSAIT...	87	MRK3	$J/\psi \to \gamma K^+ K^-$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
100 ± 3	[11] FALVARD	88	DM2	$J/\psi \to \phi K^+ K^-$

[6] From a partial-wave analysis of data using a K-matrix formalism with 5 poles.
[7] CHABAUD 81 is a reanalysis of PAWLICKI 77 data.
[8] From an amplitude analysis where the $f'_2(1525)$ width and elasticity are in complete disagreement with the values obtained from $K\overline{K}$ channel, making the solution dubious.
[9] From a fit to the D with $f_2(1270)$-$f'_2(1525)$ interference. Mass fixed at 1516 MeV.
[10] From an analysis ignoring interference with $f_J(1710)$.
[11] From an analysis including interference with $f_J(1710)$.

$f'_2(1525)$ DECAY MODES

	Mode	Fraction (Γ_i/Γ)
Γ_1	$K\overline{K}$	$(71.3\ ^{+2.1}_{-2.5})$ %
Γ_2	$\eta\eta$	$(27.9\ ^{+2.5}_{-2.1})$ %
Γ_3	$\pi\pi$	$(8.2 \pm 1.6) \times 10^{-3}$
Γ_4	$\gamma\gamma$	$(1.38 \pm 0.24) \times 10^{-6}$
Γ_5	$K\overline{K}^*(892)+$ c.c.	
Γ_6	$\pi\pi\eta$	
Γ_7	$\pi K\overline{K}$	
Γ_8	$\pi^+\pi^+\pi^-\pi^-$	

CONSTRAINED FIT INFORMATION

An overall fit to the total width, 3 partial widths, a combination of partial widths obtained from integrated cross sections, and 2 branching ratios uses 13 measurements and one constraint to determine 5 parameters. The overall fit has a $\chi^2 = 11.4$ for 9 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, $x_i \equiv \Gamma_i/\Gamma_{\rm total}$. The fit constrains the x_i whose labels appear in this array to sum to one.

x_2	−100			
x_3	−6	−2		
x_4	−37	37	0	
Γ	59	−59	2	−43
	x_1	x_2	x_3	x_4

	Mode	Rate (MeV)
Γ_1	$K\overline{K}$	61 ± 5
Γ_2	$\eta\eta$	$23.9\ ^{+2.2}_{-1.3}$
Γ_3	$\pi\pi$	0.70 ± 0.14
Γ_4	$\gamma\gamma$	$(1.18 \pm 0.19) \times 10^{-4}$

$f_2'(1525)$ PARTIAL WIDTHS

$\Gamma(K\overline{K})$ — Γ_1

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
61 ±5 OUR FIT				
$63.0^{+6.0}_{-5.0}$	[12] LONGACRE	86	MPS	$22\ \pi^- p \to K^0_S K^0_S n$

$\Gamma(\pi\pi)$ — Γ_3

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
0.70±0.14 OUR FIT				
$1.4\ ^{+1.0}_{-0.5}$	[12] LONGACRE	86	MPS	$22\ \pi^- p \to K^0_S K^0_S n$

$\Gamma(\eta\eta)$ — Γ_2

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
$23.9^{+2.2}_{-1.3}$ OUR FIT				
$24.0^{+3.0}_{-1.0}$	[12] LONGACRE	86	MPS	$22\ \pi^- p \to K^0_S K^0_S n$

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

$f_2'(1525)$ $\Gamma(i)\Gamma(\gamma\gamma)/\Gamma(\text{total})$

$\Gamma(K\overline{K}) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$ — $\Gamma_1\Gamma_4/\Gamma$

VALUE (keV)	DOCUMENT ID		TECN	COMMENT
0.084 ±0.013 OUR FIT				
0.084 ±0.013 OUR AVERAGE				
0.067 ±0.008 ±0.015	[13] ALBRECHT	90G	ARG	$e^+e^- \to e^+e^- K^+K^-$
0.11 $^{+0.03}_{-0.02}$ ±0.02	BEHREND	89C	CELL	$e^+e^- \to e^+e^- K^0_S K^0_S$
0.10 $^{+0.04}_{-0.03}$ $^{+0.03}_{-0.02}$	BERGER	88	PLUT	$e^+e^- \to e^+e^- K^0_S K^0_S$
0.12 ±0.07 ±0.04	[13] AIHARA	86B	TPC	$e^+e^- \to e^+e^- K^+K^-$
0.11 ±0.02 ±0.04	[13] ALTHOFF	83	TASS	$e^+e^- \to e^+e^- K\overline{K}$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.0314±0.0050±0.0077	[14] ALBRECHT	90G	ARG	$e^+e^- \to e^+e^- K^+K^-$

[13] Using an incoherent background.
[14] Using a coherent background.

$f_2'(1525)$ BRANCHING RATIOS

$\Gamma(\eta\eta)/\Gamma(K\overline{K})$ — Γ_2/Γ_1

VALUE	DOCUMENT ID		TECN	COMMENT
$0.39^{+0.05}_{-0.04}$ OUR FIT				
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.11±0.04	[15] PROKOSHKIN	91	GAM4	$300\ \pi^- p \to \pi^- p\eta\eta$
<0.50	BARNES	67	HBC	4.6,5.0 $K^- p$

[15] Combining results of GAM4 with those of WA76 on $K\overline{K}$ central production and results of CBAL, MRK3 and DM2 on $J/\psi \to \gamma\eta\eta$.

$\Gamma(\pi\pi)/\Gamma_{\text{total}}$ — Γ_3/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
0.0082±0.0016 OUR FIT					
0.0075±0.0016 OUR AVERAGE					
0.007 ±0.002		COSTA...	80	OMEG	$10\ \pi^- p \to K^+K^- n$
0.027 $^{+0.071}_{-0.013}$		[16] GORLICH	80	ASPK	17,18 $\pi^- p$
0.0075±0.0025		[16,17] MARTIN	79	RVUE	

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

<0.06		95	AGUILAR-...	81B	HBC	4.2 $K^- p \to \Lambda K^+ K^-$
0.19	±0.03		CORDEN	79	OMEG	12–15 $\pi^- p \to \pi^+ \pi^- n$
<0.045		95	BARREIRO	77	HBC	4.15 $K^- p \to \Lambda K^0_S K^0_S$
0.012	±0.004		[16] PAWLICKI	77	SPEC	6 $\pi N \to K^+ K^- N$
<0.063		90	BRANDENB...	76C	ASPK	13 $K^- p \to K^+ K^- (\Lambda, \Sigma)$
<0.0086			[16] BEUSCH	75B	OSPK	8.9 $\pi^- p \to K^0 \overline{K}^0 n$

[16] Assuming that the $f'_2(1525)$ is produced by an one-pion exchange production mechanism.

[17] MARTIN 79 uses the PAWLICKI 77 data with different input value of the $f'_2(1525) \to K\overline{K}$ branching ratio.

$\Gamma(\pi\pi)/\Gamma(K\overline{K})$ $\qquad\qquad$ Γ_3/Γ_1

VALUE	DOCUMENT ID		TECN	COMMENT
0.0115±0.0022 OUR FIT				
0.075 ±0.035	AUGUSTIN	87	DM2	$J/\psi \to \gamma \pi^+ \pi^-$

$\Gamma(\pi\pi\eta)/\Gamma(K\overline{K})$ $\qquad\qquad$ Γ_6/Γ_1

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<0.41	95	AGUILAR-...	72B	HBC	3.9,4.6 $K^- p$
<0.3	67	AMMAR	67	HBC	

$\left[\Gamma(K\overline{K}^*(892)+\text{c.c.}) + \Gamma(\pi K\overline{K})\right]/\Gamma(K\overline{K})$ $\qquad\qquad$ $(\Gamma_5+\Gamma_7)/\Gamma_1$

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<0.35	95	AGUILAR-...	72B	HBC	3.9,4.6 $K^- p$
<0.4	67	AMMAR	67	HBC	

$\Gamma(\pi^+\pi^+\pi^-\pi^-)/\Gamma(K\overline{K})$ $\qquad\qquad$ Γ_8/Γ_1

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<0.32	95	AGUILAR-...	72B	HBC	3.9,4.6 $K^- p$

$\Gamma(\eta\eta)/\Gamma_{\text{total}}$ $\qquad\qquad$ Γ_2/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
0.10 ±0.03	[18] PROKOSHKIN	91	GAM4	300 $\pi^- p \to \pi^- p \eta\eta$

[18] Combining results of GAM4 with those of WA76 on $K\overline{K}$ central production and results of CBAL, MRK3 and DM2 on $J/\psi \to \gamma\eta\eta$.

$f'_2(1525)$ REFERENCES

PROKOSHKIN	91	SPD 316 155		(GAM2 Collab.)	
		Translated from DANS 316 900.			
ALBRECHT	90G	ZPHY C48 183	+Ehrlichmann, Harder+	(ARGUS Collab.)	
PDG	90	PL B239	Hernandez, Stone, Porter+	(IFIC, BOST, CIT+)	
BEHREND	89C	ZPHY C43 91	+Criegee, Dainton+	(CELLO Collab.)	
ASTON	88D	NP B301 525	+Awaji, Bienz+	(SLAC, NAGO, CINC, INUS)	
AUGUSTIN	88	PRL 60 2238	+Calcaterra+	(DM2 Collab.)	
BERGER	88	ZPHY C37 329	+Genzel, Lackas+	(PLUTO Collab.)	
FALVARD	88	PR D38 2706	+Ajaltouni+	(CLER, FRAS, LALO, PADO)	
AUGUSTIN	87	ZPHY C36 369	+Cosme+	(LALO, CLER, FRAS, PADO)	
BALTRUSAIT...	87	PR D35 2077	Baltrusaitis, Coffman, Dubois+	(Mark III Collab.)	
AIHARA	86B	PRL 57 404	+Alston-Garnjost+	(TPC-2γ Collab.)	
LONGACRE	86	PL B177 223	+Etkin+	(BNL, BRAN, CUNY, DUKE, NDAM)	
ALTHOFF	83	PL 121B 216	+Brandelik, Boerner, Burkhardt+	(TASSO Collab.)	
ARMSTRONG	83B	NP B224 193	+	(BARI, BIRM, CERN, MILA, CURIN+)	
AGUILAR-...	81B	ZPHY C8 313	Aguilar-Benitez, Albajar+	(CERN, CDEF, MADR+)	
ALHARRAN	81	NP B191 26	+Baubillier+	(BIRM, CERN, GLAS, MICH, CURIN)	
CHABAUD	81	APP B12 575	+Niczyporuk, Becker+	(CERN, CRAC, MPIM)	
COSTA...	80	NP B175 402	Costa De Beauregard+	(BARI, BONN, CERN+)	
GORLICH	80	NP B174 16	+Niczyporuk+	(CRAC, MPIM, CERN, ZEEM)	
CORDEN	79	NP B157 250	+Dowell, Garvey+	(BIRM, RHEL, TELA, LOWC)	JP
MARTIN	79	NP B158 520	+Ozmutlu	(DURH)	
POLYCHRO...	79	PR D19 1317	Polychronakos, Cason, Bishop+	(NDAM, ANL)	
BARREIRO	77	NP B121 237	+Diaz, Gay, Hemingway+	(CERN, AMST, NIJM, OXF)	
EVANGELISTA	77	NP B127 384	+	(BARI, BONN, CERN, DARE, GLAS+)	
PAWLICKI	77	PR D15 3196	+Ayres, Cohen, Diebold, Kramer, Wicklund	(ANL)	IJP
BRANDENB...	76C	NP B104 413	Brandenburg, Carnegie, Cashmore+	(SLAC)	
BEUSCH	75B	PL 60B 101	+Birman, Websdale, Wetzel	(CERN, ETH)	
AGUILAR-...	72B	PR D6 29	Aguilar-Benitez, Chung, Eisner, Samios	(BNL)	
AMMAR	67	PRL 19 1071	+Davis, Hwang, Dagan, Derrick+	(NWES, ANL)	JP
BARNES	67	PRL 19 964	+Dornan, Goldberg, Leitner+	(BNL, SYRA)	IJPC
CRENNELL	66	PRL 16 1025	+Kalbfleisch, Lai, Scarr, Schumann+	(BNL)	I

OTHER RELATED PAPERS

JENNI	83	PR D27 1031	+Burke, Telnov, Abrams, Blocker+	(SLAC, LBL)
ARMSTRONG	82	PL 110B 77	+Baubillier+	(BARI, BIRM, CERN, MILA, CURIN+)
ETKIN	82B	PR D25 1786	+Foley, Lai+	(BNL, CUNY, TUFTS, VAND)
LUKE	82	DESY 82/073		(DESY)
ABRAMS	67B	PRL 18 620	+Kehoe, Glasser, Sechi-Zorn, Wolsky	(UMD)
BARNES	65	PRL 15 322	+Culwick, Guidoni, Kalbfleisch, Goz+	(BNL, SYRA)

$f_0(1525)$

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

OMITTED FROM SUMMARY TABLE

This entry contains evidence for $K\overline{K}$ $\pi\pi$ and $\eta\eta$ S-wave intensity peaking at the mass of the $f_2'(1525)$. Needs confirmation.

$f_0(1525)$ MASS

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
≈ 1525 OUR ESTIMATE				
1447.8± 3.1 OUR AVERAGE				
1446 ± 5	ABATZIS	94	OMEG	450 $pp \to pp2(\pi^+\pi^-)$
1449 ± 4	ARMSTRONG	89E	OMEG	300 $pp \to pp2(\pi^+\pi^-)$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
1545 ±25	AMSLER	94E	CBAR	0.0 $\overline{p}p \to \pi^0\eta\eta'$
1520 ±25	[1] ANISOVICH	94	CBAR	0.0 $\overline{p}p \to 3\pi^0, \pi^0\eta\eta$
1505 ±20	[2] BUGG	94	RVUE	$\overline{p}p \to 3\pi^0, \eta\eta\pi^0, \eta\pi^0\pi^0$
1560 ±25	AMSLER	93C	CBAR	0.0 $\overline{p}p \to \pi^0\eta\eta$
~ 1525	ASTON	88D	LASS	11 $K^-p \to K_S^0K_S^0\Lambda$
~ 1525	BAUBILLIER	83		8 $K^-p \to K^+K^-\Lambda$

[1] From a simultaneous analysis of the annihilations $\overline{p}p \to 3\pi^0, \pi^0\eta\eta$. Supersedes AMSLER 93C.

[2] Reanalysis of ANISOVICH 94 data.

$f_0(1525)$ WIDTH

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
63±10 OUR AVERAGE				
56±12	ABATZIS	94	OMEG	450 $pp \to pp2(\pi^+\pi^-)$
78±18	ARMSTRONG	89E	OMEG	300 $pp \to pp2(\pi^+\pi^-)$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
100±40	AMSLER	94E	CBAR	0.0 $\overline{p}p \to \pi^0\eta\eta'$
148^{+20}_{-25}	[3] ANISOVICH	94	CBAR	0.0 $\overline{p}p \to 3\pi^0, \pi^0\eta\eta$
150±20	[4] BUGG	94	RVUE	$\overline{p}p \to 3\pi^0, \eta\eta\pi^0, \eta\pi^0\pi^0$
245±50	AMSLER	93C	CBAR	0.0 $\overline{p}p \to \pi^0\eta\eta$
~ 90	BAUBILLIER	83		8 $K^-p \to K^+K^-\Lambda$

[3] From a simultaneous analysis of the annihilations $\overline{p}p \to 3\pi^0, \pi^0\eta\eta$. Supersedes AMSLER 93C.

[4] Reanalysis of ANISOVICH 94 data.

$f_0(1525)$ REFERENCES

ABATZIS	94	PL B324 509	+Antinori, Barberis+	(ATHU, BARI, BIRM, CERN, JINR)JP
AMSLER	94E	PL B340 259	+Armstrong+	(Crystal Barrel Collab.)
ANISOVICH	94	PL B323 233	+Armstrong+	(Crystal Barrel Collab.)
BUGG	94	PR D50 4412	+Anisovich+	(LOQM)
AMSLER	93C	NP A558 3C	+Augustin+	(Crystal Barrel Collab.)
ARMSTRONG	89E	PL B228 536	+Benayoun	(ATHU, BARI, BIRM, CERN, CDEF, CURIN+)
ASTON	88D	NP B301 525	+Awaji, Bienz+	(SLAC, NAGO, CINC, INUS)
BAUBILLIER	83	ZPHY C17 309	+	(BIRM, CERN, GLAS, MSU, CURIN)

$f_0(1590)$

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

See also the mini-review under non-$q\overline{q}$ candidates. (See the index for the page number.)

$f_0(1590)$ MASS

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	COMMENT
1581 ±10 OUR AVERAGE					
1560 ±25		[1] AMSLER	92	CBAR	0.0 $\overline{p}p \rightarrow \eta\eta\pi^0$
1550 ±45 ±30		BELADIDZE	92C	VES	36 π^- Be $\rightarrow \pi^-\eta'\eta$ Be
1610 ±20		ALDE	88	GAM4	300 $\pi^- N \rightarrow \pi^- N 2\eta$
1570 ±20	600±70	ALDE	87	GAM4	100 $\pi^- p \rightarrow 4\pi^0 n$
1575.0±45.0		[2] ALDE	86D	GAM4	100 $\pi^- p \rightarrow 2\eta n$
1568.0±33.0		BINON	84C	GAM2	38 $\pi^- p \rightarrow \eta\eta' n$
1592.0±25.0		BINON	83	GAM2	38 $\pi^- p \rightarrow 2\eta n$

[1] The error is mostly systematic.
[2] From central value and spread of two solutions.

$f_0(1590)$ WIDTH

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	COMMENT
180 ±17 OUR AVERAGE Error includes scale factor of 1.2.					
245 ±50		[3] AMSLER	92	CBAR	0.0 $\overline{p}p \rightarrow \eta\eta\pi^0$
153 ±67 ±50		BELADIDZE	92C	VES	36 π^- Be $\rightarrow \pi^-\eta'\eta$ Be
170 ±40		ALDE	88	GAM4	300 $\pi^- N \rightarrow \pi^- N 2\eta$
150 ±20	600±70	ALDE	87	GAM4	100 $\pi^- p \rightarrow 4\pi^0 n$
265.0±65.0		[4] ALDE	86D	GAM4	100 $\pi^- p \rightarrow 2\eta n$
260.0±60.0		BINON	84C	GAM2	38 $\pi^- p \rightarrow \eta\eta' n$
210.0±40.0		BINON	83	GAM2	38 $\pi^- p \rightarrow 2\eta n$

[3] The error is mostly systematic.
[4] From central value and spread of two solutions.

$f_0(1590)$ DECAY MODES

	Mode	Fraction (Γ_i/Γ)
Γ_1	$\eta\eta'(958)$	dominant
Γ_2	$\eta\eta$	large
Γ_3	$4\pi^0$	large
Γ_4	$\pi^0\pi^0$	
Γ_5	$K\overline{K}$	

$f_0(1590)$ BRANCHING RATIOS

$\Gamma(\eta\eta'(958))/\Gamma(\eta\eta)$ — Γ_1/Γ_2

VALUE	DOCUMENT ID		TECN	COMMENT
2.7±0.8	BINON	84C	GAM2	38 $\pi^- p \rightarrow \eta\eta' n$

$\Gamma(\eta\eta)/\Gamma_{total}$ — Γ_2/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
large	ALDE	88	GAM4	300 $\pi^- N \rightarrow \eta\eta\pi^- N$
large	BINON	83	GAM2	38 $\pi^- p \rightarrow 2\eta n$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
not seen	[5] ANISOVICH	94B	RVUE	$\overline{p}p \rightarrow \eta\eta\pi^0$

[5] ANISOVICH 94B uses ANISOVICH 94 data.

$\Gamma(4\pi^0)/\Gamma(\eta\eta)$ — Γ_3/Γ_2

VALUE	DOCUMENT ID		TECN	COMMENT
0.8 ±0.3	ALDE	87	GAM4	100 $\pi^- p \rightarrow 4\pi^0 n$

$\Gamma(\pi^0\pi^0)/\Gamma(\eta\eta)$ — Γ_4/Γ_2

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
<0.17	90	PROKOSHKIN 90	GAM4	300 $\pi^- p \to \pi^- 2\pi^0 p$
<0.3		[6] BINON 83	GAM2	38 $\pi^- p \to 2\eta n$

[6] Superseded by PROKOSHKIN 90.

$\Gamma(K\overline{K})/\Gamma(\eta\eta)$ — Γ_5/Γ_2

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<0.6		BINON 83	GAM2	38 $\pi^- p \to 2\eta n$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
<0.4	90	[7] PROKOSHKIN 91	GAM4	300 $\pi^- p \to \pi^- p\eta\eta$

[7] Combining results of GAM4 with those of WA76 on $K\overline{K}$ central production.

$f_0(1590)$ REFERENCES

ANISOVICH 94 PL B323 233 +Armstrong+ (Crystal Barrel Collab.)
ANISOVICH 94B PR D50 1972 +Bugg+ (LOQM)
AMSLER 92 PL B291 347 +Augustin, Baker+ (Crystal Barrel Collab.)
BELADIDZE 92C SJNP 55 1535 +Bityukov, Borisov (VES Collab.)JPC
Translated from YAF 55 2748.
PROKOSHKIN 91 SPD 316 155 (GAM2 Collab.)
Translated from DANS 316 900.
PROKOSHKIN 90 Hadron 89 Conf. p 27 (SERP, BELG, LANL, LAPP, PISA, KEK)
ALDE 88 PL B201 160 +Bellazzini, Binon+ (SERP, BELG, LANL, LAPP, PISA) JP
ALDE 87 PL B198 286 +Binon, Bricman+ (LANL, BRUX, SERP, LAPP)
ALDE 86D NP B269 485 +Binon, Bricman+ (BELG, LAPP, SERP, CERN) IGJP
BINON 84C NC 80A 363 +Bricman, Donskov+ (BELG, LAPP, SERP, CERN)
BINON 83 NC 78A 313 +Donskov, Duteil+ (BELG, LAPP, SERP, CERN) IGJP
Also 83B SJNP 38 561 Binon, Gouanere+ (BELG, LAPP, SERP, CERN)
Translated from YAF 38 934.

OTHER RELATED PAPERS

SLAUGHTER 88 MPL A3 1361 (LANL)

$\omega(1600)$

$I^G(J^{PC}) = 0^-(1^{--})$

See also $\omega(1420)$.

$\omega(1600)$ MASS

VALUE (MeV)	EVTS	DOCUMENT ID	TECN	CHG	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
1600 ±30		[1] CLEGG 94	RVUE		$e^+e^- \to \rho\pi$
1607 ±10		[2] CLEGG 94	RVUE		$e^+e^- \to \omega\pi\pi$
1609 ±20	315	[1] ANTONELLI 92	DM2		1.34–2.4$e^+e^- \to \rho\pi$
1663 ±12	435	[2] ANTONELLI 92	DM2		1.34–2.4$e^+e^- \to \omega\pi\pi$
1670 ±20		ATKINSON 83B	OMEG		20–70 $\gamma p \to 3\pi X$
1657 ±13		CORDIER 81	DM1		$e^+e^- \to \omega 2\pi$
1679 ±34	21	ESPOSITO 80	FRAM		$e^+e^- \to 3\pi$
1652.0±17.0		COSME 79	OSPK	0	$e^+e^- \to 3\pi$

[1] From a two Breit-Wigner fit.
[2] From a single Breit-Wigner plus background fit.

$\omega(1600)$ WIDTH

VALUE (MeV)	EVTS	DOCUMENT ID	TECN	CHG	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
140 ±50		[3] CLEGG 94	RVUE		$e^+e^- \to \rho\pi$

86 ±20		[4] CLEGG	94	RVUE	$e^+ e^- \rightarrow \omega\pi\pi$
159 ±43	315	[3] ANTONELLI	92	DM2	1.34–2.4 $e^+ e^- \rightarrow \rho\pi$
240 ±25	435	[4] ANTONELLI	92	DM2	1.34–2.4 $e^+ e^- \rightarrow \omega\pi\pi$
160 ±20		ATKINSON	83B	OMEG	20–70 $\gamma p \rightarrow 3\pi X$
136 ±46		CORDIER	81	DM1	$e^+ e^- \rightarrow \omega 2\pi$
99 ±49	21	ESPOSITO	80	FRAM	$e^+ e^- \rightarrow 3\pi$
42.0±17.0		COSME	79	OSPK 0	$e^+ e^- \rightarrow 3\pi$

[3] From a two Breit-Wigner fit.
[4] From a single Breit-Wigner plus background fit.

$\omega(1600)$ DECAY MODES

	Mode	Fraction (Γ_i/Γ)
Γ_1	$\rho\pi$	seen
Γ_2	$\omega\pi\pi$	seen
Γ_3	$e^+ e^-$	seen

$\omega(1600)$ $\Gamma(i)\Gamma(e^+ e^-)/\Gamma(\text{total})$

$\Gamma(\rho\pi) \times \Gamma(e^+ e^-)/\Gamma_{\text{total}}$ $\Gamma_1\Gamma_3/\Gamma$

VALUE (eV)	EVTS	DOCUMENT ID		TECN	COMMENT
134±14	435	[5] ANTONELLI	92	DM2	1.34–2.4 $e^+ e^- \rightarrow$ hadrons
• • • We do not use the following data for averages, fits, limits, etc. • • •					
93±27	315	ANTONELLI	92	DM2	1.34–2.4 $e^+ e^- \rightarrow \rho\pi$
96±35		DONNACHIE	89	RVUE	$e^+ e^- \rightarrow \rho\pi$

[5] From a coupled fit of $\rho\pi$ and $\omega\pi\pi$ channels.

$\Gamma(\omega\pi\pi) \times \Gamma(e^+ e^-)/\Gamma_{\text{total}}$ $\Gamma_2\Gamma_3/\Gamma$

VALUE (keV)	EVTS	DOCUMENT ID		TECN	COMMENT
170±17	435	[6] ANTONELLI	92	DM2	1.34–2.4 $e^+ e^- \rightarrow$ hadrons
• • • We do not use the following data for averages, fits, limits, etc. • • •					
135±16	435	[7] ANTONELLI	92	DM2	1.34–2.4 $e^+ e^- \rightarrow \omega\pi\pi$
56±31		DONNACHIE	89	RVUE	$e^+ e^- \rightarrow \omega 2\pi$

[6] From a coupled fit of $\rho\pi$ and $\omega\pi\pi$ channels.
[7] From a single Breit-Wigner fit.

$\omega(1600)$ REFERENCES

CLEGG 94 ZPHY C62 455 +Donnachie (LANC, MCHS)
ANTONELLI 92 ZPHY C56 15 +Baldini+ (DM2 Collab.)
DONNACHIE 89 ZPHY C42 663 +Clegg (CERN, MCHS)
ATKINSON 83B PL 127B 132 + (BONN, CERN, GLAS, LANC, MCHS, CURIN+)
CORDIER 81 PL 106B 155 +Bisello, Bizot, Buon, Delcourt, Mane (ORSAY)
ESPOSITO 80 LNC 28 195 +Marini, Patteri+ (FRAS, NAPL, PADO, ROMA)
COSME 79 NP B152 215 +Dudelzak, Grelaud, Jean-Marie, Jullian+ (IPN)

OTHER RELATED PAPERS

ATKINSON 87 ZPHY C34 157 + (BONN, CERN, GLAS, LANC, MCHS, CURIN)
ATKINSON 84 NP B231 15 + (BONN, CERN, GLAS, LANC, MCHS, CURIN+)

$X(1600)$

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

OMITTED FROM SUMMARY TABLE

Observed in the reaction $\gamma\gamma \rightarrow \rho^0\rho^0$ near threshold. The large ratio of cross-sections $\sigma(\gamma\gamma \rightarrow \rho^0\rho^0)$ / $\sigma(\gamma\gamma \rightarrow \rho^+\rho^-) \approx 4$ and the dominance of the $J^P = 2^+$ wave in the reaction $\gamma\gamma \rightarrow \rho^0\rho^0$ is a signature consistent with the production of an exotic ($I = 2$) resonance. Needs confirmation.

$X(1600)$ MASS

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*CHG*	*COMMENT*
1600±100	[1] ALBRECHT	91F	ARG	0	10.2 $e^+e^- \rightarrow e^+e^-2(\pi^+\pi^-)$

[1] Our estimate.

$X(1600)$ WIDTH

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*CHG*	*COMMENT*
400±200	[2] ALBRECHT	91F	ARG	0	10.2 $e^+e^- \rightarrow e^+e^-2(\pi^+\pi^-)$

[2] Our estimate.

$X(1600)$ REFERENCES

ALBRECHT 91F ZPHY C50 1 +Appuan, Paulini, Funk+ (ARGUS Collab.)

OTHER RELATED PAPERS

ALBRECHT 89M PL B217 205 +Bockmann+ (ARGUS Collab.)
BEHREND 89D PL B218 494 +Criegee+ (CELLO Collab.)

$f_2(1640)$

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

OMITTED FROM SUMMARY TABLE

Needs confirmation.

$f_2(1640)$ MASS

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
• • • We do not use the following data for averages, fits, limits, etc. • • •				
1647± 7	ADAMO	92	OBLX	$\overline{n}p \rightarrow 3\pi^+2\pi^-$
1590±30	BELADIDZE	92B	VES	36 $\pi^-p \rightarrow \omega\omega n$
1635± 7	ALDE	90	GAM2	38 $\pi^-p \rightarrow n\omega\omega$

$f_2(1640)$ WIDTH

VALUE (MeV)	*CL%*	*DOCUMENT ID*		*TECN*	*COMMENT*
• • • We do not use the following data for averages, fits, limits, etc. • • •					
58±20		ADAMO	92	OBLX	$\overline{n}p \rightarrow 3\pi^+2\pi^-$
100±20		BELADIDZE	92B	VES	36 $\pi^-p \rightarrow \omega\omega n$
< 70	90	ALDE	90	GAM2	38 $\pi^-p \rightarrow n\omega\omega$

$f_2(1640)$ DECAY MODES

	Mode	Fraction (Γ_i/Γ)
Γ_1	$\omega\omega$	seen

$f_2(1640)$ BRANCHING RATIOS

$\Gamma(\omega\omega)/\Gamma_{total}$ **Γ_1/Γ**

VALUE	*DOCUMENT ID*		*TECN*	*COMMENT*
seen	ALDE	89B	GAM2	38 $\pi^-p \rightarrow n\omega\omega$

$f_2(1640)$ REFERENCES

ADAMO	92	PL B287 368	+Agnello, Balestra+	(OBELIX Collab.)
BELADIDZE	92B	ZPHY C54 367	+Bityukov, Borisov+	(VES Collab.)
ALDE	90	PL B241 600	+Binon+	(SERP, BELG, LANL, LAPP, PISA, KEK)
ALDE	89B	PL B216 451	+Binon, Bricman+	(SERP, BELG, LANL, LAPP, TBIL) IGJPC

$\omega_3(1670)$

$I^G(J^{PC}) = 0^-(3^{--})$

$\omega_3(1670)$ MASS

VALUE (MeV)	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
1668 ± 5 OUR AVERAGE					
1685.0±20.0	60	BAUBILLIER	79	HBC	8.2 $K^- p$ backward
1673.0±12.0	430	[1,2] BALTAY	78E	HBC	15 $\pi^+ p \rightarrow \Delta 3\pi$
1650.0±12.0		CORDEN	78B	OMEG	8–12 $\pi^- p \rightarrow N 3\pi$
1669 ±11	600	[2] WAGNER	75	HBC	7 $\pi^+ p \rightarrow \Delta^{++} 3\pi$
1678 ±14	500	DIAZ	74	DBC	6 $\pi^+ n \rightarrow p 3\pi^0$
1660 ±13	200	DIAZ	74	DBC	6 $\pi^+ n \rightarrow p \omega \pi^0 \pi^0$
1679 ±17	200	MATTHEWS	71D	DBC	7.0 $\pi^+ n \rightarrow p 3\pi^0$
1670 ±20		KENYON	69	DBC	8 $\pi^+ n \rightarrow p 3\pi^0$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
~1700.0	110	[1] CERRADA	77B	HBC	4.2 $K^- p \rightarrow \Lambda 3\pi$
1695.0±20.0		BARNES	69B	HBC	4.6 $K^- p \rightarrow \omega 2\pi X$
1636 ±20		ARMENISE	68B	DBC	5.1 $\pi^+ n \rightarrow p 3\pi^0$

[1] Phase rotation seen for $J^P = 3^-$ $\rho\pi$ wave.
[2] From a fit to $I(J^P) = 0(3^-)$ $\rho\pi$ partial wave.

$\omega_3(1670)$ WIDTH

VALUE (MeV)	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
173 ±11 OUR AVERAGE					
160.0±80.0	60	[3] BAUBILLIER	79	HBC	8.2 $K^- p$ backward
173.0±16.0	430	[4,5] BALTAY	78E	HBC	15 $\pi^+ p \rightarrow \Delta 3\pi$
253.0±39.0		CORDEN	78B	OMEG	8–12 $\pi^- p \rightarrow N 3\pi$
173 ±28	600	[3,5] WAGNER	75	HBC	7 $\pi^+ p \rightarrow \Delta^{++} 3\pi$
167 ±40	500	DIAZ	74	DBC	6 $\pi^+ n \rightarrow p 3\pi^0$
122 ±39	200	DIAZ	74	DBC	6 $\pi^+ n \rightarrow p \omega \pi^0 \pi^0$
155 ±40	200	[3] MATTHEWS	71D	DBC	7.0 $\pi^+ n \rightarrow p 3\pi^0$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
90 ±20		BARNES	69B	HBC	4.6 $K^- p \rightarrow \omega 2\pi$
100 ±40		KENYON	69	DBC	8 $\pi^+ n \rightarrow p 3\pi^0$
112 ±60		ARMENISE	68B	DBC	5.1 $\pi^+ n \rightarrow p 3\pi^0$

[3] Width errors enlarged by us to $4\Gamma/\sqrt{N}$; see the note with the $K^*(892)$ mass.
[4] Phase rotation seen for $J^P = 3^-$ $\rho\pi$ wave.
[5] From a fit to $I(J^P) = 0(3^-)$ $\rho\pi$ partial wave.

$\omega_3(1670)$ DECAY MODES

	Mode	Fraction (Γ_i/Γ)
Γ_1	$\rho\pi$	seen
Γ_2	$\omega\pi\pi$	seen
Γ_3	$b_1(1235)\pi$	possibly seen

$\omega_3(1670)$ BRANCHING RATIOS

$\Gamma(\omega\pi\pi)/\Gamma(\rho\pi)$ — Γ_2/Γ_1

VALUE	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.71±0.27	100	DIAZ	74	DBC	6 $\pi^+ n \rightarrow p 5\pi^0$

$\Gamma(b_1(1235)\pi)/\Gamma(\rho\pi)$ — Γ_3/Γ_1

VALUE	DOCUMENT ID		TECN	COMMENT
possibly seen	DIAZ	74	DBC	$6\ \pi^+ n \rightarrow p 5\pi^0$

$\Gamma(b_1(1235)\pi)/\Gamma(\omega\pi\pi)$ — Γ_3/Γ_2

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
>0.75	68	BAUBILLIER	79	HBC	$8.2\ K^- p$ backward

ω_3(1670) REFERENCES

BAUBILLIER	79	PL 89B 131	+	(BIRM, CERN, GLAS, MSU, ORSAY)
BALTAY	78E	PRL 40 87	+Cautis, Kalelkar	(COLU) JP
CORDEN	78B	NP B138 235	+Corbett, Alexander+	(BIRM, RHEL, TELA, LOWC)
CERRADA	77B	NP B126 241	+Blockzijl, Heinen+	(AMST, CERN, NIJM, OXF) JP
WAGNER	75	PL 58B 201	+Tabak, Chew	(LBL) JP
DIAZ	74	PRL 32 260	+Dibianca, Fickinger, Anderson+	(CASE, CMU)
MATTHEWS	71D	PR D3 2561	+Prentice, Yoon, Carroll+	(TNTO, WISC)
BARNES	69B	PRL 23 142	+Chung, Eisner, Flaminio+	(BNL)
KENYON	69	PRL 23 146	+Kinson, Scarr+	(BNL, UCND, ORNL)
ARMENISE	68B	PL 26B 336	+Forino, Cartacci+	(BARI, BGNA, FIRZ, ORSAY)

OTHER RELATED PAPERS

MATTHEWS	71	LNC 1 361	+Prentice, Yoon, Carroll+	(TNTO, WISC)
ARMENISE	70	LNC 4 199	+Ghidini, Foring, Cartacci+	(BARI, BGNA, FIRZ)

$\pi_2(1670)$

$I^G(J^{PC}) = 1^-(2^{-+})$

Our latest mini-review on this particle can be found in the 1984 edition.

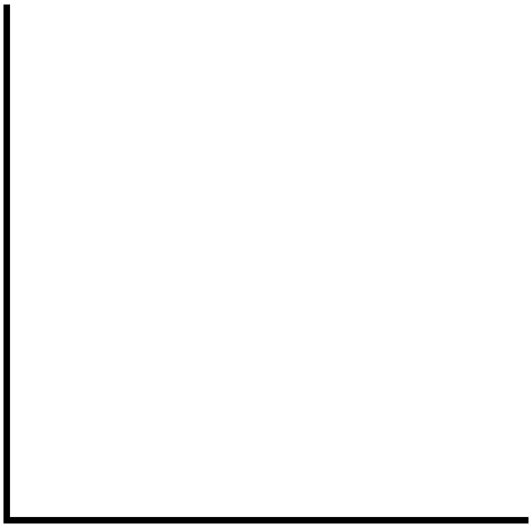
π_2(1670) MASS

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	CHG	COMMENT
1670 ±20	**OUR ESTIMATE**	This is only an educated guess; the error given is larger than the error on the average of the published values.				
1674 ± 6	**OUR AVERAGE**	Error includes scale factor of 1.4. See the ideogram below.				
1690 ±14		[1] BERDNIKOV	94	VES		$37\ \pi^- A \rightarrow K^+ K^- \pi^- A$
1710 ±20	700±150	ANTIPOV	87	SIGM	−	$50\ \pi^-$ Cu $\rightarrow \mu^+ \mu^- \pi^-$ Cu
1676 ± 6		[1] EVANGELISTA	81	OMEG	−	$12\ \pi^- p \rightarrow 3\pi p$
1657.0±14.0		[1,2] DAUM	80D	SPEC	−	63–94 $\pi p \rightarrow 3\pi X$
1662.0±10.0	2000	[1] BALTAY	77	HBC	+	$15\ \pi^+ p \rightarrow p 3\pi$
• • • We do not use the following data for averages, fits, limits, etc. • • •						
1742 ±31 ±49		ANTREASYAN	90	CBAL		$e^+ e^- \rightarrow e^+ e^- \pi^0 \pi^0 \pi^0$
1710.0±20.0		[3] DAUM	81B	SPEC	−	63,94 $\pi^- p$
1640 ±10	575	KALELKAR	75	HBC	+	$15\ \pi^+ p \rightarrow p \pi^+ f_2$
1660 ±10		[1] ASCOLI	73	HBC	−	5–25 $\pi^- p \rightarrow p \pi_2$

[1] From a fit to $J^P = 2^-$ S-wave $f_2(1270)\pi$ partial wave.

[2] Clear phase rotation seen in $2^- S$, $2^- P$, $2^- D$ waves. We quote central value and spread of single-resonance fits to three channels.

[3] From a two-resonance fit to four $2^- 0^+$ waves. This should not be averaged with all the single resonance fits.



$\pi_2(1670)$ mass (MeV)

$\pi_2(1670)$ WIDTH

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	CHG	COMMENT
236 ±14 OUR AVERAGE						
190 ±50		[4] BERDNIKOV	94	VES		37 $\pi^- A \rightarrow K^+ K^- \pi^- A$
170 ±80	700±150	ANTIPOV	87	SIGM	−	50 π^- Cu $\rightarrow \mu^+ \mu^- \pi^-$ Cu
260 ±20		[4] EVANGELISTA	81	OMEG	−	12 $\pi^- p \rightarrow 3\pi p$
219.0±20.0		[4,5] DAUM	80D	SPEC	−	63–94 $\pi p \rightarrow 3\pi X$
285.0±60.0	2000	[4] BALTAY	77	HBC	+	15 $\pi^+ p \rightarrow p 3\pi$
• • • We do not use the following data for averages, fits, limits, etc. • • •						
236 ±49 ±36		ANTREASYAN	90	CBAL		$e^+ e^- \rightarrow e^+ e^- \pi^0 \pi^0 \pi^0$
312.0±50.0		[6] DAUM	81B	SPEC	−	63,94 $\pi^- p$
240 ±30	575	KALELKAR	75	HBC	+	15 $\pi^+ p \rightarrow p \pi^+ f_2$
270 ±60		[4] ASCOLI	73	HBC	−	5–25 $\pi^- p \rightarrow p \pi_2$

[4] From a fit to $J^P = 2^-$ $f_2(1270)\pi$ partial wave.

[5] Clear phase rotation seen in $2^- S$, $2^- P$, $2^- D$ waves. We quote central value and spread of single-resonance fits to three channels.

[6] From a two-resonance fit to four $2^- 0^+$ waves. This should not be averaged with all the single resonance fits.

$\pi_2(1670)$ DECAY MODES

	Mode	Fraction (Γ_i/Γ)
Γ_1	$f_2(1270)\pi$	(56.2±3.2) %
Γ_2	$\pi^\pm \pi^+ \pi^-$	(53 ±4) %
Γ_3	$\rho\pi$	(31 ±4) %
Γ_4	$f_0(1300)\pi$	(8.7±3.4) %
Γ_5	$K\overline{K}^*(892)+$ c.c.	(4.2±1.4) %
Γ_6	$\gamma\gamma$	(5.7±1.1) $\times 10^{-6}$
Γ_7	$\eta\pi$	< 5 %
Γ_8	$\pi^\pm 2\pi^+ 2\pi^-$	< 5 %

CONSTRAINED FIT INFORMATION

An overall fit to 4 branching ratios uses 6 measurements and one constraint to determine 4 parameters. The overall fit has a $\chi^2 =$ 1.9 for 3 degrees of freedom.

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

x_3	−53		
x_4	−29	−59	
x_5	−8	−21	−9
	x_1	x_3	x_4

$\pi_2(1670)$ PARTIAL WIDTHS

$\Gamma(\gamma\gamma)$ Γ_6

VALUE (keV)	DOCUMENT ID		TECN	CHG	COMMENT
1.35±0.26 OUR AVERAGE					
1.41±0.23±0.28	ANTREASYAN	90	CBAL	0	$e^+e^- \rightarrow e^+e^-\pi^0\pi^0\pi^0$
1.3 ±0.3 ±0.2	[7] BEHREND	90C	CELL	0	$e^+e^- \rightarrow e^+e^-\pi^+\pi^-\pi^0$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.8 ±0.3 ±0.12	[8] BEHREND	90C	CELL	0	$e^+e^- \rightarrow e^+e^-\pi^+\pi^-\pi^0$

[7] Incoherent Ansatz.
[8] Constructive interference between $f_2(1270)$, $\rho\pi$ and background.

$\pi_2(1670)$ BRANCHING RATIOS

$\Gamma(\rho\pi)/\Gamma(\pi^\pm\pi^+\pi^-)$ $\frac{1}{2}\Gamma_3/\Gamma_2 = \frac{1}{2}\Gamma_3/(0.567\Gamma_1+\frac{1}{2}\Gamma_3+0.624\Gamma_4)$

VALUE	DOCUMENT ID		TECN	CHG	COMMENT
0.29±0.04 OUR FIT					
0.29±0.05	[9] DAUM	81B	SPEC		63,94 $\pi^- p$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<0.3	BARTSCH	68	HBC	+	8 $\pi^+ p \rightarrow 3\pi p$
<0.4	FERBEL	68	RVUE	±	

[9] From a two-resonance fit to four 2^-0^+ waves.

$\Gamma(f_2(1270)\pi)/\Gamma(\pi^\pm\pi^+\pi^-)$ $0.567\Gamma_1/\Gamma_2 = 0.567\Gamma_1/(0.567\Gamma_1+\frac{1}{2}\Gamma_3+0.624\Gamma_4)$

(With $f_2(1270) \rightarrow \pi^+\pi^-$.)

VALUE	DOCUMENT ID		TECN	CHG	COMMENT
0.604±0.035 OUR FIT					
0.60 ±0.05 OUR AVERAGE	Error includes scale factor of 1.3. See the ideogram below.				
0.61 ±0.04	[10] DAUM	81B	SPEC		63,94 $\pi^- p$
0.76 $^{+0.24}_{-0.34}$	ARMENISE	69	DBC	+	5.1 $\pi^+ d \rightarrow d3\pi$
0.35 ±0.20	BALTAY	68	HBC	+	7–8.5 $\pi^+ p$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.59	BARTSCH	68	HBC	+	8 $\pi^+ p \rightarrow 3\pi p$

[10] From a two-resonance fit to four 2^-0^+ waves.

$\Gamma\left(f_2(1270)\,\pi\right)/\Gamma\left(\pi^{\pm}\,\pi^{+}\,\pi^{-}\right)$

$\Gamma(\eta\pi)/\Gamma(\pi^{\pm}\pi^{+}\pi^{-})$ $\quad\Gamma_7/\Gamma_2 = \Gamma_7/(0.567\Gamma_1+\frac{1}{2}\Gamma_3+0.624\Gamma_4)$

(All η decays.)

VALUE	DOCUMENT ID		TECN	CHG	COMMENT
<0.09	BALTAY	68	HBC	+	7–8.5 $\pi^+ p$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<0.10	CRENNELL	70	HBC	−	6 $\pi^- p \to f_2 \pi^- N$

$\Gamma(\pi^{\pm}2\pi^{+}2\pi^{-})/\Gamma(\pi^{\pm}\pi^{+}\pi^{-})$ $\quad\Gamma_8/\Gamma_2 = \Gamma_8/(0.567\Gamma_1+\frac{1}{2}\Gamma_3+0.624\Gamma_4)$

VALUE	DOCUMENT ID		TECN	CHG	COMMENT
<0.10	CRENNELL	70	HBC	−	6 $\pi^- p \to f_2 \pi^- N$
<0.1	BALTAY	68	HBC	+	7,8.5 $\pi^+ p$

$\Gamma(f_0(1300)\pi)/\Gamma(\pi^{\pm}\pi^{+}\pi^{-})$ $\quad 0.624\Gamma_4/\Gamma_2 = 0.624\Gamma_4/(0.567\Gamma_1+\frac{1}{2}\Gamma_3+0.624\Gamma_4)$

(With $f_0(1300) \to \pi^+\pi^-$.)

VALUE	DOCUMENT ID		TECN	COMMENT
0.10±0.04 OUR FIT				
0.10±0.05	[11] DAUM	81B	SPEC	63,94 $\pi^- p$

[11] From a two-resonance fit to four 2^-0^+ waves.

$\Gamma(K\overline{K}^*(892)+\text{c.c.})/\Gamma(f_2(1270)\pi)$ $\quad\Gamma_5/\Gamma_1$

VALUE	DOCUMENT ID		TECN	CHG	COMMENT
0.075±0.025 OUR FIT					
0.075±0.025	[12] ARMSTRONG	82B	OMEG	−	16 $\pi^- p \to K^+ K^- \pi^- p$

[12] From a partial-wave analysis of $K^+ K^- \pi^-$ system.

D-wave/S-wave RATIO FOR $\pi_2(1670) \to f_2(1270)\pi$

VALUE	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.22±0.10	[13] DAUM	81B	SPEC	63,94 $\pi^- p$

[13] From a two-resonance fit to four 2^-0^+ waves.

$\pi_2(1670)$ REFERENCES

BERDNIKOV	94	PL B337 219	+Bityukov+	(SERP)
ANTREASYAN	90	ZPHY C48 561	+Bartels, Besset+	(Crystal Ball Collab.)
BEHREND	90C	ZPHY C46 583	+Criegee+	(CELLO Collab.)
ANTIPOV	87	EPL 4 403	+Batarin+	(SERP, JINR, INRM, TBIL, BGNA, MILA)
ARMSTRONG	82B	NP B202 1	+Baccari	(AACH3, BARI, BONN, CERN, GLAS+)
DAUM	81B	NP B182 269	+Hertzberger+	(AMST, CERN, CRAC, MPIM, OXF+)
EVANGELISTA	81	NP B178 197	+	(BARI, BONN, CERN, DARE, LIVP+)
Also	81B	NP B186 594	Evangelista	
DAUM	80D	PL 89B 285	+Hertzberger+	(AMST, CERN, CRAC, MPIM, OXF+) JP
BALTAY	77	PRL 39 591	+Cautis, Kalelkar	(COLU) JP
KALELKAR	75	Thesis Nevis 207		(COLU)
ASCOLI	73	PR D7 669		(ILL, TNTO, GENO, HAMB, MILA, SACL) JP
CRENNELL	70	PRL 24 781	+Karshon, Lai, Scarr, Sims	(BNL)
ARMENISE	69	LNC 2 501	+Ghidini, Forino, Cartacci+	(BARI, BGNA, FIRZ)
BALTAY	68	PRL 20 887	+Kung, Yeh, Ferbel+	(COLU, ROCH, RUTG, YALE) I
BARTSCH	68	NP B7 345	+Keppel, Kraus+	(AACH, BERL, CERN) JP
FERBEL	68	Phil. Conf. 335		(ROCH)

OTHER RELATED PAPERS

CHEN	83B	PR D28 2304	+Fenker+	(ARIZ, FNAL, FLOR, NDAM, TUFTS+)
LEEDOM	83	PR D27 1426	+DeBonte, Gaidos, Key, Wong+	(PURD, TNTO)
BELLINI	82B	NP B199 1	+	(CERN, MILA, JINR, BGNA, HELS, PAVI, WARS+)
FOCACCI	66	PRL 17 890	+Kienzle, Levrat, Maglich, Martin	(CERN)
LEVRAT	66	PL 22 714	+Tolstrup+	(CERN Missing Mass Spect. Collab.)
LUBATTI	66	Thesis Berkeley		(LRL)
VETLITSKY	66	PL 21 579	+Guszavin, Kliger, Zolganov+	(ITEP)
FORINO	65B	PL 19 68	+Gessaroli+	(BGNA, BARI, FIRZ, ORSAY, SACL)

$\phi(1680)$

$I^G(J^{PC}) = 0^-(1^{--})$

First identified using Dalitz plot analysis of $e^+e^- \to K K^*(892)$ (BIZOT 80, DELCOURT 81). We do not list anymore ω radial excitations under this particle. See also $\omega(1420)$ and $\omega(1600)$.

$\phi(1680)$ MASS

e^+e^- PRODUCTION

VALUE (MeV)	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
1680±50 OUR ESTIMATE		This is only an educated guess; the error given is larger than the error on the average of the published values.			
• • • We do not use the following data for averages, fits, limits, etc. • • •					
1700±20		[1] CLEGG	94	RVUE	$e^+e^- \to K^+K^-$, $K^0_S K\pi$
1657±27	367	BISELLO	91C	DM2	$e^+e^- \to K^0_S K^\pm \pi^\mp$
1655±17		[2] BISELLO	88B	DM2	$e^+e^- \to K^+K^-$
1680±10		[3] BUON	82	DM1	$e^+e^- \to$ hadrons
1677±12		[4] MANE	82	DM1	$e^+e^- \to K^0_S K\pi$

[1] Using BISELLO 88B and MANE 82 data.

PHOTOPRODUCTION

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
• • • We do not use the following data for averages, fits, limits, etc. • • •				
1726±22	BUSENITZ	89	TPS	$\gamma p \to K^+K^-X$
1760±20	ATKINSON	85C	OMEG	20–70 $\gamma p \to K\overline{K}X$
1690±10	ASTON	81F	OMEG	25–70 $\gamma p \to K^+K^-X$

[2] From global fit including ρ, ω, ϕ and $\rho(1700)$ assume mass 1570 MeV and width 510 MeV for ρ radial excitation.

[3] From global fit of ρ, ω, ϕ and their radial excitations to channels $\omega\pi^+\pi^-$, K^+K^-, $K^0_S K^0_L$, $K^0_S K^\pm\pi^\mp$. Assume mass 1570 MeV and width 510 MeV for ρ radial excitations, mass 1570 and width 500 MeV for ω radial excitation.

[4] Fit to one channel only, neglecting interference with ω, $\rho(1700)$.

$\phi(1680)$ WIDTH

e^+e^- PRODUCTION

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	COMMENT
150±50 OUR ESTIMATE This is only an educated guess; the error given is larger than the error on the average of the published values.					
• • • We do not use the following data for averages, fits, limits, etc. • • •					
300±60		[5] CLEGG	94	RVUE	$e^+e^- \rightarrow K^+K^-$, $K^0_S K\pi$
146±55	367	BISELLO	91C	DM2	$e^+e^- \rightarrow K^0_S K^\pm \pi^\mp$
207±45		[6] BISELLO	88B	DM2	$e^+e^- \rightarrow K^+K^-$
185±22		[7] BUON	82	DM1	$e^+e^- \rightarrow$ hadrons
102±36		[8] MANE	82	DM1	$e^+e^- \rightarrow K^0_S K\pi$

[5] Using BISELLO 88B and MANE 82 data.

PHOTOPRODUCTION

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
121±47	BUSENITZ	89	TPS	$\gamma p \rightarrow K^+K^-X$
80±40	ATKINSON	85C	OMEG	20–70 $\gamma p \rightarrow K\overline{K}X$
100±40	ASTON	81F	OMEG	25–70 $\gamma p \rightarrow K^+K^-X$

[6] From global fit including ρ, ω, ϕ and $\rho(1700)$ assume mass 1570 MeV and width 510 MeV for ρ radial excitation.
[7] From global fit of ρ, ω, ϕ and their radial excitations to channels $\omega\pi^+\pi^-$, K^+K^-, $K^0_S K^0_L$, $K^0_S K^\pm\pi^\mp$. Assume mass 1570 MeV and width 510 MeV for ρ radial excitations, mass 1570 and width 500 MeV for ω radial excitation.
[8] Fit to one channel only, neglecting interference with ω, $\rho(1700)$.

$\phi(1680)$ DECAY MODES

	Mode	Fraction (Γ_i/Γ)
Γ_1	$K\overline{K}^*(892)+$ c.c.	dominant
Γ_2	$K^0_S K\pi$	seen
Γ_3	$K\overline{K}$	seen
Γ_4	e^+e^-	seen
Γ_5	$\omega\pi\pi$	not seen
Γ_6	$K^+K^-\pi^0$	

$\phi(1680)$ $\Gamma(i)\Gamma(e^+e^-)/\Gamma(\text{total})$

This combination of a partial width with the partial width into e^+e^- and with the total width is obtained from the integrated cross section into channel (I) in e^+e^- annihilation. We list only data that have not been used to determine the partial width $\Gamma(I)$ or the branching ratio $\Gamma(I)$/total.

$\Gamma(K\overline{K}^*(892)+\text{c.c.}) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$ $\qquad\Gamma_1\Gamma_4/\Gamma$

VALUE (keV)	EVTS	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.48±0.14	367	BISELLO	91C	DM2	$e^+e^- \rightarrow K^0_S K^\pm\pi^\mp$

$\phi(1680)$ BRANCHING RATIOS

$\Gamma(K\overline{K}^*(892)+\text{c.c.})/\Gamma(K^0_S K\pi)$ $\qquad\Gamma_1/\Gamma_2$

VALUE	DOCUMENT ID		TECN	COMMENT
dominant	MANE	82	DM1	$e^+e^- \rightarrow K^0_S K^\pm\pi^\mp$

$\Gamma(K\overline{K})/\Gamma(K\overline{K}^*(892)+\text{c.c.})$ $\qquad\Gamma_3/\Gamma_1$

VALUE	DOCUMENT ID		TECN	COMMENT
0.07 ±0.01	BUON	82	DM1	e^+e^-

$\Gamma(\omega\pi\pi)/\Gamma(K\overline{K}^*(892)+\text{c.c.})$ $\qquad\Gamma_5/\Gamma_1$

VALUE	DOCUMENT ID		TECN	COMMENT
<0.10	BUON	82	DM1	e^+e^-

$\phi(1680)$ REFERENCES

CLEGG	94	ZPHY C62 455	+Donnachie	(LANC, MCHS)
BISELLO	91C	ZPHY C52 227	+Busetto, Castro, Nigro, Pescara+	(DM2 Collab.)
BUSENITZ	89	PR D40 1	+Olszewski, Callahan+	(ILL, FNAL)
BISELLO	88B	ZPHY C39 13	+Busetto+	(PADO, CLER, FRAS, LALO)
ATKINSON	85C	ZPHY C27 233	+	(BONN, CERN, GLAS, LANC, MCHS, CURIN+)
BUON	82	PL 118B 221	+Bisello, Bizot, Cordier, Delcourt+	(LALO, MONP)
MANE	82	PL 112B 178	+Bisello, Bizot, Buon, Delcourt, Fayard+	(LALO)
ASTON	81F	PL 104B 231		(BONN, CERN, EPOL, GLAS, LANC, MCHS+)
DELCOURT	81	PL 99B 257	+Bisello, Bizot, Buon, Cordier, Mane	(ORSAY)
BIZOT	80	Madison Conf. 546	+Bisello, Buon, Cordier, Delcourt+	(LALO, MONP)

OTHER RELATED PAPERS

ATKINSON	86C	ZPHY C30 541	+	(BONN, CERN, GLAS, LANC, MCHS, CURIN+)
ATKINSON	84	NP B231 15	+	(BONN, CERN, GLAS, LANC, MCHS, CURIN+)
ATKINSON	84B	NP B231 1	+	(BONN, CERN, GLAS, LANC, MCHS, CURIN+)
ATKINSON	83C	NP B229 269	+	(BONN, CERN, GLAS, LANC, MCHS, CURIN+)
CORDIER	81	PL 106B 155	+Bisello, Bizot, Buon, Delcourt, Mane	(ORSAY)
MANE	81	PL 99B 261	+Bisello, Bizot, Buon, Cordier, Delcourt	(ORSAY)
ASTON	80F	NP B174 269		(BONN, CERN, EPOL, GLAS, LANC, MCHS+)

$\rho_3(1690)$

$I^G(J^{PC}) = 1^+(3^{--})$

$\rho_3(1690)$ MASS

We include only high statistics experiments in the average for the 2π, $K\overline{K}$, and $K\overline{K}\pi$ modes.

2π, $K\overline{K}$, AND $K\overline{K}\pi$ MODES

VALUE (MeV)	DOCUMENT ID
1691 ±5 OUR ESTIMATE	This is only an educated guess; the error given is larger than the error on the average of the published values.
1691.4±2.7 OUR AVERAGE	Includes data from the 2 datablocks that follow this one.

2π MODE

The data in this block is included in the average printed for a previous datablock.

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	CHG	COMMENT
1686 ± 4 OUR AVERAGE						
1677 ±14		EVANGELISTA	81	OMEG	−	12 $\pi^- p \rightarrow 2\pi p$
1679.0±11.0	476	BALTAY	78B	HBC	0	15 $\pi^+ p \rightarrow \pi^+\pi^- n$
1678.0±12.0	175	[1] ANTIPOV	77	CIBS	0	25 $\pi^- p \rightarrow p 3\pi$
1690 ± 7	600	[1] ENGLER	74	DBC	0	6 $\pi^+ n \rightarrow \pi^+\pi^- p$
1693 ± 8		[2] GRAYER	74	ASPK	0	17 $\pi^- p \rightarrow \pi^+\pi^- n$
1678 ±12		MATTHEWS	71C	DBC	0	7 $\pi^+ N$
• • • We do not use the following data for averages, fits, limits, etc. • • •						
1734.0±10.0		[3] CORDEN	79	OMEG		12–15 $\pi^- p \rightarrow n 2\pi$
1692 ±12		[2,4] ESTABROOKS	75	RVUE		17 $\pi^- p \rightarrow \pi^+\pi^- n$
1737.0±23.0		ARMENISE	70	DBC	0	9 $\pi^+ N$
1650.0±35.0	122	BARTSCH	70B	HBC	+	8 $\pi^+ p \rightarrow N 2\pi$
1687 ±21		STUNTEBECK	70	HDBC	0	8 $\pi^- p$, 5.4 $\pi^+ d$
1683 ±13		ARMENISE	68	DBC	0	5.1 $\pi^+ d$
1670.0±30.0		GOLDBERG	65	HBC	0	6 $\pi^+ d$, 8 $\pi^- p$

[1] Mass errors enlarged by us to $\Gamma/\sqrt{N}$; see the note with the $K^*(892)$ mass.
[2] Uses same data as HYAMS 75.
[3] From a phase shift solution containing a $f'_2(1525)$ width two times larger than the $K\overline{K}$ result.
[4] From phase-shift analysis. Error takes account of spread of different phase-shift solutions.

$K\overline{K}$ AND $K\overline{K}\pi$ MODES

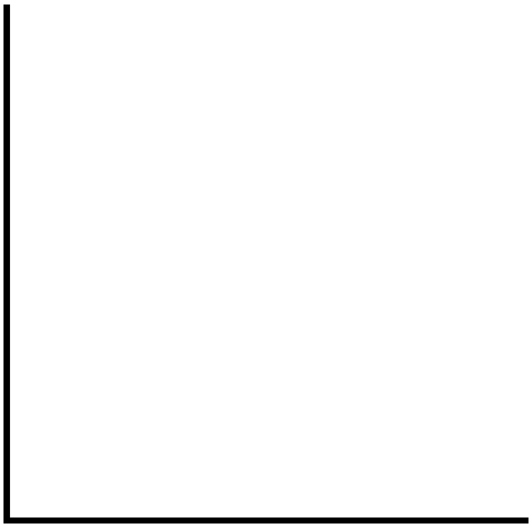
VALUE (MeV)	EVTS	DOCUMENT ID		TECN	CHG	COMMENT
The data in this block is included in the average printed for a previous datablock.						
1696 ± 4 OUR AVERAGE						
1699.0± 5.0		ALPER	80	CNTR	0	62 $\pi^- p \rightarrow K^+ K^- n$
1698 ±12	6k	[5,6] MARTIN	78D	SPEC		10 $\pi p \rightarrow K^0_S K^- p$
1692 ± 6		BLUM	75	ASPK	0	18.4 $\pi^- p \rightarrow n K^+ K^-$
1690.0±16.0		ADERHOLZ	69	HBC	+	8 $\pi^+ p \rightarrow K\overline{K}\pi$
• • • We do not use the following data for averages, fits, limits, etc. • • •						
1694.0± 8.0		[7] COSTA...	80	OMEG		10 $\pi^- p \rightarrow K^+ K^- n$

[5] From a fit to $J^P = 3^-$ partial wave.
[6] Systematic error on mass scale subtracted.
[7] They cannot distinguish between $\rho_3(1690)$ and $\omega_3(1670)$.

$(4\pi)^\pm$ MODE

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	CHG	COMMENT
1675 ±11 OUR AVERAGE	Error includes scale factor of 1.9. See the ideogram below.					
1665.0±15.0	177	BALTAY	78B	HBC	+	15 $\pi^+ p \rightarrow p 4\pi$
1670 ±10		THOMPSON	74	HBC	+	13 $\pi^+ p$
1687 ±20		CASON	73	HBC	−	8,18.5 $\pi^- p$
1630 ±15		HOLMES	72	HBC	+	10–12 $K^+ p$
1680.0±40.0	144	BARTSCH	70B	HBC	+	8 $\pi^+ p \rightarrow N 4\pi$
1705.0±21.0		CASO	70	HBC	−	11.2 $\pi^- p \rightarrow n \rho 2\pi$
1720 ±15		BALTAY	68	HBC	+	7, 8.5 $\pi^+ p$
• • • We do not use the following data for averages, fits, limits, etc. • • •						
1694 ± 6		[8] EVANGELISTA	81	OMEG	−	12 $\pi^- p \rightarrow p 4\pi$
1718 ±10		[9] EVANGELISTA	81	OMEG	−	12 $\pi^- p \rightarrow p 4\pi$
1673 ± 9		[10] EVANGELISTA	81	OMEG	−	12 $\pi^- p \rightarrow p 4\pi$
1733 ± 9	66	[11] KLIGER	74	HBC	−	4.5 $\pi^- p \rightarrow p 4\pi$
1685 ±14		[11] CASON	73	HBC	−	8,18.5 $\pi^- p$
1689.0±20.0	102	[11] BARTSCH	70B	HBC	+	8 $\pi^+ p \rightarrow N 2\rho$

[8] From $\rho^- \rho^0$ mode, not independent of the other two EVANGELISTA 81 entries.
[9] From $a_2(1320)^- \pi^0$ mode, not independent of the other two EVANGELISTA 81 entries.
[10] From $a_2(1320)^0 \pi^-$ mode, not independent of the other two EVANGELISTA 81 entries.
[11] From $\rho^\pm \rho^0$ mode.



$\rho_3(1690)$ mass, $(4\pi)^\pm$ mode (MeV)

$\omega\pi$ MODE

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*CHG*	*COMMENT*
1681 ± 6 OUR AVERAGE					
1690 ±20	ALDE	92C	GAM2		38,100 $\pi^- p \to \omega\pi^0 n$
1690 ±15	EVANGELISTA	81	OMEG	−	12 $\pi^- p \to \omega\pi p$
1666.0±14.0	GESSAROLI	77	HBC		11 $\pi^- p \to \omega\pi p$
1686 ± 9	THOMPSON	74	HBC	+	13 $\pi^+ p$
1654 ±24	BARNHAM	70	HBC	+	10 $K^+ p \to \omega\pi X$

$\eta\pi^+\pi^-$ MODE

(For difficulties with MMS experiments, see the $a_2(1320)$ mini-review in the 1973 edition.)

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*CHG*	*COMMENT*
1680 ±15	FUKUI	88	SPEC	0	8.95 $\pi^- p \to \eta\pi^+\pi^- n$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
1700.0±47.0	[12] ANDERSON	69	MMS	−	16 $\pi^- p$ backward
1632 ±15	[12,13] FOCACCI	66	MMS	−	7–12 $\pi^- p \to p$MM
1700 ±15	[12,13] FOCACCI	66	MMS	−	7–12 $\pi^- p \to p$MM
1748 ±15	[12,13] FOCACCI	66	MMS	−	7–12 $\pi^- p \to p$MM

[12] Seen in 2.5–3 GeV/c $\overline{p}p$. $2\pi^+2\pi^-$, with 0, 1, 2 $\pi^+\pi^-$ pairs in ρ band not seen by OREN 74 (2.3 GeV/c $\overline{p}p$) with more statistics. (Jan. 1976)

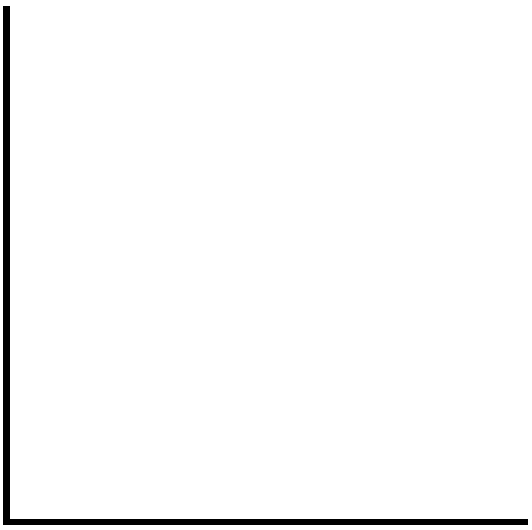
[13] Not seen by BOWEN 72.

$\rho_3(1690)$ WIDTH

We include only high statistics experiments in the average for the 2π, $K\overline{K}$, $K\overline{K}\pi$ modes.

2π, $K\overline{K}$, AND $K\overline{K}\pi$ MODES

VALUE (MeV)	*DOCUMENT ID*
215±20 OUR ESTIMATE	This is only an educated guess; the error given is larger than the error on the average of the published values.
215± 6 OUR AVERAGE	Includes data from the 2 datablocks that follow this one. Error includes scale factor of 1.8. See the ideogram below.



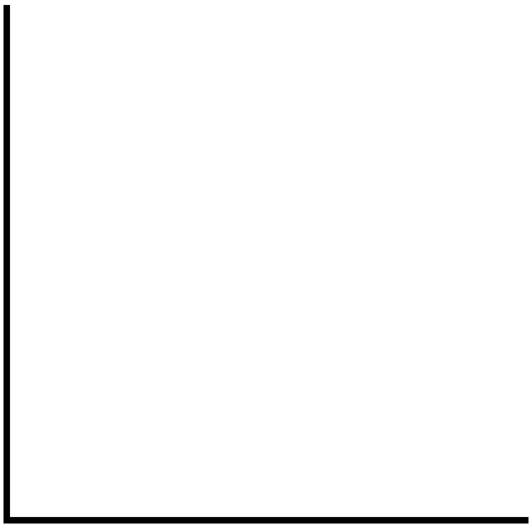
$\rho_3(1690)$ width, 2π, $K\overline{K}$, and $K\overline{K}\pi$ modes (MeV)

*CITATION: L. Montanet et al., Physical Review D50, 1173 (1994) and 1995 off-year partial update for the 1996 edition (URL: http://pdg.lbl.gov/)

2π MODE

VALUE (MeV)	*EVTS*	*DOCUMENT ID*		*TECN*	*CHG*	*COMMENT*
The data in this block is included in the average printed for a previous datablock.						
186 ±14 OUR AVERAGE		Error includes scale factor of 1.3. See the ideogram below.				
220 ±29		DENNEY	83	LASS		10 $\pi^+ N$
246 ±37		EVANGELISTA	81	OMEG	−	12 $\pi^- p \rightarrow 2\pi p$
116.0±30.0	476	BALTAY	78B	HBC	0	15 $\pi^+ p \rightarrow \pi^+ \pi^- n$
162.0±50.0	175	[14] ANTIPOV	77	CIBS	0	25 $\pi^- p \rightarrow p 3\pi$
167 ±40	600	ENGLER	74	DBC	0	6 $\pi^+ n \rightarrow \pi^+ \pi^- p$
200 ±18		[15] GRAYER	74	ASPK	0	17 $\pi^- p \rightarrow \pi^+ \pi^- n$
156 ±36		MATTHEWS	71C	DBC	0	7 $\pi^+ N$
171.0±65.0		ARMENISE	70	DBC	0	9 $\pi^+ d$
• • • We do not use the following data for averages, fits, limits, etc. • • •						
322.0±35.0		[16] CORDEN	79	OMEG		12–15 $\pi^- p \rightarrow n 2\pi$
240 ±30		[15,17] ESTABROOKS	75	RVUE		17 $\pi^- p \rightarrow \pi^+ \pi^- n$
180.0±30.0	122	BARTSCH	70B	HBC	+	8 $\pi^+ p \rightarrow N 2\pi$
267 $^{+72}_{-46}$		STUNTEBECK	70	HDBC	0	8 $\pi^- p$, 5.4 $\pi^+ d$
188 ±49		ARMENISE	68	DBC	0	5.1 $\pi^+ d$
180.0±40.0		GOLDBERG	65	HBC	0	6 $\pi^+ d$, 8 $\pi^- p$

[14] Width errors enlarged by us to $4\Gamma/\sqrt{N}$; see the note with the $K^*(892)$ mass.
[15] Uses same data as HYAMS 75 and BECKER 79.
[16] From a phase shift solution containing a $f_2'(1525)$ width two times larger than the $K\overline{K}$ result.
[17] From phase-shift analysis. Error takes account of spread of different phase-shift solutions.



$\rho_3(1690)$ width, 2π mode (MeV)

$K\overline{K}$ AND $K\overline{K}\pi$ MODES

VALUE (MeV)	*EVTS*	*DOCUMENT ID*		*TECN*	*CHG*	*COMMENT*
The data in this block is included in the average printed for a previous datablock.						
218 ± 4 OUR AVERAGE						
219.0± 4.0		ALPER	80	CNTR	0	62 $\pi^- p \rightarrow K^+ K^- n$
199 ±40	6000	[18] MARTIN	78D	SPEC		10 $\pi p \rightarrow K_S^0 K^- p$
205 ±20		BLUM	75	ASPK	0	18.4 $\pi^- p \rightarrow n K^+ K^-$
• • • We do not use the following data for averages, fits, limits, etc. • • •						

186.0±11.0		[19] COSTA...	80	OMEG		10 $\pi^- p \to K^+ K^- n$
112.0±60.0		ADERHOLZ	69	HBC	+	8 $\pi^+ p \to K \overline{K} \pi$

[18] From a fit to $J^P = 3^-$ partial wave.
[19] They cannot distinguish between $\rho_3(1690)$ and $\omega_3(1670)$.

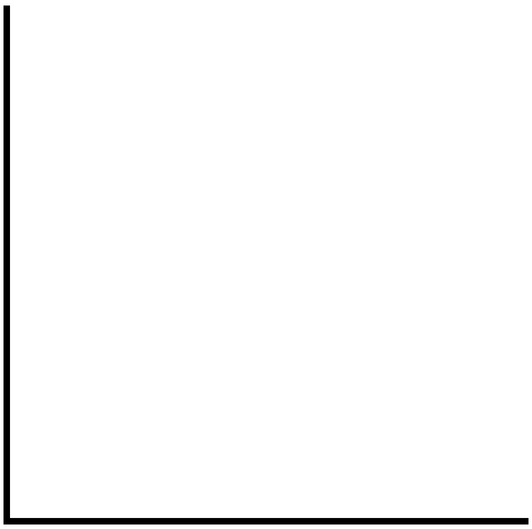
$(4\pi)^\pm$ MODE

VALUE (MeV)	*EVTS*	*DOCUMENT ID*		*TECN*	*CHG*	*COMMENT*
119 ±13 OUR AVERAGE						
105.0±30.0	177	BALTAY	78B	HBC	+	15 $\pi^+ p \to p 4\pi$
106 ±25		THOMPSON	74	HBC	+	13 $\pi^+ p$
169 $^{+70}_{-48}$		CASON	73	HBC	−	8,18.5 $\pi^- p$
130 ±30		HOLMES	72	HBC	+	10–12 $K^+ p$
135.0±30.0	144	BARTSCH	70B	HBC	+	8 $\pi^+ p \to N 4\pi$
100 ±35		BALTAY	68	HBC	+	7, 8.5 $\pi^+ p$
• • • We do not use the following data for averages, fits, limits, etc. • • •						
123 ±13		[20] EVANGELISTA	81	OMEG	−	12 $\pi^- p \to p 4\pi$
230 ±28		[21] EVANGELISTA	81	OMEG	−	12 $\pi^- p \to p 4\pi$
184 ±33		[22] EVANGELISTA	81	OMEG	−	12 $\pi^- p \to p 4\pi$
150	66	[23] KLIGER	74	HBC	−	4.5 $\pi^- p \to p 4\pi$
125 $^{+83}_{-35}$		[23] CASON	73	HBC	−	8,18.5 $\pi^- p$
180.0±30.0	90	[23] BARTSCH	70B	HBC	+	8 $\pi^+ p \to N a_2 \pi$
160.0±30.0	102	BARTSCH	70B	HBC	+	8 $\pi^+ p \to N 2\rho$

[20] From $\rho^- \rho^0$ mode, not independent of the other two EVANGELISTA 81 entries.
[21] From $a_2(1320)^- \pi^0$ mode, not independent of the other two EVANGELISTA 81 entries.
[22] From $a_2(1320)^0 \pi^-$ mode, not independent of the other two EVANGELISTA 81 entries.
[23] From $\rho^\pm \rho^0$ mode.

$\omega\pi$ MODE

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*CHG*	*COMMENT*
150 ±31 OUR AVERAGE	Error includes scale factor of 1.8. See the ideogram below.				
230 ±30	ALDE	92C	GAM2		38,100 $\pi^- p \to \omega \pi^0 n$
190 ±65	EVANGELISTA	81	OMEG	−	12 $\pi^- p \to \omega \pi p$
160.0±56.0	GESSAROLI	77	HBC		11 $\pi^- p \to \omega \pi p$
89 ±25	THOMPSON	74	HBC	+	13 $\pi^+ p$
130 $^{+73}_{-43}$	BARNHAM	70	HBC	+	10 $K^+ p \to \omega \pi X$



$\rho_3(1690)$ width, $\omega\pi$ mode (MeV)

$\eta\pi^+\pi^-$ MODE

(For difficulties with MMS experiments, see the $a_2(1320)$ mini-review in the 1973 edition.)

VALUE (MeV)	DOCUMENT ID		TECN	CHG	COMMENT
106 ±27	FUKUI	88	SPEC	0	8.95 $\pi^- p \rightarrow \eta\pi^+\pi^- n$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
195.0	[24] ANDERSON	69	MMS	–	16 $\pi^- p$ backward
< 21	[24,25] FOCACCI	66	MMS	–	7–12 $\pi^- p \rightarrow p$MM
< 30	[24,25] FOCACCI	66	MMS	–	7–12 $\pi^- p \rightarrow p$MM
< 38	[24,25] FOCACCI	66	MMS	–	7–12 $\pi^- p \rightarrow p$MM

[24] Seen in 2.5–3 GeV/c $\overline{p}p$. $2\pi^+2\pi^-$, with 0, 1, 2 $\pi^+\pi^-$ pairs in ρ^0 band not seen by OREN 74 (2.3 GeV/c $\overline{p}p$) with more statistics. (Jan. 1979)

[25] Not seen by BOWEN 72.

$\rho_3(1690)$ DECAY MODES

	Mode	Fraction (Γ_i/Γ)	Scale factor
Γ_1	4π	(71.1 ± 1.9) %	
Γ_2	$\pi^\pm\pi^+\pi^-\pi^0$	(67 ±22) %	
Γ_3	$\pi\pi$	(23.6 ± 1.3) %	
Γ_4	$\omega\pi$	(16 ± 6) %	
Γ_5	$K\overline{K}\pi$	(3.8 ± 1.2) %	
Γ_6	$K\overline{K}$	(1.58± 0.26) %	1.2
Γ_7	$\eta\pi^+\pi^-$	seen	
Γ_8	$\pi\pi\rho$ Excluding 2ρ and $a_2(1320)\pi$.		
Γ_9	$a_2(1320)\pi$		
Γ_{10}	$\rho\rho$		
Γ_{11}	$\phi\pi$		
Γ_{12}	$\eta\pi$		
Γ_{13}	$\pi^\pm 2\pi^+ 2\pi^- \pi^0$		

CONSTRAINED FIT INFORMATION

An overall fit to 5 branching ratios uses 10 measurements and one constraint to determine 4 parameters. The overall fit has a $\chi^2 =$ 14.7 for 7 degrees of freedom.

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

x_3	−77		
x_5	−74	17	
x_6	−15	2	0
	x_1	x_3	x_5

$\rho_3(1690)$ BRANCHING RATIOS

$\Gamma(\pi\pi)/\Gamma_{\rm total}$ $\qquad\Gamma_3/\Gamma$

VALUE	DOCUMENT ID		TECN	CHG	COMMENT
0.236±0.013 OUR FIT					
0.243±0.013 OUR AVERAGE					
$0.259^{+0.018}_{-0.019}$	BECKER	79	ASPK	0	17 $\pi^- p$ polarized
0.23 ±0.02	CORDEN	79	OMEG		12–15 $\pi^- p \rightarrow n 2\pi$
0.22 ±0.04	[26] MATTHEWS	71C	HDBC	0	7 $\pi^+ n \rightarrow \pi^- p$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.245±0.006	[27] ESTABROOKS	75	RVUE		17 $\pi^- p \rightarrow \pi^+\pi^- n$

[26] One-pion-exchange model used in this estimation.
[27] From phase-shift analysis of HYAMS 75 data.

$\Gamma(\pi\pi)/\Gamma(\pi^{\pm}\pi^{+}\pi^{-}\pi^{0})$ — Γ_3/Γ_2

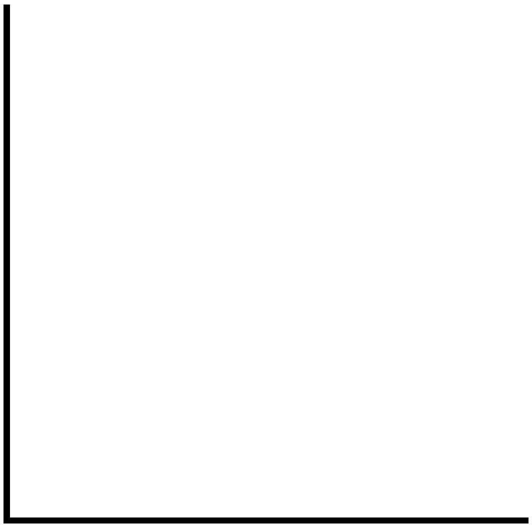
VALUE	DOCUMENT ID		TECN	CHG	COMMENT
0.35±0.11	CASON	73	HBC	−	8,18.5 $\pi^- p$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<0.2	HOLMES	72	HBC	+	10–12 $K^+ p$
<0.12	BALLAM	71B	HBC	−	16 $\pi^- p$

$\Gamma(\pi\pi)/\Gamma(4\pi)$ — Γ_3/Γ_1

VALUE	DOCUMENT ID		TECN	CHG	COMMENT
0.332±0.026 OUR FIT Error includes scale factor of 1.1.					
0.30 ±0.10	BALTAY	78B	HBC	0	15 $\pi^+ p \to p 4\pi$

$\Gamma(K\overline{K})/\Gamma(\pi\pi)$ — Γ_6/Γ_3

VALUE	DOCUMENT ID		TECN	CHG	COMMENT
0.067±0.011 OUR FIT Error includes scale factor of 1.2.					
$0.118^{+0.039}_{-0.032}$ OUR AVERAGE Error includes scale factor of 1.7. See the ideogram below.					
$0.191^{+0.040}_{-0.037}$	GORLICH	80	ASPK	0	17,18 $\pi^- p$ polarized
0.08 ±0.03	BARTSCH	70B	HBC	+	8 $\pi^+ p$
$0.08^{+0.08}_{-0.03}$	CRENNELL	68B	HBC		6.0 $\pi^- p$



$\Gamma(K\overline{K})/\Gamma(\pi\pi)$

$\Gamma(K\overline{K}\pi)/\Gamma(\pi\pi)$ — Γ_5/Γ_3

VALUE	DOCUMENT ID		TECN	CHG	COMMENT
0.16±0.05 OUR FIT					
0.16±0.05	[28] BARTSCH	70B	HBC	+	8 $\pi^+ p$

[28] Increased by us to correspond to B($\rho_3(1690) \to \pi\pi$)=0.24.

$[\Gamma(\pi\pi\rho)+\Gamma(a_2(1320)\pi)+\Gamma(\rho\rho)]/\Gamma(\pi^{\pm}\pi^{+}\pi^{-}\pi^{0})$ — $(\Gamma_8+\Gamma_9+\Gamma_{10})/\Gamma_2$

VALUE	DOCUMENT ID		TECN	CHG	COMMENT
0.94±0.09 OUR AVERAGE					
0.96±0.21	BALTAY	78B	HBC	+	15 $\pi^+ p \to p 4\pi$
0.88±0.15	BALLAM	71B	HBC	−	16 $\pi^- p$
1 ±0.15	BARTSCH	70B	HBC	+	8 $\pi^+ p$
consistent with 1	CASO	68	HBC	−	11 $\pi^- p$

$\Gamma(\rho\rho)/\Gamma(\pi^{\pm}\pi^{+}\pi^{-}\pi^{0})$ — Γ_{10}/Γ_{2}

VALUE	EVTS	DOCUMENT ID		TECN	CHG	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •						
0.12 ± 0.11		BALTAY	78B	HBC	+	15 $\pi^{+}p \rightarrow p4\pi$
0.56	66	KLIGER	74	HBC	−	4.5 $\pi^{-}p \rightarrow p4\pi$
0.13 ± 0.09		[29] THOMPSON	74	HBC	+	13 $\pi^{+}p$
$0.7\ \pm0.15$		BARTSCH	70B	HBC	+	8 $\pi^{+}p$

[29] $\rho\rho$ and $a_2(1320)\pi$ modes are indistinguishable.

$\Gamma(\rho\rho)/[\Gamma(\pi\pi\rho)+\Gamma(a_2(1320)\pi)+\Gamma(\rho\rho)]$ — $\Gamma_{10}/(\Gamma_8+\Gamma_9+\Gamma_{10})$

VALUE	DOCUMENT ID		TECN	CHG	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.48 ± 0.16	CASO	68	HBC	−	11 $\pi^{-}p$

$\Gamma(a_2(1320)\pi)/\Gamma(\pi^{\pm}\pi^{+}\pi^{-}\pi^{0})$ — Γ_{9}/Γ_{2}

VALUE	DOCUMENT ID		TECN	CHG	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.66 ± 0.08	BALTAY	78B	HBC	+	15 $\pi^{+}p \rightarrow p4\pi$
0.36 ± 0.14	[30] THOMPSON	74	HBC	+	13 $\pi^{+}p$
not seen	CASON	73	HBC	−	8,18.5 $\pi^{-}p$
$0.6\ \pm0.15$	BARTSCH	70B	HBC	+	8 $\pi^{+}p$
0.6	BALTAY	68	HBC	+	7,8.5 $\pi^{+}p$

[30] $\rho\rho$ and $a_2(1320)\pi$ modes are indistinguishable.

$\Gamma(\omega\pi)/\Gamma(\pi^{\pm}\pi^{+}\pi^{-}\pi^{0})$ — Γ_{4}/Γ_{2}

VALUE	CL%	DOCUMENT ID		TECN	CHG	COMMENT
0.23±0.05 OUR AVERAGE Error includes scale factor of 1.2.						
0.33 ± 0.07		THOMPSON	74	HBC	+	13 $\pi^{+}p$
0.12 ± 0.07		BALLAM	71B	HBC	−	16 $\pi^{-}p$
0.25 ± 0.10		BALTAY	68	HBC	+	7,8.5 $\pi^{+}p$
0.25 ± 0.10		JOHNSTON	68	HBC	−	7.0 $\pi^{-}p$
• • • We do not use the following data for averages, fits, limits, etc. • • •						
<0.11	95	BALTAY	78B	HBC	+	15 $\pi^{+}p \rightarrow p4\pi$
<0.09		KLIGER	74	HBC	−	4.5 $\pi^{-}p \rightarrow p4\pi$

$\Gamma(\phi\pi)/\Gamma(\pi^{\pm}\pi^{+}\pi^{-}\pi^{0})$ — Γ_{11}/Γ_{2}

VALUE	DOCUMENT ID		TECN	CHG	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<0.11	BALTAY	68	HBC	+	7,8.5 $\pi^{+}p$

$\Gamma(\pi^{\pm}2\pi^{+}2\pi^{-}\pi^{0})/\Gamma(\pi^{\pm}\pi^{+}\pi^{-}\pi^{0})$ — Γ_{13}/Γ_{2}

VALUE	DOCUMENT ID		TECN	CHG	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<0.15	BALTAY	68	HBC	+	7,8.5 $\pi^{+}p$

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

VALUE	DOCUMENT ID		TECN	CHG	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<0.02	THOMPSON	74	HBC	+	13 $\pi^{+}p$

$\Gamma(K\overline{K})/\Gamma_{\text{total}}$ — Γ_{6}/Γ

VALUE	DOCUMENT ID		TECN	CHG	COMMENT
0.0158±0.0026 OUR FIT Error includes scale factor of 1.2.					
0.0130±0.0024 OUR AVERAGE					
$0.013\ \pm0.003$	COSTA...	80	OMEG	0	10 $\pi^{-}p \rightarrow K^{+}K^{-}n$
$0.013\ \pm0.004$	[31] MARTIN	78B	SPEC	−	10 $\pi p \rightarrow K^{0}_{S}K^{-}p$

[31] From $(\Gamma_3\Gamma_6)^{1/2} = 0.056 \pm 0.034$ assuming $B(\rho_3(1690) \rightarrow \pi\pi) = 0.24$.

$\Gamma(\omega\pi)/[\Gamma(\omega\pi)+\Gamma(\rho\rho)]$ — $\Gamma_{4}/(\Gamma_4+\Gamma_{10})$

VALUE	DOCUMENT ID		TECN	CHG	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.22 ± 0.08	CASON	73	HBC	−	8,18.5 $\pi^{-}p$

$\Gamma(\eta\pi^+\pi^-)/\Gamma_{total}$ **Γ_7/Γ**

VALUE	DOCUMENT ID		TECN	COMMENT
seen	FUKUI	88	SPEC	8.95 $\pi^- p \rightarrow \eta\pi^+\pi^- n$

$\rho_3(1690)$ REFERENCES

ALDE	92C	ZPHY C54 553	+Bellazzini+	(SERP, BELG, LANL, LAPP, PISA, KEK)
FUKUI	88	PL B202 441	+Horikawa+	(SUGI, NAGO, KEK, KYOT, MIYA)
DENNEY	83	PR D28 2726	+Cranley, Firestone, Chapman+	(IOWA, MICH)
EVANGELISTA	81	NP B178 197	+	(BARI, BONN, CERN, DARE, LIVP+)
ALPER	80	PL 94B 422	+Becker+	(AMST, CERN, CRAC, MPIM, OXF+)
COSTA...	80	NP B175 402	Costa De Beauregard+	(BARI, BONN, CERN+)
GORLICH	80	NP B174 16	+Niczyporuk+	(CRAC, MPIM, CERN, ZEEM)
BECKER	79	NP B151 46	+Blanar, Blum+	(MPIM, CERN, ZEEM, CRAC)
CORDEN	79	NP B157 250	+Dowell, Garvey+	(BIRM, RHEL, TELA, LOWC) JP
BALTAY	78B	PR D17 62	+Cautis, Cohen, Csorna+	(COLU, BING)
MARTIN	78B	NP B140 158	+Ozmutlu, Baldi, Bohringer, Dorsaz+	(DURH, GEVA)
MARTIN	78D	PL 74B 417	+Ozmutlu, Baldi, Bohringer, Dorsaz+	(DURH, GEVA)
ANTIPOV	77	NP B119 45	+Busnello, Damgaard, Kienzle+	(SERP, GEVA)
GESSAROLI	77	NP B126 382	+	(BGNA, FIRZ, GENO, MILA, OXF, PAVI)
BLUM	75	PL 57B 403	+Chabaud, Dietl, Garelick, Grayer+	(CERN, MPIM) JP
ESTABROOKS	75	NP B95 322	+Martin	(DURH)
HYAMS	75	NP B100 205	+Jones, Weilhammer, Blum, Dietl+	(CERN, MPIM)
ENGLER	74	PR D10 2070	+Kraemer, Toaff, Weisser, Diaz+	(CMU, CASE)
GRAYER	74	NP B75 189	+Hyams, Blum, Dietl+	(CERN, MPIM)
KLIGER	74	SJNP 19 428 Translated from YAF 19 839.	+Beketov, Grechko, Guzhavin, Dubovikov+	(ITEP)
OREN	74	NP B71 189	+Cooper, Fields, Rhines, Allison+	(ANL, OXF)
THOMPSON	74	NP B69 220	+Gaidos, McIlwain, Miller, Mulera+	(PURD)
CASON	73	PR D7 1971	+Biswas, Kenney, Madden+	(NDAM)
BOWEN	72	PRL 29 890	+Earles, Faissler, Blieden+	(NEAS, STON)
HOLMES	72	PR D6 3336	+Ferbel, Slattery, Werner	(ROCH)
BALLAM	71B	PR D3 2606	+Chadwick, Guiragossian, Johnson+	(SLAC)
MATTHEWS	71C	NP B33 1	+Prentice, Yoon, Carroll+	(TNTO, WISC) JP
ARMENISE	70	LNC 4 199	+Ghidini, Foring, Cartacci+	(BARI, BGNA, FIRZ)
BARNHAM	70	PRL 24 1083	+Colley, Jobes, Kenyon, Pathak, Riddiford	(BIRM)
BARTSCH	70B	NP B22 109	+Kraus, Tsanos, Grote+	(AACH, BERL, CERN)
CASO	70	LNC 3 707	+Conte, Tomasini+	(GENO, HAMB, MILA, SACL)
STUNTEBECK	70	PL 32B 391	+Kenney, Deery, Biswas, Cason+	(NDAM)
ADERHOLZ	69	NP B11 259	+Bartsch+	(AACH3, BERL, CERN, JAGL, WARS)
ANDERSON	69	PRL 22 1390	+Collins+	(BNL, CMU)
ARMENISE	68	NC 54A 999	+Ghidini, Forino+	(BARI, BGNA, FIRZ, ORSAY) I
BALTAY	68	PRL 20 887	+Kung, Yeh, Ferbel+	(COLU, ROCH, RUTG, YALE) I
CASO	68	NC 54A 983	+Conte, Cords, Diaz+	(GENO, HAMB, MILA, SACL)
CRENNELL	68B	PL 28B 136	+Karshon, Lai, Scarr, Skillicorn	(BNL)
JOHNSTON	68	PRL 20 1414	+Prentice, Steenberg, Yoon	(TNTO, WISC) IJP
FOCACCI	66	PRL 17 890	+Kienzle, Levrat, Maglich, Martin	(CERN)
GOLDBERG	65	PL 17 354	+	(CERN, EPOL, ORSAY, MILA, CEA, SACL)

OTHER RELATED PAPERS

BARNETT	83B	PL 120B 455	+Blockus, Burka, Chien, Christian+	(JHU)
EHRLICH	66	PR 152 1194	+Selove, Yuta	(PENN)
LEVRAT	66	PL 22 714	+Tolstrup+	(CERN Missing Mass Spect. Collab.)
SEGUINOT	66	PL 19 712	+Martin+	(CERN Missing Mass Spect. Collab.)
BELLINI	65	NC 40A 948	+DiCorato, Duimio, Fiorini	(MILA)
DEUTSCH...	65	PL 18 351	Deutschmann+	(AACH3, BERL, CERN)
FORINO	65	PL 19 65	+Gessaroli+	(BGNA, ORSAY, SACL)

$\boxed{\rho(1700)}$

$I^G(J^{PC}) = 1^+(1^{--})$

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$\rho(1700)$ MASS

$\eta\rho^0$ AND MIXED MODES

VALUE (MeV)	DOCUMENT ID
1700±20 OUR ESTIMATE	This is only an educated guess; the error given is larger than the error on the average of the published values.
1712±13 OUR AVERAGE	Includes data from the 2 datablocks that follow this one. Error includes scale factor of 1.2.

$\eta\rho^0$ MODE

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
The data in this block is included in the average printed for a previous datablock.				
1740±20	ANTONELLI	88	DM2	$e^+e^- \rightarrow \eta\pi^+\pi^-$
1701±15	[1] FUKUI	88	SPEC	8.95 $\pi^- p \rightarrow \eta\pi^+\pi^- n$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
1635±20	[2] FUKUI	88	SPEC	8.95 $\pi^- p \rightarrow \eta\pi^+\pi^- n$

[1] From a two Breit-Wigner fit.
[2] From a single Breit-Wigner fit.

$\pi^+\pi^-$ MODE

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
1730 $\pm$30	CLEGG	94	RVUE	$e^+e^- \rightarrow \pi^+\pi^-$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
1768 $\pm$21	BISELLO	89	DM2	$e^+e^- \rightarrow \pi^+\pi^-$
1745.7$\pm$91.9	DUBNICKA	89	RVUE	$e^+e^- \rightarrow \pi^+\pi^-$
1546 $\pm$26	GESHKENBEIN	89	RVUE	
1650	[3] ERKAL	85	RVUE	20–70 $\gamma p \rightarrow \gamma\pi$
1550 $\pm$70	ABE	84B	HYBR	20 $\gamma p \rightarrow \pi^+\pi^- p$
1590 $\pm$20	[4] ASTON	80	OMEG	20–70 $\gamma p \rightarrow p 2\pi$
1600.0$\pm$10.0	[5] ATIYA	79B	SPEC	50 γC $\rightarrow$ C2π
$1598.0^{+24.0}_{-22.0}$	BECKER	79	ASPK	17 $\pi^- p$ polarized
1659 $\pm$25	[3] LANG	79	RVUE	
1575	[3] MARTIN	78C	RVUE	17 $\pi^- p \rightarrow \pi^+\pi^- n$
1610 $\pm$30	[3] FROGGATT	77	RVUE	17 $\pi^- p \rightarrow \pi^+\pi^- n$
1590 $\pm$20	[6] HYAMS	73	ASPK	17 $\pi^- p \rightarrow \pi^+\pi^- n$

$K\overline{K}$ MODE

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	CHG	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •						
1582$\pm$36	1600	CLELAND	82B	SPEC	$\pm$	50 $\pi p \rightarrow K^0_S K^\pm p$

2($\pi^+\pi^-$) MODE

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	COMMENT
1520$\pm$ 30		[4] ASTON	81E	OMEG	20–70 $\gamma p \rightarrow p 4\pi$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
1570$\pm$ 20		[7] CORDIER	82	DM1	$e^+e^- \rightarrow 2(\pi^+\pi^-)$
1654$\pm$ 25		[8] DIBIANCA	81	DBC	$\pi^+ d \rightarrow pp2(\pi^+\pi^-)$
1666$\pm$ 39		[7] BACCI	80	FRAG	$e^+e^- \rightarrow 2(\pi^+\pi^-)$
1780	34	KILLIAN	80	SPEC	11 $e^- p \rightarrow 2(\pi^+\pi^-)$
1500		[9] ATIYA	79B	SPEC	50 γC $\rightarrow$ C$4\pi^\pm$
1570$\pm$ 60	65	[10] ALEXANDER	75	HBC	7.5 $\gamma p \rightarrow p 4\pi$
1550$\pm$ 60		[4] CONVERSI	74	OSPK	$e^+e^- \rightarrow 2(\pi^+\pi^-)$
1550$\pm$ 50	160	SCHACHT	74	STRC	5.5–9 $\gamma p \rightarrow p 4\pi$
1450$\pm$100	340	SCHACHT	74	STRC	9–18 $\gamma p \rightarrow p 4\pi$
1430$\pm$ 50	400	BINGHAM	72B	HBC	9.3 $\gamma p \rightarrow p 4\pi$

$\pi^+\pi^-\pi^0\pi^0$ MODE

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
1660$\pm$30	ATKINSON	85B	OMEG	20–70 γp

3($\pi^+\pi^-$) AND 2($\pi^+\pi^-\pi^0$) MODES

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
1783$\pm$15	CLEGG	90	RVUE	$e^+e^- \rightarrow 3(\pi^+\pi^-)2(\pi^+\pi^-\pi^0)$

[3] From phase shift analysis of HYAMS 73 data.
[4] Simple relativistic Breit-Wigner fit with constant width.
[5] An additional 40 MeV uncertainty in both the mass and width is present due to the choice of the background shape.
[6] Included in BECKER 79 analysis.
[7] Simple relativistic Breit-Wigner fit with model dependent width.
[8] One peak fit result.
[9] Parameters roughly estimated, not from a fit.
[10] Skew mass distribution compensated by Ross-Stodolsky factor.

$\rho(1700)$ WIDTH

$\eta\rho^0$, $\pi^+\pi^-$, AND MIXED MODES

VALUE (MeV)	*DOCUMENT ID*
235±50 OUR ESTIMATE	This is only an educated guess; the error given is larger than the error on the average of the published values.
212±32 OUR AVERAGE	Includes data from the 3 datablocks that follow this one. Error includes scale factor of 1.9. See the ideogram below.

$\rho(1700)$ width, $\eta\rho^0$, $\pi^+\pi^-$, and mixed modes (MeV)

$\eta\rho^0$ MODE

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
The data in this block is included in the average printed for a previous datablock.				
150±30	ANTONELLI	88	DM2	$e^+e^- \rightarrow \eta\pi^+\pi^-$
282±44	[11] FUKUI	88	SPEC	8.95 $\pi^- p \rightarrow \eta\pi^+\pi^- n$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
317±35	[12] FUKUI	88	SPEC	8.95 $\pi^- p \rightarrow \eta\pi^+\pi^- n$

[11] From a two Breit-Wigner fit.
[12] From a single Breit-Wigner fit.

$\pi^+\pi^-$ MODE

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
The data in this block is included in the average printed for a previous datablock.				
400 ±100	CLEGG	94	RVUE	$e^+e^- \rightarrow \pi^+\pi^-$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
224 ± 22	BISELLO	89	DM2	$e^+e^- \rightarrow \pi^+\pi^-$
242.5±163.0	DUBNICKA	89	RVUE	$e^+e^- \rightarrow \pi^+\pi^-$
620 ± 60	GESHKENBEIN	89	RVUE	
<315	[13] ERKAL	85	RVUE	20–70 $\gamma p \rightarrow \gamma\pi$
280 $^{+30}_{-80}$	ABE	84B	HYBR	20 $\gamma p \rightarrow \pi^+\pi^- p$
230.0± 80.0	[14] ASTON	80	OMEG	20–70 $\gamma p \rightarrow p2\pi$
283.0± 14.0	[15] ATIYA	79B	SPEC	50 $\gamma C \rightarrow C2\pi$
175.0$^{+98.0}_{-53.0}$	BECKER	79	ASPK	17 $\pi^- p$ polarized
232 ± 34	[13] LANG	79	RVUE	
340	[13] MARTIN	78C	RVUE	17 $\pi^- p \rightarrow \pi^+\pi^- n$
300 ±100	[13] FROGGATT	77	RVUE	17 $\pi^- p \rightarrow \pi^+\pi^- n$
180 ± 50	[16] HYAMS	73	ASPK	17 $\pi^- p \rightarrow \pi^+\pi^- n$

$K\overline{K}$ MODE

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	CHG	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •						
265±120	1600	CLELAND	82B	SPEC	±	50 $\pi p \rightarrow K^0_S K^\pm p$

$2(\pi^+\pi^-)$ MODE

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	COMMENT
400± 50		[14] ASTON	81E	OMEG	20–70 $\gamma p \rightarrow p 4\pi$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
510± 40		[17] CORDIER	82	DM1	$e^+e^- \rightarrow 2(\pi^+\pi^-)$
400±146		[18] DIBIANCA	81	DBC	$\pi^+ d \rightarrow pp2(\pi^+\pi^-)$
700±160		[17] BACCI	80	FRAG	$e^+e^- \rightarrow 2(\pi^+\pi^-)$
100	34	KILLIAN	80	SPEC	11 $e^- p \rightarrow 2(\pi^+\pi^-)$
600		[19] ATIYA	79B	SPEC	50 γC $\rightarrow$ C$4\pi^\pm$
340±160	65	[20] ALEXANDER	75	HBC	7.5 $\gamma p \rightarrow p 4\pi$
360±100		[14] CONVERSI	74	OSPK	$e^+e^- \rightarrow 2(\pi^+\pi^-)$
400±120	160	[21] SCHACHT	74	STRC	5.5–9 $\gamma p \rightarrow p 4\pi$
850±200	340	[21] SCHACHT	74	STRC	9–18 $\gamma p \rightarrow p 4\pi$
650±100	400	BINGHAM	72B	HBC	9.3 $\gamma p \rightarrow p 4\pi$

$\pi^+\pi^-\pi^0\pi^0$ MODE

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
300±50	ATKINSON	85B	OMEG	20–70 γp

$3(\pi^+\pi^-)$ AND $2(\pi^+\pi^-\pi^0)$ MODES

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
285±20	CLEGG	90	RVUE	$e^+e^- \rightarrow 3(\pi^+\pi^-)2(\pi^+\pi^-\pi^0)$

[13] From phase shift analysis of HYAMS 73 data.
[14] Simple relativistic Breit-Wigner fit with constant width.
[15] An additional 40 MeV uncertainty in both the mass and width is present due to the choice of the background shape.
[16] Included in BECKER 79 analysis.
[17] Simple relativistic Breit-Wigner fit with model-dependent width.
[18] One peak fit result.
[19] Parameters roughly estimated, not from a fit.
[20] Skew mass distribution compensated by Ross-Stodolsky factor.
[21] Width errors enlarged by us to $4\Gamma/\sqrt{N}$; see the note with the $K^*(892)$ mass.

$\rho(1700)$ DECAY MODES

	Mode		Fraction (Γ_i/Γ)
Γ_1	$\rho\pi\pi$		dominant
Γ_2	$\rho^0\pi^+\pi^-$		large
Γ_3	$\rho^0\pi^0\pi^0$		
Γ_4	$\rho^\pm\pi^\mp\pi^0$	[a]	large
Γ_5	$2(\pi^+\pi^-)$		large
Γ_6	$\pi^+\pi^-$		seen
Γ_7	$K\overline{K}^*(892)+$ c.c.		seen
Γ_8	$\eta\rho$		seen
Γ_9	$K\overline{K}$		seen
Γ_{10}	e^+e^-		seen
Γ_{11}	$\rho^0\rho^0$		
Γ_{12}	$\pi\omega$		

[a] The value is for the sum of the charge states indicated.

$\rho(1700)$ $\Gamma(i)\Gamma(e^+e^-)/\Gamma(\text{total})$

This combination of a partial width with the partial width into e^+e^- and with the total width is obtained from the cross-section into channel$_I$ in e^+e^- annihilation.

$\Gamma(2(\pi^+\pi^-)) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$ — $\Gamma_5\Gamma_{10}/\Gamma$

VALUE (keV)	*DOCUMENT ID*		*TECN*	*COMMENT*
2.83±0.42	BACCI	80	FRAG	$e^+e^- \to 2(\pi^+\pi^-)$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
2.6 ±0.2	DELCOURT	81B	DM1	$e^+e^- \to 2(\pi^+\pi^-)$

$\Gamma(\pi^+\pi^-) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$ — $\Gamma_6\Gamma_{10}/\Gamma$

VALUE (keV)	*DOCUMENT ID*		*TECN*	*COMMENT*
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.13	[22] DIEKMAN	88	RVUE	$e^+e^- \to \pi^+\pi^-$

[22] Using total width = 220 MeV.

$\Gamma(K\overline{K}^*(892)+\text{c.c.}) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$ — $\Gamma_7\Gamma_{10}/\Gamma$

VALUE (keV)	*DOCUMENT ID*		*TECN*	*COMMENT*
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.305±0.071	[23] BIZOT	80	DM1	e^+e^-

$\Gamma(\eta\rho) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$ — $\Gamma_8\Gamma_{10}/\Gamma$

VALUE (eV)	*DOCUMENT ID*		*TECN*	*COMMENT*
7 ±3	ANTONELLI	88	DM2	$e^+e^- \to \eta\pi^+\pi^-$

$\Gamma(K\overline{K}) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$ — $\Gamma_9\Gamma_{10}/\Gamma$

VALUE (keV)	*DOCUMENT ID*		*TECN*	*COMMENT*
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.035±0.029	[23] BIZOT	80	DM1	e^+e^-

$\Gamma(\rho\pi\pi) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$ — $\Gamma_1\Gamma_{10}/\Gamma$

VALUE (keV)	*DOCUMENT ID*		*TECN*	*COMMENT*
• • • We do not use the following data for averages, fits, limits, etc. • • •				
3.510±0.090	[23] BIZOT	80	DM1	e^+e^-

[23] Model dependent.

$\rho(1700)$ BRANCHING RATIOS

$\Gamma(\pi^+\pi^-)/\Gamma_{\text{total}}$ — Γ_6/Γ

VALUE	*DOCUMENT ID*		*TECN*	*COMMENT*
• • • We do not use the following data for averages, fits, limits, etc. • • •				
$0.287^{+0.043}_{-0.042}$	BECKER	79	ASPK	17 π^-p polarized
0.15 to 0.30	[24] MARTIN	78C	RVUE	17 $\pi^-p \to \pi^+\pi^-n$
<0.20	[25] COSTA...	77B	RVUE	$e^+e^- \to 2\pi$, 4π
0.30 ±0.05	[24] FROGGATT	77	RVUE	17 $\pi^-p \to \pi^+\pi^-n$
<0.15	[26] EISENBERG	73	HBC	5 $\pi^+p \to \Delta^{++}2\pi$
0.25 ±0.05	[27] HYAMS	73	ASPK	17 $\pi^-p \to \pi^+\pi^-n$
0.20 ±0.05	MONTANET	73	HBC	0.0 $\overline{p}p$

[24] From phase shift analysis of HYAMS 73 data.
[25] Estimate using unitarity, time reversal invariance, Breit-Wigner.
[26] Estimated using one-pion-exchange model.
[27] Included in BECKER 79 analysis.

$\Gamma(\pi^+\pi^-)/\Gamma(2(\pi^+\pi^-))$ — Γ_6/Γ_5

VALUE	*DOCUMENT ID*		*TECN*	*COMMENT*
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.13±0.05	ASTON	80	OMEG	20–70 $\gamma p \to p2\pi$
<0.14	[28] DAVIER	73	STRC	6–18 $\gamma p \to p4\pi$
<0.2	[29] BINGHAM	72B	HBC	9.3 $\gamma p \to p2\pi$

[28] Upper limit is estimate.
[29] 2σ upper limit.

$\Gamma(K\overline{K}^*(892)+\text{c.c.})/\Gamma(2(\pi^+\pi^-))$ — Γ_7/Γ_5

VALUE	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.15 ± 0.03	[30] DELCOURT	81B	DM1	$e^+e^- \rightarrow \overline{K}K\pi$

[30] Assuming $\rho(1700)$ and ω radial excitations to be degenerate in mass.

$\Gamma(\eta\rho)/\Gamma_{\text{total}}$ — Γ_8/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.04		DONNACHIE	87B	RVUE	
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<0.02	58	ATKINSON	86B	OMEG	20–70 γp

$\Gamma(\eta\rho)/\Gamma(2(\pi^+\pi^-))$ — Γ_8/Γ_5

VALUE	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.123 ± 0.027	DELCOURT	82	DM1	$e^+e^- \rightarrow \pi^+\pi^-$ MM
~ 0.1	ASTON	80	OMEG	20–70 γp

$\Gamma(\pi^+\pi^-\text{ neutrals})/\Gamma(2(\pi^+\pi^-))$ — $(\Gamma_3+\Gamma_4+0.709\Gamma_8)/\Gamma_5$

VALUE	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
2.6 ± 0.4	[31] BALLAM	74	HBC	9.3 γp

[31] Upper limit. Background not subtracted.

$\Gamma(K\overline{K})/\Gamma(2(\pi^+\pi^-))$ — Γ_9/Γ_5

VALUE	CL%	DOCUMENT ID		TECN	CHG	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •						
0.015 ± 0.010		[32] DELCOURT	81B	DM1		$e^+e^- \rightarrow \overline{K}K$
<0.04	95	BINGHAM	72B	HBC	0	9.3 γp

[32] Assuming $\rho(1700)$ and ω radial excitations to be degenerate in mass.

$\Gamma(K\overline{K})/\Gamma(K\overline{K}^*(892)+\text{c.c.})$ — Γ_9/Γ_7

VALUE	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.052 ± 0.026	BUON	82	DM1	$e^+e^- \rightarrow$ hadrons

$\Gamma(\rho^0\pi^+\pi^-)/\Gamma(2(\pi^+\pi^-))$ — Γ_2/Γ_5

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
~ 1.0		DELCOURT	81B	DM1	$e^+e^- \rightarrow 2(\pi^+\pi^-)$
$0.7\ \pm0.1$	500	SCHACHT	74	STRC	5.5–18 $\gamma p \rightarrow p4\pi$
0.80		[33] BINGHAM	72B	HBC	9.3 $\gamma p \rightarrow p4\pi$

[33] The $\pi\pi$ system is in S-wave.

$\Gamma(\rho^0\pi^0\pi^0)/\Gamma(\rho^\pm\pi^\mp\pi^0)$ — Γ_3/Γ_4

VALUE	DOCUMENT ID		TECN	CHG	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<0.10	ATKINSON	85B	OMEG		20–70 γp
<0.15	ATKINSON	82	OMEG	0	20–70 $\gamma p \rightarrow p4\pi$

$\rho(1700)$ REFERENCES

CLEGG	94	ZPHY C62 455	+Donnachie	(LANC, MCHS)
CLEGG	90	ZPHY C45 677	+Donnachie	(LANC, MCHS)
BISELLO	89	PL B220 321	+Busetto+	(DM2 Collab.)
DUBNICKA	89	JPG 15 1349	+Martinovic+	(JINR, SLOV)
GESHKENBEIN	89	ZPHY 45 351		(ITEP)
ANTONELLI	88	PL B212 133	+Baldini+	(DM2 Collab.)
DIEKMAN	88	PRPL 159 101		(BONN)
FUKUI	88	PL B202 441	+Horikawa+	(SUGI, NAGO, KEK, KYOT, MIYA)
DONNACHIE	87B	ZPHY C34 257	+Clegg	(MCHS, LANC)
ATKINSON	86B	ZPHY C30 531	+	(BONN, CERN, GLAS, LANC, MCHS, CURIN+)
ATKINSON	85B	ZPHY C26 499	+	(BONN, CERN, GLAS, LANC, MCHS, CURIN+)
ERKAL	85	ZPHY C29 485	+Olsson	(WISC)
ABE	84B	PRL 53 751	+Bacon, Ballam+	(SLAC Hybrid Facility Photon Collab.)
ATKINSON	82	PL 108B 55	+	(BONN, CERN, GLAS, LANC, MCHS, CURIN+)
BUON	82	PL 118B 221	+Bisello, Bizot, Cordier, Delcourt+	(LALO, MONP)
CLELAND	82B	NP B208 228	+Delfosse, Dorsaz, Gloor	(DURH, GEVA, LAUS, PITT)
CORDIER	82	PL 109B 129	+Bisello, Bizot, Buon, Delcourt	(LALO)
DELCOURT	82	PL 113B 93	+Bisello, Bizot, Buon, Cordier, Mane	(LALO)
ASTON	81E	NP B189 15		(BONN, CERN, EPOL, GLAS, LANC, MCHS+)

DELCOURT	81B	Bonn Conf. 205		(ORSAY)
Also	82	PL 109B 129	Cordier, Bisello, Bizot, Buon, Delcourt	(LALO)
DIBIANCA	81	PR D23 595	+Fickinger, Malko, Dado, Engler+	(CASE, CMU)
ASTON	80	PL 92B 215		(BONN, CERN, EPOL, GLAS, LANC, MCHS+)
BACCI	80	PL 95B 139	+DeZorzi, Penso, Baldini-Celio+	(ROMA, FRAS)
BIZOT	80	Madison Conf. 546	+Bisello, Buon, Cordier, Delcourt+	(LALO, MONP)
KILLIAN	80	PR D21 3005	+Treadwell, Ahrens, Berkelman, Cassel+	(CORN)
ATIYA	79B	PRL 43 1691	+Holmes, Knapp, Lee, Seto+	(COLU, ILL, FNAL)
BECKER	79	NP B151 46	+Blanar, Blum+	(MPIM, CERN, ZEEM, CRAC)
LANG	79	PR D19 956	+Mas-Parareda	(GRAZ)
MARTIN	78C	ANP 114 1	+Pennington	(CERN)
COSTA...	77B	PL 71B 345	Costa De Beauregard, Pire, Truong	(EPOL)
FROGGATT	77	NP B129 89	+Petersen	(GLAS, NORD)
ALEXANDER	75	PL 57B 487	+Benary, Gandsman, Lissauer+	(TELA)
BALLAM	74	NP B76 375	+Chadwick, Bingham, Fretter+	(SLAC, LBL, MPIM)
CONVERSI	74	PL 52B 493	+Paoluzi, Ceradini, Grilli+	(ROMA, FRAS)
SCHACHT	74	NP B81 205	+Derado, Fries, Park, Yount	(MPIM)
DAVIER	73	NP B58 31	+Derado, Fries, Liu, Mozley, Odian, Park+	(SLAC)
EISENBERG	73	PL 43B 149	+Karshon, Mikenberg, Pitluck+	(REHO)
HYAMS	73	NP B64 134	+Jones, Weilhammer, Blum, Dietl+	(CERN, MPIM)
MONTANET	73	Erice School 518		(CERN)
BINGHAM	72B	PL 41B 635	+Rabin, Rosenfeld, Smadja+	(LBL, UCB, SLAC) IGJP

OTHER RELATED PAPERS

AMSLER	93B	PL B311 362	+Armstrong, Augustin+	(Crystal Barrel Collab.)
LANDSBERG	92	SJNP 55 1051 Translated from YAF 55 1896.		(SERP)
ASTON	91B	NPBPS 21 105	+Awaji, Bienz+	(LASS Collab.)
ACHASOV	88C	PL B209 373	+Kozhevnikov	(NOVO)
BRAU	88	PR D37 2379	+Franek+	(SLAC Hybrid Facility Photon Collab.) JP
CLEGG	88	ZPHY C40 313	+Donnachie	(MCHS, LANC)
ASTON	87	NP B292 693	+Awaji, D'Amore+	(SLAC, NAGO, CINC, INUS)
ERKAL	86	ZPHY C31 615	+Olsson	(WISC)
BARKOV	85	NP B256 365	+Chilingarov, Eidelman, Khazin, Lelchuk+	(NOVO)
BISELLO	85	LAL 85-15	+Augustin, Ajaltouni+	(PADO, LALO, CLER, FRAS)
ATKINSON	84C	NP B243 1	+	(BONN, CERN, GLAS, LANC, MCHS, CURIN+) JP
ATKINSON	83B	PL 127B 132	+	(BONN, CERN, GLAS, LANC, MCHS, CURIN+)
ATKINSON	83C	NP B229 269	+	(BONN, CERN, GLAS, LANC, MCHS, CURIN+)
AUGUSTIN	83	LAL 83-21	+Ayach, Bisello, Baldini+	(LALO, PADO, FRAS)
SHAMBROOM	82	PR D26 1	+Wilson, Anderson, Francis+	(HARV, EFI, ILL, OXF)
BARBER	80C	ZPHY C4 169	+Dainton, Brodbeck, Brookes+	(DARE, LANC, SHEF)
KILLIAN	80	PR D21 3005	+Treadwell, Ahrens, Berkelman, Cassel+	(CORN)
COSME	76	PL 63B 352	+Courau, Dudelzak, Grelaud, Jean-Marie+	(ORSAY)
FRENKIEL	72	NP B47 61	+Ghesquiere, Lillestol, Chung+	(CDEF, CERN)
ALVENSLEBEN	71	PRL 26 273	+Becker, Bertram, Chen+	(DESY, MIT) G
BRAUN	71	NP B30 213	+Fridman, Gerber, Givernaud+	(STRB) G
BULOS	71	PRL 26 149	+Busza, Kehoe, Beniston+	(SLAC, UMD, IBM, LBL) G
LAYSSAC	71	NC 6A 134	+Renard	(MONP)

$X(1700)$

$I^G(J^{PC}) = \text{even}^+(?^{?+})$

OMITTED FROM SUMMARY TABLE

Enhancement seen in the $\eta\pi\pi$ system produced in the radiative decay of the $J/\psi(1S)$. May contain significant substructure. Relation to other enhancements seen in radiative $J/\psi(1S)$ decay unclear (see HITLIN 83). Enhancement seen in the $J = 2$, $\rho\pi\pi$ wave of the $\pi^+\pi^-\pi^+\pi^-$ system produced in pomeron-pomeron collisions. Tentatively called $X(1700)$ by us. Needs confirmation.

$X(1700)$ MASS

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
1700.0±45	EDWARDS	83B	CBAL	$J/\psi \rightarrow \eta\gamma 2\pi$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
~ 1750	BREAKSTONE	93	SFM	$pp \rightarrow pp\pi^+\pi^-\pi^+\pi^-$

$X(1700)$ WIDTH

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
520±110	EDWARDS	83B	CBAL	$J/\psi \rightarrow \eta\gamma 2\pi$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
200 to 300	BREAKSTONE	93	SFM	$pp \rightarrow pp\pi^+\pi^-\pi^+\pi^-$

$X(1700)$ REFERENCES

BREAKSTONE	93	ZPHY C58 251	+Campanini+	(IOWA, CERN, DORT, HEIDH, WARS)
EDWARDS	83B	PRL 51 859	+Partridge, Peck+	(CIT, HARV, PRIN, STAN, SLAC)
HITLIN	83	Cornell Conf. 746		(CIT)

$f_J(1710)$ was $\theta(1690)$

$I^G(J^{PC}) = 0^+(\text{even}\,{+}{+})$

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$f_J(1710)$ MASS

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
1709 ± 5 OUR AVERAGE				
1713 ±10	ARMSTRONG	89D	OMEG	300 $pp \to ppK^+K^-$
1706 ±10	ARMSTRONG	89D	OMEG	300 $pp \to ppK^0_SK^0_S$
1707.0±10.0	AUGUSTIN	88	DM2	$J/\psi \to \gamma K^+K^-$
1698 ±15	AUGUSTIN	87	DM2	$J/\psi \to \gamma\pi^+\pi^-$
1720 ±10 ±10	BALTRUSAIT..	87	MRK3	$J/\psi \to \gamma K^+K^-$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
1710 ±20	CHEN	91	MRK3	$J/\psi \to \gamma\pi^+\pi^-, \gamma K\overline{K}$
1700 ±15	BOLONKIN	88	SPEC	40 $\pi^-p \to K^0_SK^0_Sn$
1720 ±60	BOLONKIN	88	SPEC	40 $\pi^-p \to K^0_SK^0_Sn$
1638 ±10	[1] FALVARD	88	DM2	$J/\psi \to \phi K^+K^-$
1690 ± 4	[2] FALVARD	88	DM2	$J/\psi \to \phi K^+K^-$
1730 $^{+\ 2}_{-10}$	[3,4] LONGACRE	86	MPS	22 $\pi^-p \to n2K^0_S$
1742.0±15.0	WILLIAMS	84	MPSF	200 $\pi^-N \to 2K^0_SX$
1670 ±50	BLOOM	83	CBAL	$J/\psi \to \gamma 2\eta$
1650 ±50	BURKE	82	MRK2	$J/\psi \to \gamma 2\rho$
1730.0±10 ±20	ETKIN	82C	MPS	23 $\pi^-p \to n2K^0_S$
1708.0±30.0	FRANKLIN	82	MRK2	$e^+e^- \to \gamma K^+K^-$

[1] From an analysis ignoring interference with $f'_2(1525)$.
[2] From an analysis including interference with $f'_2(1525)$.
[3] From a partial-wave analysis of data using a K-matrix formalism with 5 poles, but assuming spin 2.
[4] Fit with constrained inelasticity.

$f_J(1710)$ WIDTH

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
140 ± 12 OUR AVERAGE				
181 ± 30	ARMSTRONG	89D	OMEG	300 $pp \to ppK^+K^-$
104 ± 30	ARMSTRONG	89D	OMEG	300 $pp \to ppK^0_SK^0_S$
166.4± 33.2	AUGUSTIN	88	DM2	$J/\psi \to \gamma K^+K^-$
136 ± 28	AUGUSTIN	87	DM2	$J/\psi \to \gamma\pi^+\pi^-$
130 ± 20	BALTRUSAIT..	87	MRK3	$J/\psi \to \gamma K^+K^-$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
186 ± 30	CHEN	91	MRK3	$J/\psi \to \gamma\pi^+\pi^-, \gamma K\overline{K}$
30 ± 20	BOLONKIN	88	SPEC	40 $\pi^-p \to K^0_SK^0_Sn$
350 ±150	BOLONKIN	88	SPEC	40 $\pi^-p \to K^0_SK^0_Sn$
148 ± 17	[5] FALVARD	88	DM2	$J/\psi \to \phi K^+K^-$
184 ± 6	[6] FALVARD	88	DM2	$J/\psi \to \phi K^+K^-$
122 $^{+\ 74}_{-\ 15}$	[7,8] LONGACRE	86	MPS	22 $\pi^-p \to n2K^0_S$
57.0± 38.0	WILLIAMS	84	MPSF	200 $\pi^-N \to 2K^0_SX$
160 ± 80	BLOOM	83	CBAL	$J/\psi \to \gamma 2\eta$
200 ±100	BURKE	82	MRK2	$J/\psi \to \gamma 2\rho$
200.0$^{+156.0}_{-\ \ 9.0}$	[9] ETKIN	82B	MPS	23 $\pi^-p \to n2K^0_S$
156.0± 60.0	FRANKLIN	82	MRK2	$e^+e^- \to \gamma K^+K^-$

[5] From an analysis ignoring interference with $f'_2(1525)$.
[6] From an analysis including interference with $f'_2(1525)$.

[7] From a partial-wave analysis of data using a K-matrix formalism with 5 poles, but assuming spin 2.
[8] Fit with constrained inelasticity.
[9] From an amplitude analysis of the $K^0_S K^0_S$ system.

$f_J(1710)$ DECAY MODES

	Mode	Fraction (Γ_i/Γ)
Γ_1	$K\overline{K}$	seen
Γ_2	$\eta\eta$	
Γ_3	$\pi\pi$	seen
Γ_4	$\rho\rho$	
Γ_5	$\gamma\gamma$	

$f_J(1710)$ $\Gamma(i)\Gamma(\gamma\gamma)/\Gamma(\text{total})$

$\Gamma(K\overline{K}) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$ — $\Gamma_1\Gamma_5/\Gamma$

VALUE (keV)	CL%	DOCUMENT ID		TECN	COMMENT
<0.11	95	[10] BEHREND	89C	CELL	$\gamma\gamma \to K^0_S K^0_S$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<0.48	95	ALBRECHT	90G	ARG	$\gamma\gamma \to K^+K^-$
<0.28	95	[10] ALTHOFF	85B	TASS	$\gamma\gamma \to K\overline{K}\pi$

[10] Assuming helicity 2.

$f_J(1710)$ BRANCHING RATIOS

$\Gamma(K\overline{K})/\Gamma_{\text{total}}$ — Γ_1/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
$0.38^{+0.09}_{-0.19}$	[11,12] LONGACRE	86	MPS	$22\ \pi^- p \to n 2K^0_S$

$\Gamma(\eta\eta)/\Gamma_{\text{total}}$ — Γ_2/Γ

VALUE	DOCUMENT ID		TECN
• • • We do not use the following data for averages, fits, limits, etc. • • •			
$0.18^{+0.03}_{-0.13}$	[11,12] LONGACRE	86	RVUE

$\Gamma(\pi\pi)/\Gamma_{\text{total}}$ — Γ_3/Γ

VALUE	DOCUMENT ID		TECN
• • • We do not use the following data for averages, fits, limits, etc. • • •			
$0.039^{+0.002}_{-0.024}$	[11,12] LONGACRE	86	RVUE

$\Gamma(\pi\pi)/\Gamma(K\overline{K})$ — Γ_3/Γ_1

VALUE	DOCUMENT ID		TECN	COMMENT
0.39±0.14	ARMSTRONG	91	OMEG	$300\ pp \to pp\pi\pi,\ ppKK$

[11] From a partial-wave analysis of data using a K-matrix formalism with 5 poles, but assuming spin 2.
[12] Fit with constrained inelasticity.

$f_J(1710)$ REFERENCES

ARMSTRONG	91	ZPHY C51 351	+Benayoun+	(ATHU, BARI, BIRM, CERN, CDEF)
CHEN SLAC-PUB-5669	91	Hadron 91 Conf.		(Mark III Collab.)
ALBRECHT	90G	ZPHY C48 183	+Ehrlichmann, Harder+	(ARGUS Collab.)
ARMSTRONG	89D	PL B227 186	+Benayoun	(ATHU, BARI, BIRM, CERN, CDEF)
BEHREND	89C	ZPHY C43 91	+Criegee, Dainton+	(CELLO Collab.)
AUGUSTIN	88	PRL 60 2238	+Calcaterra+	(DM2 Collab.)
BOLONKIN	88	NP B309 426	+Bloshenko, Gorin+	(ITEP, SERP)
FALVARD	88	PR D38 2706	+Ajaltouni+	(CLER, FRAS, LALO, PADO)
AUGUSTIN	87	ZPHY C36 369	+Cosme+	(LALO, CLER, FRAS, PADO)
BALTRUSAIT...	87	PR D35 2077	Baltrusaitis, Coffman, Dubois+	(Mark III Collab.)
LONGACRE	86	PL B177 223	+Etkin+	(BNL, BRAN, CUNY, DUKE, NDAM)
ALTHOFF	85B	ZPHY C29 189	+Braunschweig, Kirschfink+	(TASSO Collab.)
WILLIAMS	84	PR D30 877	+Diamond+	(VAND, NDAM, TUFTS, ARIZ, FNAL+)
BLOOM	83	ARNS 33 143	+Peck	(SLAC, CIT)
BURKE	82	PRL 49 632	+Trilling, Abrams, Alam, Blocker+	(LBL, SLAC)
ETKIN	82B	PR D25 1786	+Foley, Lai+	(BNL, CUNY, TUFTS, VAND)
ETKIN	82C	PR D25 2446	+Foley, Lai+	(BNL, CUNY, TUFTS, VAND)
FRANKLIN	82	SLAC-254		(SLAC)

OTHER RELATED PAPERS

CHEN 91 Hadron 91 Conf. (Mark III Collab.)
SLAC-PUB-5669
PROKOSHKIN 91 SPD 316 155 (GAM2 Collab.)
Translated from DANS 316 900.
BISELLO 89B PR D39 701 Busetto+ (DM2 Collab.)
ASTON 88D NP B301 525 +Awaji, Bienz+ (SLAC, NAGO, CINC, INUS)
AKESSON 86 NP B264 154 +Albrow, Almehed+ (Axial Field Spec. Collab.)
ARMSTRONG 86B PL 167B 133 +Bloodworth, Carney+ (ATHU, BARI, BIRM, CERN)
BALTRUSAIT... 86B PR D33 1222 Baltrusaitis, Coffman, Hauser+ (Mark III Collab.)
ALTHOFF 83 PL 121B 216 +Brandelik, Boerner, Burkhardt+ (TASSO Collab.)
BARNETT 83B PL 120B 455 +Blockus, Burka, Chien, Christian+ (JHU)
ALTHOFF 82 ZPHY C16 13 +Boerner, Burkhardt+ (TASSO Collab.)
BARNES 82 PL B116 365 +Close (RHEL)
BARNES 82B NP B198 360 +Close, Monaghan (RHEL, OXFTP)
TANIMOTO 82 PL 116B 198 (BIEL)

$X(1740)$

$I^G(J^{PC}) = 0^+(\text{even}\ {+}{+})$

OMITTED FROM SUMMARY TABLE

We have collected here resonances in the $\eta\eta$ channel which may be not the same state. See also the minireview under $f_0(1710)$. $J^P = 0^+$ or 2^+.

$X(1740)$ MASS

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •			
1748±10	ARMSTRONG 93C	SPEC	$\overline{p}p \rightarrow \pi^0\eta\eta \rightarrow 6\gamma$
1744±15	[1] ALDE 92D	GAM2	$38\ \pi^- p \rightarrow \eta\eta N^*$

[1] ALDE 92 combines all the GAMS-2000 data.

$X(1740)$ WIDTH

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •			
264±25	ARMSTRONG 93C	SPEC	$\overline{p}p \rightarrow \pi^0\eta\eta \rightarrow 6\gamma$
< 80	ALDE 92D	GAM2	$38\ \pi^- p \rightarrow \eta\eta N^*$

$X(1740)$ DECAY MODES

	Mode
Γ_1	$\eta\eta$
Γ_2	$\pi^0\pi^0$
Γ_3	$\eta\eta'$

$X(1740)$ BRANCHING RATIOS

$\Gamma(\pi^0\pi^0)/\Gamma(\eta\eta)$ — Γ_2/Γ_1

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
<1	90	ALDE 92D	GAM2	$38\ \pi^- p \rightarrow \eta\eta N^*$

$\Gamma(\eta\eta')/\Gamma(\eta\eta)$ — Γ_3/Γ_1

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
<1	90	ALDE 92D	GAM2	$38\ \pi^- p \rightarrow \eta\eta N^*$

$X(1740)$ REFERENCES

ARMSTRONG 93C PL B307 394 +Bettoni+ (FNAL, FERR, GENO, UCI, NWES+)
ALDE 92 PL B276 375 + (SERP, BELG, LANC, LAPP, PISA, KEK)
ALDE 92D PL B284 457 +Binon, Bricman+ (GAM2 Collab.)
Translated from YAF 54 745.

$\eta(1760)$

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

OMITTED FROM SUMMARY TABLE

Seen by DM2 in the $\rho\rho$ system BISELLO 89B. Needs confirmation. Structure in this region has been reported before in the same system BALTRUSAITIS 86B and in the $\omega\omega$ system BALTRUSAITIS 85C, BISELLO 87.

$\eta(1760)$ MASS

VALUE (MeV)	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
1760±11	320	[1] BISELLO	89B	DM2	$J/\psi \to 4\pi\gamma$

[1] Estimated by us from various fits.

$\eta(1760)$ WIDTH

VALUE (MeV)	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
60±16	320	[2] BISELLO	89B	DM2	$J/\psi \to 4\pi\gamma$

[2] Estimated by us from various fits.

$\eta(1760)$ REFERENCES

BISELLO	89B	PR D39 701	Busetto+	(DM2 Collab.)
BISELLO	87	PL B192 239	+Ajaltouni, Baldini+	(PADO, CLER, FRAS, LALO)
BALTRUSAIT...	86B	PR D33 1222	Baltrusaitis, Coffman, Hauser+	(Mark III Collab.)
BALTRUSAIT...	85C	PRL 55 1723	Baltrusaitis+	(CIT, UCSC, ILL, SLAC, WASH)

$\pi(1770)$

$I^G(J^{PC}) = 1^-(0^{-+})$

OMITTED FROM SUMMARY TABLE

Seen in partial-wave analysis of the diffractively produced 3π system. Needs confirmation.

$\pi(1770)$ MASS

VALUE (MeV)	*EVTS*	*DOCUMENT ID*		*TECN*	*CHG*	*COMMENT*
1786±13 OUR AVERAGE						
1790±14		BERDNIKOV	94	VES		$37\ \pi^- A \to K^+ K^- \pi^- A$
1770±30	1100	BELLINI	82	SPEC	−	$40\ \pi^- A \to 3\pi A$

$\pi(1770)$ WIDTH

VALUE (MeV)	*EVTS*	*DOCUMENT ID*		*TECN*	*CHG*	*COMMENT*
276±50 OUR AVERAGE Error includes scale factor of 1.2.						
210±70		BERDNIKOV	94	VES		$37\ \pi^- A \to K^+ K^- \pi^- A$
310±50	1100	BELLINI	82	SPEC	−	$40\ \pi^- A \to 3\pi A$

$\pi(1770)$ DECAY MODES

	Mode	Fraction (Γ_i/Γ)
Γ_1	$f_0(1300)\pi$	seen
Γ_2	$\rho\pi$	not seen
Γ_3	$f_0(980)\pi^-$	seen
Γ_4	$K_0^*(1430)K^-$	seen

$\pi(1770)$ BRANCHING RATIOS

$\Gamma(f_0(1300)\pi)/\Gamma_{total}$ **Γ_1/Γ**

VALUE	*DOCUMENT ID*		*TECN*	*CHG*	*COMMENT*
seen	BELLINI	82	SPEC	−	$40\ \pi^- A \to 3\pi A$

$\Gamma(\rho\pi)/\Gamma_{total}$ — Γ_2/Γ

VALUE	DOCUMENT ID		TECN	CHG	COMMENT
not seen	BELLINI	82	SPEC	–	40 $\pi^- A \to 3\pi A$

$\Gamma(f_0(980)\pi^-)/\Gamma_{total}$ — Γ_3/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
seen	BERDNIKOV	94	VES	37 $\pi^- A \to K^+ K^- \pi^- A$

$\Gamma(K_0^*(1430)K^-)/\Gamma_{total}$ — Γ_4/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
seen	BERDNIKOV	94	VES	37 $\pi^- A \to K^+ K^- \pi^- A$

$\pi(1770)$ REFERENCES

BERDNIKOV 94 PL B337 219 +Bityukov+ (SERP)
BELLINI 82 PRL 48 1697 +Frabetti, Ivanshin, Litkin+ (MILA, BGNA, JINR)

$X(1775)$

$I^G(J^{PC}) = 1^-(?^{-+})$

OMITTED FROM SUMMARY TABLE

Seen in the charge exchange photoproduction reactions $\gamma p \to (p\pi^+)(\pi^+\pi^-\pi^-)$, $\gamma p \to n\pi^+\pi^+\pi^-$. Needs confirmation.

$X(1775)$ MASS

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
1776±13 OUR AVERAGE				
1763±20	CONDO	91	SHF	$\gamma p \to (p\pi^+)(\pi^+\pi^-\pi^-)$
1787±18	CONDO	91	SHF	$\gamma p \to n\pi^+\pi^+\pi^-$

$X(1775)$ WIDTH

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
155±40 OUR AVERAGE				
192±60	CONDO	91	SHF	$\gamma p \to (p\pi^+)(\pi^+\pi^-\pi^-)$
118±60	CONDO	91	SHF	$\gamma p \to n\pi^+\pi^+\pi^-$

$X(1775)$ DECAY MODES

	Mode
Γ_1	$\rho\pi$
Γ_2	$f_2(1270)\pi$

$X(1775)$ BRANCHING RATIOS

$\Gamma(\rho\pi)/\Gamma(f_2(1270)\pi)$ — Γ_1/Γ_2

VALUE	DOCUMENT ID		TECN	COMMENT
1.43±0.26 OUR AVERAGE				
1.3 ±0.3	CONDO	91	SHF	$\gamma p \to (p\pi^+)(\pi^+\pi^-\pi^-)$
1.8 ±0.5	CONDO	91	SHF	$\gamma p \to n\pi^+\pi^+\pi^-$

$X(1775)$ REFERENCES

CONDO 91 PR D43 2787 +Handler+ (SLAC Hybrid Collab.)

$f_2(1810)$

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

OMITTED FROM SUMMARY TABLE

From an amplitude analysis of the K^+K^- system seen in $\pi^- p \to K^+K^- n$ at 10 GeV/c. Confirmed by LONGACRE 86. Seen also in $\pi^+\pi^- \to 2\pi^0$ amplitude nalysis (CASON 82), in the partial-wave analysis of the $\eta\eta$ system (ALDE 86D) and in the $4\pi^0$ mass spectrum (ALDE 88). Needs confirmation.

$f_2(1810)$ MASS

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
• • • We do not use the following data for averages, fits, limits, etc. • • •				
1858^{+18}_{-71}	[1] LONGACRE	86	RVUE	Compilation
1799 ± 15	CASON	82	STRC	$8\ \pi^+ p \to p\pi^+ 2\pi^0$
1857^{+35}_{-24}	[2] COSTA...	80	OMEG	$10\ \pi^- p \to K^+K^- n$

[1] From a partial-wave analysis of data using a K-matrix formalism with 5 poles. Includes compilation of several other experiments.

[2] Error increased by spread of two solutions. Included in LONGACRE 86 global analysis.

$f_2(1810)$ WIDTH

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
• • • We do not use the following data for averages, fits, limits, etc. • • •				
$388^{+\ 15}_{-\ 21}$	[3] LONGACRE	86	RVUE	Compilation
$280^{+\ 42}_{-\ 35}$	CASON	82	STRC	$8\ \pi^+ p \to p\pi^+ 2\pi^0$
185^{+102}_{-139}	[4] COSTA...	80	OMEG	$10\ \pi^- p \to K^+K^- n$

[3] From a partial-wave analysis of data using a K-matrix formalism with 5 poles. Includes compilation of several other experiments.

[4] Error increased by spread of two solutions. Included in LONGACRE 86 global analysis.

$f_2(1810)$ DECAY MODES

	Mode	Fraction (Γ_i/Γ)
Γ_1	$\pi\pi$	$(21.0^{+\ 2.0}_{-\ 3.0})$ %
Γ_2	$\eta\eta$	$(\ 8.0^{+28.0}_{-\ 3.0}) \times 10^{-3}$
Γ_3	$4\pi^0$	
Γ_4	K^+K^-	$(\ 3.0^{+19.0}_{-\ 2.0}) \times 10^{-3}$

$f_2(1810)$ BRANCHING RATIOS

$\Gamma(\pi\pi)/\Gamma_{\text{total}}$ — Γ_1/Γ

VALUE	*DOCUMENT ID*		*TECN*	*COMMENT*
$\mathbf{0.21\ ^{+0.02}_{-0.03}}$	[5] LONGACRE	86	RVUE	Compilation
• • • We do not use the following data for averages, fits, limits, etc. • • •				
$0.44\ \pm0.03$	[6] CASON	82	STRC	$8\ \pi^+ p \to p\pi^+ 2\pi^0$

$\Gamma(\eta\eta)/\Gamma_{\text{total}}$ — Γ_2/Γ

VALUE	*DOCUMENT ID*		*TECN*	*COMMENT*
$\mathbf{0.008\ ^{+0.028}_{-0.003}}$	[5] LONGACRE	86	RVUE	Compilation

$\Gamma(K^+K^-)/\Gamma_{total}$ — Γ_4/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
0.003 $^{+0.019}_{-0.002}$	[5] LONGACRE	86	RVUE	Compilation
• • • We do not use the following data for averages, fits, limits, etc. • • •				
seen	COSTA...	80	OMEG	$10\ \pi^- p \rightarrow K^+ K^- n$

[5] From a partial-wave analysis of data using a K-matrix formalism with 5 poles. Includes compilation of several other experiments.

[6] Included in LONGACRE 86 global analysis.

$f_2(1810)$ REFERENCES

ALDE	88	PL B201 160	+Bellazzini, Binon+	(SERP, BELG, LANL, LAPP, PISA)
ALDE	86D	NP B269 485	+Binon, Bricman+	(BELG, LAPP, SERP, CERN)
LONGACRE	86	PL B177 223	+Etkin+	(BNL, BRAN, CUNY, DUKE, NDAM)
CASON	82	PRL 48 1316	+Biswas, Baumbaugh, Bishop+	(NDAM, ANL)
COSTA...	80	NP B175 402	Costa De Beauregard+	(BARI, BONN, CERN+)

OTHER RELATED PAPERS

AKER	91	PL B260 249	+Amsler, Peters+	(Crystal Barrel Collab.)
ALDE	88	PL B201 160	+Bellazzini, Binon+	(SERP, BELG, LANL, LAPP, PISA)
ALDE	86D	NP B269 485	+Binon, Bricman+	(BELG, LAPP, SERP, CERN)
CASON	83	PR D28 1586	+Cannata, Baumbaugh, Bishop+	(NDAM, ANL)
ETKIN	82B	PR D25 1786	+Foley, Lai+	(BNL, CUNY, TUFTS, VAND)

$X(1830)$

$I^G(J^{PC}) = 1^-(?^{?+})$

OMITTED FROM SUMMARY TABLE

Observed in coherent production on a carbon and beryllium nucleus. $J^{PC} = 1^{++}$ and 2^{-+} preferred. Needs confirmation.

$X(1830)$ MASS

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	COMMENT
1832±27 OUR AVERAGE Error includes scale factor of 1.3.					
1873±33±20		BELADIDZE	92C	VES	$36\ \pi^- \mathrm{Be} \rightarrow \pi^- \eta' \eta \mathrm{Be}$
1814±10±23	426± 57	BITYUKOV	91	VES	$36\ \pi^- \mathrm{C} \rightarrow \pi^- \eta \eta \mathrm{C}$

$X(1830)$ WIDTH

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	COMMENT
214±27 OUR AVERAGE					
225±35±20		BELADIDZE	92C	VES	$36\ \pi^- \mathrm{Be} \rightarrow \pi^- \eta' \eta \mathrm{Be}$
205±18±32	426± 57	BITYUKOV	91	VES	$36\ \pi^- \mathrm{C} \rightarrow \pi^- \eta \eta \mathrm{C}$

$X(1830)$ DECAY MODES

	Mode	Fraction (Γ_i/Γ)
Γ_1	$\pi \eta \eta$	
Γ_2	$\pi \eta \eta'(958)$	
Γ_3	$\pi f_0(1590)$	seen

$X(1830)$ BRANCHING RATIOS

$\Gamma(\pi \eta \eta'(958))/\Gamma(\pi \eta \eta)$ — Γ_2/Γ_1

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.29±0.06 OUR AVERAGE					
0.29±0.07		BELADIDZE	92C	VES	$36\ \pi^- \mathrm{Be} \rightarrow \pi^- \eta' \eta \mathrm{Be}$
0.3 ±0.1	426± 57	BITYUKOV	91	VES	$36\ \pi^- \mathrm{C} \rightarrow \pi^- \eta \eta \mathrm{C}$

$X(1830)$ REFERENCES

BELADIDZE 92C SJNP 55 1535 +Bityukov, Borisov (VES Collab.)
Translated from YAF 55 2748.
BITYUKOV 91 PL B268 137 +Borisov+ (SERP, TBIL)

OTHER RELATED PAPERS

BORISOV 92 SJNP 55 1441 +Gershtein, Zaitsev (SERP)
Translated from YAF 55 2583.

$\phi_3(1850)$

$I^G(J^{PC}) = 0^-(3^{--})$

Seen in the $K\overline{K}$ and $K\overline{K}\pi$ mass distributions.

$\phi_3(1850)$ MASS

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	COMMENT
1854 ± 7 OUR AVERAGE					
1855 ±10		ASTON	88E	LASS	11 $K^- p \to K^- K^+ \Lambda$, $K^0_S K^\pm \pi^\mp \Lambda$
$1870.0^{+30.0}_{-20.0}$	430	ARMSTRONG	82	OMEG	18.5 $K^- p \to K^- K^+ \Lambda$
1850.0±10.0	123	ALHARRAN	81B	HBC	8.25 $K^- p \to K\overline{K}\Lambda$

$\phi_3(1850)$ WIDTH

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	COMMENT
87^{+28}_{-23} OUR AVERAGE Error includes scale factor of 1.2.					
64 ±31		ASTON	88E	LASS	11 $K^- p \to K^- K^+ \Lambda$, $K^0_S K^\pm \pi^\mp \Lambda$
$160.0^{+90.0}_{-50.0}$	430	ARMSTRONG	82	OMEG	18.5 $K^- p \to K^- K^+ \Lambda$
$80.0^{+40.0}_{-30.0}$	123	ALHARRAN	81B	HBC	8.25 $K^- p \to K\overline{K}\Lambda$

$\phi_3(1850)$ DECAY MODES

	Mode	Fraction (Γ_i/Γ)
Γ_1	$K\overline{K}$	seen
Γ_2	$K\overline{K}^*(892)+$ c.c.	seen

$\phi_3(1850)$ BRANCHING RATIOS

$\Gamma(K\overline{K}^*(892)+\text{c.c.})/\Gamma(K\overline{K})$ — Γ_2/Γ_1

VALUE	DOCUMENT ID		TECN	COMMENT
$\mathbf{0.55^{+0.85}_{-0.45}}$	ASTON	88E	LASS	11 $K^- p \to K^- K^+ \Lambda$, $K^0_S K^\pm \pi^\mp \Lambda$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.8 ±0.4	ALHARRAN	81B	HBC	8.25 $K^- p \to K\overline{K}\pi\Lambda$

$\phi_3(1850)$ REFERENCES

ASTON 88E PL B208 324 +Awaji, Biewz+ (SLAC, NAGO, CINC, INUS) IGJPC
ARMSTRONG 82 PL 110B 77 +Baubillier+ (BARI, BIRM, CERN, MILA, CURIN+) JP
ALHARRAN 81B PL 101B 357 +Amirzadeh+ (BIRM, CERN, GLAS, MICH, CURIN)

OTHER RELATED PAPERS

CORDIER 82B PL 110B 335 +Bisello, Bizot, Buon, Delcourt, Fayard+ (LALO)
ASTON 80B PL 92B 219 (BONN, CERN, EPOL, GLAS, LANC, MCHS+)

$\eta_2(1870)$

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

OMITTED FROM SUMMARY TABLE

Needs confirmation.

$\eta_2(1870)$ MASS

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	COMMENT
1881±32±40	26	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. • • •					
1850±50		FEINDT	91	CELL	$\gamma\gamma \to \eta\pi^+\pi^-$

$\eta_2(1870)$ WIDTH

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	COMMENT
221± 92±44	26	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. • • •					
~ 360		FEINDT	91	CELL	$\gamma\gamma \to \eta\pi^+\pi^-$

$\eta_2(1870)$ DECAY MODES

	Mode
Γ_1	$\eta\pi\pi$
Γ_2	$a_2(1320)\pi$
Γ_3	$f_0(980)\eta$

$\eta_2(1870)$ REFERENCES

KARCH 92 ZPHY C54 33 +Antreasyan, Bartels+ (Crystal Ball Collab.)

FEINDT 91 Singapore Conf. 537

OTHER RELATED PAPERS

KARCH 90 PL B249 353 +Antreasyan, Bartels+ (Crystal Ball Collab.)

$X(1910)$

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

OMITTED FROM SUMMARY TABLE

We list here several bumps seen in the mass distributions of different final states.

$X(1910)$ MASS

VALUE (MeV)	DOCUMENT ID
1810 to 1920 OUR ESTIMATE	

$X(1910)$ $4\pi^0$ MODE

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
1806±10	1600±100	ALDE	87	GAM4	100 $\pi^- p \to 4\pi^0 n$
1870±40		ALDE	86D	GAM4	100 $\pi^- p \to 4\gamma n$

$X(1910)$ $\omega\omega$ MODE

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
1920±10	BELADIDZE	92B	VES	36 $\pi^- p \to \omega\omega n$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
1924±14	ALDE	90	GAM2	38 $\pi^- p \to n\omega\omega$

$X(1910)$ $\eta\eta'$ MODE

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
1911±10	ALDE	91B	GAM2	38 $\pi^- p \rightarrow \eta\eta' n$

$X(1910)$ WIDTH

VALUE (MeV)	DOCUMENT ID
90 to 250 OUR ESTIMATE	

$X(1910)$ $4\pi^0$ MODE

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
190±20	1600±100	ALDE	87	GAM4	100 $\pi^- p \rightarrow 4\pi^0 n$
250±30		ALDE	86D	GAM4	100 $\pi^- p \rightarrow 4\gamma n$

$X(1910)$ $\omega\omega$ MODE

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
90±20	BELADIDZE	92B	VES	36 $\pi^- p \rightarrow \omega\omega n$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
91±50	ALDE	90	GAM2	38 $\pi^- p \rightarrow n\omega\omega$

$X(1910)$ $\eta\eta'$ MODE

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
90±35	ALDE	91B	GAM2	38 $\pi^- p \rightarrow \eta\eta' n$

$X(1910)$ DECAY MODES

	Mode
Γ_1	$4\pi^0$
Γ_2	$\pi\pi$
Γ_3	$\pi^0\pi^0$
Γ_4	$K^0_S K^0_S$
Γ_5	$\eta\eta$
Γ_6	$\omega\omega$
Γ_7	$\eta\eta'$
Γ_8	$\eta\pi\pi$
Γ_9	$\eta'\eta'$

$X(1910)$ BRANCHING RATIOS

$\Gamma(\pi^0\pi^0)/\Gamma(4\pi^0)$ — Γ_3/Γ_1

VALUE	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
<0.25	ALDE	87	GAM4	100 $\pi^- p \rightarrow 4\pi^0 n$

$\Gamma(4\pi^0)/\Gamma(\eta\eta)$ — Γ_1/Γ_5

VALUE	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.8±0.3	ALDE	87	GAM4	100 $\pi^- p \rightarrow 4\pi^0 n$

$\Gamma(\omega\omega)/\Gamma_{\text{total}}$ — Γ_6/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
seen	ALDE	89B	GAM2	38 $\pi^- p \rightarrow n\omega\omega$

$\Gamma(\pi^0\pi^0)/\Gamma(\eta\eta')$ — Γ_3/Γ_7

VALUE	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
<0.1	ALDE	89	GAM2	$38\pi^- p \rightarrow n\eta\eta'$

$\Gamma(\eta\eta)/\Gamma(\eta\eta')$ — Γ_5/Γ_7

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<0.05	90	ALDE	91B	GAM2	$38\pi^- p \rightarrow n\eta\eta'$

$\Gamma(K^0_S K^0_S)/\Gamma(\eta\eta')$ — Γ_4/Γ_7

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<0.066	90	BALOSHIN	86	SPEC	$40\pi p \rightarrow K^0_S K^0_S n$

$\Gamma(\eta'\eta')/\Gamma_{total}$ — Γ_9/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
possibly seen	BELADIDZE	92D	VES	$37\ \pi^- p \rightarrow \eta'\eta' n$

X(1910) REFERENCES

BELADIDZE 92B ZPHY C54 367 +Bityukov, Borisov+ (VES Collab.)
BELADIDZE 92D ZPHY C57 13 +Berdnikov+ (VES Collab.)
ALDE 91B SJNP 54 455 +Binon+ (SERP, BELG, LANL, LAPP, PISA, KEK)
Translated from YAF 54 751.
ALDE 90 PL B241 600 +Binon+ (SERP, BELG, LANL, LAPP, PISA, KEK)
ALDE 89 PL B216 447 +Binon, Bricman, Donskov+ (SERP, BELG, LANL, LAPP)
ALDE 89B PL B216 451 +Binon, Bricman+ (SERP, BELG, LANL, LAPP, TBIL)
ALDE 87 PL B198 286 +Binon, Bricman+ (LANL, BRUX, SERP, LAPP)
ALDE 86D NP B269 485 +Binon, Bricman+ (BELG, LAPP, SERP, CERN)
BALOSHIN 86 SJNP 43 959 +Barkov, Bolonkin, Vladimirskii, Grigoriev+ (ITEP)
Translated from YAF 43 1487.

$f_2(1950)$

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

OMITTED FROM SUMMARY TABLE

Needs confirmation.

$f_2(1950)$ MASS

VALUE (MeV)	DOCUMENT ID		TECN	CHG	COMMENT
1950±15	[1] ASTON	91	LASS	0	$11\ K^- p \rightarrow \Lambda K \overline{K} \pi\pi$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
~ 1996	HASAN	94	RVUE		$\overline{p} p \rightarrow \pi\pi$

[1] Cannot determine spin to be 2.

$f_2(1950)$ WIDTH

VALUE (MeV)	DOCUMENT ID		TECN	CHG	COMMENT
250±50	[2] ASTON	91	LASS	0	$11\ K^- p \rightarrow \Lambda K \overline{K} \pi\pi$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
~ 134	HASAN	94	RVUE		$\overline{p} p \rightarrow \pi\pi$

[2] Cannot determine spin to be 2.

$f_2(1950)$ DECAY MODES

	Mode
Γ_1	$K^*(892)\overline{K}^*(892)$
Γ_2	$\pi^0\pi^0$

$f_2(1950)$ BRANCHING RATIOS

$\Gamma(K^*(892)\overline{K}^*(892))/\Gamma_{total}$ — Γ_1/Γ

VALUE	DOCUMENT ID		TECN	CHG	COMMENT
seen	ASTON	91	LASS	0	$11\ K^- p \rightarrow \Lambda K \overline{K} \pi\pi$

f_2(1950) REFERENCES

HASAN	94	PL B334 215	+Bugg	(LOQM)
ASTON	91	NP B21 5 (suppl)	+Awaji+	(LASS Collab.)

OTHER RELATED PAPERS

BIENZ	90	SLAC 369		(LASS Collab.)
ALBRECHT	88N	PL B212 528	+	(ARGUS Collab.)
ALBRECHT	87Q	PL B198 255	+Binder+	(ARGUS Collab.)
ARMSTRONG	87C	ZPHY C34 33	+Bloodworth+	(CERN, BIRM, BARI, ATHU, CURIN+)

f_2(2010)

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

See also the mini-review under non-$q\overline{q}$ candidates. (See the index for the page number.)

f_2(2010) MASS

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
2011 $^{+62}_{-76}$	[1] ETKIN	88	MPS	22 $\pi^- p \to \phi\phi n$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
1980 ± 20	[2] BOLONKIN	88	SPEC	40 $\pi^- p \to K^0_S K^0_S n$
$2050.0^{+\ 90.0}_{-\ 50.0}$	ETKIN	85	MPS	22 $\pi^- p \to 2\phi n$
$2120.0^{+\ 20.0}_{-120.0}$	LINDENBAUM	84	RVUE	
2160.0 ± 50.0	ETKIN	82	MPS	22 $\pi^- p \to 2\phi n$

[1] Includes data of ETKIN 85. The percentage of the resonance going into $\phi\phi$ 2^{++} S_2, D_2, and D_0 is 98^{+1}_{-3}, 0^{+1}_{-0}, and 2^{+2}_{-1}, respectively.

[2] Statistically very weak, only 1.4 s.d.

f_2(2010) WIDTH

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
202 $^{+67}_{-62}$	[3] ETKIN	88	MPS	22 $\pi^- p \to \phi\phi n$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
145 ± 50	[4] BOLONKIN	88	SPEC	40 $\pi^- p \to K^0_S K^0_S n$
$200.0^{+160.0}_{-\ 50.0}$	ETKIN	85	MPS	22 $\pi^- p \to 2\phi n$
$300.0^{+150.0}_{-\ 50.0}$	LINDENBAUM	84	RVUE	
310.0 ± 70.0	ETKIN	82	MPS	22 $\pi^- p \to 2\phi n$

[3] Includes data of ETKIN 85.

[4] Statistically very weak, only 1.4 s.d.

f_2(2010) DECAY MODES

	Mode	Fraction (Γ_i/Γ)
Γ_1	$\phi\phi$	seen

f_2(2010) REFERENCES

BOLONKIN	88	NP B309 426	+Bloshenko, Gorin+	(ITEP, SERP)
ETKIN	88	PL B201 568	+Foley, Lindenbaum+	(BNL, CUNY)
ETKIN	85	PL 165B 217	+Foley, Longacre, Lindenbaum+	(BNL, CUNY)
LINDENBAUM	84	CNPP 13 285		(CUNY)
ETKIN	82	PRL 49 1620	+Foley, Longacre, Lindenbaum+	(BNL, CUNY)
Also	83	Brighton Conf. 351	Lindenbaum	(BNL, CUNY)

OTHER RELATED PAPERS

ARMSTRONG	89B	PL B221 221	+Benayoun+	(CERN, CDEF, BIRM, BARI, ATHU, CURIN+)
GREEN	86	PRL 56 1639	+Lai+	(FNAL, ARIZ, FSU, NDAM, TUFTS, VAND+)
BOOTH	84	NP B242 51	+Ballance, Carroll, Donald+	(LIVP, GLAS, CERN)

$a_4(2040)$

$I^G(J^{PC}) = 1^-(4^{++})$

OMITTED FROM SUMMARY TABLE

Seen in partial-wave analysis of the $K\overline{K}$ and $\pi^+\pi^-\pi^0$ systems. Needs confirmation.

$a_4(2040)$ MASS

VALUE (MeV)	DOCUMENT ID		TECN	CHG	COMMENT
2037 ±26 OUR AVERAGE					
2040.0±30.0	[1] CLELAND	82B	SPEC	±	50 $\pi p \rightarrow K^0_S K^{\pm} p$
2030.0±50.0	[2] CORDEN	78C	OMEG	0	15 $\pi^- p \rightarrow 3\pi n$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
1903.0±10.0	[3] BALDI	78	SPEC	−	10 $\pi^- p \rightarrow p K^0_S K^-$

[1] From an amplitude analysis.
[2] $J^P = 4^+$ is favored, though $J^P = 2^+$ cannot be excluded.
[3] From a fit to the Y^0_8 moment. Limited by phase space.

$a_4(2040)$ WIDTH

VALUE (MeV)	DOCUMENT ID		TECN	CHG	COMMENT
427 ±120 OUR AVERAGE					
380.0±150.0	[4] CLELAND	82B	SPEC	±	50 $\pi p \rightarrow K^0_S K^{\pm} p$
510.0±200.0	[5] CORDEN	78C	OMEG	0	15 $\pi^- p \rightarrow 3\pi n$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
166.0± 43.0	[6] BALDI	78	SPEC	−	10 $\pi^- p \rightarrow p K^0_S K^-$

[4] From an amplitude analysis.
[5] $J^P = 4^+$ is favored, though $J^P = 2^+$ cannot be excluded.
[6] From a fit to the Y^0_8 moment. Limited by phase space.

$a_4(2040)$ DECAY MODES

	Mode	Fraction (Γ_i/Γ)
Γ_1	$K\overline{K}$	seen
Γ_2	$\pi^+\pi^-\pi^0$	seen

$a_4(2040)$ BRANCHING RATIOS

$\Gamma(K\overline{K})/\Gamma_{total}$ Γ_1/Γ

VALUE	DOCUMENT ID		TECN	CHG	COMMENT
seen	BALDI	78	SPEC	±	10 $\pi^- p \rightarrow K^0_S K^- p$

$\Gamma(\pi^+\pi^-\pi^0)/\Gamma_{total}$ Γ_2/Γ

VALUE	DOCUMENT ID		TECN	CHG	COMMENT
seen	CORDEN	78C	OMEG	0	15 $\pi^- p \rightarrow 3\pi n$

$a_4(2040)$ REFERENCES

CLELAND	82B	NP B208 228	+Delfosse, Dorsaz, Gloor	(DURH, GEVA, LAUS, PITT)
BALDI	78	PL 74B 413	+Bohringer, Dorsaz, Hungerbuhler+	(GEVA) JP
CORDEN	78C	NP B136 77	+Dowell, Garvey+	(BIRM, RHEL, TELA, LOWC) JP

OTHER RELATED PAPERS

DELFOSSE	81	NP B183 349	+Guisan, Martin, Muhlemann, Weill+	(GEVA, LAUS)

$a_3(2050)$

$I^G(J^{PC}) = 1^-(3^{++})$

OMITTED FROM SUMMARY TABLE

Needs confirmation.

$a_3(2050)$ MASS

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	CHG	COMMENT
2014±60 OUR AVERAGE		Error includes scale factor of 2.2.				
1964±35		[1] ARMSTRONG	93D	SPEC		$\overline{p}p \to 3\pi^0 \to 6\gamma$
2080±40	208	KALELKAR	75	HBC	+	$15\ \pi^+ p \to p\pi^+\rho_3$
• • • We do not use the following data for averages, fits, limits, etc. • • •						
∼ 2100		ANTIPOV	77	CIBS	−	$25\ \pi^- p \to p\pi^-\rho_3$
2214±15		BALTAY	77	HBC	0	$15\ \pi^- p \to \Delta^{++} 3\pi$

[1] Cannot determine spin to be 3.

$a_3(2050)$ WIDTH

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	CHG	COMMENT
257±50 OUR AVERAGE		Error includes scale factor of 1.2.				
225±50		[2] ARMSTRONG	93D	SPEC		$\overline{p}p \to 3\pi^0 \to 6\gamma$
340±80	208	KALELKAR	75	HBC	+	$15\ \pi^+ p \to p\pi^+\rho_3$
• • • We do not use the following data for averages, fits, limits, etc. • • •						
∼ 500		ANTIPOV	77	CIBS	−	$25\ \pi^- p \to p\pi^-\rho_3$
355±21		BALTAY	77	HBC	0	$15\ \pi^- p \to \Delta^{++} 3\pi$

[2] Cannot determine spin to be 3.

$a_3(2050)$ DECAY MODES

	Mode	Fraction (Γ_i/Γ)
Γ_1	3π	
Γ_2	$\rho_3(1690)\pi$	dominant

$a_3(2050)$ BRANCHING RATIOS

$\Gamma(\rho_3(1690)\pi)/\Gamma(3\pi)$ **Γ_2/Γ_1**

VALUE	DOCUMENT ID		TECN	CHG	COMMENT
dominant	KALELKAR	75	HBC	+	$15\ \pi^+ p \to p 3\pi$

$a_3(2050)$ REFERENCES

ARMSTRONG 93D PL B307 399 +Bettoni+ (FNAL, FERR, GENO, UCI, NWES+)
ANTIPOV 77 NP B119 45 +Busnello, Damgaard, Kienzle+ (SERP, GEVA)
BALTAY 77 PRL 39 591 +Cautis, Kalelkar (COLU) JP
KALELKAR 75 Thesis Nevis 207 (COLU)

OTHER RELATED PAPERS

HARRIS 81 ZPHY C9 275 +Dunn, Lubatti, Moriyasu, Podolsky+ (SEAT, UCB)
HUSON 68 PL 28B 208 +Lubatti, Six, Veillet+ (ORSAY, MILA, UCLA)
DANYSZ 67B NC 51A 801 +French, Simak (CERN)

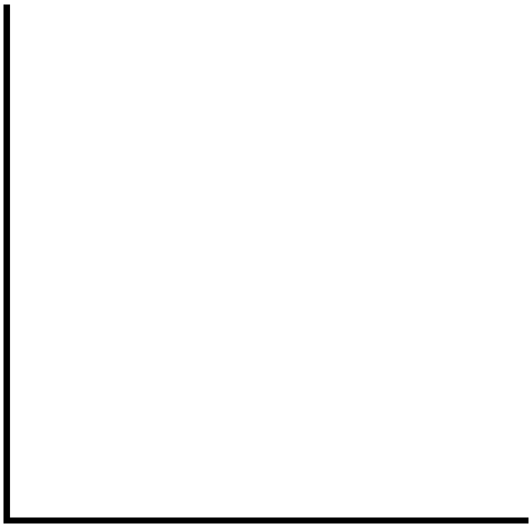
$f_4(2050)$

$I^G(J^{PC}) = 0^+(4^{++})$

$f_4(2050)$ MASS

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	COMMENT
2044 ±11 OUR AVERAGE		Error includes scale factor of 1.4. See the ideogram below.			
1970 ±30		BELADIDZE	92B	VES	36 $\pi^- p \rightarrow \omega\omega n$
2060 ±20		ALDE	90	GAM2	38 $\pi^- p \rightarrow n\omega\omega$
2038 ±30		AUGUSTIN	87	DM2	$J/\psi \rightarrow \gamma\pi^+\pi^-$
2086 ±15		BALTRUSAIT...	87	MRK3	$J/\psi \rightarrow \gamma\pi^+\pi^-$
2000.0±60.0		ALDE	86D	GAM4	100 $\pi^- p \rightarrow n2\eta$
2020.0±20.0	40k	[1] BINON	84B	GAM2	38 $\pi^- p \rightarrow n2\pi^0$
2015.0±28.0		[1] CASON	82	STRC	8 $\pi^+ p \rightarrow p\pi^+ 2\pi^0$
2031.0^{+25}_{-36}		ETKIN	82B	MPS	23 $\pi^- p \rightarrow n2K^0_S$
2020 ±30	700	APEL	75	NICE	40 $\pi^- p \rightarrow n2\pi^0$
2050 ±25		BLUM	75	ASPK	18.4 $\pi^- p \rightarrow nK^+K^-$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
1978.0± 5.0		[2] ALPER	80	CNTR	62 $\pi^- p \rightarrow K^+K^- n$
2040.0±10.0		[2] ROZANSKA	80	SPRK	18 $\pi^- p \rightarrow p\overline{p}n$
1935.0±13.0		[2] CORDEN	79	OMEG	12–15 $\pi^- p \rightarrow n2\pi$
1988.0± 7.0		EVANGELISTA	79B	OMEG	10 $\pi^- p \rightarrow K^+K^- n$
1922.0±14.0		[3] ANTIPOV	77	CIBS	25 $\pi^- p \rightarrow p3\pi$

[1] From amplitude analysis of reaction $\pi^+\pi^- \rightarrow 2\pi^0$.
[2] $I(J^P) = 0(4^+)$ from amplitude analysis assuming one-pion exchange.
[3] Width errors enlarged by us to $4\Gamma/\sqrt{N}$; see the note with the $K^*(892)$ mass.



$f_4(2050)$ mass (MeV)

$f_4(2050)$ WIDTH

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	COMMENT
208 ± 13 OUR AVERAGE		Error includes scale factor of 1.2.			
300 ± 50		BELADIDZE	92B	VES	36 $\pi^- p \rightarrow \omega\omega n$
170 ± 60		ALDE	90	GAM2	38 $\pi^- p \rightarrow n\omega\omega$
304 ± 60		AUGUSTIN	87	DM2	$J/\psi \rightarrow \gamma\pi^+\pi^-$
210 ± 63		BALTRUSAIT...	87	MRK3	$J/\psi \rightarrow \gamma\pi^+\pi^-$
400.0±100.0		ALDE	86D	GAM4	100 $\pi^- p \rightarrow n2\eta$
240.0± 40.0	40k	[4] BINON	84B	GAM2	38 $\pi^- p \rightarrow n2\pi^0$

190.0 ± 14.0		DENNEY	83	LASS	$10\ \pi^+ n/\pi^+ p$
$186.0^{+103.0}_{-58.0}$		[4] CASON	82	STRC	$8\ \pi^+ p \rightarrow p\pi^+ 2\pi^0$
305.0^{+36}_{-119}		ETKIN	82B	MPS	$23\ \pi^- p \rightarrow n 2K^0_S$
180 ± 60	700	APEL	75	NICE	$40\ \pi^- p \rightarrow n 2\pi^0$
$225\ ^{+120}_{-70}$		BLUM	75	ASPK	$18.4\ \pi^- p \rightarrow nK^+K^-$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
243.0 ± 16.0		[5] ALPER	80	CNTR	$62\ \pi^- p \rightarrow K^+K^- n$
140.0 ± 15.0		[5] ROZANSKA	80	SPRK	$18\ \pi^- p \rightarrow p\overline{p} n$
263.0 ± 57.0		[5] CORDEN	79	OMEG	$12\text{–}15\ \pi^- p \rightarrow n 2\pi$
100.0 ± 28.0		EVANGELISTA	79B	OMEG	$10\ \pi^- p \rightarrow K^+K^- n$
107.0 ± 56.0		[6] ANTIPOV	77	CIBS	$25\ \pi^- p \rightarrow p 3\pi$

[4] From amplitude analysis of reaction $\pi^+\pi^- \rightarrow 2\pi^0$.
[5] $I(J^P) = 0(4^+)$ from amplitude analysis assuming one-pion exchange.
[6] Width errors enlarged by us to $4\Gamma/\sqrt{N}$; see the note with the $K^*(892)$ mass.

$f_4(2050)$ DECAY MODES

	Mode	Fraction (Γ_i/Γ)
Γ_1	$\omega\omega$	(26 ± 6) %
Γ_2	$\pi\pi$	(17.0 ± 1.5) %
Γ_3	$K\overline{K}$	$(6.8^{+3.4}_{-1.8}) \times 10^{-3}$
Γ_4	$\eta\eta$	$(2.1 \pm 0.8) \times 10^{-3}$
Γ_5	$4\pi^0$	< 1.2 %
Γ_6	$\gamma\gamma$	

$f_4(2050)$ $\Gamma(i)\Gamma(\gamma\gamma)/\Gamma(\text{total})$

$\Gamma(K\overline{K}) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$ — $\Gamma_3\Gamma_6/\Gamma$

VALUE (keV)	*CL%*	*DOCUMENT ID*		*TECN*	*COMMENT*
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<0.29	95	ALTHOFF	85B	TASS	$\gamma\gamma \rightarrow K\overline{K}\pi$

$\Gamma(\pi\pi) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$ — $\Gamma_2\Gamma_6/\Gamma$

VALUE (keV)	*CL%*	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
<1.1	95	13 ± 4	OEST	90	JADE	$e^+e^- \rightarrow e^+e^-\pi^0\pi^0$

$f_4(2050)$ BRANCHING RATIOS

$\Gamma(\omega\omega)/\Gamma(\pi\pi)$ — Γ_1/Γ_2

VALUE	*DOCUMENT ID*		*TECN*	*COMMENT*
1.5 ±0.3	ALDE	90	GAM2	$38\ \pi^- p \rightarrow n\omega\omega$

$\Gamma(\pi\pi)/\Gamma_{\text{total}}$ — Γ_2/Γ

VALUE	*DOCUMENT ID*		*TECN*	*COMMENT*
0.170±0.015 OUR AVERAGE				
0.18 ± 0.03	[7] BINON	83C	GAM2	$38\ \pi^- p \rightarrow n 4\gamma$
0.16 ± 0.03	[7] CASON	82	STRC	$8\ \pi^+ p \rightarrow p\pi^+ 2\pi^0$
0.17 ± 0.02	[7] CORDEN	79	OMEG	$12\text{–}15\ \pi^- p \rightarrow n 2\pi$

[7] Assuming one pion exchange.

$\Gamma(K\overline{K})/\Gamma(\pi\pi)$ — Γ_3/Γ_2

VALUE	*DOCUMENT ID*		*TECN*	*COMMENT*
$\mathbf{0.04\ ^{+0.02}_{-0.01}}$	ETKIN	82B	MPS	$23\ \pi^- p \rightarrow n 2K^0_S$

$\Gamma(\eta\eta)/\Gamma_{\text{total}}$ — Γ_4/Γ

VALUE (units 10^{-3})	*DOCUMENT ID*		*TECN*	*COMMENT*
2.1±0.8	ALDE	86D	GAM4	$100\ \pi^- p \rightarrow n 4\gamma$

$\Gamma(4\pi^0)/\Gamma_{total}$ — Γ_5/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
<0.012	ALDE	87	GAM4	100 $\pi^- p \rightarrow 4\pi^0 n$

$f_4(2050)$ REFERENCES

BELADIDZE	92B	ZPHY C54 367	+Bityukov, Borisov+	(VES Collab.)
ALDE	90	PL B241 600	+Binon+	(SERP, BELG, LANL, LAPP, PISA, KEK)
OEST	90	ZPHY C47 343	+Olsson+	(JADE Collab.)
ALDE	87	PL B198 286	+Binon, Bricman+	(LANL, BRUX, SERP, LAPP)
AUGUSTIN	87	ZPHY C36 369	+Cosme+	(LALO, CLER, FRAS, PADO)
BALTRUSAIT...	87	PR D35 2077	Baltrusaitis, Coffman, Dubois+	(Mark III Collab.)
ALDE	86D	NP B269 485	+Binon, Bricman+	(BELG, LAPP, SERP, CERN)
ALTHOFF	85B	ZPHY C29 189	+Braunschweig, Kirschfink+	(TASSO Collab.)
BINON	84B	LNC 39 41	+Donskov, Duteil, Gouanere+	(SERP, BELG, LAPP)
BINON	83C	SJNP 38 723	+Gouanere, Donskov, Duteil+	(SERP, BRUX+)
		Translated from YAF 38 1199.		
DENNEY	83	PR D28 2726	+Cranley, Firestone, Chapman+	(IOWA, MICH)
CASON	82	PRL 48 1316	+Biswas, Baumbaugh, Bishop+	(NDAM, ANL)
ETKIN	82B	PR D25 1786	+Foley, Lai+	(BNL, CUNY, TUFTS, VAND)
ALPER	80	PL 94B 422	+Becker+	(AMST, CERN, CRAC, MPIM, OXF+)
ROZANSKA	80	NP B162 505	+Blum, Dietl, Grayer, Lorenz+	(MPIM, CERN)
CORDEN	79	NP B157 250	+Dowell, Garvey+	(BIRM, RHEL, TELA, LOWC) JP
EVANGELISTA	79B	NP B154 381	+	(BARI, BONN, CERN, DARE, GLAS, LIVP+)
ANTIPOV	77	NP B119 45	+Busnello, Damgaard, Kienzle+	(SERP, GEVA)
APEL	75	PL 57B 398	+Augenstein+	(KARLK, KARLE, PISA, SERP, WIEN, CERN) JP
BLUM	75	PL 57B 403	+Chabaud, Dietl, Garelick, Grayer+	(CERN, MPIM) JP

OTHER RELATED PAPERS

CASON	83	PR D28 1586	+Cannata, Baumbaugh, Bishop+	(NDAM, ANL)
GOTTESMAN	80	PR D22 1503	+Jacobs+	(SYRA, BRAN, BNL, CINC)
WAGNER	74	London Conf. 2 27		(MPIM)

$\pi_2(2100)$

$I^G(J^{PC}) = 1^-(2^{-+})$

OMITTED FROM SUMMARY TABLE

Seen in the $\rho\pi$, $f_0(1300)\pi$, and $f_2(1270)\pi$ $J^P = 2^-$ waves of the diffractively produced 3π system. Needs confirmation.

$\pi_2(2100)$ MASS

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
2100±150	[1] DAUM	81B	CNTR	63,94 $\pi^- p \rightarrow 3\pi X$

[1] From a two-resonance fit to four 2^-0^+ waves.

$\pi_2(2100)$ WIDTH

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
651±50	[2] DAUM	81B	CNTR	63,94 $\pi^- p \rightarrow 3\pi X$

[2] From a two-resonance fit to four 2^-0^+ waves.

$\pi_2(2100)$ DECAY MODES

	Mode	Fraction (Γ_i/Γ)
Γ_1	3π	seen
Γ_2	$\rho\pi$	seen
Γ_3	$f_2(1270)\pi$	seen
Γ_4	$f_0(1300)\pi$	seen

$\pi_2(2100)$ BRANCHING RATIOS

$\Gamma(\rho\pi)/\Gamma(3\pi)$ — Γ_2/Γ_1

VALUE	DOCUMENT ID		TECN	COMMENT
0.19±0.05	[3] DAUM	81B	CNTR	63,94 $\pi^- p$

$\Gamma(f_2(1270)\pi)/\Gamma(3\pi)$ — Γ_3/Γ_1

VALUE	DOCUMENT ID		TECN	COMMENT
0.36±0.09	[3] DAUM	81B	CNTR	63,94 $\pi^- p$

$\Gamma(f_0(1300)\pi)/\Gamma(3\pi)$ — Γ_4/Γ_1

VALUE	DOCUMENT ID	TECN	COMMENT
0.45±0.07	[3] DAUM 81B	CNTR	63,94 $\pi^- p$

D-wave/S-wave RATIO FOR $\pi_2(2100) \to f_2(1270)\pi$

VALUE	DOCUMENT ID	TECN	COMMENT
0.39±0.23	[3] DAUM 81B	CNTR	63,94 $\pi^- p$

[3] From a two-resonance fit to four 2^-0^+ waves.

$\pi_2(2100)$ REFERENCES

DAUM 81B NP B182 269 +Hertzberger+ (AMST, CERN, CRAC, MPIM, OXF+)

$f_2(2150)$

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

OMITTED FROM SUMMARY TABLE

This entry was previously called T_0.

$f_2(2150)$ MASS

$\overline{p}p \to \pi\pi$

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •			
~ 2226	HASAN 94	RVUE	$\overline{p}p \to \pi\pi$
~ 2170.0	[1] MARTIN 80B	RVUE	
~ 2150.0	[1] MARTIN 80C	RVUE	
~ 2150.0	[2] DULUDE 78B	OSPK	1–2 $\overline{p}p \to \pi^0\pi^0$

[1] $I(J^P) = 0(2^+)$ from simultaneous analysis of $p\overline{p} \to \pi^-\pi^+$ and $\pi^0\pi^0$.

[2] $I^G(J^P) = 0^+(2^+)$ from partial-wave amplitude analysis.

S-CHANNEL $\overline{p}p$ or $\overline{N}N$

VALUE (MeV)	DOCUMENT ID	TECN	CHG	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
~ 2190.0	[3] CUTTS 78B	CNTR		0.97–3 $\overline{p}p \to \overline{N}N$
2155.0±15.0	[3,4] COUPLAND 77	CNTR	0	0.7–2.4 $\overline{p}p \to \overline{p}p$
2193 ± 2	[3,5] ALSPECTOR 73	CNTR		$\overline{p}p$ S channel

[3] Isospins 0 and 1 not separated.

[4] From a fit to the total elastic cross section.

[5] Referred to as T or T region by ALSPECTOR 73.

OTHER HADRONIC MODES

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •			
2104±20	ARMSTRONG 93C	SPEC	$\overline{p}p \to \pi^0\eta\eta \to 6\gamma$
2175±20	PROKOSHKIN 90	GAM4	300 $\pi^- N \to \pi^- N 2\eta$, 450 $pN \to pN2\eta$

$f_2(2150)$ WIDTH

$\overline{p}p \to \pi\pi$

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •			
~ 226	HASAN 94	RVUE	$\overline{p}p \to \pi\pi$
~ 250.0	[6] MARTIN 80B	RVUE	
~ 250.0	[6] MARTIN 80C	RVUE	
~ 250.0	[7] DULUDE 78B	OSPK	1–2 $\overline{p}p \to \pi^0\pi^0$

[6] $I(J^P) = 0(2^+)$ from simultaneous analysis of $p\overline{p} \to \pi^-\pi^+$ and $\pi^0\pi^0$.

[7] $I^G(J^P) = 0^+(2^+)$ from partial-wave amplitude analysis.

S-CHANNEL $\overline{p}p$ or $\overline{N}N$

VALUE (MeV)	DOCUMENT ID		TECN	CHG	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
135.0±75.0	[8,9] COUPLAND	77	CNTR	0	0.7–2.4 $\overline{p}p \rightarrow \overline{p}p$
98 ± 8	[9] ALSPECTOR	73	CNTR		$\overline{p}p$ S channel

[8] From a fit to the total elastic cross section.
[9] Isospins 0 and 1 not separated.

OTHER HADRONIC MODES

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
203±10	ARMSTRONG	93C	SPEC	$\overline{p}p \rightarrow \pi^0\eta\eta \rightarrow 6\gamma$
150±35	PROKOSHKIN	90	GAM4	300 $\pi^- N \rightarrow \pi^- N 2\eta$, 450 $pN \rightarrow pN2\eta$

$f_2(2150)$ DECAY MODES

	Mode
Γ_1	$\pi\pi$

$f_2(2150)$ REFERENCES

HASAN 94 PL B334 215 +Bugg (LOQM)
ARMSTRONG 93C PL B307 394 +Bettoni+ (FNAL, FERR, GENO, UCI, NWES+)
PROKOSHKIN 90 Hadron 89 Conf. p 27 (SERP, BELG, LANL, LAPP, PISA, KEK)
MARTIN 80B NP B176 355 +Morgan (LOUC, RHEL) JP
MARTIN 80C NP B169 216 +Pennington (DURH) JP
CUTTS 78B PR D17 16 +Good, Grannis, Green, Lee+ (STON, WISC)
DULUDE 78B PL 79B 335 +Lanou, Massimo, Peaslee+ (BROW, MIT, BARI) JP
COUPLAND 77 PL 71B 460 +Eisenhandler, Gibson, Astbury+ (LOQM, RHEL)
ALSPECTOR 73 PRL 30 511 +Cohen, Cvijanovich+ (RUTG, UPNJ)

OTHER RELATED PAPERS

FIELDS 71 PRL 27 1749 +Cooper, Rhines, Allison (ANL, OXF)
YOH 71 PRL 26 922 +Barish, Caroll, Lobkowicz+ (CIT, BNL, ROCH)

$\rho(2150)$

$I^G(J^{PC}) = 1^+(1^{--})$

OMITTED FROM SUMMARY TABLE

This entry was previously called $T_1(2190)$.

Our latest mini-review on this particle can be found in the 1984 edition.

$\rho(2150)$ MASS

$\overline{p}p \rightarrow \pi\pi$

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
~ 2191	HASAN	94	RVUE	$\overline{p}p \rightarrow \pi\pi$
~ 1988	HASAN	94	RVUE	$\overline{p}p \rightarrow \pi\pi$
~ 2170.0	[2] MARTIN	80B	RVUE	
~ 2100.0	[2] MARTIN	80C	RVUE	

S-CHANNEL $\overline{N}N$

VALUE (MeV)	DOCUMENT ID		TECN	CHG	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
~ 2190.0	[3] CUTTS	78B	CNTR		0.97–3 $\overline{p}p \rightarrow \overline{N}N$
2155.0±15.0	[3,4] COUPLAND	77	CNTR	0	0.7–2.4 $\overline{p}p \rightarrow \overline{p}p$
2193 ± 2	[3,5] ALSPECTOR	73	CNTR		$\overline{p}p$ S channel
2190 ±10	[6] ABRAMS	70	CNTR		S channel $\overline{p}N$

$e^+ e^- \rightarrow \pi^+ \pi^-, K^+ K^-, 6\pi$

VALUE (MeV)	DOCUMENT ID		TECN	CHG	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
2153±37	BIAGINI	91	RVUE		$e^+ e^- \rightarrow \pi^+ \pi^-, K^+ K^-$
2110±50	[1] CLEGG	90	RVUE	0	$e^+ e^- \rightarrow 3(\pi^+ \pi^-), 2(\pi^+ \pi^- \pi^0)$

[1] Includes ATKINSON 85.
[2] $I(J^P) = 1(1^-)$ from simultaneous analysis of $p\overline{p} \rightarrow \pi^- \pi^+$ and $\pi^0 \pi^0$.
[3] Isospins 0 and 1 not separated.
[4] From a fit to the total elastic cross section.
[5] Referred to as T or T region by ALSPECTOR 73.
[6] Seen as bump in $I = 1$ state. See also COOPER 68. PEASLEE 75 confirm $\overline{p}p$ results of ABRAMS 70, no narrow structure.

$\rho(2150)$ WIDTH

$\overline{p}p \rightarrow \pi\pi$

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
~ 260	HASAN	94	RVUE	$\overline{p}p \rightarrow \pi\pi$
~ 244	HASAN	94	RVUE	$\overline{p}p \rightarrow \pi\pi$
~ 250.0	[8] MARTIN	80B	RVUE	
~ 200.0	[8] MARTIN	80C	RVUE	

S-CHANNEL $\overline{N}N$

VALUE (MeV)	DOCUMENT ID		TECN	CHG	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
135.0±75.0	[9,10] COUPLAND	77	CNTR	0	0.7–2.4 $\overline{p}p \rightarrow \overline{p}p$
98 ± 8	[10] ALSPECTOR	73	CNTR		$\overline{p}p$ S channel
~ 85	[11] ABRAMS	70	CNTR		S channel $\overline{p}N$

$e^+ e^- \rightarrow \pi^+ \pi^-, K^+ K^-, 6\pi$

VALUE (MeV)	DOCUMENT ID		TECN	CHG	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
389± 79	BIAGINI	91	RVUE		$e^+ e^- \rightarrow \pi^+ \pi^-, K^+ K^-$
410±100	[7] CLEGG	90	RVUE	0	$e^+ e^- \rightarrow 3(\pi^+ \pi^-), 2(\pi^+ \pi^- \pi^0)$

[7] Includes ATKINSON 85.
[8] $I(J^P) = 1(1^-)$ from simultaneous analysis of $p\overline{p} \rightarrow \pi^- \pi^+$ and $\pi^0 \pi^0$.
[9] From a fit to the total elastic cross section.
[10] Isospins 0 and 1 not separated.
[11] Seen as bump in $I = 1$ state. See also COOPER 68. PEASLEE 75 confirm $\overline{p}p$ results of ABRAMS 70, no narrow structure.

$\rho(2150)$ REFERENCES

HASAN	94	PL B334 215	+Bugg	(LOQM)
BIAGINI	91	NC 104A 363	+Dubnicka+	(FRAS, PRAG)
CLEGG	90	ZPHY C45 677	+Donnachie	(LANC, MCHS)
ATKINSON	85	ZPHY C29 333	+	(BONN, CERN, GLAS, LANC, MCHS, IPNP+)
MARTIN	80B	NP B176 355	+Morgan	(LOUC, RHEL) JP
MARTIN	80C	NP B169 216	+Pennington	(DURH) JP
CUTTS	78B	PR D17 16	+Good, Grannis, Green, Lee+	(STON, WISC)
COUPLAND	77	PL 71B 460	+Eisenhandler, Gibson, Astbury+	(LOQM, RHEL)
PEASLEE	75	PL 57B 189	+Demarzo, Guerriero+	(CANB, BARI, BROW, MIT)
ALSPECTOR	73	PRL 30 511	+Cohen, Cvijanovich+	(RUTG, UPNJ)
ABRAMS	70	PR D1 1917	+Cool, Giacomelli, Kycia, Leontic, Li+	(BNL)
COOPER	68	PRL 20 1059	+Hyman, Manner, Musgrave+	(ANL)

OTHER RELATED PAPERS

BRICMAN	69	PL 29B 451	+Ferro-Luzzi, Bizard+	(CERN, CAEN, SACL)
ABRAMS	67C	PRL 18 1209	+Cool, Giacomelli, Kycia, Leontic, Li+	(BNL)

$f_0(2200)$

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

OMITTED FROM SUMMARY TABLE

Seen at DCI in the $K^0_S K^0_S$ system. Not seen in Υ radiative decays (BARU 89). Needs confirmation.

$f_0(2200)$ MASS

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*CHG*	*COMMENT*
2197±17	[1] AUGUSTIN	88	DM2	0	$J/\psi \to \gamma K^0_S K^0_S$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
~ 2122	HASAN	94	RVUE		$\overline{p}p \to \pi\pi$
~ 2321	HASAN	94	RVUE		$\overline{p}p \to \pi\pi$

[1] Cannot determine spin to be 0.

$f_0(2200)$ WIDTH

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*CHG*	*COMMENT*
201±51	[2] AUGUSTIN	88	DM2	0	$J/\psi \to \gamma K^0_S K^0_S$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
~ 273	HASAN	94	RVUE		$\overline{p}p \to \pi\pi$
~ 223	HASAN	94	RVUE		$\overline{p}p \to \pi\pi$

[2] Cannot determine spin to be 0.

$f_0(2200)$ REFERENCES

HASAN	94	PL B334 215	+Bugg	(LOQM)
BARU	89	ZPHY C42 505	+Beilin, Blinov+	(NOVO)
AUGUSTIN	88	PRL 60 2238	+Calcaterra+	(DM2 Collab.)

$\rho(2210)$

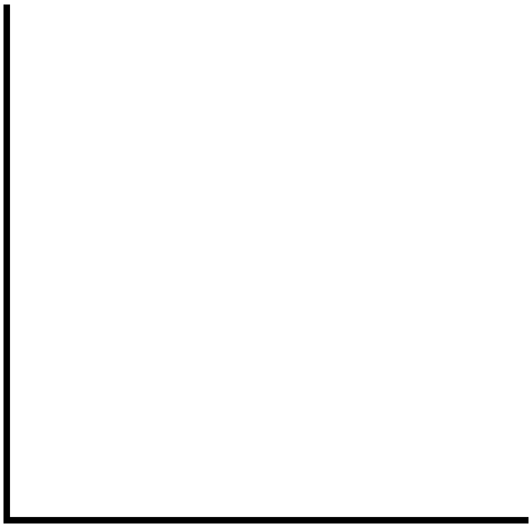
$I^G(J^{PC}) = 1^+(1^{--})$

OMITTED FROM SUMMARY TABLE

Seen in one-pion exchange production of the $\omega\pi^0$ system and diffractive photoproduction of the $\omega\pi^+\pi^-\pi^0$ system. Needs confirmation.

$\rho(2210)$ MASS

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
2212±22 OUR AVERAGE	Error includes scale factor of 1.4. See the ideogram below.			
2220±20	ALDE	92C	GAM2	38 $\pi^- p \to n\omega\pi^0$
2170±30	ALDE	92C	GAM4	100 $\pi^- p \to n\omega\pi^0$
2280±50	ATKINSON	85	OMEG	20–70 $\gamma p \to p\omega\pi^+\pi^-\pi^0$



$\rho(2210)$ mass (MeV)

$\rho(2210)$ WIDTH

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
286± 80 OUR AVERAGE	Error includes scale factor of 1.6.			
240± 60	ALDE	92C	GAM2	38 $\pi^- p \rightarrow n\omega\pi^0$
~ 300	ALDE	92C	GAM4	100 $\pi^- p \rightarrow n\omega\pi^0$
440±110	ATKINSON	85	OMEG	20–70 $\gamma p \rightarrow p\omega\pi^+\pi^-\pi^0$

$\rho(2210)$ REFERENCES

ALDE 92C ZPHY C54 553 +Bellazzini+ (SERP, BELG, LANL, LAPP, PISA, KEK)
ATKINSON 85 ZPHY C29 333 + (BONN, CERN, GLAS, LANC, MCHS, IPNP+)

$f_4(2220)$ was $\xi(2220)$

$I^G(J^{PC}) = 0^+(4^{++})$

OMITTED FROM SUMMARY TABLE

This state has been seen at SPEAR in the $K\overline{K}$ systems (K^+K^- and $K^0_S K^0_S$) produced in the radiative decay of $J/\psi(1S)$. Seen in $\eta\eta'$ (ALDE 86B), in $K^0_S K^0_S$ (ASTON 88D), and in K^+K^- (ASTON 88F). Needs confirmation. Also J needs confirmation. Not seen in Υ radiative decays nor in B inclusive decay (BEHRENDS 84). Not seen in $\overline{p}p \rightarrow K^+K^-$ formation experiment (BARDIN 87,SCULLI 87) and $\overline{p}p \rightarrow K^0_S K^0_S$ formation experiment (BARNES 93). Not seen at DCI in either K^+K^- or $K^0_S K^0_S$ systems (AUGUSTIN 88).

$f_4(2220)$ MASS

VALUE (MeV)	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
2225± 6 OUR AVERAGE					
$2209^{+17}_{-15}\pm10$		ASTON	88F	LASS	11 $K^- p \rightarrow K^+K^-\Lambda$
2230±20		BOLONKIN	88	SPEC	40 $\pi^- p \rightarrow K^0_S K^0_S n$
2220±10	41	ALDE	86B	GAM4	38–100 $\pi p \rightarrow n\eta\eta'$
2230± 6±14	93	BALTRUSAIT...	86D	MRK3	$e^+e^- \rightarrow \gamma K^+K^-$
2232± 7± 7	23	BALTRUSAIT...	86D	MRK3	$e^+e^- \rightarrow \gamma K^0_S K^0_S$

$f_4(2220)$ WIDTH

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	COMMENT
38^{+15}_{-13} OUR AVERAGE					
60^{+107}_{-57}		ASTON	88F	LASS	$11\ K^- p \to K^+ K^- \Lambda$
80 ± 30		BOLONKIN	88	SPEC	$40\ \pi^- p \to K^0_S K^0_S n$
$26^{+20}_{-16}\pm 17$	93	BALTRUSAIT...	86D	MRK3	$e^+ e^- \to \gamma K^+ K^-$
$18^{+23}_{-15}\pm 10$	23	BALTRUSAIT...	86D	MRK3	$e^+ e^- \to \gamma K^0_S K^0_S$

$f_4(2220)$ DECAY MODES

	Mode	Fraction (Γ_i/Γ)	Confidence level
Γ_1	$K\overline{K}$		
Γ_2	$p\overline{p}$	$<1.1\times 10^{-3}$	99.7%
Γ_3	$\gamma\gamma$		
Γ_4	$\eta\eta'(958)$		

$f_4(2220)$ $\Gamma(i)\Gamma(\gamma\gamma)/\Gamma(\text{total})$

$\Gamma(K\overline{K}) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$ $\Gamma_1\Gamma_3/\Gamma$

VALUE (keV)	CL%	DOCUMENT ID		TECN	COMMENT
<0.086	95	[1] ALBRECHT	90G	ARG	$\gamma\gamma \to K^+ K^-$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<1.0	95	[2] ALTHOFF	85B	TASS	$\gamma\gamma,\ K\overline{K}\pi$

[1] Assuming $J^P = 2^+$.
[2] True for $J^P = 0^+$ and $J^P = 2^+$.

$f_4(2220)$ BRANCHING RATIOS

$\Gamma(p\overline{p})/\Gamma_{\text{total}}$ Γ_2/Γ

VALUE (units 10^{-3})	CL%	DOCUMENT ID		TECN	COMMENT
<1.1	99.7	[3] BARNES	93	SPEC	$1.3\text{-}1.57\,\overline{p}p \to K^0_S K^0_S$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<2.6	99.7	[3] BARDIN	87	CNTR	$1.3\text{-}1.5\,\overline{p}p \to K^+ K^-$
<3.6	99.7	[3] SCULLI	87	CNTR	$1.29\text{-}1.55\,\overline{p}p \to K^+ K^-$

[3] Assuming Γ = 30-35 MeV, $J^P = 2^+$ and B($f_4(2220) \to K\overline{K}$) = 10%.

$f_4(2220)$ REFERENCES

BARNES	93	PL B309 469	+Birien, Breunlich	(PS185 Collab.)
ALBRECHT	90G	ZPHY C48 183	+Ehrlichmann, Harder+	(ARGUS Collab.)
ASTON	88D	NP B301 525	+Awaji, Bienz+	(SLAC, NAGO, CINC, INUS)
ASTON	88F	PL B215 199	+Awaji+	(SLAC, NAGO, CINC, INUS) JP
AUGUSTIN	88	PRL 60 2238	+Calcaterra+	(DM2 Collab.)
BOLONKIN	88	NP B309 426	+Bloshenko, Gorin+	(ITEP, SERP)
BARDIN	87	PL B195 292	+Burgun+	(SACL, FERR, CERN, PADO, TORI)
SCULLI	87	PRL 58 1715	+Christenson, Kreiter, Nemethy, Yamin	(NYU, BNL)
ALDE	86B	PL B177 120	+Binon, Bricman+	(SERP, BELG, LANL, LAPP)
BALTRUSAIT...	86D	PRL 56 107	Baltrusaitis	(CIT, UCSC, ILL, SLAC, WASH)
ALTHOFF	85B	ZPHY C29 189	+Braunschweig, Kirschfink+	(TASSO Collab.)
BEHRENDS	84	PL 137B 277	+Chadwich, Chauveau, Gentile+	(CLEO Collab.)

OTHER RELATED PAPERS

BARDIN	87	PL B195 292	+Burgun+	(SACL, FERR, CERN, PADO, TORI)
YAOUANC	85	ZPHY C28 309	+Oliver, Pene, Raynal, Ono	(ORSAY, TOKY)
GODFREY	84	PL 141B 439	+Kokoski, Isgur	(TNTO)
SHATZ	84	PL 138B 209		(CIT)
WILLEY	84	PRL 52 585		(PITT)
EINSWEILER	83	Brighton Conf. 348		(Mark III Collab.)
HITLIN	83	Cornell Conf. 746		(CIT)

$\eta(2225)$

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

OMITTED FROM SUMMARY TABLE

Seen in $J/\psi \to \gamma\phi\phi$. Needs confirmation.

$\eta(2225)$ MASS

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
$2230\pm25\pm15$	BAI	90B	MRK3	$J/\psi \to \gamma K^+K^-K^+K^-$
$2214\pm20\pm13$	BAI	90B	MRK3	$J/\psi \to \gamma K^+K^-K^0_S K^0_L$
~ 2220	BISELLO	86B	DM2	$J/\psi \to \gamma K^+K^-K^+K^-$

$\eta(2225)$ WIDTH

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
$\mathbf{150^{+300}_{-60}\pm60}$	BAI	90B	MRK3	$J/\psi \to \gamma K^+K^-K^+K^-$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
~ 80	BISELLO	86B	DM2	$J/\psi \to \gamma K^+K^-K^+K^-$

$\eta(2225)$ REFERENCES

BAI	90B	PRL 65 1309	+Blaylock+	(Mark III Collab.)
BISELLO	86B	PL B179 294	+Busetto, Castro, Limentani+	(DM2 Collab.)

$\rho_3(2250)$

$I^G(J^{PC}) = 1^+(3^{--})$

OMITTED FROM SUMMARY TABLE

Contains results only from formation experiments. For production experiments see the $\overline{N}N(1100\text{–}3600)$ entry. See also $\rho(2150)$, $f_2(2150)$, $f_4(2300)$, $\rho_5(2350)$.

$\rho_3(2250)$ MASS

$\overline{p}p \to \pi\pi$ or $K\overline{K}$

VALUE (MeV)	DOCUMENT ID		TECN	CHG	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
~ 2232	HASAN	94	RVUE		$\overline{p}p \to \pi\pi$
~ 2007	HASAN	94	RVUE		$\overline{p}p \to \pi\pi$
~ 2250.0	[1] MARTIN	80B	RVUE		
~ 2300.0	[1] MARTIN	80C	RVUE		
~ 2140.0	[2] CARTER	78B	CNTR	0	0.7–2.4 $\overline{p}p \to K^-K^+$
~ 2150.0	[3] CARTER	77	CNTR	0	0.7–2.4 $\overline{p}p \to \pi\pi$

[1] $I(J^P) = 1(3^-)$ from simultaneous analysis of $p\overline{p} \to \pi^-\pi^+$ and $\pi^0\pi^0$.
[2] $I = 0, 1$. $J^P = 3^-$ from Barrelet-zero analysis.
[3] $I(J^P) = 1(3^-)$ from amplitude analysis.

S-CHANNEL $\overline{N}N$

VALUE (MeV)	DOCUMENT ID		TECN	CHG	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
~ 2190.0	[4] CUTTS	78B	CNTR		0.97–3 $\overline{p}p \to \overline{N}N$
2155.0 ± 15.0	[4,5] COUPLAND	77	CNTR	0	0.7–2.4 $\overline{p}p \to \overline{p}p$
2193 ± 2	[4,6] ALSPECTOR	73	CNTR		$\overline{p}p$ S channel
2190 ± 10	[7] ABRAMS	70	CNTR		S channel $\overline{p}N$

[4] Isospins 0 and 1 not separated.
[5] From a fit to the total elastic cross section.
[6] Referred to as T or T region by ALSPECTOR 73.
[7] Seen as bump in $I = 1$ state. See also COOPER 68. PEASLEE 75 confirm $\overline{p}p$ results of ABRAMS 70, no narrow structure.

$\rho_3(2250)$ WIDTH

$\overline{p}p \to \pi\pi$ or $K\overline{K}$

VALUE (MeV)	DOCUMENT ID		TECN	CHG	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
~ 270	HASAN	94	RVUE		$\overline{p}p \to \pi\pi$
~ 287	HASAN	94	RVUE		$\overline{p}p \to \pi\pi$
~ 250.0	[8] MARTIN	80B	RVUE		
~ 200.0	[8] MARTIN	80C	RVUE		
~ 150.0	[9] CARTER	78B	CNTR	0	0.7–2.4 $\overline{p}p \to K^- K^+$
~ 200.0	[10] CARTER	77	CNTR	0	0.7–2.4 $\overline{p}p \to \pi\pi$

[8] $I(J^P) = 1(3^-)$ from simultaneous analysis of $p\overline{p} \to \pi^-\pi^+$ and $\pi^0\pi^0$.
[9] $I = 0, 1$. $J^P = 3^-$ from Barrelet-zero analysis.
[10] $I(J^P) = 1(3^-)$ from amplitude analysis.

S-CHANNEL $\overline{N}N$

VALUE (MeV)	DOCUMENT ID		TECN	CHG	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
135.0±75.0	[11,12] COUPLAND	77	CNTR	0	0.7–2.4 $\overline{p}p \to \overline{p}p$
98 ± 8	[12] ALSPECTOR	73	CNTR		$\overline{p}p$ S channel
~ 85	[13] ABRAMS	70	CNTR		S channel $\overline{p}N$

[11] From a fit to the total elastic cross section.
[12] Isospins 0 and 1 not separated.
[13] Seen as bump in $I = 1$ state. See also COOPER 68. PEASLEE 75 confirm $\overline{p}p$ results of ABRAMS 70, no narrow structure.

$\rho_3(2250)$ REFERENCES

HASAN	94	PL B334 215	+Bugg	(LOQM)
MARTIN	80B	NP B176 355	+Morgan	(LOUC, RHEL) JP
MARTIN	80C	NP B169 216	+Pennington	(DURH) JP
CARTER	78B	NP B141 467		(LOQM)
CUTTS	78B	PR D17 16	+Good, Grannis, Green, Lee+	(STON, WISC)
CARTER	77	PL 67B 117	+Coupland, Eisenhandler, Astbury+	(LOQM, RHEL) JP
COUPLAND	77	PL 71B 460	+Eisenhandler, Gibson, Astbury+	(LOQM, RHEL)
PEASLEE	75	PL 57B 189	+Demarzo, Guerriero+	(CANB, BARI, BROW, MIT)
ALSPECTOR	73	PRL 30 511	+Cohen, Cvijanovich+	(RUTG, UPNJ)
ABRAMS	70	PR D1 1917	+Cool, Giacomelli, Kycia, Leontic, Li+	(BNL)
COOPER	68	PRL 20 1059	+Hyman, Manner, Musgrave+	(ANL)

OTHER RELATED PAPERS

MARTIN	79B	PL 86B 93	+Pennington	(DURH)
CARTER	78	NP B132 176		(LOQM) JP
CARTER	77B	PL 67B 122		(LOQM) JP
CARTER	77C	NP B127 202	+Coupland, Atkinson+	(LOQM, DARE, RHEL)
MONTANET	77	Boston Conf. 260		(CERN)
ZEMANY	76	NP B103 537	+MingMa, Mountz, Smith	(MSU)
BERTANZA	74	NC 23A 209	+Bigi, Casali, Lariccia+	(PISA, PADO, TORI)
BETTINI	73	NC 15A 563	+Alston-Garnjost, Bigi+	(PADO, LBL, PISA, TORI)
DONNACHIE	73	LNC 7 285	+Thomas	(MCHS)
NICHOLSON	73	PR D7 2572	+Delorme, Carroll+	(CIT, ROCH, BNL)
FIELDS	71	PRL 27 1749	+Cooper, Rhines, Allison	(ANL, OXF)
YOH	71	PRL 26 922	+Barish, Caroll, Lobkowicz+	(CIT, BNL, ROCH)
ABRAMS	67C	PRL 18 1209	+Cool, Giacomelli, Kycia, Leontic, Li+	(BNL)

$f_2(2300)$

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

See also the mini-review under non-$q\overline{q}$ candidates. (See the index for the page number.)

$f_2(2300)$ MASS

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
2297 ±28	[1] ETKIN	88	MPS	22 $\pi^- p \rightarrow \phi\phi n$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
2231.0±10.0	BOOTH	86	OMEG	85 π^- Be $\rightarrow$ 2ϕBe
$2220.0^{+90.0}_{-20.0}$	LINDENBAUM	84	RVUE	
2320.0±40.0	ETKIN	82	MPS	22 $\pi^- p \rightarrow 2\phi n$

[1] Includes data of ETKIN 85. The percentage of the resonance going into $\phi\phi$ 2^{++} S_2, D_2, and D_0 is $6^{+15}_{-\ 5}$, 25^{+18}_{-14}, and 69^{+16}_{-27}, respectively.

$f_2(2300)$ WIDTH

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
149 ±41	[2] ETKIN	88	MPS	22 $\pi^- p \rightarrow \phi\phi n$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
133.0±50.0	BOOTH	86	OMEG	85 π^- Be $\rightarrow$ 2ϕBe
200.0±50.0	LINDENBAUM	84	RVUE	
220.0±70.0	ETKIN	82	MPS	22 $\pi^- p \rightarrow 2\phi n$

[2] Includes data of ETKIN 85.

$f_2(2300)$ DECAY MODES

	Mode	Fraction (Γ_i/Γ)
Γ_1	$\phi\phi$	seen

$f_2(2300)$ REFERENCES

ETKIN	88	PL B201 568	+Foley, Lindenbaum+	(BNL, CUNY)
BOOTH	86	NP B273 677	+Carroll, Donald, Edwards+	(LIVP, GLAS, CERN)
ETKIN	85	PL 165B 217	+Foley, Longacre, Lindenbaum+	(BNL, CUNY)
LINDENBAUM	84	CNPP 13 285		(CUNY)
ETKIN	82	PRL 49 1620	+Foley, Longacre, Lindenbaum+	(BNL, CUNY)
Also	83	Brighton Conf. 351	Lindenbaum	(BNL, CUNY)

OTHER RELATED PAPERS

ARMSTRONG	89B	PL B221 221	+Benayoun+	(CERN, CDEF, BIRM, BARI, ATHU, CURIN+)
GREEN	86	PRL 56 1639	+Lai+	(FNAL, ARIZ, FSU, NDAM, TUFTS, VAND+)
BOOTH	84	NP B242 51	+Ballance, Carroll, Donald+	(LIVP, GLAS, CERN)

$f_4(2300)$

$I^G(J^{PC}) = 0^+(4^{++})$

OMITTED FROM SUMMARY TABLE

This entry was previously called $U_0(2350)$. Contains results only from formation experiments. For production experiments see the $\overline{N}N(1100\text{–}3600)$ entry. See also $\rho(2150)$, $f_2(2150)$, $\rho_3(2250)$, $\rho_5(2350)$.

$f_4(2300)$ MASS

$\overline{p}p \to \pi\pi$ or $\overline{K}K$

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
~ 2314	HASAN	94	RVUE	$\overline{p}p \to \pi\pi$
~ 2300	[1] MARTIN	80B	RVUE	
~ 2300	[1] MARTIN	80C	RVUE	
~ 2340	[2] CARTER	78B	CNTR	0.7–2.4 $\overline{p}p \to K^-K^+$
~ 2330	DULUDE	78B	OSPK	1–2 $\overline{p}p \to \pi^0\pi^0$
~ 2310	[3] CARTER	77	CNTR	0.7–2.4 $\overline{p}p \to \pi\pi$

[1] $I(J^P) = 0(4^+)$ from simultaneous analysis of $p\overline{p} \to \pi^-\pi^+$ and $\pi^0\pi^0$.
[2] $I(J^P) = 0(4^+)$ from Barrelet-zero analysis.
[3] $I(J^P) = 0(4^+)$ from amplitude analysis.

S-CHANNEL $\overline{p}p$ or $\overline{N}N$

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
~ 2380.0	[4] CUTTS	78B	CNTR	0.97–3 $\overline{p}p \to \overline{N}N$
2345 ± 15.0	[4,5] COUPLAND	77	CNTR	0.7–2.4 $\overline{p}p \to \overline{p}p$
2359 ± 2	[4,6] ALSPECTOR	73	CNTR	$\overline{p}p$ S channel
2375 ± 10	ABRAMS	70	CNTR	S channel $\overline{N}N$

[4] Isospins 0 and 1 not separated.
[5] From a fit to the total elastic cross section.
[6] Referred to as U or U region by ALSPECTOR 73.

$f_4(2300)$ WIDTH

$\overline{p}p \to \pi\pi$ or $\overline{K}K$

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
~ 278	HASAN	94	RVUE	$\overline{p}p \to \pi\pi$
~ 200	[7] MARTIN	80C	RVUE	
~ 150	[8] CARTER	78B	CNTR	0.7–2.4 $\overline{p}p \to K^-K^+$
~ 210	[9] CARTER	77	CNTR	0.7–2.4 $\overline{p}p \to \pi\pi$

[7] $I(J^P) = 0(4^+)$ from simultaneous analysis of $p\overline{p} \to \pi^-\pi^+$ and $\pi^0\pi^0$.
[8] $I(J^P) = 0(4^+)$ from Barrelet-zero analysis.
[9] $I(J^P) = 0(4^+)$ from amplitude analysis.

S-CHANNEL $\overline{p}p$ or $\overline{N}N$

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
$135.0^{+150.0}_{-65.0}$	[10,11] COUPLAND	77	CNTR	0.7–2.4 $\overline{p}p \to \overline{p}p$
165^{+18}_{-8}	[11] ALSPECTOR	73	CNTR	$\overline{p}p$ S channel
~ 190	ABRAMS	70	CNTR	S channel $\overline{N}N$

[10] From a fit to the total elastic cross section.
[11] Isospins 0 and 1 not separated.

$f_4(2300)$ REFERENCES

HASAN	94	PL B334 215	+Bugg	(LOQM)
MARTIN	80B	NP B176 355	+Morgan	(LOUC, RHEL) JP
MARTIN	80C	NP B169 216	+Pennington	(DURH) JP
CARTER	78B	NP B141 467		(LOQM)
CUTTS	78B	PR D17 16	+Good, Grannis, Green, Lee+	(STON, WISC)
DULUDE	78B	PL 79B 335	+Lanou, Massimo, Peaslee+	(BROW, MIT, BARI) JP
CARTER	77	PL 67B 117	+Coupland, Eisenhandler, Astbury+	(LOQM, RHEL) JP
COUPLAND	77	PL 71B 460	+Eisenhandler, Gibson, Astbury+	(LOQM, RHEL)
ALSPECTOR	73	PRL 30 511	+Cohen, Cvijanovich+	(RUTG, UPNJ)
ABRAMS	70	PR D1 1917	+Cool, Giacomelli, Kycia, Leontic, Li+	(BNL)

OTHER RELATED PAPERS

FIELDS	71	PRL 27 1749	+Cooper, Rhines, Allison	(ANL, OXF)
YOH	71	PRL 26 922	+Barish, Caroll, Lobkowicz+	(CIT, BNL, ROCH)
BRICMAN	69	PL 29B 451	+Ferro-Luzzi, Bizard+	(CERN, CAEN, SACL)

$f_2(2340)$

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

See also the mini-review under non-$q\overline{q}$ candidates. (See the index for the page number.)

$f_2(2340)$ MASS

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
2339 ±55	[1] ETKIN	88	MPS	$22\ \pi^- p \to \phi\phi n$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
2392.0±10.0	BOOTH	86	OMEG	$85\ \pi^-\mathrm{Be} \to 2\phi\mathrm{Be}$
2360.0±20.0	LINDENBAUM	84	RVUE	

[1] Includes data of ETKIN 85. The percentage of the resonance going into $\phi\phi\ 2^{++}\ S_2$, D_2, and D_0 is 37 ± 19, $4^{+12}_{-\ 4}$, and 59^{+21}_{-19}, respectively.

$f_2(2340)$ WIDTH

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
319 $^{+81}_{-69}$	[2] ETKIN	88	MPS	$22\ \pi^- p \to \phi\phi n$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
198.0± 50.0	BOOTH	86	OMEG	$85\ \pi^-\mathrm{Be} \to 2\phi\mathrm{Be}$
$150.0^{+150.0}_{-\ 50.0}$	LINDENBAUM	84	RVUE	

[2] Includes data of ETKIN 85.

$f_2(2340)$ DECAY MODES

	Mode	Fraction (Γ_i/Γ)
Γ_1	$\phi\phi$	seen

$f_2(2340)$ REFERENCES

ETKIN	88	PL B201 568	+Foley, Lindenbaum+	(BNL, CUNY)
BOOTH	86	NP B273 677	+Carroll, Donald, Edwards+	(LIVP, GLAS, CERN)
ETKIN	85	PL 165B 217	+Foley, Longacre, Lindenbaum+	(BNL, CUNY)
LINDENBAUM	84	CNPP 13 285		(CUNY)

OTHER RELATED PAPERS

ARMSTRONG	89B	PL B221 221	+Benayoun+	(CERN, CDEF, BIRM, BARI, ATHU, CURIN+)
GREEN	86	PRL 56 1639	+Lai+	(FNAL, ARIZ, FSU, NDAM, TUFTS, VAND+)
BOOTH	84	NP B242 51	+Ballance, Carroll, Donald+	(LIVP, GLAS, CERN)

$\rho_5(2350)$

$I^G(J^{PC}) = 1^+(5^{--})$

OMITTED FROM SUMMARY TABLE

This entry was previously called $U_1(2400)$. Contains results only from formation experiments. For production experiments see the $\overline{N}N(1100\text{–}3600)$ entry. See also $\rho(2150)$, $f_2(2150)$, $\rho_3(2250)$, $f_4(2300)$.

$\rho_5(2350)$ MASS

$\overline{p}p \to \pi\pi$ or $\overline{K}K$

VALUE (MeV)	DOCUMENT ID		TECN	CHG	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
~ 2303	HASAN	94	RVUE		$\overline{p}p \to \pi\pi$
~ 2300	[1] MARTIN	80B	RVUE		
~ 2250	[1] MARTIN	80C	RVUE		
~ 2500	[2] CARTER	78B	CNTR	0	0.7–2.4 $\overline{p}p \to K^- K^+$
~ 2480	[3] CARTER	77	CNTR	0	0.7–2.4 $\overline{p}p \to \pi\pi$

[1] $I(J^P) = 1(5^-)$ from simultaneous analysis of $p\overline{p} \to \pi^-\pi^+$ and $\pi^0\pi^0$.
[2] $I = 0(1)$; $J^P = 5^-$ from Barrelet-zero analysis.
[3] $I(J^P) = 1(5^-)$ from amplitude analysis.

S-CHANNEL $\overline{N}N$

VALUE (MeV)	DOCUMENT ID		TECN	CHG	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
~ 2380	[4] CUTTS	78B	CNTR		0.97–3 $\overline{p}p \to \overline{N}N$
2345.0±15.0	[4,5] COUPLAND	77	CNTR	0	0.7–2.4 $\overline{p}p \to \overline{p}p$
2359 ± 2	[4,6] ALSPECTOR	73	CNTR		$\overline{p}p$ S channel
2350 ±10	[7] ABRAMS	70	CNTR		S channel $\overline{N}N$
2360.0±25.0	[8] OH	70B	HDBC	−0	$\overline{p}(pn)$, $K^* K 2\pi$

[4] Isospins 0 and 1 not separated.
[5] From a fit to the total elastic cross section.
[6] Referred to as U or U region by ALSPECTOR 73.
[7] For $I = 1$ $\overline{N}N$.
[8] No evidence for this bump seen in the $\overline{p}p$ data of CHAPMAN 71B. Narrow state not confirmed by OH 73 with more data.

$\rho_5(2350)$ WIDTH

$\overline{p}p \to \pi\pi$ or $\overline{K}K$

VALUE (MeV)	DOCUMENT ID		TECN	CHG	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
~ 169	HASAN	94	RVUE		$\overline{p}p \to \pi\pi$
~ 250	[9] MARTIN	80B	RVUE		
~ 300	[9] MARTIN	80C	RVUE		
~ 150	[10] CARTER	78B	CNTR	0	0.7–2.4 $\overline{p}p \to K^- K^+$
~ 210	[11] CARTER	77	CNTR	0	0.7–2.4 $\overline{p}p \to \pi\pi$

[9] $I(J^P) = 1(5^-)$ from simultaneous analysis of $p\overline{p} \to \pi^-\pi^+$ and $\pi^0\pi^0$.
[10] $I = 0(1)$; $J^P = 5^-$ from Barrelet-zero analysis.
[11] $I(J^P) = 1(5^-)$ from amplitude analysis.

S-CHANNEL $\overline{N}N$

VALUE (MeV)	DOCUMENT ID		TECN	CHG	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$135.0^{+150.0}_{-65.0}$	[12,13] COUPLAND	77	CNTR	0	0.7–2.4 $\overline{p}p \to \overline{p}p$
165^{+18}_{-8}	[13] ALSPECTOR	73	CNTR		$\overline{p}p$ S channel
< 60.0	[14] OH	70B	HDBC	−0	$\overline{p}(pn)$, $K^* K 2\pi$
~ 140	ABRAMS	67C	CNTR		S channel $\overline{p}N$

[12] From a fit to the total elastic cross section.
[13] Isospins 0 and 1 not separated.
[14] No evidence for this bump seen in the $\overline{p}p$ data of CHAPMAN 71B. Narrow state not confirmed by OH 73 with more data.

$\rho_5(2350)$ REFERENCES

HASAN	94	PL B334 215	+Bugg	(LOQM)
MARTIN	80B	NP B176 355	+Morgan	(LOUC, RHEL) JP
MARTIN	80C	NP B169 216	+Pennington	(DURH) JP
CARTER	78B	NP B141 467		(LOQM)
CUTTS	78B	PR D17 16	+Good, Grannis, Green, Lee+	(STON, WISC)
CARTER	77	PL 67B 117	+Coupland, Eisenhandler, Astbury+	(LOQM, RHEL) JP
COUPLAND	77	PL 71B 460	+Eisenhandler, Gibson, Astbury+	(LOQM, RHEL)
ALSPECTOR	73	PRL 30 511	+Cohen, Cvijanovich+	(RUTG, UPNJ)
OH	73	NP B51 57	+Eastman, MingMa, Parker, Smith+	(MSU)
CHAPMAN	71B	PR D4 1275	+Green, Lys, Murphy, Ring+	(MICH)
ABRAMS	70	PR D1 1917	+Cool, Giacomelli, Kycia, Leontic, Li+	(BNL)
OH	70B	PRL 24 1257	+Parker, Eastman, Smith, Sprafka, Ma	(MSU)
ABRAMS	67C	PRL 18 1209	+Cool, Giacomelli, Kycia, Leontic, Li+	(BNL)

OTHER RELATED PAPERS

CASO	70	LNC 3 707	+Conte, Tomasini+	(GENO, HAMB, MILA, SACL)
BRICMAN	69	PL 29B 451	+Ferro-Luzzi, Bizard+	(CERN, CAEN, SACL)

$a_6(2450)$

$I^G(J^{PC}) = 1^-(6^{++})$

OMITTED FROM SUMMARY TABLE

Seen in partial-wave analysis of the $K\overline{K}$ system. Needs confirmation.

$a_6(2450)$ MASS

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*CHG*	*COMMENT*
2450±130	[1] CLELAND	82B	SPEC	$\pm$	$50\ \pi p \rightarrow K^0_S K^\pm p$

[1] From an amplitude analysis.

$a_6(2450)$ WIDTH

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*CHG*	*COMMENT*
400±250	[2] CLELAND	82B	SPEC	$\pm$	$50\ \pi p \rightarrow K^0_S K^\pm p$

[2] From an amplitude analysis.

$a_6(2450)$ DECAY MODES

	Mode
Γ_1	$K\overline{K}$

$a_6(2450)$ REFERENCES

CLELAND	82B	NP B208 228	+Delfosse, Dorsaz, Gloor	(DURH, GEVA, LAUS, PITT)

$f_6(2510)$

$I^G(J^{PC}) = 0^+(6^{++})$

OMITTED FROM SUMMARY TABLE

Seen in $\pi^0\pi^0$. Needs confirmation.

$f_6(2510)$ MASS

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
2510.0±30.0	BINON	84B	GAM2	38 $\pi^- p \to n 2\pi^0$

$f_6(2510)$ WIDTH

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
240.0±60.0	BINON	84B	GAM2	23 $\pi^- p \to n 2\pi^0$

$f_6(2510)$ DECAY MODES

	Mode	Fraction (Γ_i/Γ)
Γ_1	$\pi\pi$	(6.0±1.0) %

$f_6(2510)$ BRANCHING RATIOS

$\Gamma(\pi\pi)/\Gamma_{total}$ **Γ_1/Γ**

VALUE	DOCUMENT ID		TECN	COMMENT
0.06 ±0.01	[1] BINON	83C	GAM2	38 $\pi^- p \to n 4\gamma$

[1] Assuming one pion exchange.

$f_6(2510)$ REFERENCES

BINON 84B LNC 39 41 +Donskov, Duteil, Gouanere+ (SERP, BELG, LAPP) JP
BINON 83C SJNP 38 723 +Gouanere, Donskov, Duteil+ (SERP, BRUX+)
Translated from YAF 38 1199.

$X(3250)$

$I^G(J^{PC}) = ?^?(?^{??})$

OMITTED FROM SUMMARY TABLE

Narrow peak observed in several final states with hidden strangeness ($\Lambda\overline{p}K^+$, $\Lambda\overline{p}K^+\pi^\pm$, $K^0 p\overline{p}K^\pm$). Needs confirmation. See also under non-$q\overline{q}$ candidates. (See the index for the page number.)

$X(3250)$ MASS

3-BODY DECAYS

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
3250±8±20	[1] ALEEV	93	BIS2	$X(3250) \to \Lambda\overline{p}K^+$
3265±7±20	[1] ALEEV	93	BIS2	$X(3250) \to \overline{\Lambda}pK^-$

[1] Supersedes KEKELIDZE 90.

4-BODY DECAYS

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
3245±8±20	[1] ALEEV	93	BIS2	$X(3250) \to \Lambda\overline{p}K^+\pi^\pm$
3250±9±20	[1] ALEEV	93	BIS2	$X(3250) \to \overline{\Lambda}pK^-\pi^\mp$
3270±8±20	[1] ALEEV	93	BIS2	$X(3250) \to K^0_S p\overline{p}K^\pm$

$X(3250)$ WIDTH

3-BODY DECAYS

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
45 ± 18	[2] ALEEV	93	BIS2	$X(3250) \rightarrow \Lambda \overline{p} K^+$
40 ± 18	[2] ALEEV	93	BIS2	$X(3250) \rightarrow \overline{\Lambda} p K^-$

[2] Supersedes KEKELIDZE 90.

4-BODY DECAYS

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
25 ± 11	[2] ALEEV	93	BIS2	$X(3250) \rightarrow \Lambda \overline{p} K^+ \pi^\pm$
50 ± 20	[2] ALEEV	93	BIS2	$X(3250) \rightarrow \overline{\Lambda} p K^- \pi^\mp$
25 ± 11	[2] ALEEV	93	BIS2	$X(3250) \rightarrow K^0_S p \overline{p} K^\pm$

$X(3250)$ DECAY MODES

	Mode
Γ_1	$\Lambda \overline{p} K^+$
Γ_2	$\Lambda \overline{p} K^+ \pi^\pm$
Γ_3	$K^0 p \overline{p} K^\pm$

$X(3250)$ REFERENCES

ALEEV 93 PAN 56 1358 +Balandin+ (BIS-2 Collab.)
Translated from YAF 56 100.
KEKELIDZE 90 Hadron 89 Conf. p 551+Aleev+ (BIS-2 Collab.)