$f_0(600)$ or σ

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

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$f_0(600)$ 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. • • •					
$532 - i272$		BLACK	01	RVUE	$\pi^0\pi^0 \to \pi^0\pi^0$
$(470 \pm 30) - i(295 \pm 20)$	[1]	COLANGELO	01	RVUE	$\pi\pi \to \pi\pi$
$(535^{+48}_{-36}) - i(155^{+76}_{-53})$	[2]	ISHIDA	01		$\Upsilon(3S) \to \Upsilon\pi\pi$
$610 \pm 14 - i620 \pm 26$	[3]	SUROVTSEV	01	RVUE	$\pi\pi \to \pi\pi$, $K\overline{K}$
$(558^{+34}_{-27}) - i(196^{+32}_{-41})$		ISHIDA	00B		$p\overline{p} \to \pi^0\pi^0\pi^0$
$445 - i235$		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	$\pi\pi \to \pi\pi$, $K\overline{K}$
$(602 \pm 26) - i(196 \pm 27)$	[4]	ISHIDA	97		$\pi\pi \to \pi\pi$
$(537 \pm 20) - i(250 \pm 17)$	[5]	KAMINSKI	97B	RVUE	$\pi\pi \to \pi\pi$, $K\overline{K}$, 4π
$470 - i250$	[6,7]	TORNQVIST	96	RVUE	$\pi\pi \to \pi\pi$, $K\overline{K}$, $K\pi$, $\eta\pi$
$\sim (1100 - i300)$		AMSLER	95B	CBAR	$\overline{p}p \to 3\pi^0$
$400 - i500$	[7,8]	AMSLER	95D	CBAR	$\overline{p}p \to 3\pi^0$
$1100 - i137$	[7,9]	AMSLER	95D	CBAR	$\overline{p}p \to 3\pi^0$
$387 - i305$	[7,10]	JANSSEN	95	RVUE	$\pi\pi \to \pi\pi$, $K\overline{K}$
$525 - i269$	[11]	ACHASOV	94	RVUE	$\pi\pi \to \pi\pi$
$(506 \pm 10) - i(247 \pm 3)$		KAMINSKI	94	RVUE	$\pi\pi \to \pi\pi$, $K\overline{K}$
$370 - i356$	[12]	ZOU	94B	RVUE	$\pi\pi \to \pi\pi$, $K\overline{K}$
$408 - i342$	[7,12]	ZOU	93	RVUE	$\pi\pi \to \pi\pi$, $K\overline{K}$
$870 - i370$	[7,13]	AU	87	RVUE	$\pi\pi \to \pi\pi$, $K\overline{K}$
$470 - i208$	[14]	BEVEREN	86	RVUE	$\pi\pi \to \pi\pi$, $K\overline{K}$, $\eta\eta$, ...
$(750 \pm 50) - i(450 \pm 50)$	[15]	ESTABROOKS	79	RVUE	$\pi\pi \to \pi\pi$, $K\overline{K}$
$(660 \pm 100) - i(320 \pm 70)$		PROTOPOP...	73	HBC	$\pi\pi \to \pi\pi$, $K\overline{K}$
$650 - i370$	[16]	BASDEVANT	72	RVUE	$\pi\pi \to \pi\pi$

[1] From a phase-shift analysis of HYAMS 73 and PROTOPOPESCU 73 data.

[2] A similar analysis (KOMADA 01) finds $(580^{+79}_{-30}) - i(190^{+107}_{-49})$ MeV.

[3] Coupled channel reanalysis of BATON 70, BENSINGER 71, BAILLON 72, HYAMS 73, HYAMS 75, ROSSELET 77, COHEN 80, and ETKIN 82B using the uniformizing variable.

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

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

[6] 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.
[7] Demonstrates explicitly that $f_0(600)$ and $f_0(1370)$ are two different poles.
[8] Coupled channel analysis of $\overline{p}p \rightarrow 3\pi^0$, $\pi^0\eta\eta$ and $\pi^0\pi^0\eta$ on sheet II.
[9] Coupled channel analysis of $\overline{p}p \rightarrow 3\pi^0$, $\pi^0\eta\eta$ and $\pi^0\pi^0\eta$ on sheet III.
[10] Analysis of data from FALVARD 88.
[11] Analysis of data from OCHS 73, ESTABROOKS 75, ROSSELET 77, and MUKHIN 80.
[12] Analysis of data from OCHS 73, GRAYER 74, and ROSSELET 77.
[13] Analysis of data from OCHS 73, GRAYER 74, BECKER 79, and CASON 83.
[14] Uses data from PROTOPOPESCU 73, HYAMS 73, HYAMS 75, GRAYER 74, ESTABROOKS 74, ESTABROOKS 75, FROGGATT 77, CORDEN 79, BISWAS 81.
[15] Analysis of data from APEL 73, GRAYER 74, CASON 76, PAWLICKI 77. Includes spread and errors of 4 solutions.
[16] Analysis of data from BATON 70, BENSINGER 71, COLTON 71, BAILLON 72,PROTOPOPESCU 73, and WALKER 67.

$f_0(600)$ 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. • • •				
513 ± 32	[17] MURAMATSU	02	CLEO	$D^0 \rightarrow K^0_S \pi^+ \pi^-$
$478^{+24}_{-23} \pm 17$	AITALA	01B	E791	$D^+ \rightarrow \pi^- \pi^+ \pi^+$
$563 \pm {}^{+58}_{-20}$	[18] ISHIDA	01		$\Upsilon(3S) \rightarrow \Upsilon \pi\pi$
555	[19] ASNER	00	CLE2	$\tau^- \rightarrow \pi^- \pi^0 \pi^0 \nu_\tau$
540 ± 36	ISHIDA	00B		$p\overline{p} \rightarrow \pi^0 \pi^0 \pi^0$
750 ± 4	ALEKSEEV	99	SPEC	$1.78\ \pi^- p_{\rm polar} \rightarrow \pi^- \pi^+ n$
744 ± 5	ALEKSEEV	98	SPEC	$1.78\ \pi^- p_{\rm polar} \rightarrow \pi^- \pi^+ n$
759 ± 5	[20] TROYAN	98		$5.2\ np \rightarrow np\pi^+\pi^-$
780 ± 30	ALDE	97	GAM2	$450\ pp \rightarrow pp\pi^0\pi^0$
585 ± 20	[21] ISHIDA	97		$\pi\pi \rightarrow \pi\pi$
761 ± 12	[22] SVEC	96	RVUE	6–$17\ \pi N_{\rm polar} \rightarrow \pi^+\pi^- N$
~ 860	[23,24] TORNQVIST	96	RVUE	$\pi\pi \rightarrow \pi\pi$, $K\overline{K}$, $K\pi$, $\eta\pi$
1165 ± 50	[25,26] ANISOVICH	95	RVUE	$\pi^- p \rightarrow \pi^0\pi^0 n$, $\overline{p}p \rightarrow \pi^0\pi^0\pi^0$, $\pi^0\pi^0\eta$, $\pi^0\eta\eta$
~ 1000	[27] ACHASOV	94	RVUE	$\pi\pi \rightarrow \pi\pi$
414 ± 20	[22] AUGUSTIN	89	DM2	

[17] Statistical uncertainty only.
[18] A similar analysis (KOMADA 01) finds 526^{+48}_{-37} MeV.
[19] From the best fit of the Dalitz plot.
[20] 6σ effect, no PWA.
[21] Reanalysis of data from HYAMS 73, GRAYER 74, SRINIVASAN 75, and ROSSELET 77 using the interfering amplitude method.
[22] Breit-Wigner fit to S-wave intensity measured in $\pi N \rightarrow \pi^- \pi^+ N$ on polarized targets. The fit does not include $f_0(980)$.
[23] 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.

[24] Also observed by ASNER 00 in $\tau^- \to \pi^- \pi^0 \pi^0 \nu_\tau$ decays.
[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 $f_0(600)$ and $f_0(1370)$ are two different poles.
[27] Analysis of data from OCHS 73, ESTABROOKS 75, ROSSELET 77, and MUKHIN 80.

$f_0(600)$ 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. • • •				
335 ± 67	[28] MURAMATSU	02	CLEO	$D^0 \to K^0_S \pi^+ \pi^-$
$324 {}^{+42}_{-40} \pm 21$	AITALA	01B	E791	$D^+ \to \pi^- \pi^+ \pi^+$
$372 \pm {}^{+229}_{-95}$	[29] ISHIDA	01		$\Upsilon(3S) \to \Upsilon \pi\pi$
540	[30] ASNER	00	CLE2	$\tau^- \to \pi^- \pi^0 \pi^0 \nu_\tau$
372 ± 80	ISHIDA	00B		$p\overline{p} \to \pi^0 \pi^0 \pi^0$
119 ± 13	ALEKSEEV	99	SPEC	$1.78\ \pi^- p_{\rm polar} \to \pi^- \pi^+ n$
77 ± 22	ALEKSEEV	98	SPEC	$1.78\ \pi^- p_{\rm polar} \to \pi^- \pi^+ n$
35 ± 12	[31] TROYAN	98		$5.2\ np \to np\pi^+ \pi^-$
780 ± 60	ALDE	97	GAM2	$450\ pp \to pp\pi^0 \pi^0$
385 ± 70	[32] ISHIDA	97		$\pi\pi \to \pi\pi$
290 ± 54	[33] SVEC	96	RVUE	6–$17\ \pi N_{\rm polar} \to \pi^+ \pi^- N$
~ 880	[34,35] TORNQVIST	96	RVUE	$\pi\pi \to \pi\pi$, $K\overline{K}$, $K\pi$, $\eta\pi$
460 ± 40	[36,37] 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	[38] ACHASOV	94	RVUE	$\pi\pi \to \pi\pi$
494 ± 58	[33] AUGUSTIN	89	DM2	

[28] Statistical uncertainty only.
[29] A similar analysis (KOMADA 01) finds $301 {}^{+145}_{-100}$ MeV.
[30] From the best fit of the Dalitz plot.
[31] 6σ effect, no PWA.
[32] Reanalysis of data from HYAMS 73, GRAYER 74, SRINIVASAN 75, and ROSSELET 77 using the interfering amplitude method.
[33] Breit-Wigner fit to S-wave intensity measured in $\pi N \to \pi^- \pi^+ N$ on polarized targets. The fit does not include $f_0(980)$.
[34] 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.
[35] Also observed by ASNER 00 in $\tau^- \to \pi^- \pi^0 \pi^0 \nu_\tau$ decays.
[36] 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.
[37] The pole is on Sheet III. Demonstrates explicitly that $f_0(600)$ and $f_0(1370)$ are two different poles.
[38] Analysis of data from OCHS 73, ESTABROOKS 75, ROSSELET 77, and MUKHIN 80.

$f_0(600)$ DECAY MODES

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

$f_0(600)$ PARTIAL WIDTHS

$\Gamma(\gamma\gamma)$ — Γ_2

VALUE (keV)	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
3.8±1.5	[39,40] BOGLIONE	99	RVUE	$\gamma\gamma \to \pi^+\pi^-, \pi^0\pi^0$
5.4±2.3	[39] MORGAN	90	RVUE	$\gamma\gamma \to \pi^+\pi^-, \pi^0\pi^0$
10 ±6	COURAU	86	DM1	$e^+e^- \to \pi^+\pi^-e^+e^-$

[39] This width could equally well be assigned to the $f_0(1370)$. The authors analyse data from BOYER 90 and MARSISKE 90 and report strong correlation with $\gamma\gamma$ width of $f_2(1270)$.

[40] Supersedes MORGAN 90.

$f_0(600)$ REFERENCES

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BIJNENS	96	PL B374 210	J. Bijnens *et al.*	(NORD, BERN, WIEN+)
BONUTTI	96	PRL 77 603	F. Bonutti *et al.*	(TRSTI, TRSTT, TRIU)
BUGG	96	NP B471 59	D.V. Bugg, A.V. Sarantsev, B.S. Zou	(LOQM, PNPI)
HARADA	96	PR D54 1991	M. Harasa *et al.*	(SYRA)
ISHIDA	96	PTP 95 745	S. Ishida *et al.*	(TOKY, MIYA, KEK)
AMSLER	95C	PL B353 571	C. Amsler *et al.*	(Crystal Barrel Collab.)
AMSLER	95F	PL B358 389	C. Amsler *et al.*	(Crystal Barrel Collab.)
ANTINORI	95	PL B353 589	F. Antinori *et al.*	(ATHU, BARI, BIRM+)
BUGG	95	PL B353 378	D.V. Bugg *et al.*	(LOQM, PNPI, WASH)
GASPERO	95	NP A588 861	M. Gaspero	(ROMA)
TORNQVIST	95	ZPHY C68 647	N.A. Tornqvist	(HELS)
AMSLER	94	PL B322 431	C. Amsler *et al.*	(Crystal Barrel Collab.)
BUGG	94	PR D50 4412	D.V. Bugg *et al.*	(LOQM)
ADAMO	93	NP A558 13C	A. Adamo *et al.*	(OBELIX Collab.)
GASPERO	93	NP A562 407	M. Gaspero	(ROMAI)
MORGAN	93	PR D48 1185	D. Morgan, M.R. Pennington	(RAL, DURH)
Also	93C	NC A Conf. Suppl.	D. Morgan	(RAL)
BOLTON	92B	PRL 69 1328	T. Bolton *et al.*	(Mark III Collab.)
SVEC	92	PR D45 55	M. Svec, A. de Lesquen, L. van Rossum	(MCGI+)
SVEC	92B	PR D45 1518	M. Svec, A. de Lesquen, L. van Rossum	(MCGI+)
SVEC	92C	PR D46 949	M. Svec, A. de Lesquen, L. van Rossum	(MCGI+)
RIGGENBACH	91	PR D43 127	C. Riggenbach *et al.*	(BERN, CERN, MASA)
BAI	90C	PRL 65 2507	Z. Bai *et al.*	(Mark III Collab.)
WEINSTEIN	90	PR D41 2236	J. Weinstein, N. Isgur	(TNTO)
WEINSTEIN	89	UTPT 89 03	J. Weinstein, N. Isgur	(TNTO)
ASTON	88D	NP B301 525	D. Aston *et al.*	(SLAC, NAGO, CINC, INUS)
LONGACRE	86	PL B177 223	R.S. Longacre *et al.*	(BNL, BRAN, CUNY+)
ACHASOV	84	ZPHY C22 53	N.N. Achasov, S.A. Devyanin, G.N. Shestakov	(NOVM)
GASSER	84	ANP 158 142	J. Gasser, H. Leutwyler	
BINON	83	NC 78A 313	F.G. Binon *et al.*	(BELG, LAPP, SERP+)
TORNQVIST	82	PRL 49 624	N.A. Tornqvist	(HELS)
COSTA	80	NP B175 402	G. Costa *et al.*	(BARI, BONN, CERN, GLAS+)
BECKER	79B	NP B150 301	H. Becker *et al.*	(MPIM, CERN, ZEEM, CRAC)
NAGELS	79	PR D20 1633	M.M. Nagels, T.A. Rijken, J.J. de Swart	(NIJM)
POLYCHRO...	79	PR D19 1317	V.A. Polychronakos *et al.*	(NDAM, ANL) IJP
CORDEN	78	NP B144 253	M.J. Corden *et al.*	(BIRM, RHEL, TELA+)
JAFFE	77	PR D15 267,281	R. Jaffe	(MIT)
FLATTE	76	PL 63B 224	S.M. Flatte	(CERN)
WETZEL	76	NP B115 208	W. Wetzel *et al.*	(ETH, CERN, LOIC)
DEFOIX	72	NP B44 125	C. Defoix *et al.*	(CDEF, CERN)