$f_0(400\text{–}1200)$ or σ

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

See "Note on scalar mesons" under $f_0(1370)$.

$f_0(400\text{–}1200)$ T-MATRIX POLE $\sqrt{s}$

Note that $\Gamma \approx 2\ \mathrm{Im}(\sqrt{s_{\mathrm{pole}}})$.

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
(400–1200)−*i*(300–500) OUR ESTIMATE				
• • • We do not use the following data for averages, fits, limits, etc. • • •				
$445 - i235$	HANNAH	99	RVUE	π scalar form factor
$(523 \pm 12) - i(259 \pm 7)$	KAMINSKI	99	RVUE	$\pi\pi \to \pi\pi$, $K\overline{K}$, $\sigma\sigma$
$442 - i\ 227$	OLLER	99	RVUE	$\pi\pi \to \pi\pi$, $K\overline{K}$
$469 - i203$	OLLER	99B	RVUE	$\pi\pi \to \pi\pi$, $K\overline{K}$
$445 - i221$	OLLER	99C	RVUE	$\pi\pi \to \pi\pi$, $K\overline{K}$, $\eta\eta$
$(1530^{+\ 90}_{-250}) - i(560 \pm 40)$	ANISOVICH	98B	RVUE	Compilation
$420 - i\ 212$	LOCHER	98	RVUE	$\pi\pi \to \pi\pi$, $K\overline{K}$
$(602 \pm 26) - i(196 \pm 27)$	[1] ISHIDA	97		$\pi\pi \to \pi\pi$
$(537 \pm 20) - i(250 \pm 17)$	[2] KAMINSKI	97B	RVUE	$\pi\pi \to \pi\pi$, $K\overline{K}$, 4π
$470 - i250$	[3,4] TORNQVIST	96	RVUE	$\pi\pi \to \pi\pi$, $K\overline{K}$, $K\pi$, $\eta\pi$
$\sim (1100 - i300)$	AMSLER	95B	CBAR	$\overline{p}p \to 3\pi^0$
$400 - i500$	[4,5] AMSLER	95D	CBAR	$\overline{p}p \to 3\pi^0$
$1100 - i137$	[4,6] AMSLER	95D	CBAR	$\overline{p}p \to 3\pi^0$
$387 - i305$	[4,7] JANSSEN	95	RVUE	$\pi\pi \to \pi\pi$, $K\overline{K}$
$525 - i269$	[8] ACHASOV	94	RVUE	$\pi\pi \to \pi\pi$
$(506 \pm 10) - i(247 \pm 3)$	KAMINSKI	94	RVUE	$\pi\pi \to \pi\pi$, $K\overline{K}$
$370 - i356$	[9] ZOU	94B	RVUE	$\pi\pi \to \pi\pi$, $K\overline{K}$
$408 - i342$	[4,9] ZOU	93	RVUE	$\pi\pi \to \pi\pi$, $K\overline{K}$
$870 - i370$	[4,10] AU	87	RVUE	$\pi\pi \to \pi\pi$, $K\overline{K}$
$470 - i208$	[11] BEVEREN	86	RVUE	$\pi\pi \to \pi\pi$, $K\overline{K}$, $\eta\eta$, ...
$(750 \pm 50) - i(450 \pm 50)$	[12] ESTABROOKS	79	RVUE	$\pi\pi \to \pi\pi$, $K\overline{K}$
$(660 \pm 100) - i(320 \pm 70)$	PROTOPOP...	73	HBC	$\pi\pi \to \pi\pi$, $K\overline{K}$
$650 - i370$	[13] BASDEVANT	72	RVUE	$\pi\pi \to \pi\pi$

[1] Reanalysis of data from HYAMS 73, GRAYER 74, SRINIVASAN 75, and ROSSELET 77 using the interfering amplitude method.

[2] Average and spread of 4 variants ("up" and "down") of KAMINSKI 97B 3-channel model.

[3] Uses data from BEIER 72B, OCHS 73, HYAMS 73, GRAYER 74, ROSSELET 77, CASON 83, ASTON 88, and ARMSTRONG 91B. Coupled channel analysis with flavor symmetry and all light two-pseudoscalars systems.

[4] Demonstrates explicitly that $f_0(400\text{–}1200)$ and $f_0(1370)$ are two different poles.

[5] Coupled channel analysis of $\overline{p}p \to 3\pi^0$, $\pi^0\eta\eta$ and $\pi^0\pi^0\eta$ on sheet II.

[6] Coupled channel analysis of $\overline{p}p \to 3\pi^0$, $\pi^0\eta\eta$ and $\pi^0\pi^0\eta$ on sheet III.

[7] Analysis of data from FALVARD 88.

[8] Analysis of data from OCHS 73, ESTABROOKS 75, ROSSELET 77, and MUKHIN 80.

[9] Analysis of data from OCHS 73, GRAYER 74, and ROSSELET 77.

[10] Analysis of data from OCHS 73, GRAYER 74, BECKER 79, and CASON 83.

[11] Uses data from PROTOPOPESCU 73, HYAMS 73, HYAMS 75, GRAYER 74, ESTABROOKS 74, ESTABROOKS 75, FROGGATT 77, CORDEN 79, BISWAS 81.
[12] Analysis of data from APEL 73, GRAYER 74, CASON 76, PAWLICKI 77. Includes spread and errors of 4 solutions.
[13] Analysis of data from BATON 70, BENSINGER 71, COLTON 71, BAILLON 72,PROTOPOPESCU 73, and WALKER 67.

f_0(400–1200) BREIT-WIGNER MASS OR K-MATRIX POLE PARAMETERS

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
(400–1200) OUR ESTIMATE				
• • • We do not use the following data for averages, fits, limits, etc. • • •				
750 ± 4	ALEKSEEV	99	SPEC	1.78 $\pi^- p_{polar} \rightarrow \pi^-\pi^+ n$
744 ± 5	ALEKSEEV	98	SPEC	1.78 $\pi^- p_{polar} \rightarrow \pi^-\pi^+ n$
759 ± 5	[14] TROYAN	98		5.2 $n p \rightarrow n p \pi^+\pi^-$
780 ± 30	ALDE	97	GAM2	450 $p p \rightarrow p p \pi^0\pi^0$
585 ± 20	[15] ISHIDA	97		$\pi\pi \rightarrow \pi\pi$
761 ± 12	[16] SVEC	96	RVUE	6–17 $\pi N_{polar} \rightarrow \pi^+\pi^- N$
$\sim$ 860	[17] TORNQVIST	96	RVUE	$\pi\pi \rightarrow \pi\pi$, $K\overline{K}$, $K\pi$, $\eta\pi$
1165 ± 50	[18,19] ANISOVICH	95	RVUE	$\pi^- p \rightarrow \pi^0\pi^0 n$, $\overline{p}p \rightarrow \pi^0\pi^0\pi^0$, $\pi^0\pi^0\eta$, $\pi^0\eta\eta$
$\sim$ 1000	[20] ACHASOV	94	RVUE	$\pi\pi \rightarrow \pi\pi$
414 ± 20	[16] AUGUSTIN	89	DM2	

[14] 6σ effect, no PWA.
[15] Reanalysis of data from HYAMS 73, GRAYER 74, SRINIVASAN 75, and ROSSELET 77 using the interfering amplitude method.
[16] Breit-Wigner fit to S-wave intensity measured in $\pi N \rightarrow \pi^-\pi^+ N$ on polarized targets. The fit does not include $f_0(980)$.
[17] Uses data from ASTON 88, OCHS 73, HYAMS 73, ARMSTRONG 91B, GRAYER 74, CASON 83, ROSSELET 77, and BEIER 72B. Coupled channel analysis with flavor symmetry and all light two-pseudoscalars systems.
[18] Uses $\pi^0\pi^0$ data from ANISOVICH 94, AMSLER 94D, and ALDE 95B, $\pi^+\pi^-$ data from OCHS 73, GRAYER 74 and ROSSELET 77, and $\eta\eta$ data fromANISOVICH 94.
[19] The pole is on Sheet III. Demonstrates explicitly that f_0(400–1200) and $f_0(1370)$ are two different poles.
[20] Analysis of data from OCHS 73, ESTABROOKS 75, ROSSELET 77, and MUKHIN 80.

f_0(400–1200) BREIT-WIGNER WIDTH

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
(600–1000) OUR ESTIMATE				
• • • We do not use the following data for averages, fits, limits, etc. • • •				
119 ± 13	ALEKSEEV	99	SPEC	1.78 $\pi^- p_{polar} \rightarrow \pi^-\pi^+ n$
77 ± 22	ALEKSEEV	98	SPEC	1.78 $\pi^- p_{polar} \rightarrow \pi^-\pi^+ n$
35 ± 12	[21] TROYAN	98		5.2 $n p \rightarrow n p \pi^+\pi^-$
780 ± 60	ALDE	97	GAM2	450 $p p \rightarrow p p \pi^0\pi^0$

385±70	[22] ISHIDA	97		$\pi\pi \to \pi\pi$
290±54	[23] SVEC	96	RVUE	6–17 $\pi N_{polar} \to \pi^+\pi^- N$
∼ 880	[24] TORNQVIST	96	RVUE	$\pi\pi \to \pi\pi$, $K\overline{K}$, $K\pi$, $\eta\pi$
460±40	[25,26] ANISOVICH	95	RVUE	$\pi^- p \to \pi^0\pi^0 n$, $\overline{p}p \to \pi^0\pi^0\pi^0$, $\pi^0\pi^0\eta$, $\pi^0\eta\eta$
∼ 3200	[27] ACHASOV	94	RVUE	$\pi\pi \to \pi\pi$
494±58	[23] AUGUSTIN	89	DM2	

[21] 6σ effect, no PWA.

[22] Reanalysis of data from HYAMS 73, GRAYER 74, SRINIVASAN 75, and ROSSELET 77 using the interfering amplitude method.

[23] Breit-Wigner fit to S-wave intensity measured in $\pi N \to \pi^-\pi^+ N$ on polarized targets. The fit does not include $f_0(980)$.

[24] Uses data from ASTON 88, OCHS 73, HYAMS 73, ARMSTRONG 91B, GRAYER 74, CASON 83, ROSSELET 77, and BEIER 72B. Coupled channel analysis with flavor symmetry and all light two-pseudoscalars systems.

[25] Uses $\pi^0\pi^0$ data from ANISOVICH 94, AMSLER 94D, and ALDE 95B, $\pi^+\pi^-$ data from OCHS 73, GRAYER 74 and ROSSELET 77, and $\eta\eta$ data fromANISOVICH 94.

[26] The pole is on Sheet III. Demonstrates explicitly that f_0(400–1200) and f_0(1370) are two different poles.

[27] Analysis of data from OCHS 73, ESTABROOKS 75, ROSSELET 77, and MUKHIN 80.

f_0(400–1200) DECAY MODES

	Mode	Fraction (Γ_i/Γ)
Γ_1	$\pi\pi$	dominant
Γ_2	$\gamma\gamma$	seen

f_0(400–1200) PARTIAL WIDTHS

$\Gamma(\gamma\gamma)$ Γ_2

VALUE (keV)	*DOCUMENT ID*		*TECN*	*COMMENT*
seen	[28] MORGAN	90	RVUE	$\gamma\gamma \to \pi^+\pi^-$, $\pi^0\pi^0$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
10±6	COURAU	86	DM1	$e^+e^- \to \pi^+\pi^- e^+e^-$

[28] Analysis of data from BOYER 90 and MARSISKE 90.

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HANNAH	99	PR D60 017502	T. Hannah	
KAMINSKI	99	EPJ C9 141	R. Kaminski, L. Lesniak, B. Loiseau	
OLLER	99	PR D60 099906	J.A. Oller *et al.*	
OLLER	99B	NP A652 407	J.A. Oller, E. Oset	
OLLER	99C	PR D60 074023	J.A. Oller, E. Oset	
ALEKSEEV	98	PAN 61 174	I.G. Alekseev *et al.*	
ANISOVICH	98B	UFN 41 419	V.V. Anisovich *et al.*	
LOCHER	98	EPJ C4 317	M.P. Locher *et al.*	(PSI)
TROYAN	98	JINRRC 5 33	Yu. Troyan *et al.*	
ALDE	97	PL B397 350	D.M. Alde *et al.*	(GAMS Collab.)
ISHIDA	97	PTP 98 1005	S. Ishida *et al.*	(TOKY, MIYA, KEK)
KAMINSKI	97B	PL B413 130	R. Kaminski *et al.*	(CRAC, IPN)
Also	96	PTP 95 745	S. Ishida *et al.*	(TOKY, MIYA, KEK)
SVEC	96	PR D53 2343	M. Svec	(MCGI)
TORNQVIST	96	PRL 76 1575	N.A. Tornqvist, M. Roos	(HELS)
ALDE	95B	ZPHY C66 375	D.M. Alde *et al.*	(GAMS Collab.)
AMSLER	95B	PL B342 433	C. Amsler *et al.*	(Crystal Barrel Collab.)
AMSLER	95D	PL B355 425	C. Amsler *et al.*	(Crystal Barrel Collab.)
ANISOVICH	95	PL B355 363	V.V. Anisovich *et al.*	(PNPI, SERP)
JANSSEN	95	PR D52 2690	G. Janssen *et al.*	(STON, ADLD, JULI)
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AMSLER	94D	PL B333 277	C. Amsler *et al.*	(Crystal Barrel Collab.)
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ARMSTRONG	91B	ZPHY C52 389	T.A. Armstrong *et al.*	(ATHU, BARI, BIRM+)
BOYER	90	PR D42 1350	J. Boyer *et al.*	(Mark II Collab.)
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MORGAN	90	ZPHY C48 623	D. Morgan, M.R. Pennington	(RAL, DURH)
AUGUSTIN	89	NP B320 1	J.E. Augustin, G. Cosme	(DM2 Collab.)
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AU	87	PR D35 1633	K.L. Au, D. Morgan, M.R. Pennington	(DURH, RAL)
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CASON	83	PR D28 1586	N.M. Cason *et al.*	(NDAM, ANL)
BISWAS	81	PRL 47 1378	N.N. Biswas *et al.*	(NDAM, ANL)
MUKHIN	80	JETPL 32 601	K.N. Mukhin *et al.*	(KIAE)
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CORDEN	79	NP B157 250	M.J. Corden *et al.*	(BIRM, RHEL, TELA+) JP
ESTABROOKS	79	PR D19 2678	P. Estabrooks	(CARL)
FROGGATT	77	NP B129 89	C.D. Froggatt, J.L. Petersen	(GLAS, NORD)
PAWLICKI	77	PR D15 3196	A.J. Pawlicki *et al.*	(ANL) IJ
ROSSELET	77	PR D15 574	L. Rosselet *et al.*	(GEVA, SACL)
CASON	76	PRL 36 1485	N.M. Cason *et al.*	(NDAM, ANL) IJ
ESTABROOKS	75	NP B95 322	P.G. Estabrooks, A.D. Martin	(DURH)
HYAMS	75	NP B100 205	B.D. Hyams *et al.*	(CERN, MPIM)
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MALTMAN	97	PL B393 19	K. Maltman, C.E. Wolfe	(YORKC)
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SVEC	97	PR D55 4355	M. Svec	
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ABELE	96	PL B380 453	A. Abele *et al.*	(Crystal Barrel Collab.)
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JAFFE	77	PR D15 267,281	R. Jaffe	(MIT)
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