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)

$\rho(1700)$

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

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

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 in the annihilation reactions $e^+e^- \to \pi^+\pi^-$, $2\pi^+2\pi^-$, and $\pi^+\pi^-\pi^0\pi^0$, and in the photoproduction reactions $\gamma p \to \pi^+\pi^- p$, $2\pi^+2\pi^- p$, and $\pi^+\pi^-\pi^0\pi^0 p$, had also argued that to obtain a consistent picture two resonances, whose masses and widths could be fixed reasonably well, were necessary. This picture was supported by the analysis of DONNACHIE 87B of $J^P = 1^-$ $\eta\rho^0$ mass spectra obtained in photoproduction and in e^+e^- annihilations; the analysis showed the need for a contribution from a ρ meson with a mass of about 1470 MeV, but could say little about a higher-mass resonance (actually the data could be explained without it). Confirmation of the decay $\rho(1450) \to \omega\pi$, and a tight constraint on the mass due to strong interference with the $\rho(770)$ tail, was found by DONNACHIE 91 in an analysis of $e^+e^- \to \omega\pi$.

The analysis of DONNACHIE 87 was extended by CLEGG 88 to include new data on 4π systems produced in e^+e^- annihilation and in τ decay (4π τ decays and 4π annihilation reactions 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 $\rho(1450) \to 4\pi$ were obtained, the quality of the data used by CLEGG 88 prevented any conclusion on $\rho(1700) \to 4\pi$ decay.

An analysis by CLEGG 90 of 6π mass spectra from e^+e^- annihilation and from diffractive photoproduction provides evidence for two ρ mesons at about 2.1 and 1.8 GeV that decay strongly into 6π states. While the former is a candidate for a new resonance, the latter could be a manifestation of the $\rho(1700)$, distorted by threshold effects.

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 $\pi^- p$ 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 with significant statistics (280 $e^+e^- \to \pi^+\pi^-$ events with very low background); a deep minimum is observed around 1.6 GeV, and the best fit to the form factor is obtained with the hypothesis of ρ-like resonances at 1420 and 1770 MeV with widths of about 250 MeV. ANTONELLI 88 found that the $e^+e^- \to \eta\pi^+\pi^-$ cross section (using three different η decay modes) is better fitted with two fully interfering Breit-Wigners, with parameters in fair agreement with those of DONNACHIE 87 and BISELLO 89.

These results (although ANTONELLI 88 is statistically less significant than BISELLO 89) have also resolved the disagreement between DONNACHIE 87 and FUKUI 88 on the $\rho(1450)$ width in favor of the DONNACHIE 87 value. From this point of view, the two experiments can be considered as solid confirmation of the $\rho(1450)$. For the possibility that its $\phi\pi$ mode actually contains two independent vector states, see LANDSBERG 92.

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 $J^P = 1^-$ $\rho(770) \to \pi\omega$ 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 $\rho(1450)$.

$\rho(1700)$ 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.

MIXED MODES

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

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
1700±25	DONNACHIE	87	RVUE	
• • • We do not use the following data for averages, fits, limits, etc. • • •				
1580±20	[1] BUON	82	DM1	$e^+e^- \to$ hadrons

$\eta\rho^0$ MODE

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

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