$\rho(1700)$ REFERENCES

CLEGG	90	ZPHY C45 677	+Donnachie	(LANC, MCHS)
BISELLO	89	PL B220 321	+Busetto+	(DM2 Collab.)
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	87	ZPHY C33 407	+Mirzaie	(MCHS)
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		(SERP)
		Translated from YAF 55 1896.		
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	$J/\psi \to \eta\gamma 2\pi$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
~ 1750	BREAKSTONE	93	SFM	$pp \to pp\pi^+\pi^-\pi^+\pi^-$

$X(1700)$ WIDTH

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
520±110	EDWARDS	83B	CBAL	$J/\psi \to \eta\gamma 2\pi$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
200 to 300	BREAKSTONE	93	SFM	$pp \to pp\pi^+\pi^-\pi^+\pi^-$

$X(1700)$ 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 $\theta(1690)$

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

NOTE ON THE $f_J(1710)$

The $f_J(1710)$ is seen in the "gluon rich" radiative decay $J/\psi(1S) \to \gamma f_J(1710)$; therefore $C = +$. It decays into 2η and $K^0_S K^0_S$, which implies $I^G J^{PC} = 0^+(\text{even})^{++}$. In an amplitude analysis of the $K\overline{K}$ and $\pi^+\pi^-$ systems produced in $J/\psi(1S)$ radiative decay, CHEN 91 finds a large spin-0 component for this particle, but WA 76 favors spin 2 in central production. The spin is thus uncertain. This resonance is also observed in $K\overline{K}$ systems recoiling against a ϕ or an ω in hadronic $J/\psi(1S)$ decay [however, according to FALVARD 88, $J/\psi(1S) \to \omega f_J(1710)$ is rather controversial]. The $f_J(1710)$ is not seen in $J/\psi(1S) \to \gamma\rho^0\rho^0$ (BISELLO 89B), in agreement with the indication (BALTRUSAITIS 85G) that the $\rho\rho$ enhancement in this region has $J^P = 0^-$, and hence is unrelated to the $f_J(1710)$.

Clear evidence is seen in hadroproduction (ARMSTRONG 89D, 300-GeV/c pp central production of $K\overline{K}$), both in K^+K^- and $K^0_S K^0_S$. Mass and width determinations are complicated because the spectra are dominated by overlap with the $f_2'(1525)$. The apparent large disagreement between the widths found by ARMSTRONG 89D in the two channels (≈ 180 MeV in K^+K^- and ≈ 100 MeV in $K^0_S K^0_S$) can be explained by the arbitrariness of the polynomial-exponential background shape, which leads to a large systematic error for the width. ARMSTRONG 93C also sees in $\eta\eta$ a broad peak at 1747 MeV, which may be the $f_J(1710)$. This resonance is not observed in the exclusive hypercharge-exchange reaction $K^-p \to K^0_S K^0_S \Lambda$ (ASTON 88D).

A partial-wave analysis of the $K^0_S K^0_S$ system (BOLONKIN 88) finds a D_0 wave ($J^{PC} = 2^{++}$) behavior near 1700 MeV, but the width (≈ 30 MeV) is much narrower than that observed in $J/\psi(1S)$ decays and in hadroproduction.

Note that in our 1992 edition, this particle was named the $f_2(1710)$; see also our "Note on Non-$q\overline{q}$ Mesons."

$f_J(1710)$ 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	$300\ pp \to ppK^0_S K^0_S$
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	$40\ \pi^-p \to K^0_S K^0_S n$
1720 ±60	BOLONKIN	88	SPEC	$40\ \pi^-p \to K^0_S K^0_S n$
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	$200\ \pi^-N \to 2K^0_S X$
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.