NODE=M016

$f_4(2050)$

$I^G(J^{PC}) = 0^+(4^{++})$

$f_4(2050)$ MASS

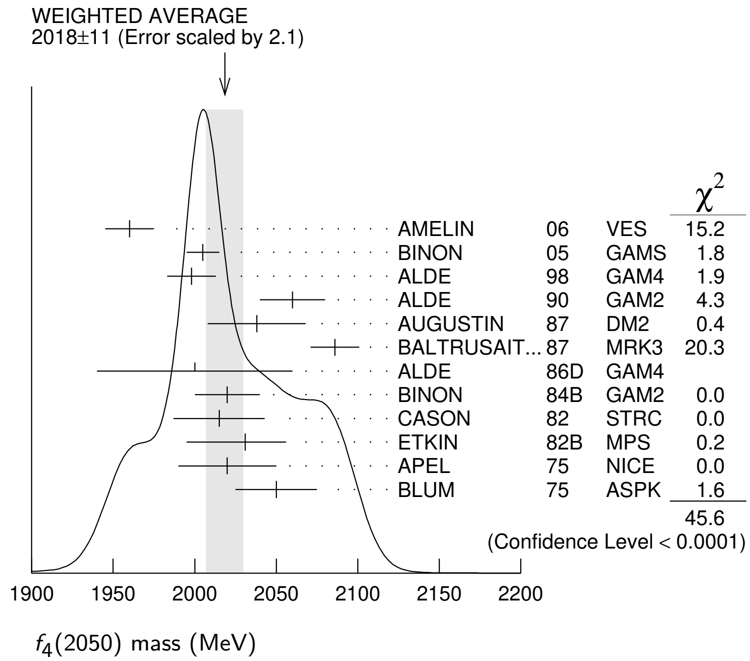
NODE=M016205

NODE=M016M

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	COMMENT
2018±11 OUR AVERAGE		Error includes scale factor of 2.1. See the ideogram below.			
1960±15		AMELIN	06	VES	36 $\pi^- p \to \omega\omega n$
2005±10		[1] BINON	05	GAMS	33 $\pi^- p \to \eta\eta n$
1998±15		ALDE	98	GAM4	100 $\pi^- p \to \pi^0\pi^0 n$
2060±20		ALDE	90	GAM2	38 $\pi^- p \to \omega\omega n$
2038±30		AUGUSTIN	87	DM2	$J/\psi \to \gamma\pi^+\pi^-$
2086±15		BALTRUSAIT...	87	MRK3	$J/\psi \to \gamma\pi^+\pi^-$
2000±60		ALDE	86D	GAM4	100 $\pi^- p \to n2\eta$
2020±20	40k	[2] BINON	84B	GAM2	38 $\pi^- p \to n2\pi^0$
2015±28		[3] CASON	82	STRC	8 $\pi^+ p \to \Delta^{++}\pi^0\pi^0$
2031^{+25}_{-36}		ETKIN	82B	MPS	23 $\pi^- p \to n2K^0_S$
2020±30	700	APEL	75	NICE	40 $\pi^- p \to n2\pi^0$
2050±25		BLUM	75	ASPK	18.4 $\pi^- p \to nK^+K^-$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
2018± 6		ANISOVICH	00J	SPEC	2.0 $\overline{p}p \to \eta\pi^0\pi^0$, $\pi^0\pi^0$, $\eta\eta$, $\eta\eta'$, $\pi\pi$
∼ 2000		[4] MARTIN	98	RVUE	$N\overline{N} \to \pi\pi$
∼ 2010		[5] MARTIN	97	RVUE	$\overline{N}N \to \pi\pi$
∼ 2040		[6] OAKDEN	94	RVUE	0.36–1.55 $\overline{p}p \to \pi\pi$
∼ 1990		[7] OAKDEN	94	RVUE	0.36–1.55 $\overline{p}p \to \pi\pi$
1978± 5		[8] ALPER	80	CNTR	62 $\pi^- p \to K^+K^- n$
2040±10		[8] ROZANSKA	80	SPRK	18 $\pi^- p \to p\overline{p}n$
1935±13		[8] CORDEN	79	OMEG	12–15 $\pi^- p \to n2\pi$
1988± 7		EVANGELIS...	79B	OMEG	10 $\pi^- p \to K^+K^- n$
1922±14		[9] ANTIPOV	77	CIBS	25 $\pi^- p \to p3\pi$

OCCUR=2

[1] From the first PWA solution. NODE=M016M;LINKAGE=BI
[2] From a partial-wave analysis of the data. NODE=M016M;LINKAGE=N
[3] From an amplitude analysis of the reaction $\pi^+\pi^- \to 2\pi^0$. NODE=M016M;LINKAGE=NN
[4] Energy-dependent analysis. NODE=M016M;LINKAGE=RB
[5] Single energy analysis. NODE=M016M;LINKAGE=BR
[6] From solution A 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=M016M;LINKAGE=B
[7] 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=M016M;LINKAGE=BB
[8] $I(J^P) = 0(4^+)$ from amplitude analysis assuming one-pion exchange. NODE=M016M;LINKAGE=M
[9] Width errors enlarged by us to $4\Gamma/\sqrt{N}$; see the note with the $K^*(892)$ mass. NODE=M016M;LINKAGE=T



$f_4(2050)$ WIDTH

NODE=M016210

NODE=M016W

VALUE (MeV)	*EVTS*	*DOCUMENT ID*	*TECN*	*COMMENT*
237± 18 OUR AVERAGE		Error includes scale factor of 1.9. See the ideogram below.		
290± 20		AMELIN	06 VES	36 $\pi^- p \to \omega\omega n$
340± 80		[10] BINON	05 GAMS	33 $\pi^- p \to \eta\eta n$
395± 40		ALDE	98 GAM4	100 $\pi^- p \to \pi^0\pi^0 n$
170± 60		ALDE	90 GAM2	38 $\pi^- p \to \omega\omega n$
304± 60		AUGUSTIN	87 DM2	$J/\psi \to \gamma\pi^+\pi^-$
210± 63		BALTRUSAIT...	87 MRK3	$J/\psi \to \gamma\pi^+\pi^-$
400±100		ALDE	86D GAM4	100 $\pi^- p \to n 2\eta$
240± 40	40k	[11] BINON	84B GAM2	38 $\pi^- p \to n 2\pi^0$
190± 14		DENNEY	83 LASS	10 $\pi^+ n/\pi^+ p$
186^{+103}_{-58}		[12] CASON	82 STRC	8 $\pi^+ p \to \Delta^{++}\pi^0\pi^0$
305^{+36}_{-119}		ETKIN	82B MPS	23 $\pi^- p \to n 2K^0_S$
180± 60	700	APEL	75 NICE	40 $\pi^- p \to n 2\pi^0$
225^{+120}_{-70}		BLUM	75 ASPK	18.4 $\pi^- p \to n K^+ K^-$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
182± 7		ANISOVICH	00J SPEC	2.0 $\overline{p}p \to \eta\pi^0\pi^0$, $\pi^0\pi^0$, $\eta\eta$, $\eta\eta'$, $\pi\pi$
∼ 170		[13] MARTIN	98 RVUE	$N\overline{N} \to \pi\pi$
∼ 200		[14] MARTIN	97 RVUE	$\overline{N}N \to \pi\pi$
∼ 60		[15] OAKDEN	94 RVUE	0.36–1.55 $\overline{p}p \to \pi\pi$
∼ 80		[16] OAKDEN	94 RVUE	0.36–1.55 $\overline{p}p \to \pi\pi$
243± 16		[17] ALPER	80 CNTR	62 $\pi^- p \to K^+K^- n$
140± 15		[17] ROZANSKA	80 SPRK	18 $\pi^- p \to p\overline{p}n$
263± 57		[17] CORDEN	79 OMEG	12–15 $\pi^- p \to n 2\pi$
100± 28		EVANGELIS...	79B OMEG	10 $\pi^- p \to K^+K^- n$
107± 56		[18] ANTIPOV	77 CIBS	25 $\pi^- p \to p 3\pi$

OCCUR=2

[10] From the first PWA solution. NODE=M016W;LINKAGE=BI

[11] From a partial-wave analysis of the data. NODE=M016W;LINKAGE=N

[12] From an amplitude analysis of the reaction $\pi^+\pi^- \to 2\pi^0$. NODE=M016W;LINKAGE=NN

[13] Energy-dependent analysis. NODE=M016W;LINKAGE=RB

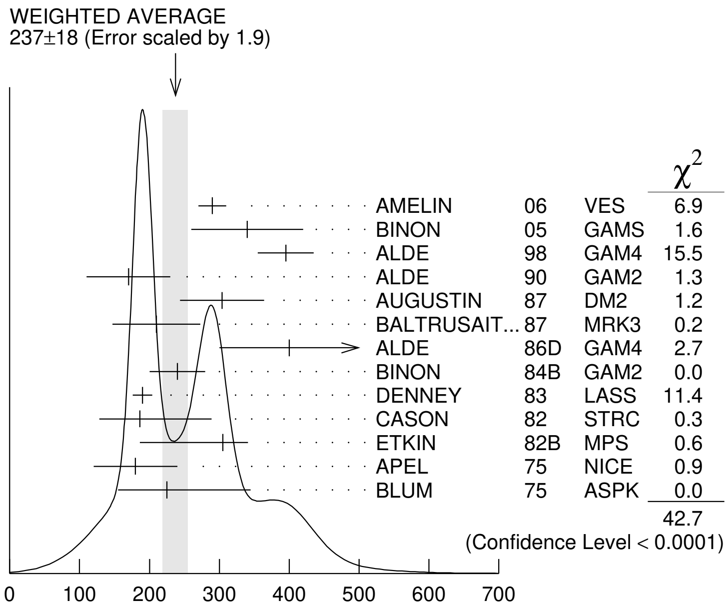
[14] Single energy analysis. NODE=M016W;LINKAGE=BR

[15] From solution A 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=M016W;LINKAGE=BW

[16] 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=M016W;LINKAGE=BB

[17] $I(J^P) = 0(4^+)$ from amplitude analysis assuming one-pion exchange. NODE=M016W;LINKAGE=M

[18] Width errors enlarged by us to $4\Gamma/\sqrt{N}$; see the note with the $K^*(892)$ mass. NODE=M016W;LINKAGE=T



$f_4(2050)$ WIDTH

$f_4(2050)$ DECAY MODES

NODE=M016215;NODE=M016

	Mode	Fraction (Γ_i/Γ)	
Γ_1	$\omega\omega$	seen	DESIG=6
Γ_2	$\pi\pi$	(17.0 ± 1.5) %	DESIG=1
Γ_3	$K\overline{K}$	$(\ 6.8^{+3.4}_{-1.8}) \times 10^{-3}$	DESIG=2
Γ_4	$\eta\eta$	$(\ 2.1\pm0.8) \times 10^{-3}$	DESIG=3
Γ_5	$4\pi^0$	$<$ 1.2 %	DESIG=5
Γ_6	$\gamma\gamma$		DESIG=4
Γ_7	$a_2(1320)\pi$	seen	DESIG=7

$f_4(2050)$ $\Gamma(i)\Gamma(\gamma\gamma)/\Gamma(\text{total})$

NODE=M016220

$\Gamma(K\overline{K}) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$ $\Gamma_3\Gamma_6/\Gamma$

NODE=M016G2
NODE=M016G2

VALUE (keV)	*CL%*	*DOCUMENT ID*		*TECN*	*COMMENT*
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<0.29	95	ALTHOFF	85B	TASS	$\gamma\gamma \to K\overline{K}\pi$

$\Gamma(\pi\pi) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$ $\Gamma_2\Gamma_6/\Gamma$

NODE=M016G3
NODE=M016G3

VALUE (keV)	*CL%*	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
<1.1	95	13 ± 4	OEST	90	JADE	$e^+e^- \to e^+e^-\pi^0\pi^0$

$f_4(2050)$ BRANCHING RATIOS

NODE=M016225

$\Gamma(\omega\omega)/\Gamma_{\text{total}}$ Γ_1/Γ

NODE=M016R7
NODE=M016R7

VALUE	*DOCUMENT ID*		*TECN*	*COMMENT*
seen	AMELIN	06	VES	36 $\pi^- p \to \omega\omega n$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
not seen	BARBERIS	00F		450 $pp \to p_f\omega\omega p_s$

$\Gamma(\omega\omega)/\Gamma(\pi\pi)$ Γ_1/Γ_2

NODE=M016R5
NODE=M016R5

VALUE	*DOCUMENT ID*		*TECN*	*COMMENT*
1.5±0.3	ALDE	90	GAM2	38 $\pi^- p \to \omega\omega n$

$\Gamma(\pi\pi)/\Gamma_{total}$ Γ_2/Γ

NODE=M016R1

VALUE	DOCUMENT ID		TECN	COMMENT
0.170±0.015 OUR AVERAGE				
0.18 ±0.03	[19] BINON	83C	GAM2	38 $\pi^- p \to n 4\gamma$
0.16 ±0.03	[19] CASON	82	STRC	8 $\pi^+ p \to \Delta^{++} \pi^0 \pi^0$
0.17 ±0.02	[19] CORDEN	79	OMEG	12–15 $\pi^- p \to n 2\pi$

[19] Assuming one pion exchange.

NODE=M016R1;LINKAGE=A

$\Gamma(K\overline{K})/\Gamma(\pi\pi)$ Γ_3/Γ_2

NODE=M016R2

VALUE	DOCUMENT ID		TECN	COMMENT
$0.04^{+0.02}_{-0.01}$	ETKIN	82B	MPS	23 $\pi^- p \to n 2 K^0_S$

$\Gamma(\eta\eta)/\Gamma_{total}$ Γ_4/Γ

NODE=M016R3

VALUE (units 10^{-3})	DOCUMENT ID		TECN	COMMENT
2.1±0.8	ALDE	86D	GAM4	100 $\pi^- p \to n 4\gamma$

$\Gamma(4\pi^0)/\Gamma_{total}$ Γ_5/Γ

NODE=M016R4

VALUE	DOCUMENT ID		TECN	COMMENT
<0.012	ALDE	87	GAM4	100 $\pi^- p \to 4\pi^0 n$

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

NODE=M016R6

VALUE	DOCUMENT ID		TECN	COMMENT
seen	AMELIN	00	VES	37 $\pi^- p \to \eta\pi^+\pi^- n$

$f_4(2050)$ REFERENCES

NODE=M016

AMELIN	06	PAN 69 690	D.V. Amelin *et al.*	(VES Collab.)	REFID=51574
		Translated from YAF 69 715.			
BINON	05	PAN 68 960	F. Binon *et al.*		REFID=50780
		Translated from YAF 68 998.			
AMELIN	00	NP A668 83	D. Amelin *et al.*	(VES Collab.)	REFID=47432
ANISOVICH	00J	PL B491 47	A.V. Anisovich *et al.*		REFID=47950
BARBERIS	00F	PL B484 198	D. Barberis *et al.*	(WA 102 Collab.)	REFID=47962
ALDE	98	EPJ A3 361	D. Alde *et al.*	(GAM4 Collab.)	REFID=46605
Also		PAN 62 405	D. Alde *et al.*	(GAMS Collab.)	REFID=46914
		Translated from YAF 62 446.			
MARTIN	98	PR C57 3492	B.R. Martin *et al.*		REFID=46373
MARTIN	97	PR C56 1114	B.R. Martin, G.C. Oades	(LOUC, AARH)	REFID=45685
KLOET	96	PR D53 6120	W.M. Kloet, F. Myhrer	(RUTG, NORD)	REFID=45212
OAKDEN	94	NP A574 731	M.N. Oakden, M.R. Pennington	(DURH)	REFID=45210
ALDE	90	PL B241 600	D.M. Alde *et al.*	(SERP, BELG, LANL, LAPP+)	REFID=40935
OEST	90	ZPHY C47 343	T. Oest *et al.*	(JADE Collab.)	REFID=41358
ALDE	87	PL B198 286	D.M. Alde *et al.*	(LANL, BRUX, SERP, LAPP)	REFID=40221
AUGUSTIN	87	ZPHY C36 369	J.E. Augustin *et al.*	(LALO, CLER, FRAS+)	REFID=40268
BALTRUSAIT...	87	PR D35 2077	R.M. Baltrusaitis *et al.*	(Mark III Collab.)	REFID=40010
ALDE	86D	NP B269 485	D.M. Alde *et al.*	(BELG, LAPP, SERP, CERN+)	REFID=20765
ALTHOFF	85B	ZPHY C29 189	M. Althoff *et al.*	(TASSO Collab.)	REFID=21349
BINON	84B	LNC 39 41	F.G. Binon *et al.*	(SERP, BELG, LAPP)	REFID=21780
BINON	83C	SJNP 38 723	F.G. Binon *et al.*	(SERP, BRUX+)	REFID=40288
		Translated from YAF 38 1199.			
DENNEY	83	PR D28 2726	D.L. Denney *et al.*	(IOWA, MICH)	REFID=20754
CASON	82	PRL 48 1316	N.M. Cason *et al.*	(NDAM, ANL)	REFID=20746
ETKIN	82B	PR D25 1786	A. Etkin *et al.*	(BNL, CUNY, TUFTS, VAND)	REFID=20390
ALPER	80	PL 94B 422	B. Alper *et al.*	(AMST, CERN, CRAC, MPIM+)	REFID=21665
ROZANSKA	80	NP B162 505	M. Rozanska *et al.*	(MPIM, CERN)	REFID=21774
CORDEN	79	NP B157 250	M.J. Corden *et al.*	(BIRM, RHEL, TELA+) JP	REFID=20374
EVANGELIS...	79B	NP B154 381	C. Evangelista *et al.*	(BARI, BONN, CERN+)	REFID=21967
ANTIPOV	77	NP B119 45	Y.M. Antipov *et al.*	(SERP, GEVA)	REFID=20728
APEL	75	PL 57B 398	W.D. Apel *et al.*	(KARLK, KARLE, PISA, SERP+) JP	REFID=20720
BLUM	75	PL 57B 403	W. Blum *et al.*	(CERN, MPIM) JP	REFID=21651

OTHER RELATED PAPERS

BUGG	07	EPJ C52 55	D. Bugg		REFID=51888
ANISOVICH	99D	PL B452 180	A.V. Anisovich *et al.*		REFID=46901
Also		NP A651 253	A.V. Anisovich *et al.*		REFID=46926
ANISOVICH	99F	NP A651 253	A.V. Anisovich *et al.*		REFID=46926
PROKOSHKIN	97	SPD 42 117	Y.D. Prokoshkin *et al.*	(SERP)	REFID=45386
		Translated from DANS 353 323.			
CASON	83	PR D28 1586	N.M. Cason *et al.*	(NDAM, ANL)	REFID=20752
GOTTESMAN	80	PR D22 1503	S.R. Gottesman *et al.*	(SYRA, BRAN, BNL+)	REFID=21099
EISENHAND...	75	NP B96 109	E. Eisenhandler *et al.*	(LOQM, LIVP, DARE+)	REFID=21821
WAGNER	74	London Conf. 2 27	F. Wagner	(MPIM)	REFID=21767