$a_0(980)$

$I^G(J^{PC}) = 1^-(0^{++})$

See our minireview on scalar mesons under $f_0(600)$. (See the index for the page number.)

$a_0(980)$ MASS

VALUE (MeV)	DOCUMENT ID
980±20 OUR ESTIMATE	Mass determination very model dependent

$\eta\pi$ FINAL STATE ONLY

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	CHG	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •						
982.5 ± 1.6 ±1.1	16.9k	[1] AMBROSINO	09F	KLOE		1.02 $e^+e^- \rightarrow \eta\pi^0\gamma$
986 ± 4		ANISOVICH	09	RVUE		0.0 $\overline{p}p$, πN
982.3 $^{+0.6}_{-0.7}$ $^{+3.1}_{-4.7}$		[2] UEHARA	09A	BELL		$\gamma\gamma \rightarrow \pi^0\eta$
987.4 ± 1.0 ±3.0		[3,4] BUGG	08A	RVUE	0	$\overline{p}p \rightarrow \pi^0\pi^0\eta$
989.1 ± 1.0 ±3.0		[4,5] BUGG	08A	RVUE	0	$\overline{p}p \rightarrow \pi^0\pi^0\eta$
985 ± 4 ±6	318	ACHARD	02B	L3		183–209 $e^+e^- \rightarrow e^+e^-\eta\pi^+\pi^-$
995 $^{+52}_{-10}$	36	[6] ACHASOV	00F	SND		$e^+e^- \rightarrow \eta\pi^0\gamma$
994 $^{+33}_{-8}$	36	[7] ACHASOV	00F	SND		$e^+e^- \rightarrow \eta\pi^0\gamma$
975 ± 7		BARBERIS	00H			450 $pp \rightarrow p_f\eta\pi^0 p_s$
988 ± 8		BARBERIS	00H			450 $pp \rightarrow \Delta_f^{++}\eta\pi^- p_s$
∼ 1055		[8] OLLER	99	RVUE		$\eta\pi$, $K\overline{K}$
∼ 1009.2		[8] OLLER	99B	RVUE		$\pi\pi \rightarrow \pi\pi$, $K\overline{K}$
993.1 ± 2.1		[9] TEIGE	99	B852		18.3 $\pi^-p \rightarrow \eta\pi^+\pi^-n$
988 ± 6		[8] ANISOVICH	98B	RVUE		Compilation
987		TORNQVIST	96	RVUE		$\pi\pi \rightarrow \pi\pi$, $K\overline{K}$, $K\pi$, $\eta\pi$
991		JANSSEN	95	RVUE		$\eta\pi \rightarrow \eta\pi$, $K\overline{K}$, $K\pi$, $\eta\pi$
984.45± 1.23±0.34		AMSLER	94C	CBAR		0.0 $\overline{p}p \rightarrow \omega\eta\pi^0$
982 ± 2		[10] AMSLER	92	CBAR		0.0 $\overline{p}p \rightarrow \eta\eta\pi^0$
984 ± 4	1040	[10] ARMSTRONG	91B	OMEG	±	300 $pp \rightarrow pp\eta\pi^+\pi^-$
976 ± 6		ATKINSON	84E	OMEG	±	25–55 $\gamma p \rightarrow \eta\pi n$
986 ± 3	500	[11] EVANGELIS...	81	OMEG	±	12 $\pi^-p \rightarrow \eta\pi^+\pi^-\pi^-p$
990 ± 7	145	[11] GURTU	79	HBC	±	4.2 $K^-p \rightarrow \Lambda\eta 2\pi$
980 ±11	47	CONFORTO	78	OSPK	−	4.5 $\pi^-p \rightarrow pX^-$
978 ±16	50	CORDEN	78	OMEG	±	12–15 $\pi^-p \rightarrow n\eta 2\pi$
977 ± 7		GRASSLER	77	HBC	−	16 $\pi^{\mp}p \rightarrow p\eta 3\pi$

989	± 4	70	WELLS	75	HBC	−	3.1–6 $K^- p \to \Lambda \eta 2\pi$
972	±10	150	DEFOIX	72	HBC	±	0.7 $\overline{p} p \to 7\pi$
970	±15	20	BARNES	69C	HBC	−	4–5 $K^- p \to \Lambda \eta 2\pi$
980	±10		CAMPBELL	69	DBC	±	2.7 $\pi^+ d$
980	±10	15	MILLER	69B	HBC	−	4.5 $K^- N \to \eta \pi \Lambda$
980	±10	30	AMMAR	68	HBC	±	5.5 $K^- p \to \Lambda \eta 2\pi$

[1] Using the model of ACHASOV 89 and ACHASOV 03B.
[2] From a fit with the S-wave amplitude including two interfering Breit-Wigners plus a background term.
[3] Parameterizes couplings to $\overline{K} K$, $\pi \eta$, and $\pi \eta'$.
[4] Using AMSLER 94D and ABELE 98.
[5] From the T-matrix pole on sheet II.
[6] Using the model of ACHASOV 89. Supersedes ACHASOV 98B.
[7] Using the model of JAFFE 77. Supersedes ACHASOV 98B.
[8] T-matrix pole.
[9] Breit-Wigner fit, average between $a_0^\pm$ and a_0^0. The fit favors a slightly heavier $a_0^\pm$.
[10] From a single Breit-Wigner fit.
[11] From $f_1(1285)$ decay.

$K\overline{K}$ ONLY

VALUE (MeV)	*EVTS*	*DOCUMENT ID*		*TECN*	*CHG*	*COMMENT*
• • • We do not use the following data for averages, fits, limits, etc. • • •						
∼ 1053		[12] OLLER	99C	RVUE		$\pi\pi \to \pi\pi$, $K\overline{K}$
982 ± 3		[13] ABELE	98	CBAR		0.0 $\overline{p} p \to K^0_L K^\pm \pi^\mp$
975 ±15		BERTIN	98B	OBLX	±	0.0 $\overline{p} p \to K^\pm K_S \pi^\mp$
976 ± 6	316	DEBILLY	80	HBC	±	1.2–2 $\overline{p} p \to f_1(1285)\omega$
1016 ±10	100	[14] ASTIER	67	HBC	±	0.0 $\overline{p} p$
1003.3± 7.0	143	[15] ROSENFELD	65	RVUE	±	

[12] T-matrix pole.
[13] T-matrix pole on sheet II, the pole on sheet III is at 1006-i49 MeV.
[14] ASTIER 67 includes data of BARLOW 67, CONFORTO 67, ARMENTEROS 65.
[15] Plus systematic errors.

a_0(980) WIDTH

VALUE (MeV)	*EVTS*	*DOCUMENT ID*		*TECN*	*CHG*	*COMMENT*
50 to 100 OUR ESTIMATE Width determination very model dependent. Peak width in $\eta\pi$ is about 60 MeV, but decay width can be much larger.						
• • • We do not use the following data for averages, fits, limits, etc. • • •						
75.6 ± 1.6 $^{+17.4}_{-10.0}$		[16] UEHARA	09A	BELL		$\gamma\gamma \to \pi^0 \eta$
80.2 ± 3.8 ± 5.4		[17] BUGG	08A	RVUE	0	$\overline{p} p \to \pi^0 \pi^0 \eta$
50 ±13 ± 4	318	ACHARD	02B	L3		183–209 $e^+ e^- \to e^+ e^- \eta \pi^+ \pi^-$
72 ±16		BARBERIS	00H			450 $p p \to p_f \eta \pi^0 p_s$
61 ±19		BARBERIS	00H			450 $p p \to \Delta_f^{++} \eta \pi^- p_s$
∼ 42		[18] OLLER	99	RVUE		$\eta\pi$, $K\overline{K}$
∼ 112		[18] OLLER	99B	RVUE		$\pi\pi \to \eta\pi$, $K\overline{K}$

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	CHG	COMMENT
71 ± 7		TEIGE	99	B852		18.3 $\pi^- p \to \eta\pi^+\pi^- n$
92 ±20		[18] ANISOVICH	98B	RVUE		Compilation
65 ±10		[19] BERTIN	98B	OBLX	±	0.0 $\overline{p}p \to K^\pm K_S \pi^\mp$
~ 100		TORNQVIST	96	RVUE		$\pi\pi \to \pi\pi$, $K\overline{K}$, $K\pi$, $\eta\pi$
202		JANSSEN	95	RVUE		$\eta\pi \to \eta\pi$, $K\overline{K}$, $K\pi$, $\eta\pi$
54.12± 0.34± 0.12		AMSLER	94C	CBAR		0.0 $\overline{p}p \to \omega\eta\pi^0$
54 ±10		[20] AMSLER	92	CBAR		0.0 $\overline{p}p \to \eta\eta\pi^0$
95 ±14	1040	[20] ARMSTRONG	91B	OMEG	±	300 $pp \to pp\eta\pi^+\pi^-$
62 ±15	500	[21] EVANGELIS...	81	OMEG	±	12 $\pi^- p \to \eta\pi^+\pi^-\pi^- p$
60 ±20	145	[21] GURTU	79	HBC	±	4.2 $K^- p \to \Lambda\eta 2\pi$
60 $^{+50}_{-30}$	47	CONFORTO	78	OSPK	−	4.5 $\pi^- p \to pX^-$
86.0 $^{+60.0}_{-50.0}$	50	CORDEN	78	OMEG	±	12–15 $\pi^- p \to n\eta 2\pi$
44 ±22		GRASSLER	77	HBC	−	16 $\pi^\mp p \to p\eta 3\pi$
80 to 300		[22] FLATTE	76	RVUE	−	4.2 $K^- p \to \Lambda\eta 2\pi$
16.0 $^{+25.0}_{-16.0}$	70	WELLS	75	HBC	−	3.1–6 $K^- p \to \Lambda\eta 2\pi$
30 ± 5	150	DEFOIX	72	HBC	±	0.7 $\overline{p}p \to 7\pi$
40 ±15		CAMPBELL	69	DBC	±	2.7 $\pi^+ d$
60 ±30	15	MILLER	69B	HBC	−	4.5 $K^- N \to \eta\pi\Lambda$
80 ±30	30	AMMAR	68	HBC	±	5.5 $K^- p \to \Lambda\eta 2\pi$

[16] From a fit with the S-wave amplitude including two interfering Breit-Wigners plus a background term.
[17] From the T-matrix pole on sheet II, using AMSLER 94D and ABELE 98.
[18] T-matrix pole.
[19] The $\eta\pi$ width.
[20] From a single Breit-Wigner fit.
[21] From $f_1(1285)$ decay.
[22] Using a two-channel resonance parametrization of GAY 76B data.

$K\overline{K}$ ONLY

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	CHG	COMMENT
92± 8		[23] ABELE	98	CBAR		0.0 $\overline{p}p \to K^0_L K^\pm \pi^\mp$
• • • We do not use the following data for averages, fits, limits, etc. • • •						
~ 24		[24] OLLER	99C	RVUE		$\pi\pi \to \pi\pi$, $K\overline{K}$
~ 25	100	[25] ASTIER	67	HBC	±	
57±13	143	[26] ROSENFELD	65	RVUE	±	

[23] T-matrix pole on sheet II, the pole on sheet III is at 1006-i49 MeV.
[24] T-matrix pole.
[25] ASTIER 67 includes data of BARLOW 67, CONFORTO 67, ARMENTEROS 65.
[26] Plus systematic errors.

$a_0(980)$ DECAY MODES

	Mode	Fraction (Γ_i/Γ)
Γ_1	$\eta\pi$	dominant
Γ_2	$K\overline{K}$	seen
Γ_3	$\rho\pi$	
Γ_4	$\gamma\gamma$	seen
Γ_5	e^+e^-	

$a_0(980)$ PARTIAL WIDTHS

$\Gamma(\gamma\gamma)$ — Γ_4

VALUE (keV)	*DOCUMENT ID*		*TECN*
• • • We do not use the following data for averages, fits, limits, etc. • • •			
0.30 ± 0.10	[27] AMSLER	98	RVUE

[27] Using $\Gamma_{\gamma\gamma}$B($a0(980) \rightarrow \eta\pi$) =0.24 ± 0.08 keV.

$a_0(980)$ $\Gamma(i)\Gamma(\gamma\gamma)/\Gamma(\text{total})$

$\Gamma(\eta\pi) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$ — $\Gamma_1\Gamma_4/\Gamma$

VALUE (keV)	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
$0.21\ ^{+0.08}_{-0.04}$ OUR AVERAGE					
$0.128\ ^{+0.003}_{-0.002}\ ^{+0.502}_{-0.043}$		[28] UEHARA	09A	BELL	$\gamma\gamma \rightarrow \pi^0\eta$
$0.28\ \pm0.04\ \pm0.10$	44	OEST	90	JADE	$e^+e^- \rightarrow e^+e^-\pi^0\eta$
$0.19\ \pm0.07\ ^{+0.10}_{-0.07}$		ANTREASYAN	86	CBAL	$e^+e^- \rightarrow e^+e^-\pi^0\eta$

[28] From a fit with the S-wave amplitude including two interfering Breit-Wigners plus a background term.

$\Gamma(\eta\pi) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$ — $\Gamma_1\Gamma_5/\Gamma$

VALUE (eV)	*CL%*	*DOCUMENT ID*		*TECN*	*COMMENT*
<1.5	90	VOROBYEV	88	ND	$e^+e^- \rightarrow \pi^0\eta$

$a_0(980)$ BRANCHING RATIOS

$\Gamma(K\overline{K})/\Gamma(\eta\pi)$ — Γ_2/Γ_1

VALUE	*DOCUMENT ID*		*TECN*	*CHG*	*COMMENT*
0.183±0.024 OUR AVERAGE Error includes scale factor of 1.2.					
$0.57\ \pm0.16$	[29] BARGIOTTI	03	OBLX		$\overline{p}p$
$0.23\ \pm0.05$	[30] ABELE	98	CBAR		0.0 $\overline{p}p \rightarrow K^0_L K^\pm\pi^\mp$
$0.166\pm0.01\ \pm0.02$	[31] BARBERIS	98C	OMEG		450 $pp \rightarrow p_f f_1(1285) p_s$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$1.20\ \pm0.15$	[32] ANISOVICH	09	RVUE		0.0 $\overline{p}p$, πN
$1.05\ \pm0.07\ \pm0.05$	[33] BUGG	08A	RVUE	0	$\overline{p}p \rightarrow \pi^0\pi^0\eta$
~ 0.60	OLLER	99B	RVUE		$\pi\pi \rightarrow \eta\pi$, $K\overline{K}$
$0.7\ \ \pm0.3$	[31] CORDEN	78	OMEG		12–15 $\pi^- p \rightarrow n\eta 2\pi$
$0.25\ \pm0.08$	[31] DEFOIX	72	HBC	$\pm$	0.7 $\overline{p} \rightarrow 7\pi$

$\Gamma(\rho\pi)/\Gamma(\eta\pi)$ Γ_3/Γ_1

$\rho\pi$ forbidden.

VALUE	CL%	DOCUMENT ID		TECN	CHG	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •						
<0.25	70	AMMAR	70	HBC	$\pm$	4.1,5.5 $K^- p \rightarrow \Lambda\eta 2\pi$

[29] Coupled channel analysis of $\pi^+\pi^-\pi^0$, $K^+K^-\pi^0$, and $K^\pm K^0_S\pi^\mp$.

[30] Using $\pi^0\pi^0\eta$ from AMSLER 94D.

[31] From the decay of $f_1(1285)$.

[32] This is a ratio of couplings.

[33] A ratio of couplings, using AMSLER 94D and ABELE 98. Supersedes BUGG 94.

$a_0(980)$ REFERENCES

AMBROSINO	09F	PL B681 5	F. Ambrosino et al.	(KLOE Collab.)
ANISOVICH	09	IJMP A24 2481	V.V. Anisovich, A.V. Sarantsev	
UEHARA	09A	PR D80 032001	S. Uehara et al.	(BELLE Collab.)
BUGG	08A	PR D78 074023	D.V. Bugg	(LOQM)
ACHASOV	03B	PR D68 014006	N.N. Achsaov, A.V. Kiselev	
BARGIOTTI	03	EPJ C26 371	M. Bargiotti et al.	(OBELIX Collab.)
ACHARD	02B	PL B526 269	P. Achard et al.	(L3 Collab.)
ACHASOV	00F	PL B479 53	M.N. Achasov et al.	(Novosibirsk SND Collab.)
BARBERIS	00H	PL B488 225	D. Barberis et al.	(WA 102 Collab.)
OLLER	99	PR D60 099906 (erratum)	J.A. Oller et al.	
OLLER	99B	NP A652 407 (erratum)	J.A. Oller, E. Oset	
OLLER	99C	PR D60 074023	J.A. Oller, E. Oset	
TEIGE	99	PR D59 012001	S. Teige et al.	(BNL E852 Collab.)
ABELE	98	PR D57 3860	A. Abele et al.	(Crystal Barrel Collab.)
ACHASOV	98B	PL B438 441	M.N. Achasov et al.	(Novosibirsk SND Collab.)
AMSLER	98	RMP 70 1293	C. Amsler	
ANISOVICH	98B	SPU 41 419	V.V. Anisovich et al.	
		Translated from UFN 168 481.		
BARBERIS	98C	PL B440 225	D. Barberis et al.	(WA 102 Collab.)
BERTIN	98B	PL B434 180	A. Bertin et al.	(OBELIX Collab.)
TORNQVIST	96	PRL 76 1575	N.A. Tornqvist, M. Roos	(HELS)
JANSSEN	95	PR D52 2690	G. Janssen et al.	(STON, ADLD, JULI)
AMSLER	94C	PL B327 425	C. Amsler et al.	(Crystal Barrel Collab.)
AMSLER	94D	PL B333 277	C. Amsler et al.	(Crystal Barrel Collab.)
BUGG	94	PR D50 4412	D.V. Bugg et al.	(LOQM)
AMSLER	92	PL B291 347	C. Amsler et al.	(Crystal Barrel Collab.)
ARMSTRONG	91B	ZPHY C52 389	T.A. Armstrong et al.	(ATHU, BARI, BIRM+)
OEST	90	ZPHY C47 343	T. Oest et al.	(JADE Collab.)
ACHASOV	89	NP B315 465	N.N. Achasov, V.N. Ivanchenko	
VOROBYEV	88	SJNP 48 273	P.V. Vorobiev et al.	(NOVO)
		Translated from YAF 48 436.		
ANTREASYAN	86	PR D33 1847	D. Antreasyan et al.	(Crystal Ball Collab.)
ATKINSON	84E	PL 138B 459	M. Atkinson et al.	(BONN, CERN, GLAS+)
EVANGELIS...	81	NP B178 197	C. Evangelista et al.	(BARI, BONN, CERN+)
DEBILLY	80	NP B176 1	L. de Billy et al.	(CURIN, LAUS, NEUC+)
GURTU	79	NP B151 181	A. Gurtu et al.	(CERN, ZEEM, NIJM, OXF)
CONFORTO	78	LNC 23 419	B. Conforto et al.	(RHEL, TNTO, CHIC+)
CORDEN	78	NP B144 253	M.J. Corden et al.	(BIRM, RHEL, TELA+)
GRASSLER	77	NP B121 189	H. Grassler et al.	(AACH3, BERL, BONN+)
JAFFE	77	PR D15 267,281	R. Jaffe	(MIT)
FLATTE	76	PL 63B 224	S.M. Flatte	(CERN)
GAY	76B	PL 63B 220	J.B. Gay et al.	(CERN, AMST, NIJM) JP
WELLS	75	NP B101 333	J. Wells et al.	(OXF)
DEFOIX	72	NP B44 125	C. Defoix et al.	(CDEF, CERN)
AMMAR	70	PR D2 430	R. Ammar et al.	(KANS, NWES, ANL, WISC)
BARNES	69C	PRL 23 610	V.E. Barnes et al.	(BNL, SYRA)
CAMPBELL	69	PRL 22 1204	J.H. Campbell et al.	(PURD)
MILLER	69B	PL 29B 255	D.H. Miller et al.	(PURD)
Also		PR 188 2011	W.L. Yen et al.	(PURD)
AMMAR	68	PRL 21 1832	R. Ammar et al.	(NWES, ANL)
ASTIER	67	PL 25B 294	A. Astier et al.	(CDEF, CERN, IRAD)
Includes data of BARLOW 67, CONFORTO 67, and ARMENTEROS 65.				

BARLOW	67	NC 50A 701	J. Barlow *et al.*	(CERN, CDEF, IRAD, LIVP)
CONFORTO	67	NP B3 469	G. Conforto *et al.*	(CERN, CDEF, IPNP+)
ARMENTEROS	65	PL 17 344	R. Armenteros *et al.*	(CERN, CDEF)
ROSENFELD	65	Oxford Conf. 58	A.H. Rosenfeld	(LRL)