$f_J(1710)$

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

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 $C = +1$. 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 ARMSTRONG 89D 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 by DM2 (BISELLO 89B) in $J/\psi(1S) \to \gamma\rho^0\rho^0$, in agreement with the indication from MARK III (BALTRUSAITIS 86B) that the $\rho\rho$ enhancement in this region has $J^P = 0^-$, and hence is unrelated to the $f_J(1710)$. However, a reanalysis (BUGG 95) of the 4π channel from MARK III, including now two $\pi\pi$ S-waves in addition to $\rho\rho$, finds 0^{++}.

Clear evidence is seen in 300-GeV/c pp central production in both K^+K^- and $K^0_S K^0_S$ (ARMSTRONG 89D). 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 hypercharge-exchange reactions $K^-p \to K^0_S K^0_S \Lambda$ (ASTON 88D) and $K^-p \to K^0_S K^0_S Y^*$ (BOLONKIN 86).

A partial-wave analysis of the $\pi^-p \to K^0_S K^0_S$ system (BOLONKIN 88) finds a D_0 wave behavior ($J^{PC} = 2^{++}$) 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*
1697± 4 OUR AVERAGE	Error includes scale factor of 1.4. See the ideogram below.		
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±10	AUGUSTIN 88	DM2	$J/\psi \to \gamma K^+K^-$
1690± 4	[1] FALVARD 88	DM2	$J/\psi \to \phi K^+K^-$
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. • • •			
1768±14	BALOSHIN 95	SPEC	40 π^- C $\to K^0_S K^0_S$ X
1750±15	[2] BUGG 95	MRK3	$J/\psi \to \gamma\pi^+\pi^-\pi^+\pi^-$
1748±10	ARMSTRONG 93C	SPEC	$\overline{p}p \to \pi^0\eta\eta \to 6\gamma$
~ 1750	BREAKSTONE 93	SFM	$pp \to pp\pi^+\pi^-\pi^+\pi^-$
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	[3] FALVARD 88	DM2	$J/\psi \to \phi K^+K^-$
$1730^{+\ 2}_{-10}$	[4,5] LONGACRE 86	MPS	22 $\pi^- p \to n 2K^0_S$
1742±15	WILLIAMS 84	MPSF	200 $\pi^- N \to 2K^0_S$ X
1670±50	BLOOM 83	CBAL	$J/\psi \to \gamma 2\eta$
1700±45	EDWARDS 83B	CBAL	$J/\psi \to \eta\gamma 2\pi$
1650±50	BURKE 82	MRK2	$J/\psi \to \gamma 2\rho$
1730±10±20	ETKIN 82C	MPS	23 $\pi^- p \to n 2K^0_S$
1708±30	FRANKLIN 82	MRK2	$e^+e^- \to \gamma K^+K^-$

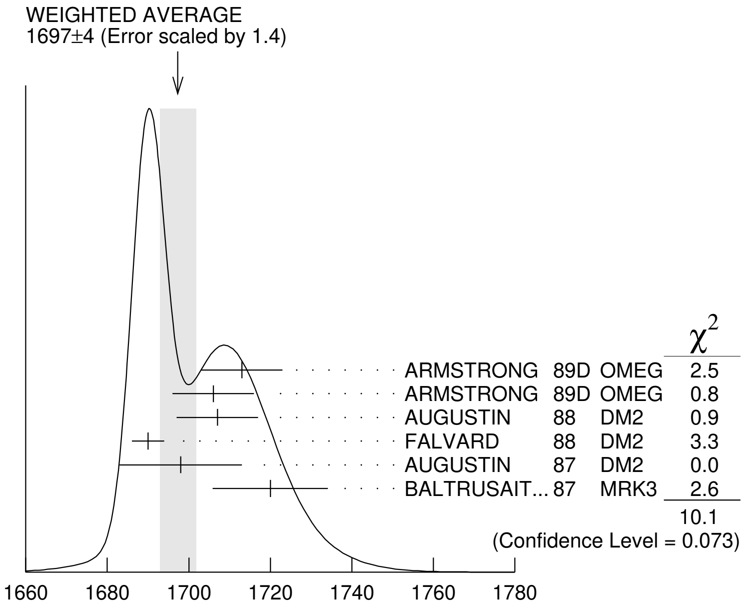
[1] From an analysis including interference with $f_2'(1525)$.

[2] From a fit to the 0^+ partial wave.

[3] From an analysis ignoring interference with $f_2'(1525)$.

[4] From a partial-wave analysis of data using a K-matrix formalism with 5 poles, but assuming spin 2.

[5] Fit with constrained inelasticity.



$f_J(1710)$ mass (MeV)

$f_J(1710)$ WIDTH

VALUE (MeV)	*DOCUMENT ID*	*TECN*	*COMMENT*
175 ± 9 OUR AVERAGE	Error includes scale factor of 1.7. See the ideogram below.		
181 ± 30	ARMSTRONG 89D	OMEG	300 $pp \to ppK^+K^-$
104 ± 30	ARMSTRONG 89D	OMEG	300 $pp \to ppK^0_S K^0_S$
166.4 ± 33.2	AUGUSTIN 88	DM2	$J/\psi \to \gamma K^+K^-$
184 ± 6	[6] FALVARD 88	DM2	$J/\psi \to \phi K^+K^-$
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. • • •			
56 ± 19	BALOSHIN 95	SPEC	40 π^- C $\to K^0_S K^0_S X$
160 ± 40	[7] BUGG 95	MRK3	$J/\psi \to \gamma\pi^+\pi^-\pi^+\pi^-$
264 ± 25	ARMSTRONG 93C	SPEC	$\overline{p}p \to \pi^0\eta\eta \to 6\gamma$
200 to 300	BREAKSTONE 93	SFM	$pp \to pp\pi^+\pi^-\pi^+\pi^-$
186 ± 30	CHEN 91	MRK3	$J/\psi \to \gamma\pi^+\pi^-, \gamma K\overline{K}$
30 ± 20	BOLONKIN 88	SPEC	40 $\pi^- p \to K^0_S K^0_S n$
350 ±150	BOLONKIN 88	SPEC	40 $\pi^- p \to K^0_S K^0_S n$
148 ± 17	[8] FALVARD 88	DM2	$J/\psi \to \phi K^+K^-$
122 $^{+74}_{-15}$	[9,10] LONGACRE 86	MPS	22 $\pi^- p \to n2K^0_S$
57 ± 38	WILLIAMS 84	MPSF	200 $\pi^- N \to 2K^0_S X$
160 ± 80	BLOOM 83	CBAL	$J/\psi \to \gamma 2\eta$
520 ±110	EDWARDS 83B	CBAL	$J/\psi \to \eta\gamma 2\pi$
200 ±100	BURKE 82	MRK2	$J/\psi \to \gamma 2\rho$
200.0 $^{+156.0}_{-9.0}$	[11] ETKIN 82B	MPS	23 $\pi^- p \to n2K^0_S$
156 ± 60	FRANKLIN 82	MRK2	$e^+e^- \to \gamma K^+K^-$

[6] From an analysis including interference with $f'_2(1525)$.

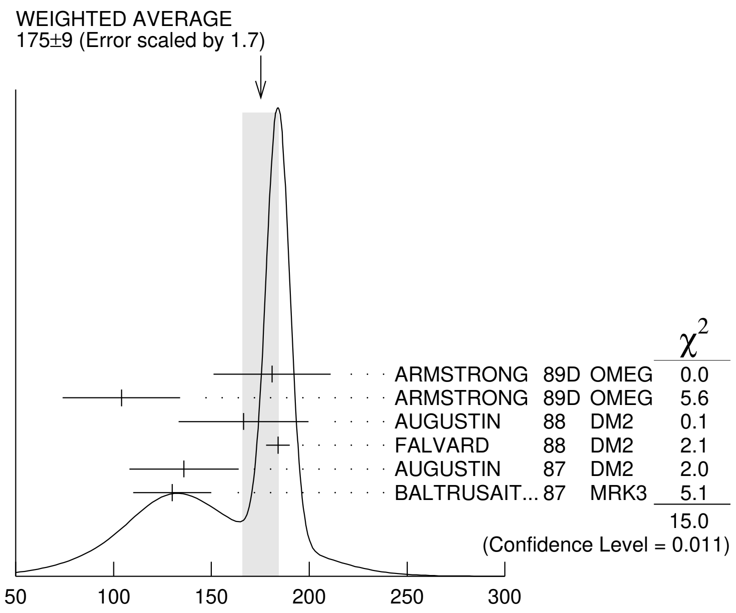
[7] From a fit to the 0^+ partial wave.

[8] From an analysis ignoring interference with $f'_2(1525)$.

[9] From a partial-wave analysis of data using a K-matrix formalism with 5 poles, but assuming spin 2.

[10] Fit with constrained inelasticity.

[11] From an amplitude analysis of the $K^0_S K^0_S$ system.



$f_J(1710)$ width (MeV)

$f_J(1710)$ DECAY MODES

	Mode	Fraction (Γ_i/Γ)
Γ_1	$K\overline{K}$	seen
Γ_2	$\eta\eta$	seen
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	[12] BEHREND 89C	CELL	$\gamma\gamma \rightarrow K^0_S K^0_S$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
<0.48	95	ALBRECHT 90G	ARG	$\gamma\gamma \rightarrow K^+ K^-$
<0.28	95	[12] ALTHOFF 85B	TASS	$\gamma\gamma \rightarrow K\overline{K}\pi$

[12] 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. • • •			
$0.38^{+0.09}_{-0.19}$	[13,14] LONGACRE 86	MPS	$22\ \pi^- p \rightarrow n 2K^0_S$

$\Gamma(\eta\eta)/\Gamma_{\text{total}}$ — Γ_2/Γ

VALUE	*DOCUMENT ID*	*TECN*
• • • We do not use the following data for averages, fits, limits, etc. • • •		
$0.18^{+0.03}_{-0.13}$	[13,14] 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. • • •		
$0.039^{+0.002}_{-0.024}$	[13,14] 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	$300\ pp \rightarrow pp\pi\pi$, $ppK\overline{K}$

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

VALUE	*CL%*	*DOCUMENT ID*	*TECN*	*COMMENT*
• • • We do not use the following data for averages, fits, limits, etc. • • •				
<0.02	90	[15] PROKOSHKIN 91	GA24	$300\ \pi^- p \rightarrow \pi^- p\eta\eta$

[13] From a partial-wave analysis of data using a K-matrix formalism with 5 poles, but assuming spin 2.
[14] Fit with constrained inelasticity.
[15] Combining results of GAM4 with those of ARMSTRONG 89D.

$f_J(1710)$ REFERENCES

BALOSHIN	95	PAN 58 46	+Bolonkin, Vladimirskii+	(ITEP)
		Translated from YAF 58 50.		
BUGG	95	PL B353 378	+Scott, Zoli+	(LOQM, PNPI, WASH)
ARMSTRONG	93C	PL B307 394	+Bettoni+	(FNAL, FERR, GENO, UCI, NWES+)
BREAKSTONE	93	ZPHY C58 251	+Campanini+	(IOWA, CERN, DORT, HEIDH, WARS)
ARMSTRONG	91	ZPHY C51 351	+Benayoun+	(ATHU, BARI, BIRM, CERN, CDEF)
CHEN	91	Hadron 91 Conf.		(Mark III Collab.)
SLAC-PUB-5669				
PROKOSHKIN	91	SPD 36 155		(GAM2, GAM4 Collab.)
		Translated from DANS 316 900.		

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)
EDWARDS	83B	PRL 51 859	+Partridge, Peck+	(CIT, HARV, PRIN, STAN, SLAC)
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

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)