

$f_2(1950)$

$$I^G(J^{PC}) = 0^+(2^{++})$$

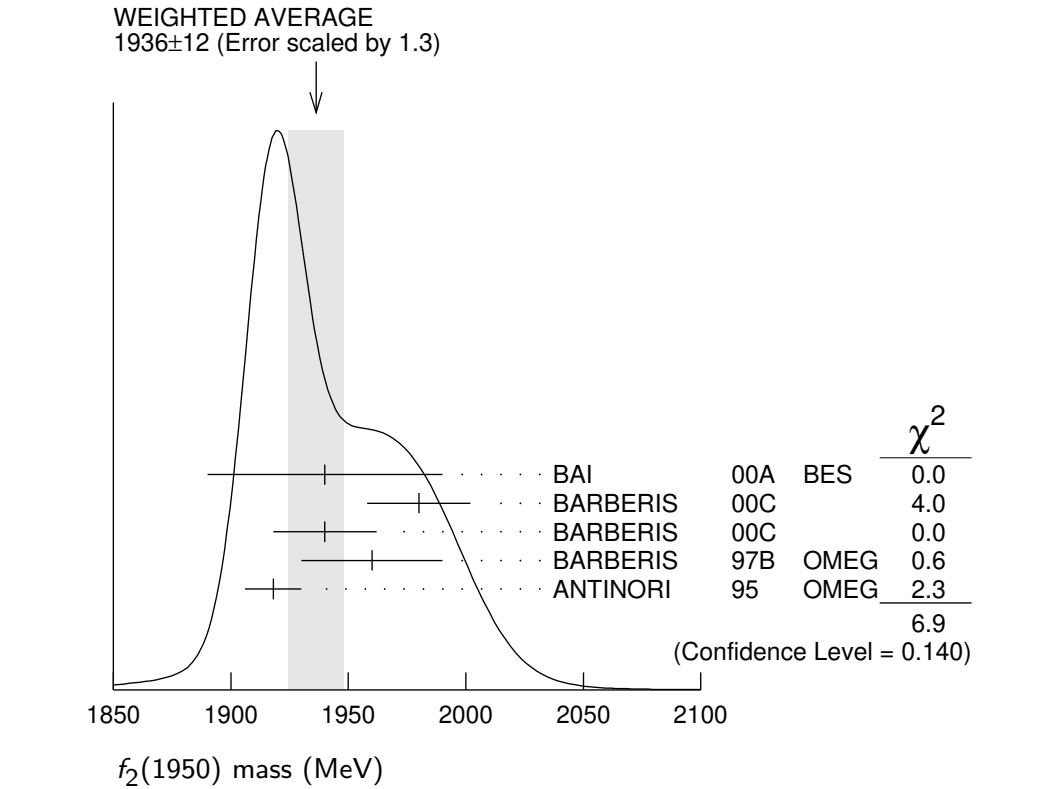
 $f_2(1950)$ T-MATRIX POLE $\sqrt{s}$ Note that $\Gamma = -2 \operatorname{Im}(\sqrt{s})$.

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
(1830–2020) – i (110–220) OUR ESTIMATE			
$(1955 \pm 75) - i (175 \pm 57)$	¹ RODAS	22	RVUE $J/\psi(1S) \rightarrow \gamma (\pi\pi, K\bar{K})$
$(1978.2 \pm 1.8^{+28.4}_{-16.9}) - i$	² ALBRECHT	20	RVUE $0.9 \bar{p}p \rightarrow \pi^0\pi^0\eta, \pi^0\eta\eta,$ $\pi^0 K^+ K^-$
$(118.8 \pm 0.8^{+20.8}_{-7.8})$			
$(1867 \pm 46) - i (193 \pm 29)$	AMSLER	02	CBAR $0.9 \bar{p}p \rightarrow \pi^0\eta\eta, \pi^0\pi^0\pi^0$
¹ T-matrix pole from coupled channel K-matrix fit to data on $J/\psi \rightarrow \gamma\pi^0\pi^0$ (ABLIKIM 15AE) and $J/\psi \rightarrow \gamma K_S^0 K_S^0$ (ABLIKIM 18AA).			
² T-matrix pole, 4 poles, 4 channels, including scattering data from HYAMS 75 ($\pi\pi$), LONGACRE 86 ($K\bar{K}$), BINON 83 ($\eta\eta$).			

 $f_2(1950)$ MASS

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
1936$\pm$12 OUR AVERAGE Error includes scale factor of 1.3. See the ideogram below.			
1940 $\pm$ 50	BAI	00A	BES $J/\psi \rightarrow \gamma(\pi^+\pi^-\pi^+\pi^-)$
1980 $\pm$ 22	¹ BARBERIS	00C	450 $pp \rightarrow pp4\pi$
1940 $\pm$ 22	² BARBERIS	00C	450 $pp \rightarrow pp2\pi2\pi^0$
1960 $\pm$ 30	BARBERIS	97B	OMEG 450 $pp \rightarrow pp2(\pi^+\pi^-)$
1918 $\pm$ 12	ANTINORI	95	OMEG 300,450 $pp \rightarrow pp2(\pi^+\pi^-)$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
2038 $^{+13+12}_{-11-73}$	³ UEHARA	09	BELL 10.6 $e^+e^- \rightarrow e^+e^-\pi^0\pi^0$
1930 $\pm$ 25	⁴ BINON	05	GAMS 33 $\pi^-p \rightarrow \eta\eta n$
1980 $\pm 2\pm 14$	ABE	04	BELL 10.6 $e^+e^- \rightarrow e^+e^-K^+K^-$
2010 $\pm$ 25	ANISOVICH	00J	SPEC
1980 $\pm$ 50	ANISOVICH	99B	SPEC 1.35–1.94 $p\bar{p} \rightarrow \eta\eta\pi^0$
~ 1990	⁵ OAKDEN	94	RVUE 0.36–1.55 $\bar{p}p \rightarrow \pi\pi$
1950 $\pm$ 15	⁶ ASTON	91	LASS 11 $K^-p \rightarrow \Lambda K\bar{K}\pi\pi$

¹ Decaying into $\pi^+\pi^-\pi^0$.² Decaying into $2(\pi^+\pi^-)$.³ Taking into account $f_4(2050)$.⁴ First solution, PWA is ambiguous.⁵ From solution B of amplitude analysis of data on $\bar{p}p \rightarrow \pi\pi$. See however KLOET 96 who fit $\pi^+\pi^-$ only and find waves only up to $J = 3$ to be important but not significantly resonant.⁶ Cannot determine spin to be 2.



$f_2(1950)$ WIDTH

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
464 ± 24 OUR AVERAGE			
380^{+120}_{-90}	BAI	00A	BES $J/\psi \rightarrow \gamma(\pi^+\pi^-\pi^+\pi^-)$
520 ± 50	¹ BARBERIS	00C	450 $pp \rightarrow pp4\pi$
485 ± 55	² BARBERIS	00C	450 $pp \rightarrow pp4\pi$
460 ± 40	BARBERIS	97B	OMEG 450 $pp \rightarrow pp2(\pi^+\pi^-)$
390 ± 60	ANTINORI	95	OMEG 300,450 $pp \rightarrow pp2(\pi^+\pi^-)$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
$441^{+27+28}_{-25-192}$	³ UEHARA	09	BELL 10.6 $e^+e^- \rightarrow e^+e^-\pi^0\pi^0$
450 ± 50	⁴ BINON	05	GAMS 33 $\pi^-p \rightarrow \eta\eta n$
$297 \pm 12 \pm 6$	ABE	04	BELL 10.6 $e^+e^- \rightarrow e^+e^-K^+K^-$
495 ± 35	ANISOVICH	00J	SPEC
500 ± 100	ANISOVICH	99B	SPEC 1.35–1.94 $p\bar{p} \rightarrow \eta\eta\pi^0$
~ 100	⁵ OAKDEN	94	RVUE 0.36–1.55 $\bar{p}p \rightarrow \pi\pi$
250 ± 50	⁶ ASTON	91	LASS 11 $K^-p \rightarrow \Lambda K\bar{K}\pi\pi$
¹ Decaying into $\pi^+\pi^-2\pi^0$.			
² Decaying into $2(\pi^+\pi^-)$.			
³ Taking into account $f_4(2050)$.			
⁴ First solution, PWA is ambiguous.			
⁵ From solution B of amplitude analysis of data on $\bar{p}p \rightarrow \pi\pi$. See however KLOET 96 who fit $\pi^+\pi^-$ only and find waves only up to $J = 3$ to be important but not significantly resonant.			

⁶ Cannot determine spin to be 2. **$f_2(1950)$ DECAY MODES**

	Mode	Fraction (Γ_i/Γ)
Γ_1	$K^*(892)\bar{K}^*(892)$	seen
Γ_2	$\pi\pi$	
Γ_3	$\pi^+\pi^-$	seen
Γ_4	$\pi^0\pi^0$	seen
Γ_5	4π	seen
Γ_6	$\pi^+\pi^-\pi^+\pi^-$	
Γ_7	$a_2(1320)\pi$	
Γ_8	$\eta\eta$	seen
Γ_9	$K\bar{K}$	seen
Γ_{10}	$\gamma\gamma$	seen
Γ_{11}	$p\bar{p}$	seen

 $f_2(1950)$ $\Gamma(i)\Gamma(\gamma\gamma)/\Gamma(\text{total})$

$\Gamma(K\bar{K}) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$ $\Gamma_9\Gamma_{10}/\Gamma$

VALUE (eV)	DOCUMENT ID	TECN	COMMENT
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• • • We do not use the following data for averages, fits, limits, etc. • • •

$122 \pm 4 \pm 26$	¹ ABE	04	BELL	$10.6 e^+e^- \rightarrow e^+e^- K^+K^-$
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¹ Assuming spin 2.

$\Gamma(\pi\pi) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$ $\Gamma_2\Gamma_{10}/\Gamma$

VALUE	DOCUMENT ID	TECN	COMMENT
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• • • We do not use the following data for averages, fits, limits, etc. • • •

$162^{+69+1137}_{-42-204}$	¹ UEHARA	09	BELL	$10.6 e^+e^- \rightarrow e^+e^- \pi^0\pi^0$
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¹ Taking into account $f_4(2050)$.

 $f_2(1950)$ BRANCHING RATIOS

$\Gamma(K^*(892)\bar{K}^*(892))/\Gamma_{\text{total}}$ Γ_1/Γ

VALUE	DOCUMENT ID	TECN	CHG	COMMENT
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seen	ASTON	91	LASS	0	11 $K^-p \rightarrow \Lambda K\bar{K}\pi\pi$
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$\Gamma(a_2(1320)\pi)/\Gamma_{\text{total}}$ Γ_7/Γ

VALUE	DOCUMENT ID	TECN	COMMENT
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• • • We do not use the following data for averages, fits, limits, etc. • • •

not seen	BARBERIS	00B	450 $pp \rightarrow p_f \eta \pi^+ \pi^- p_s$
not seen	BARBERIS	00C	450 $pp \rightarrow p_f 4\pi p_s$
possibly seen	BARBERIS	97B	OMEG 450 $pp \rightarrow pp2(\pi^+\pi^-)$

$\Gamma(\eta\eta)/\Gamma(4\pi)$ Γ_8/Γ_5

VALUE	CL%	DOCUMENT ID	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •			
$<5.0 \times 10^{-3}$	90	BARBERIS	00E 450 $pp \rightarrow p_f \eta \eta p_s$

 $\Gamma(\eta\eta)/\Gamma(\pi^+\pi^-)$ Γ_8/Γ_3

VALUE	DOCUMENT ID	TECN	COMMENT
0.14 ± 0.05	AMSLER	02	CBAR 0.9 $\bar{p}p \rightarrow \pi^0 \eta \eta, \pi^0 \pi^0 \pi^0$

 $\Gamma(p\bar{p})/\Gamma_{\text{total}}$ Γ_{11}/Γ

VALUE	EVTs	DOCUMENT ID	TECN	COMMENT
seen	111	ALEXANDER	10	CLEO $\psi(2S) \rightarrow \gamma p \bar{p}$

 $f_2(1950)$ REFERENCES

RODAS	22	EPJ C82 80	A. Rodas <i>et al.</i>	(JPAC Collab.)
ALBRECHT	20	EPJ C80 453	M. Albrecht <i>et al.</i>	(Crystal Barrel Collab.)
ABLIKIM	18AA	PR D98 072003	M. Ablikim <i>et al.</i>	(BESIII Collab.)
ABLIKIM	15AE	PR D92 052003	M. Ablikim <i>et al.</i>	(BESIII Collab.)
ALEXANDER	10	PR D82 092002	J.P. Alexander <i>et al.</i>	(CLEO Collab.)
UEHARA	09	PR D79 052009	S. Uehara <i>et al.</i>	(BELLE Collab.)
BINON	05	PAN 68 960	F. Binon <i>et al.</i>	(BELLE Collab.)
ABE	04	EPJ C32 323	K. Abe <i>et al.</i>	(BELLE Collab.)
AMSLER	02	EPJ C23 29	C. Amsler <i>et al.</i>	(Crystal Barrel Collab.)
ANISOVICH	00J	PL B491 47	A.V. Anisovich <i>et al.</i>	(RAL, LOQM, PNPI+)
BAI	00A	PL B472 207	J.Z. Bai <i>et al.</i>	(BES Collab.)
BARBERIS	00B	PL B471 435	D. Barberis <i>et al.</i>	(WA 102 Collab.)
BARBERIS	00C	PL B471 440	D. Barberis <i>et al.</i>	(WA 102 Collab.)
BARBERIS	00E	PL B479 59	D. Barberis <i>et al.</i>	(WA 102 Collab.)
ANISOVICH	99B	PL B449 154	A.V. Anisovich <i>et al.</i>	
BARBERIS	97B	PL B413 217	D. Barberis <i>et al.</i>	(WA 102 Collab.)
KLOET	96	PR D53 6120	W.M. Kloet, F. Myhrer	(RUTG, NORD)
ANTINORI	95	PL B353 589	F. Antinori <i>et al.</i>	(ATHU, BARI, BIRM+) JP
OAKDEN	94	NP A574 731	M.N. Oakden, M.R. Pennington	(DURH)
ASTON	91	NPBPS B21 5	D. Aston <i>et al.</i>	(LASS Collab.)
LONGACRE	86	PL B177 223	R.S. Longacre <i>et al.</i>	(BNL, BRAN, CUNY+)
BINON	83	NC 78A 313	F.G. Binon <i>et al.</i>	(BELG, LAPP, SERP+)
HYAMS	75	NP B100 205	B.D. Hyams <i>et al.</i>	(CERN, MPIM)