$\rho(1700)$

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

THE $\rho(1450)$ AND THE $\rho(1700)$

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In our 1988 edition, we replaced the $\rho(1600)$ entry with two new ones, the $\rho(1450)$ and the $\rho(1700)$, because there was emerging evidence that the 1600-MeV region actually contains two ρ-like resonances. ERKAL 86 had pointed out this possibility with a theoretical analysis on the consistency of 2π and 4π electromagnetic form factors and the $\pi\pi$ scattering length. DONNACHIE 87, with a full analysis of data on the 2π and 4π final states in e^+e^- annihilation and photoproduction reactions, had also argued that in order to obtain a consistent picture, two resonances were necessary. The existence of $\rho(1450)$ was supported by the analysis of $\eta\rho^0$ mass spectra obtained in photoproduction and e^+e^- annihilation (DONNACHIE 87B), as well as that of $e^+e^- \rightarrow \omega\pi$ (DONNACHIE 91).

The analysis of DONNACHIE 87 was further extended by CLEGG 88, 94 to include new data on 4π systems produced in e^+e^- annihilation, and in τ decays (τ decays to 4π and e^+e^- annihilation to 4π can be related by the Conserved Vector Current assumption). These systems were successfully analyzed using interfering contributions from two ρ-like states, and from the tail of the $\rho(770)$ decaying into two-body states. While specific conclusions on $\rho(1450) \rightarrow 4\pi$ were obtained, little could be said about the $\rho(1700)$.

Independent evidence for two 1^- states is provided by KILLIAN 80 in 4π electroproduction at $\langle Q^2 \rangle = 1$ (GeV/c)^2, and by FUKUI 88 in a high-statistics sample of the $\eta\pi\pi$ system in π^-p charge exchange.

This scenario with two overlapping resonances is supported by other data. `BISELLO 89` measured the pion form factor in the interval 1.35–2.4 GeV and observed a deep minimum around 1.6 GeV. The best fit was obtained with the hypothesis of ρ-like resonances at 1420 and 1770 MeV, with widths of about 250 MeV. `ANTONELLI 88` found that the $e^+e^- \rightarrow \eta\pi^+\pi^-$ cross section is better fitted with two fully interfering Breit-Wigners, with parameters in fair agreement with those of `DONNACHIE 87` and `BISELLO 89`. These results can be considered as a confirmation of the $\rho(1450)$.

Decisive evidence for the $\pi\pi$ decay mode of both $\rho(1450)$ and $\rho(1700)$ came from recent results in $\overline{p}p$ annihilation at rest (`ABELE 97`). It was shown that these resonances also possess a $K\overline{K}$ decay mode (`ABELE 98, BERTIN 98B, ABELE 99D`). High statistics studies of the decays $\tau \rightarrow \pi\pi\nu_\tau$ (`BARATE 97M, URHEIM 97`), and $\tau \rightarrow 4\pi\nu_\tau$ (`EDWARDS 00A`), also require the $\rho(1450)$, but are not sensitive to the $\rho(1700)$, because it is too close to the τ mass. Recently in a very high statistics study of the $\tau \rightarrow \pi\pi\nu_\tau$ decay performed at Belle (`ABE 05H`) both $\rho(1450)$ and $\rho(1700)$ were observed for the first time in τ decays.

The structure of these ρ states is not yet completely clear. `BARNES 97` and `CLOSE 97C` claim that $\rho(1450)$ has a mass consistent with radial $2S$, but its decays show characteristics of hybrids, and suggest that this state may be a $2S$-hybrid mixture. `DONNACHIE 99` argues that hybrid states could have a 4π decay mode dominated by the $a_1\pi$. Such behavior has recently been observed by `AKHMETSHIN 99E` in $e^+e^- \rightarrow 4\pi$ in the energy range 1.05–1.38 GeV, and by `EDWARDS 00A` in $\tau \rightarrow 4\pi$ decays. `ALEXANDER 01B` observed the $\rho(1450) \rightarrow \omega\pi$ decay mode in B-meson decays, however, didn't find $\rho(1700) \rightarrow \omega\pi^0$. A similar conclusion is made by `AKHMETSHIN 03B` who studied the process $e^+e^- \to \omega\pi^0$. Various decay modes of the $\rho(1450)$ and $\rho(1700)$ were observed in $\bar{p}n$ and $\bar{p}p$ annihilation (ABELE 01B, BARGIOTTI 03B), but no definite conclusions could be drawn. More data should be collected to clarify the nature of the ρ states, particularly in the energy range above 1.6 GeV.

We also list under the $\rho(1450)$ the $\phi\pi$ state with $J^{PC} = 1^{--}$ or $C(1480)$ observed by BITYUKOV 87. While ACHASOV 96B shows that it may be a threshold effect, CLEGG 88 and LANDSBERG 92 suggest two independent vector states with this decay mode. Note, however, that $C(1480)$ in its $\phi\pi$ decay mode was not confirmed by e^+e^- (DOLINSKY 91, BISELLO 91C) and $\overline{p}p$ (ABELE 97H) experiments.

Several observations on the $\omega\pi$ system in the 1200-MeV region (FRENKIEL 72, COSME 76, BARBER 80C, ASTON 80C, ATKINSON 84C, BRAU 88, AMSLER 93B) may be interpreted in terms of either $J^P = 1^-$ $\rho(770) \to \omega\pi$ production (LAYSSAC 71), or $J^P = 1^+$ $b_1(1235)$ production (BRAU 88, AMSLER 93B). We argue that no special entry for a $\rho(1250)$ is needed. The LASS amplitude analysis (ASTON 91B) showing evidence for $\rho(1270)$ is preliminary and needs confirmation. For completeness, the relevant observations are listed under the $\rho(1450)$.

Evidence for ρ-like mesons decaying into 6π states was first noted by CLEGG 90 in the analysis of 6π mass spectra from e^+e^- annihilation (BISELLO 81, CASTRO 88) and diffractive photoproduction (ATKINSON 85). CLEGG 90 argued that two states at about 2.1 and 1.8 GeV exist: while the former is a candidate for a new resonance ($\rho(2150)$), the latter could be a manifestation of the $\rho(1700)$ distorted by threshold effects. Recently, the E687 Collaboration at Fermilab reported an observation of a narrow dip structure at 1.9 GeV in the $3\pi^+3\pi^-$ diffractive photoproduction (FRABETTI 01). A similar effect of the dip in the cross section of $e^+e^- \rightarrow 6\pi$ around 1.9 GeV has been earlier reported by DM2 (`CASTRO 88`), where 6π included both $3\pi^+3\pi^-$ and $2\pi^+2\pi^-2\pi^0$. Later the dip in the R value (the total cross section of $e^+e^- \rightarrow$ hadrons divided by the cross section of $e^+e^- \rightarrow \mu^+\mu^-$) was observed by `ANTONELLI 96`, again around 1.9 GeV. This energy is close to the $N\bar{N}$ threshold which hints to the possible relation between the dip and $N\bar{N}$, e.g., the frequently discussed narrow $N\bar{N}$ resonance or just a threshold effect. Such behaviour is also characteristic of exotic objects like vector $q\bar{q}$ hybrids. Note that `AGNELLO 02` failed to find this state in the reaction $\bar{n}p \rightarrow 3\pi^+2\pi^-\pi^0$. A reanalysis of the E687 data by `FRABETTI 04` shows that a dip may arise due to interference of a narrow object with a broad $\rho(1700)$ independently of the nature of the former. Recently BaBar studied the processes $e^+e^- \rightarrow 3\pi^+3\pi^-$ and $e^+e^- \rightarrow 2\pi^+2\pi^-2\pi^0$ using the radiative return and observed a structure around 1.9 GeV in both final states (`AUBERT 06D`). The data are not well described by a single Breit-Wigner state, and a good fit is achieved while taking into account the interference of such a structure with a Jacob-Slansky amplitude for continuum. The mass of this state obtained by BaBar is consistent with `ANTONELLI 96` and `FRABETTI 01`, but the width is substantially larger. We list these observations under a separate particle $\rho(1900)$, which needs confirmation.

$\rho(1700)$ MASS

$\eta\rho^0$ AND $\pi^+\pi^-$ MODES

VALUE (MeV)	*DOCUMENT ID*
1720±20 OUR ESTIMATE	

$\eta\rho^0$ MODE

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. • • •

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
1740±20	ANTONELLI	88	DM2	$e^+e^- \to \eta\pi^+\pi^-$
1701±15	[2] FUKUI	88	SPEC	8.95 $\pi^- p \to \eta\pi^+\pi^- n$

$\pi\pi$ MODE

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. • • •

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
$1780\ ^{+37}_{-29}$	[3] ABELE	97	CBAR	$\overline{p}n \to \pi^-\pi^0\pi^0$
1719 ±15	[3] BERTIN	97C	OBLX	0.0 $\overline{p}p \to \pi^+\pi^-\pi^0$
1730 ±30	CLEGG	94	RVUE	$e^+e^- \to \pi^+\pi^-$
1768 ±21	BISELLO	89	DM2	$e^+e^- \to \pi^+\pi^-$
1745.7±91.9	DUBNICKA	89	RVUE	$e^+e^- \to \pi^+\pi^-$
1546 ±26	GESHKEN...	89	RVUE	
1650	[4] ERKAL	85	RVUE	20–70 $\gamma p \to \gamma\pi$
1550 ±70	ABE	84B	HYBR	20 $\gamma p \to \pi^+\pi^- p$
1590 ±20	[5] ASTON	80	OMEG	20–70 $\gamma p \to p 2\pi$
1600 ±10	[6] ATIYA	79B	SPEC	50 γC → C2π
$1598\ ^{+24}_{-22}$	BECKER	79	ASPK	17 $\pi^- p$ polarized
1659 ±25	[4] LANG	79	RVUE	
1575	[4] MARTIN	78C	RVUE	17 $\pi^- p \to \pi^+\pi^- n$
1610 ±30	[4] FROGGATT	77	RVUE	17 $\pi^- p \to \pi^+\pi^- n$
1590 ±20	[7] HYAMS	73	ASPK	17 $\pi^- p \to \pi^+\pi^- n$

$\pi\omega$ MODE

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

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
1550 to 1620	[8] ACHASOV	00I	SND	$e^+e^- \to \pi^0\pi^0\gamma$
1580 to 1710	[9] ACHASOV	00I	SND	$e^+e^- \to \pi^0\pi^0\gamma$
1710±90	ACHASOV	97	RVUE	$e^+e^- \to \omega\pi^0$

$K\overline{K}$ MODE

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

VALUE (MeV)	*EVTS*	*DOCUMENT ID*		*TECN*	*CHG*	*COMMENT*
1740.8±22.2	27k	[1] ABELE	99D	CBAR	±	0.0 $\overline{p}p \to K^+K^-\pi^0$
1582 ±36	1600	CLELAND	82B	SPEC	±	50 $\pi p \to K^0_S K^\pm p$

[1] K-matrix pole. Isospin not determined, could be $\omega(1650)$ or $\phi(1680)$.

$2(\pi^+\pi^-)$ MODE

VALUE (MeV)	*EVTS*	*DOCUMENT ID*	*TECN*	*COMMENT*
• • • We do not use the following data for averages, fits, limits, etc. • • •				
1851^{+27}_{-24}		ACHASOV 97	RVUE	$e^+e^- \to 2(\pi^+\pi^-)$
1570 ± 20		[10] CORDIER 82	DM1	$e^+e^- \to 2(\pi^+\pi^-)$
1520 ± 30		[5] ASTON 81E	OMEG	20–70 $\gamma p \to p4\pi$
1654 ± 25		[11] DIBIANCA 81	DBC	$\pi^+ d \to pp2(\pi^+\pi^-)$
1666 ± 39		[10] BACCI 80	FRAG	$e^+e^- \to 2(\pi^+\pi^-)$
1780	34	KILLIAN 80	SPEC	11 $e^- p \to 2(\pi^+\pi^-)$
1500		[12] ATIYA 79B	SPEC	50 $\gamma C \to C4\pi^{\pm}$
1570 ± 60	65	[13] ALEXANDER 75	HBC	7.5 $\gamma p \to p4\pi$
1550 ± 60		[5] CONVERSI 74	OSPK	$e^+e^- \to 2(\pi^+\pi^-)$
1550 ± 50	160	SCHACHT 74	STRC	5.5–9 $\gamma p \to p4\pi$
1450 ± 100	340	SCHACHT 74	STRC	9–18 $\gamma p \to p4\pi$
1430 ± 50	400	BINGHAM 72B	HBC	9.3 $\gamma p \to p4\pi$

$\pi^+\pi^-\pi^0\pi^0$ MODE

VALUE (MeV)	*DOCUMENT ID*	*TECN*	*COMMENT*
• • • We do not use the following data for averages, fits, limits, etc. • • •			
1660 ± 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. • • •			
1730 ± 34	[14] FRABETTI 04	E687	$\gamma p \to 3\pi^+ 3\pi^- p$
1783 ± 15	CLEGG 90	RVUE	$e^+e^- \to 3(\pi^+\pi^-)2(\pi^+\pi^-\pi^0)$

[2] Assuming $\rho^+ f_0(1370)$ decay mode interferes with $a_1(1260)^+\pi$ background. From a two Breit-Wigner fit.

[3] T-matrix pole.

[4] From phase shift analysis of HYAMS 73 data.

[5] Simple relativistic Breit-Wigner fit with constant width.

[6] An additional 40 MeV uncertainty in both the mass and width is present due to the choice of the background shape.

[7] Included in BECKER 79 analysis.

[8] Taking into account both $\rho(1450)$ and $\rho(1700)$ contributions. Using the data of ACHASOV 00I on $e^+e^- \to \omega\pi^0$ and of EDWARDS 00A on $\tau^- \to \omega\pi^-\nu_\tau$. $\rho(1450)$ mass and width fixed at 1400 MeV and 500 MeV respectively.

[9] Taking into account the $\rho(1700)$ contribution only. Using the data of ACHASOV 00I on $e^+e^- \to \omega\pi^0$ and of EDWARDS 00A on $\tau^- \to \omega\pi^-\nu_\tau$.

[10] Simple relativistic Breit-Wigner fit with model dependent width.

[11] One peak fit result.

[12] Parameters roughly estimated, not from a fit.

[13] Skew mass distribution compensated by Ross-Stodolsky factor.

[14] From a fit with two resonances with the JACOB 72 continuum.

$\rho(1700)$ WIDTH

$\eta\rho^0$ AND $\pi^+\pi^-$ MODES

VALUE (MeV)	*DOCUMENT ID*
250±100 OUR ESTIMATE	

$\eta\rho^0$ MODE

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

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

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

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
150±30	ANTONELLI	88	DM2	$e^+e^- \to \eta\pi^+\pi^-$
282±44	[16] FUKUI	88	SPEC	8.95 $\pi^-p \to \eta\pi^+\pi^-n$

$\pi\pi$ MODE

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

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

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

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
275 ± 45	[17] ABELE	97	CBAR	$\overline{p}n \to \pi^-\pi^0\pi^0$
310 ± 40	[17] BERTIN	97C	OBLX	0.0 $\overline{p}p \to \pi^+\pi^-\pi^0$
400 ±100	CLEGG	94	RVUE	$e^+e^- \to \pi^+\pi^-$
224 ± 22	BISELLO	89	DM2	$e^+e^- \to \pi^+\pi^-$
242.5±163.0	DUBNICKA	89	RVUE	$e^+e^- \to \pi^+\pi^-$
620 ± 60	GESHKEN...	89	RVUE	
<315	[18] ERKAL	85	RVUE	20–70 $\gamma p \to \gamma\pi$
280^{+30}_{-80}	ABE	84B	HYBR	20 $\gamma p \to \pi^+\pi^-p$
230 ± 80	[19] ASTON	80	OMEG	20–70 $\gamma p \to p2\pi$
283 ± 14	[20] ATIYA	79B	SPEC	50 γC $\to$ C2π
175^{+98}_{-53}	BECKER	79	ASPK	17 π^-p polarized
232 ± 34	[18] LANG	79	RVUE	
340	[18] MARTIN	78C	RVUE	17 $\pi^-p \to \pi^+\pi^-n$
300 ±100	[18] FROGGATT	77	RVUE	17 $\pi^-p \to \pi^+\pi^-n$
180 ± 50	[21] HYAMS	73	ASPK	17 $\pi^-p \to \pi^+\pi^-n$

$K\overline{K}$ MODE

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

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

VALUE (MeV)	*EVTS*	*DOCUMENT ID*		*TECN*	*CHG*	*COMMENT*
187.2± 26.7	27k	[15] ABELE	99D	CBAR	±	0.0 $\overline{p}p \to K^+K^-\pi^0$
265 ±120	1600	CLELAND	82B	SPEC	±	50 $\pi p \to K^0_S K^\pm p$

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[15] K-matrix pole. Isospin not determined, could be $\omega(1650)$ or $\phi(1680)$.

$2(\pi^+\pi^-)$ MODE

VALUE (MeV)	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
• • • We do not use the following data for averages, fits, limits, etc. • • •					
510± 40		[22] CORDIER	82	DM1	$e^+e^- \rightarrow 2(\pi^+\pi^-)$
400± 50		[19] ASTON	81E	OMEG	20–70 $\gamma p \rightarrow p4\pi$
400±146		[23] DIBIANCA	81	DBC	$\pi^+ d \rightarrow pp2(\pi^+\pi^-)$
700±160		[22] BACCI	80	FRAG	$e^+e^- \rightarrow 2(\pi^+\pi^-)$
100	34	KILLIAN	80	SPEC	11 $e^- p \rightarrow 2(\pi^+\pi^-)$
600		[24] ATIYA	79B	SPEC	50 γC $\rightarrow$ C$4\pi^\pm$
340±160	65	[25] ALEXANDER	75	HBC	7.5 $\gamma p \rightarrow p4\pi$
360±100		[19] CONVERSI	74	OSPK	$e^+e^- \rightarrow 2(\pi^+\pi^-)$
400±120	160	[26] SCHACHT	74	STRC	5.5–9 $\gamma p \rightarrow p4\pi$
850±200	340	[26] SCHACHT	74	STRC	9–18 $\gamma p \rightarrow p4\pi$
650±100	400	BINGHAM	72B	HBC	9.3 $\gamma p \rightarrow p4\pi$

$\pi^+\pi^-\pi^0\pi^0$ 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

$\omega\pi^0$ MODE

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
• • • We do not use the following data for averages, fits, limits, etc. • • •				
350 to 580	[27] ACHASOV	00I	SND	$e^+e^- \rightarrow \pi^0\pi^0\gamma$
490 to 1040	[28] ACHASOV	00I	SND	$e^+e^- \rightarrow \pi^0\pi^0\gamma$

$3(\pi^+\pi^-)$ 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. • • •				
315±100	[29] FRABETTI	04	E687	$\gamma p \rightarrow 3\pi^+3\pi^- p$
285± 20	CLEGG	90	RVUE	$e^+e^- \rightarrow$ $3(\pi^+\pi^-)2(\pi^+\pi^-\pi^0)$

[16] Assuming $\rho^+ f_0(1370)$ decay mode interferes with $a_1(1260)^+\pi$ background. From a two Breit-Wigner fit.

[17] T-matrix pole.

[18] From phase shift analysis of HYAMS 73 data.

[19] Simple relativistic Breit-Wigner fit with constant width.

[20] An additional 40 MeV uncertainty in both the mass and width is present due to the choice of the background shape.

[21] Included in BECKER 79 analysis.

[22] Simple relativistic Breit-Wigner fit with model-dependent width.

[23] One peak fit result.

[24] Parameters roughly estimated, not from a fit.

[25] Skew mass distribution compensated by Ross-Stodolsky factor.

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

[27] Taking into account both $\rho(1450)$ and $\rho(1700)$ contributions. Using the data of ACHASOV 00I on $e^+e^- \rightarrow \omega\pi^0$ and of EDWARDS 00A on $\tau^- \rightarrow \omega\pi^-\nu_\tau$. $\rho(1450)$ mass and width fixed at 1400 MeV and 500 MeV respectively.

[28] Taking into account the $\rho(1700)$ contribution only. Using the data of ACHASOV 00I on $e^+e^- \rightarrow \omega\pi^0$ and of EDWARDS 00A on $\tau^- \rightarrow \omega\pi^-\nu_\tau$.

[29] From a fit with two resonances with the JACOB 72 continuum.

$\rho(1700)$ DECAY MODES

	Mode	Fraction (Γ_i/Γ)
Γ_1	4π	
Γ_2	$2(\pi^+\pi^-)$	large
Γ_3	$\rho\pi\pi$	dominant
Γ_4	$\rho^0\pi^+\pi^-$	large
Γ_5	$\rho^0\pi^0\pi^0$	
Γ_6	$\rho^\pm\pi^\mp\pi^0$	large
Γ_7	$a_1(1260)\pi$	seen
Γ_8	$h_1(1170)\pi$	seen
Γ_9	$\pi(1300)\pi$	seen
Γ_{10}	$\rho\rho$	seen
Γ_{11}	$\pi^+\pi^-$	seen
Γ_{12}	$\pi\pi$	seen
Γ_{13}	$K\overline{K}^*(892)+$ c.c.	seen
Γ_{14}	$\eta\rho$	seen
Γ_{15}	$a_2(1320)\pi$	not seen
Γ_{16}	$K\overline{K}$	seen
Γ_{17}	e^+e^-	seen
Γ_{18}	$\pi^0\omega$	seen

$\rho(1700)$ $\Gamma(i)\Gamma(e^+e^-)/\Gamma(\text{total})$

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.

$\Gamma(2(\pi^+\pi^-)) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$ — $\Gamma_2\Gamma_{17}/\Gamma$

VALUE (keV)	*DOCUMENT ID*		*TECN*	*COMMENT*
• • • We do not use the following data for averages, fits, limits, etc. • • •				
2.6 ± 0.2	DELCOURT	81B	DM1	$e^+e^- \to 2(\pi^+\pi^-)$
2.83 ± 0.42	BACCI	80	FRAG	$e^+e^- \to 2(\pi^+\pi^-)$

$\Gamma(\pi^+\pi^-) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$ — $\Gamma_{11}\Gamma_{17}/\Gamma$

VALUE (keV)	*DOCUMENT ID*		*TECN*	*COMMENT*
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.13	[30] DIEKMAN	88	RVUE	$e^+e^- \to \pi^+\pi^-$
$0.029^{+0.016}_{-0.012}$	KURDADZE	83	OLYA	0.64–1.4 $e^+e^- \to \pi^+\pi^-$

[30] Using total width = 220 MeV.

$\Gamma(K\overline{K}^*(892)+\text{c.c.}) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$ — $\Gamma_{13}\Gamma_{17}/\Gamma$

VALUE (keV)	*DOCUMENT ID*		*TECN*	*COMMENT*
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.305 ± 0.071	[31] BIZOT	80	DM1	e^+e^-

$\Gamma(\eta\rho) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$ $\Gamma_{14}\Gamma_{17}/\Gamma$

VALUE (eV)	*DOCUMENT ID*		*TECN*	*COMMENT*
• • • We do not use the following data for averages, fits, limits, etc. • • •				
7 ± 3	ANTONELLI	88	DM2	$e^+e^- \rightarrow \eta\pi^+\pi^-$

$\Gamma(K\overline{K}) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$ $\Gamma_{16}\Gamma_{17}/\Gamma$

VALUE (keV)	*DOCUMENT ID*		*TECN*	*COMMENT*
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.035 ± 0.029	[31] BIZOT	80	DM1	e^+e^-

$\Gamma(\rho\pi\pi) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$ $\Gamma_3\Gamma_{17}/\Gamma$

VALUE (keV)	*DOCUMENT ID*		*TECN*	*COMMENT*
• • • We do not use the following data for averages, fits, limits, etc. • • •				
3.510 ± 0.090	[31] BIZOT	80	DM1	e^+e^-

[31] Model dependent.

$\rho(1700)$ BRANCHING RATIOS

$\Gamma(\pi^+\pi^-)/\Gamma_{\text{total}}$ Γ_{11}/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 $\pi^- p$ polarized
0.15 to 0.30	[32] MARTIN	78C	RVUE	17 $\pi^- p \rightarrow \pi^+\pi^- n$
<0.20	[33] COSTA...	77B	RVUE	$e^+e^- \rightarrow 2\pi, 4\pi$
0.30 ± 0.05	[32] FROGGATT	77	RVUE	17 $\pi^- p \rightarrow \pi^+\pi^- n$
<0.15	[34] EISENBERG	73	HBC	5 $\pi^+ p \rightarrow \Delta^{++}2\pi$
0.25 ± 0.05	[35] HYAMS	73	ASPK	17 $\pi^- p \rightarrow \pi^+\pi^- n$

[32] From phase shift analysis of HYAMS 73 data.
[33] Estimate using unitarity, time reversal invariance, Breit-Wigner.
[34] Estimated using one-pion-exchange model.
[35] Included in BECKER 79 analysis.

$\Gamma(\pi^+\pi^-)/\Gamma(2(\pi^+\pi^-))$ Γ_{11}/Γ_2

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 $\gamma p \rightarrow p2\pi$
<0.14	[36] DAVIER	73	STRC	6–18 $\gamma p \rightarrow p4\pi$
<0.2	[37] BINGHAM	72B	HBC	9.3 $\gamma p \rightarrow p2\pi$

[36] Upper limit is estimate.
[37] 2σ upper limit.

$\Gamma(\pi\pi)/\Gamma(4\pi)$ Γ_{12}/Γ_1

VALUE	*DOCUMENT ID*		*TECN*	*COMMENT*
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.16 ± 0.04	[42,43] ABELE	01B	CBAR	0.0 $\overline{p}n \rightarrow 5\pi$

$\Gamma\big(K\overline{K}^*(892)+\text{c.c.}\big)/\Gamma\big(2(\pi^+\pi^-)\big)$ $\qquad\Gamma_{13}/\Gamma_2$

VALUE	*DOCUMENT ID*		*TECN*	*COMMENT*
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.15±0.03	[38] DELCOURT	81B	DM1	$e^+e^- \rightarrow \overline{K}K\pi$

[38] Assuming $\rho(1700)$ and ω radial excitations to be degenerate in mass.

$\Gamma(\eta\rho)/\Gamma_{\text{total}}$ $\qquad\Gamma_{14}/\Gamma$

VALUE	*CL%*	*DOCUMENT ID*		*TECN*	*COMMENT*
• • • We do not use the following data for averages, fits, limits, etc. • • •					
possibly seen		AKHMETSHIN	00D	CMD2	$e^+e^- \rightarrow \eta\pi^+\pi^-$
<0.04		DONNACHIE	87B	RVUE	
<0.02	58	ATKINSON	86B	OMEG	20–70 γp

$\Gamma\big(a_2(1320)\pi\big)/\Gamma_{\text{total}}$ $\qquad\Gamma_{15}/\Gamma$

VALUE	*DOCUMENT ID*		*TECN*	*COMMENT*
• • • We do not use the following data for averages, fits, limits, etc. • • •				
not seen	AMELIN	00	VES	37 $\pi^- p \rightarrow \eta\pi^+\pi^- n$

$\Gamma(\eta\rho)/\Gamma\big(2(\pi^+\pi^-)\big)$ $\qquad\Gamma_{14}/\Gamma_2$

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

$\Gamma(\pi^+\pi^-\text{neutrals})/\Gamma\big(2(\pi^+\pi^-)\big)$ $\qquad(\Gamma_5+\Gamma_6+0.714\Gamma_{14})/\Gamma_2$

VALUE	*DOCUMENT ID*		*TECN*	*COMMENT*
• • • We do not use the following data for averages, fits, limits, etc. • • •				
2.6±0.4	[39] BALLAM	74	HBC	9.3 γp

[39] Upper limit. Background not subtracted.

$\Gamma(\pi^0\omega)/\Gamma_{\text{total}}$ $\qquad\Gamma_{18}/\Gamma$

VALUE	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
• • • We do not use the following data for averages, fits, limits, etc. • • •					
not seen	2382	AKHMETSHIN	03B	CMD2	$e^+e \rightarrow \pi^0\pi^0\gamma$
seen		ACHASOV	97	RVUE	$e^+e^- \rightarrow \omega\pi^0$

$\Gamma\big(a_1(1260)\pi\big)/\Gamma(4\pi)$ $\qquad\Gamma_7/\Gamma_1$

VALUE	*DOCUMENT ID*		*TECN*	*COMMENT*
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.16±0.05	[42] ABELE	01B	CBAR	0.0 $\overline{p}n \rightarrow 5\pi$

$\Gamma\big(h_1(1170)\pi\big)/\Gamma(4\pi)$ $\qquad\Gamma_8/\Gamma_1$

VALUE	*DOCUMENT ID*		*TECN*	*COMMENT*
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.17±0.06	[42] ABELE	01B	CBAR	0.0 $\overline{p}n \rightarrow 5\pi$

$\Gamma(\pi(1300)\pi)/\Gamma(4\pi)$ — Γ_9/Γ_1

VALUE	DOCUMENT ID	TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •			
0.30 ± 0.10	[42] ABELE 01B	CBAR	0.0 $\overline{p}n \rightarrow 5\pi$

$\Gamma(\rho\rho)/\Gamma(4\pi)$ — Γ_{10}/Γ_1

VALUE	DOCUMENT ID	TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •			
0.09 ± 0.03	[42] ABELE 01B	CBAR	0.0 $\overline{p}n \rightarrow 5\pi$

$\Gamma(\rho\pi\pi)/\Gamma(4\pi)$ — Γ_3/Γ_1

VALUE	DOCUMENT ID	TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •			
0.28 ± 0.06	[42] ABELE 01B	CBAR	0.0 $\overline{p}n \rightarrow 5\pi$

$\Gamma(K\overline{K})/\Gamma(2(\pi^+\pi^-))$ — Γ_{16}/Γ_2

VALUE	CL%	DOCUMENT ID	TECN	CHG	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.015 ± 0.010		[40] DELCOURT 81B	DM1		$e^+e^- \rightarrow \overline{K}K$
<0.04	95	BINGHAM 72B	HBC	0	9.3 γp

[40] 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_{16}/Γ_{13}

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_4/Γ_2

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 ± 0.1	500	SCHACHT 74	STRC	5.5–18 $\gamma p \rightarrow p4\pi$
0.80		[41] BINGHAM 72B	HBC	9.3 $\gamma p \rightarrow p4\pi$

[41] The $\pi\pi$ system is in S-wave.

$\Gamma(\rho^0\pi^0\pi^0)/\Gamma(\rho^\pm\pi^\mp\pi^0)$ — Γ_5/Γ_6

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 $\gamma p \rightarrow p4\pi$

[42] $\omega\pi$ not included.

[43] Using ABELE 97.

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