$\rho(770)$

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

THE $\rho(770)$

Because of its large width, determination of the parameters of the $\rho(770)$ is beset with many difficulties. In physical-region fits, the line shape does not correspond to a relativistic Breit-Wigner function with a P-wave width, but requires some additional shape parameter. This dependence on parametrization was demonstrated long ago by PISUT 68, who showed that the mass was consistent with values between 761 MeV and 783 MeV to within two standard deviations. When mass values are quoted, as below, with one-standard-deviation errors, the conflicts between them are evident.

The same model dependence afflicts any other source of the resonance parameters, such as the energy dependence of the phase shift δ^1_1 or the pole position. It is therefore not surprising that a recent study of $\rho(770)$ dominance in the decays of the η and η' reveals the need for specific dynamical effects in addition to the $\rho(770)$ pole (BENAYOUN 93).

Recently LAFFERTY 93 has demonstrated that Bose-Einstein correlations are another source of shifts in the $\rho(770)$ line shape.

$\rho(770)$ MASS

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

MIXED CHARGES

VALUE (MeV)	*DOCUMENT ID*
768.5±0.6 OUR AVERAGE	Includes data from the 3 datablocks that follow this one. Error includes scale factor of 1.2.

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.						
766.9±1.2 OUR AVERAGE						
768 ±9		AGUILAR-...	91	EHS		400 pp
767 ±3	2935	[2] CAPRARO	87	SPEC	−	200 π^- Cu → $\pi^- \pi^0$ Cu
761 ±5	967	[2] CAPRARO	87	SPEC	−	200 π^- Pb → $\pi^- \pi^0$ Pb
771 ±4		HUSTON	86	SPEC	+	202 π^+ A → $\pi^+ \pi^0$ 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

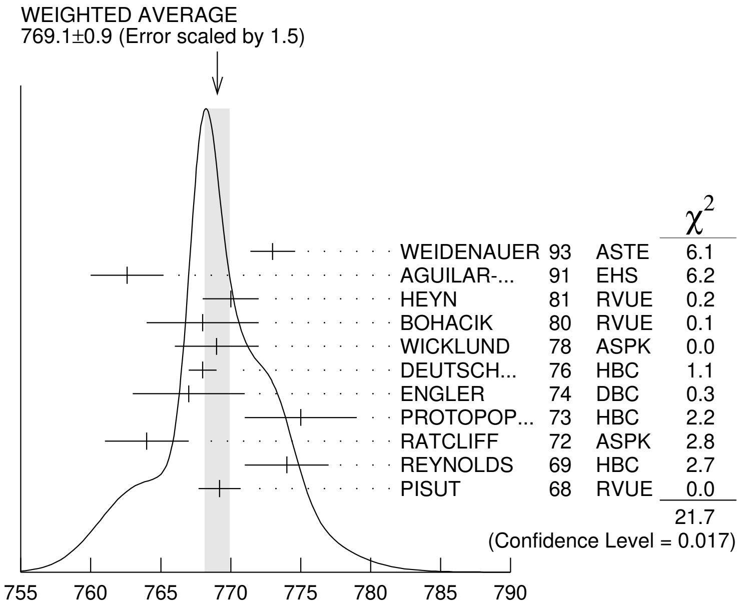
VALUE (MeV)	*EVTS*	*DOCUMENT ID*	*TECN*	*CHG*	*COMMENT*
The data in this block is included in the average printed for a previous datablock.					

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 ± 4	1930	BALLAM 72	HBC	0	2.8 γp
770 ± 4	2430	BALLAM 72	HBC	0	4.7 γp
765 ±10		ALVENSLEB... 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	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.					
769.1±0.9 OUR AVERAGE Error includes scale factor of 1.5. See the ideogram below.					
773 ±1.6		WEIDENAUER 93	ASTE		$\overline{p} p \rightarrow \pi^+ \pi^- \omega$
762.6±2.6		AGUILAR-... 91	EHS		400 pp
770 ±2		[5] HEYN 81	RVUE		Pion form factor
768 ±4		[6,7] BOHACIK 80	RVUE	0	
769 ±3		[3] WICKLUND 78	ASPK	0	3,4,6 $\pi^\pm N$
768 ±1	76000	DEUTSCH... 76	HBC	0	16 $\pi^+ p$
767 ±4	4100	ENGLER 74	DBC	0	6 $\pi^+ n \rightarrow \pi^+ \pi^- p$
775 ±4	32000	[6] PROTOPOP... 73	HBC	0	7.1 $\pi^+ p$, t <0.4
764 ±3	6800	RATCLIFF 72	ASPK	0	15 $\pi^- p$, t <0.3
774 ±3	1700	REYNOLDS 69	HBC	0	2.26 $\pi^- p$
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. • • •					
757.5±1.5		[1] BERNICHA 94	RVUE		$e^+ e^- \rightarrow \pi^+ \pi^-$
761.1±2.9		DUBNICKA 89	RVUE		π form factor
768 ±1		[9] GESHKEN... 89	RVUE		π form factor
775.9±1.1		[10] BARKOV 85	OLYA	0	$e^+ e^- \rightarrow \pi^+ \pi^-$
777.4±2.0		[11] CHABAUD 83	ASPK	0	17 $\pi^- p$ polarized
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 $\pi^- p$
775 ±3	2250	HYAMS 68	OSPK	0	11.2 $\pi^- p$

[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.

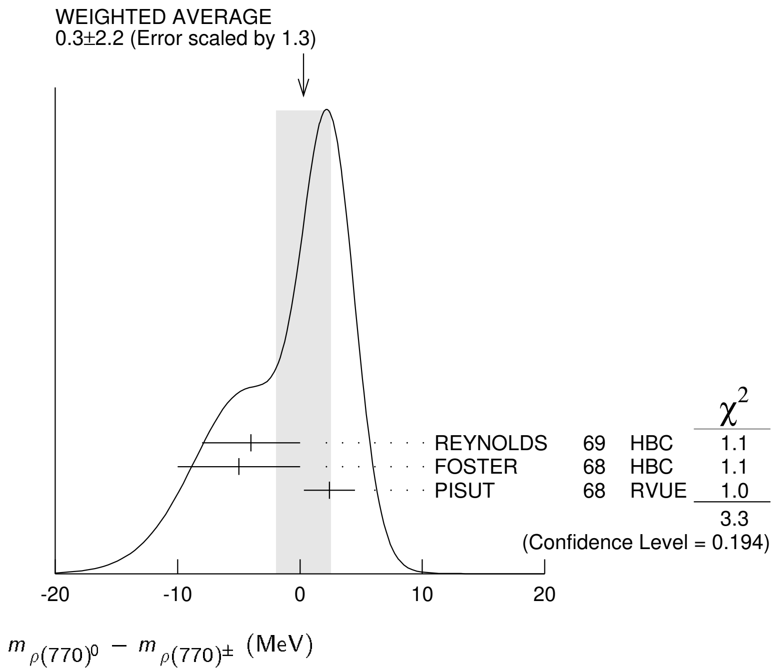
[4] From fit of 3-parameter relativistic P-wave Breit-Wigner to total mass distribution. Includes BATON 68, MILLER 67B, ALFF-STEINBERGER 66, HAGOPIAN 66, HAGOPIAN 66B, JACOBS 66B, JAMES 66, WEST 66, BLIEDEN 65 and CARMONY 64.

[5] HEYN 81 includes all spacelike and timelike F_π values until 1978.
[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 the Gounaris-Sakurai parametrization of the pion form factor.
[11] From fit of 3-parameter relativistic Breit-Wigner to helicity-zero part of P-wave intensity. CHABAUD 83 includes data of GRAYER 74.

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

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 ±4	3000	[12] REYNOLDS	69	HBC	−0	2.26 $\pi^- p$
−5 ±5	3600	[12] FOSTER	68	HBC	±0	0.0 $\overline{p}p$
2.4±2.1	22950	[13] PISUT	68	RVUE		$\pi N \rightarrow \rho N$

[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.



$\rho(770)$ 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*
$\mathbf{5.3^{+0.9}_{-0.7}}$	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*
150.7±1.2 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.

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

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

VALUE (MeV)	*EVTS*	*DOCUMENT ID*		*TECN*	*CHG*	*COMMENT*
150.9± 3.0		BARTALUCCI	78	CNTR	0	$\gamma p \rightarrow e^+ e^- p$
• • • We do not use the following data for averages, fits, limits, etc. • • •						
147 ±11		GLADDING	73	CNTR	0	2.9–4.7 γp
155 ±12	2430	BALLAM	72	HBC	0	4.7 γp
145 ±13	1930	BALLAM	72	HBC	0	2.8 γp
140 ± 5		ALVENSLEB...	70	CNTR	0	γA, t <0.01
146.1± 2.9	140k	BIGGS	70	CNTR	0	<4.1 γC → $\pi^+ \pi^-$ C
160 ±10		LANZEROTTI	68	CNTR	0	γp
130 ± 5	4000	ASBURY	67B	CNTR	0	γ + Pb

NEUTRAL ONLY, OTHER REACTIONS

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

VALUE (MeV)	*EVTS*	*DOCUMENT ID*		*TECN*	*CHG*	*COMMENT*
151.0± 2.0 OUR FIT Error includes scale factor of 1.3.						
151.0± 1.7 OUR AVERAGE Error includes scale factor of 1.1.						
145.7± 5.3		WEIDENAUER	93	ASTE		$\overline{p} p \rightarrow \pi^+ \pi^- \omega$
144.9± 3.7		DUBNICKA	89	RVUE		π form factor
148 ± 6		[18,19] BOHACIK	80	RVUE	0	
152 ± 9		[16] WICKLUND	78	ASPK	0	3,4,6 $\pi^\pm p N$
154 ± 2	76000	DEUTSCH...	76	HBC	0	16 $\pi^+ p$
157 ± 8	6800	RATCLIFF	72	ASPK	0	15 $\pi^- p$, t <0.3
143 ± 8	1700	REYNOLDS	69	HBC	0	2.26 $\pi^- p$
• • • We do not use the following data for averages, fits, limits, etc. • • •						
142.5± 3.5		[14] BERNICHA	94	RVUE		$e^+ e^- \rightarrow \pi^+ \pi^-$
138 ± 1		[20] GESHKEN...	89	RVUE		π form factor
150.5± 3.0		[21] BARKOV	85	OLYA	0	$e^+ e^- \rightarrow \pi^+ \pi^-$
$160.0^{+4.1}_{-4.0}$		[22] CHABAUD	83	ASPK	0	17 $\pi^- p$ polarized
155 ± 1		[23] HEYN	81	RVUE	0	π form factor
148.0± 1.3		[18,19] LANG	79	RVUE	0	
146 ±14	4100	ENGLER	74	DBC	0	6 $\pi^+ n$ → $\pi^+ \pi^- p$
143 ±13		[19] ESTABROOKS	74	RVUE	0	17 $\pi^- p$ → $\pi^+ \pi^- n$
160 ±10	32000	[18] PROTOPOP...	73	HBC	0	7.1 $\pi^+ p$, t <0.4
145 ±12	2250	[15] HYAMS	68	OSPK	0	11.2 $\pi^- p$
163 ±15	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 pole extrapolation.

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

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

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

[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] $(4.48 \pm 0.22) \times 10^{-5}$	
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 $\langle \delta p_i \delta p_j \rangle / (\delta p_i \cdot \delta p_j)$, in percent, from the fit to parameters p_i, including the branching fractions, $x_i \equiv \Gamma_i/\Gamma_{\rm total}$. 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 9 measurements and one constraint to determine 4 parameters. The overall fit has a $\chi^2 = 7.8$ for 6 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.

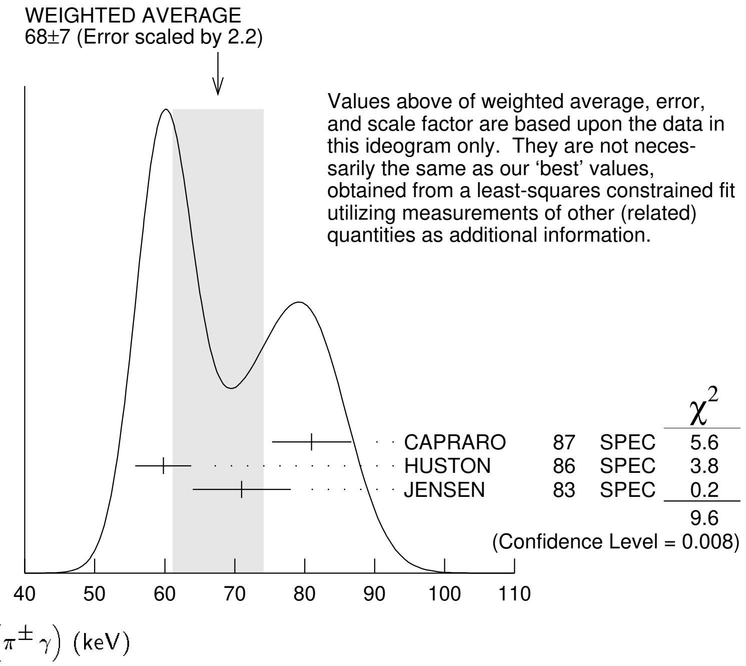
x_{10}	−79		
x_{11}	−61	0	
Γ	16	0	−27
	x_6	x_{10}	x_{11}

	Mode		Rate (MeV)	Scale factor
Γ_6	$\pi^+\pi^-$		151.0 ±2.0	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 ±4 ±4	CAPRARO	87	SPEC	−	200 $\pi^- A \to \pi^-\pi^0 A$
59.8±4.0	HUSTON	86	SPEC	+	202 $\pi^+ A \to \pi^+\pi^0 A$
71 ±7	JENSEN	83	SPEC	−	156–260 $\pi^- A \to \pi^-\pi^0 A$



$\Gamma(e^+e^-)$ — Γ_{11}

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

$\Gamma(\pi^0\gamma)$ — Γ_8

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

$\Gamma(\eta\gamma)$ — 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	$e^+e^- \to \eta\gamma$
111±22	[26] DOLINSKY	89	ND	$e^+e^- \to \eta\gamma$

[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($\omega \to \eta\gamma$).
[26] Solution corresponding to destructive ρ-ω interference.

ρ(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	±	$\pi^\pm p$ 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 $\to \mu^+\mu^-\pi^-$ 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 $\omega \to \mu^+\mu^-$ 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		$e^+e^- \to \eta\gamma$
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		$e^+e^- \to \eta\gamma$
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($\omega \to \eta\gamma$).
[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	$e^+e^- \to \pi^+\pi^-\pi^+\pi^-$

$\Gamma(\pi^+\pi^-\pi^+\pi^-)/\Gamma(\pi\pi)$ — 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 $\pi^+ p$

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

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

$\Gamma(\pi^+\pi^-\pi^0)/\Gamma(\pi\pi)$ — 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	$J/\psi \to \omega\pi^0$
<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	$e^+e^- \to \pi^+\pi^-\pi^0\pi^0$
• • • We do not use the following data for averages, fits, limits, etc. • • •						
<2	90	KURDADZE	86	OLYA	0	$e^+e^- \to \pi^+\pi^-\pi^0\pi^0$

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

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

[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	$e^+e^- \to \pi^0\gamma$

$\rho(770)$ REFERENCES

BERNICHA	94	PR D50 4454	+Lopez Castro, Pestieau	(LOUV, 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)
GESHKEN...	89	ZPHY 45 351	Geshkenbein	(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)
ALVENSLEB...	70	PRL 24 786	Alvensleben, 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)
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 Translated from ZETFP 37 613.	+Lelchuk, Pakhtusova+	(NOVO)
ALEKSEEV	82	JETP 55 591 Translated from ZETF 82 1007.	+Kartamyshev, Makarin+	(KIAE)
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)