NODE=M135

$f_2(1950)$

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

$f_2(1950)$ T-MATRIX POLE $\sqrt{s}$

NODE=M135PP

Note that $\Gamma = -2\ \mathrm{Im}(\sqrt{s})$.

NODE=M135PP

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
(1830–2020) − *i* (110–220) OUR ESTIMATE				
$(1955 \pm 75) - i\,(175 \pm 57)$	[1] RODAS	22	RVUE	$J/\psi(1S) \to \gamma\,(\pi\pi,\ K\overline{K})$
$(1978.2 \pm 1.8^{+28.4}_{-16.9}) - i\,(118.8 \pm 0.8^{+20.8}_{-7.8})$	[2] ALBRECHT	20	RVUE	$0.9\ \overline{p}p \to \pi^0\pi^0\eta,\ \pi^0\eta\eta,\ \pi^0 K^+ K^-$
$(1867 \pm 46) - i\,(193 \pm 29)$	AMSLER	02	CBAR	$0.9\ \overline{p}p \to \pi^0\eta\eta,\ \pi^0\pi^0\pi^0$

NODE=M135PP

NODE=M135PP

NODE=M135PP

→ UNCHECKED ←

[1] T-matrix pole from coupled channel K-matrix fit to data on $J/\psi \to \gamma\pi^0\pi^0$ (ABLIKIM 15AE) and $J/\psi \to \gamma K^0_S K^0_S$ (ABLIKIM 18AA).

NODE=M135PP;LINKAGE=A

[2] T-matrix pole, 4 poles, 4 channels, including scattering data from HYAMS 75 ($\pi\pi$), LONGACRE 86 ($K\overline{K}$), BINON 83 ($\eta\eta$).

NODE=M135PP;LINKAGE=B

$f_2(1950)$ MASS

NODE=M135M

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

NODE=M135M

NODE=M135M

OCCUR=2

[1] Decaying into $\pi^+\pi^- 2\pi^0$.

NODE=M135M;LINKAGE=A4

[2] Decaying into $2(\pi^+\pi^-)$.

NODE=M135M;LINKAGE=B4

[3] Taking into account $f_4(2050)$.

NODE=M135M;LINKAGE=UE

[4] First solution, PWA is ambiguous.

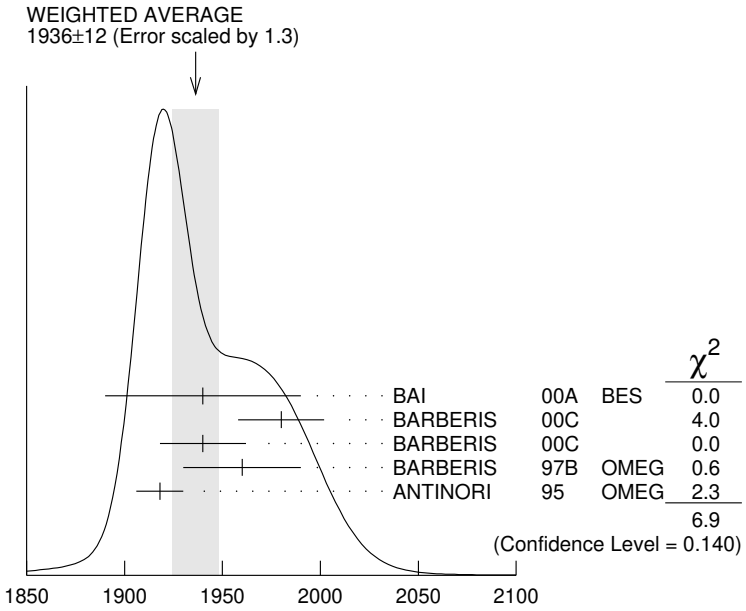
NODE=M135M;LINKAGE=BI

[5] From solution B of amplitude analysis of data on $\overline{p}p \to \pi\pi$. See however KLOET 96 who fit $\pi^+\pi^-$ only and find waves only up to $J = 3$ to be important but not significantly resonant.

NODE=M135M;LINKAGE=BB

[6] Cannot determine spin to be 2.

NODE=M135M;LINKAGE=A



$f_2(1950)$ WIDTH

NODE=M135W

NODE=M135W

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
464± 24 OUR AVERAGE				
380^{+120}_{-90}	BAI	00A	BES	$J/\psi \to \gamma(\pi^+\pi^-\pi^+\pi^-)$
520± 50	[1] BARBERIS	00C		450 $pp \to pp4\pi$
485± 55	[2] BARBERIS	00C		450 $pp \to pp4\pi$
460± 40	BARBERIS	97B	OMEG	450 $pp \to pp2(\pi^+\pi^-)$
390± 60	ANTINORI	95	OMEG	300,450 $pp \to pp2(\pi^+\pi^-)$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
$441^{+\ 27+\ 28}_{-\ 25-192}$	[3] UEHARA	09	BELL	10.6 $e^+e^- \to e^+e^-\pi^0\pi^0$
450± 50	[4] BINON	05	GAMS	33 $\pi^- p \to \eta\eta n$
297± 12± 6	ABE	04	BELL	10.6 $e^+e^- \to e^+e^-K^+K^-$
495± 35	ANISOVICH	00J	SPEC	
500±100	ANISOVICH	99B	SPEC	1.35–1.94 $p\overline{p} \to \eta\eta\pi^0$
~ 100	[5] OAKDEN	94	RVUE	0.36–1.55 $\overline{p}p \to \pi\pi$
250± 50	[6] ASTON	91	LASS	11 $K^- p \to \Lambda K\overline{K}\pi\pi$

[1] Decaying into $\pi^+\pi^-2\pi^0$. NODE=M135W;LINKAGE=A4
[2] Decaying into $2(\pi^+\pi^-)$. NODE=M135W;LINKAGE=B4
[3] Taking into account $f_4(2050)$. NODE=M135W;LINKAGE=UE
[4] First solution, PWA is ambiguous. NODE=M135W;LINKAGE=BI
[5] From solution B of amplitude analysis of data on $\overline{p}p \to \pi\pi$. See however KLOET 96 who fit $\pi^+\pi^-$ only and find waves only up to $J = 3$ to be important but not significantly resonant. NODE=M135W;LINKAGE=BB
[6] Cannot determine spin to be 2. NODE=M135W;LINKAGE=A

$f_2(1950)$ DECAY MODES

NODE=M135215;NODE=M135

	Mode	Fraction (Γ_i/Γ)	
Γ_1	$K^*(892)\overline{K}^*(892)$	seen	DESIG=1
Γ_2	$\pi\pi$		DESIG=11
Γ_3	$\pi^+\pi^-$	seen	DESIG=2;OUR EST;→ UNCHECKED ←
Γ_4	$\pi^0\pi^0$	seen	DESIG=10;OUR EST;→ UNCHECKED ←
Γ_5	4π	seen	DESIG=7;OUR EST;→ UNCHECKED ←
Γ_6	$\pi^+\pi^-\pi^+\pi^-$		DESIG=3
Γ_7	$a_2(1320)\pi$		DESIG=4
Γ_8	$\eta\eta$	seen	DESIG=6;OUR EST;→ UNCHECKED ←
Γ_9	$K\overline{K}$	seen	DESIG=8;OUR EST;→ UNCHECKED ←
Γ_{10}	$\gamma\gamma$	seen	DESIG=9;OUR EST;→ UNCHECKED ←
Γ_{11}	$p\overline{p}$	seen	DESIG=12

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

NODE=M135225

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

NODE=M135G1
NODE=M135G1

VALUE (eV)	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
$122 \pm 4 \pm 26$	[1] ABE	04	BELL	10.6 $e^+e^- \to e^+e^-K^+K^-$

[1] Assuming spin 2.

NODE=M135G1;LINKAGE=AB

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

NODE=M135G2
NODE=M135G2

VALUE	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
$162^{+69+1137}_{-42-204}$	[1] UEHARA	09	BELL	10.6 $e^+e^- \to e^+e^-\pi^0\pi^0$

[1] Taking into account $f_4(2050)$.

NODE=M135G2;LINKAGE=UE

$f_2(1950)$ BRANCHING RATIOS

NODE=M135220

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

NODE=M135R1
NODE=M135R1

VALUE	DOCUMENT ID		TECN	CHG	COMMENT
seen	ASTON	91	LASS	0	11 $K^-p \to \Lambda K\overline{K}\pi\pi$

$\Gamma(a_2(1320)\pi)/\Gamma_{\text{total}}$ Γ_7/Γ

NODE=M135R3
NODE=M135R3

VALUE	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
not seen	BARBERIS	00B		450 $pp \to p_f\eta\pi^+\pi^-p_s$
not seen	BARBERIS	00C		450 $pp \to p_f 4\pi p_s$
possibly seen	BARBERIS	97B	OMEG	450 $pp \to pp2(\pi^+\pi^-)$

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

NODE=M135R5
NODE=M135R5

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 $pp \to p_f\eta\eta p_s$

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

NODE=M135R6
NODE=M135R6

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

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

NODE=M135R07
NODE=M135R07

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

$f_2(1950)$ REFERENCES

NODE=M135

RODAS	22	EPJ C82 80	A. Rodas *et al.*	(JPAC Collab.)
ALBRECHT	20	EPJ C80 453	M. Albrecht *et al.*	(Crystal Barrel Collab.)
ABLIKIM	18AA	PR D98 072003	M. Ablikim *et al.*	(BESIII Collab.)
ABLIKIM	15AE	PR D92 052003	M. Ablikim *et al.*	(BESIII Collab.)
ALEXANDER	10	PR D82 092002	J.P. Alexander *et al.*	(CLEO Collab.)
UEHARA	09	PR D79 052009	S. Uehara *et al.*	(BELLE Collab.)
BINON	05	PAN 68 960	F. Binon *et al.*	
		Translated from YAF 68 998.		
ABE	04	EPJ C32 323	K. Abe *et al.*	(BELLE Collab.)
AMSLER	02	EPJ C23 29	C. Amsler *et al.*	(Crystal Barrel Collab.)
ANISOVICH	00J	PL B491 47	A.V. Anisovich *et al.*	(RAL, LOQM, PNPI+)
BAI	00A	PL B472 207	J.Z. Bai *et al.*	(BES Collab.)
BARBERIS	00B	PL B471 435	D. Barberis *et al.*	(WA 102 Collab.)
BARBERIS	00C	PL B471 440	D. Barberis *et al.*	(WA 102 Collab.)
BARBERIS	00E	PL B479 59	D. Barberis *et al.*	(WA 102 Collab.)
ANISOVICH	99B	PL B449 154	A.V. Anisovich *et al.*	
BARBERIS	97B	PL B413 217	D. Barberis *et al.*	(WA 102 Collab.)
KLOET	96	PR D53 6120	W.M. Kloet, F. Myhrer	(RUTG, NORD)
ANTINORI	95	PL B353 589	F. Antinori *et al.*	(ATHU, BARI, BIRM+) JP
OAKDEN	94	NP A574 731	M.N. Oakden, M.R. Pennington	(DURH)
ASTON	91	NPBPS B21 5	D. Aston *et al.*	(LASS Collab.)
LONGACRE	86	PL B177 223	R.S. Longacre *et al.*	(BNL, BRAN, CUNY+)
BINON	83	NC 78A 313	F.G. Binon *et al.*	(BELG, LAPP, SERP+)
HYAMS	75	NP B100 205	B.D. Hyams *et al.*	(CERN, MPIM)

REFID=61610
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