$a_0(980)$

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

See the related review(s):

Scalar Mesons below 1 GeV

$a_0(980)$ T-MATRIX POLE $\sqrt{s}$

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

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
(960–1030) − *i* (20–70) OUR ESTIMATE	(see Fig. 64.2 in the review)			
$(989 \pm 5) - i(40 \pm 5)$	[1] BUGG	08A	RVUE	$\overline{p}p$ annihilation data
$(1117^{+\ 24}_{-320}) - i(12^{+43}_{-12})$	[2] PELAEZ	04A	RVUE	$\pi\pi \to \pi\pi$, $\pi K \to \pi K$
$(982 \pm 3) - i(46 \pm 4)$	[3] ABELE	98	CBAR	0.0 $\overline{p}p \to K^0_L K^\pm \pi^\mp$

[1] T-matrix pole on sheet II. Parameterizes couplings to $\overline{K}K$, $\pi\eta$, and $\pi\eta'$. Uses AMSLER 94D and ABELE 98.
[2] Reanalysis of data from LINGLIN 73, ESTABROOKS 78, and ASTON 88 in the unitarized ChPT model.
[3] T-matrix pole on sheet II; the pole on sheet III is at $(1006 - i\ 49)$ MeV.

$a_0(980)$ MASS

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
980 ±20 OUR ESTIMATE	Mass determination very model dependent			
• • • We do not use the following data for averages, fits, limits, etc. • • •				
$1000.7^{+12.9}_{-\ 0.7}$	[1] LU	20	RVUE	$\gamma\gamma \to \pi^0\eta$, $K^0_S K^0_S$

[1] T-matrix pole on sheet II.

$\eta\pi$ FINAL STATE ONLY

VALUE (MeV)	*EVTS*	*DOCUMENT ID*		*TECN*	*CHG*	*COMMENT*
• • • We do not use the following data for averages, fits, limits, etc. • • •						
$1004.1 \pm 1.5 \pm 6.5$		[1] ALBRECHT	20	CBAR		0.9 $\overline{p}p \to \pi^0\pi^0\eta$, $\pi^0\eta\eta$, $\pi^0 K^+ K^-$
$982.5 \pm 1.6 \pm 1.1$	16.9k	[2] AMBROSINO	09F	KLOE		1.02 $e^+e^- \to \eta\pi^0\gamma$
986 ± 4		ANISOVICH	09	RVUE		0.0 $\overline{p}p$, πN
$982.3^{+0.6}_{-0.7}{}^{+3.1}_{-4.7}$		[3] UEHARA	09A	BELL		$\gamma\gamma \to \pi^0\eta$
$985 \pm 4 \pm 6$	318	ACHARD	02B	L3		183–209 $e^+e^- \to e^+e^-\eta\pi^+\pi^-$
995^{+52}_{-10}	36	[4] ACHASOV	00F	SND		$e^+e^- \to \eta\pi^0\gamma$
$994^{+33}_{-\ 8}$	36	[5] ACHASOV	00F	SND		$e^+e^- \to \eta\pi^0\gamma$
975 ± 7		BARBERIS	00H			450 $pp \to p_f \eta\pi^0 p_s$
988 ± 8		BARBERIS	00H			450 $pp \to \Delta^{++}_f \eta\pi^- p_s$
~ 1055		[6] OLLER	99	RVUE		$\eta\pi$, $K\overline{K}$
~ 1009.2		[6] OLLER	99B	RVUE		$\pi\pi \to \pi\pi$, $K\overline{K}$

993.1 ± 2.1		[7] TEIGE	99	B852	18.3 $\pi^- p \to \eta\pi^+\pi^- n$
988 ± 6		[6] ANISOVICH	98B	RVUE	Compilation
987		TORNQVIST	96	RVUE	$\pi\pi \to \pi\pi$, $K\overline{K}$, $K\pi$, $\eta\pi$
991		JANSSEN	95	RVUE	$\eta\pi \to \eta\pi$, $K\overline{K}$, $K\pi$, $\eta\pi$
984.45± 1.23±0.34		AMSLER	94C	CBAR	0.0 $\overline{p}p \to \omega\eta\pi^0$
982 ± 2		[8] AMSLER	92	CBAR	0.0 $\overline{p}p \to \eta\eta\pi^0$
984 ± 4	1040	[8] ARMSTRONG	91B	OMEG ±	300 $pp \to pp\eta\pi^+\pi^-$
976 ± 6		ATKINSON	84E	OMEG ±	25–55 $\gamma p \to \eta\pi n$
986 ± 3	500	[9] EVANGELIS...	81	OMEG ±	12 $\pi^- p \to \eta\pi^+\pi^-\pi^- p$
990 ± 7	145	[9] GURTU	79	HBC ±	4.2 $K^- p \to \Lambda\eta 2\pi$
980 ±11	47	CONFORTO	78	OSPK −	4.5 $\pi^- p \to pX^-$
978 ±16	50	CORDEN	78	OMEG ±	12–15 $\pi^- p \to n\eta 2\pi$
977 ± 7		GRASSLER	77	HBC −	16 $\pi^\mp p \to p\eta 3\pi$
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] T-matrix pole with 2 poles, 2 channels, pole mass on adjacent sheet 1002.4 ± 1.4 ± 6.6 MeV.
[2] Using the model of ACHASOV 89 and ACHASOV 03B.
[3] From a fit with the S-wave amplitude including two interfering Breit-Wigners plus a background term.
[4] Using the model of ACHASOV 89. Supersedes ACHASOV 98B.
[5] Using the model of JAFFE 77. Supersedes ACHASOV 98B.
[6] T-matrix pole.
[7] Breit-Wigner fit, average between $a_0^\pm$ and a_0^0. The fit favors a slightly heavier $a_0^\pm$.
[8] From a single Breit-Wigner fit.
[9] From $f_1(1285)$ decay.

$K\overline{K}$ ONLY

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$947.7^{+5.5}_{-5.0}\pm6.6$		[1] AAIJ	19H	LHCB	$pp \to D^\pm X$
925 ± 5 ±8	190k	[2] AAIJ	16N	LHCB	$D^0 \to K^0_S K^\pm \pi^\mp$
∼ 1053		[3] OLLER	99C	RVUE	$\pi\pi \to \pi\pi$, $K\overline{K}$
975 ±15		BERTIN	98B	OBLX	0.0 $\overline{p}p \to K^\pm K_s \pi^\mp$
970 ±10	316	DEBILLY	80	HBC	1.2–2 $\overline{p}p \to f_1(1285)\omega$
1016 ±10	100	[4] ASTIER	67	HBC	0.0 $\overline{p}p$
1003.3± 7.0	143	[5,6] ROSENFELD	65	RVUE	

[1] From the$D^\pm \to K^\pm K^+ K^-$ Dalitz plot fit with the Triple-M amplitude in the multi-meson model of AOUDE 18.
[2] Using a two-channel resonance parametrization with couplings fixed to ABELE 98.
[3] T-matrix pole.

[4] ASTIER 67 includes data of BARLOW 67, CONFORTO 67, ARMENTEROS 65.
[5] Note on J^P. Main argument for 0^+ is small Q value. Isotropy of decay distribution in $\overline{p}p$ at rest proves nothing. See discussion by Rosenfeld (Oxford) and Butterworth (Heidelberg).
[6] 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. • • •					
97.2 ± 1.9 ± 5.7		[1] ALBRECHT 20	CBAR		0.9 $\overline{p}p \rightarrow \pi^0\pi^0\eta$, $\pi^0\eta\eta$, $\pi^0 K^+ K^-$
73.2 $^{+25.4}_{-5.2}$		[2] LU 20	RVUE		$\gamma\gamma \rightarrow \pi^0\eta$, $K^0_S K^0_S$
75.6 ± 1.6 $^{+17.4}_{-10.0}$		[3] UEHARA 09A	BELL		$\gamma\gamma \rightarrow \pi^0\eta$
50 ±13 ± 4	318	ACHARD 02B	L3		183–209 $e^+e^- \rightarrow e^+e^-\eta\pi^+\pi^-$
72 ±16		BARBERIS 00H			450 $pp \rightarrow p_f\eta\pi^0 p_s$
61 ±19		BARBERIS 00H			450 $pp \rightarrow \Delta^{++}_f \eta\pi^- p_s$
∼ 42		[4] OLLER 99	RVUE		$\eta\pi$, $K\overline{K}$
∼ 112		[4] OLLER 99B	RVUE		$\pi\pi \rightarrow \eta\pi$, $K\overline{K}$
71 ± 7		TEIGE 99	B852		18.3 $\pi^- p \rightarrow \eta\pi^+\pi^- n$
92 ±20		[4] ANISOVICH 98B	RVUE		Compilation
65 ±10		[5] BERTIN 98B	OBLX	±	0.0 $\overline{p}p \rightarrow K^\pm K_s \pi^\mp$
∼ 100		TORNQVIST 96	RVUE		$\pi\pi \rightarrow \pi\pi$, $K\overline{K}$, $K\pi$, $\eta\pi$
202		JANSSEN 95	RVUE		$\eta\pi \rightarrow \eta\pi$, $K\overline{K}$, $K\pi$, $\eta\pi$
54.12± 0.34± 0.12		AMSLER 94C	CBAR		0.0 $\overline{p}p \rightarrow \omega\eta\pi^0$
54 ±10		[6] AMSLER 92	CBAR		0.0 $\overline{p}p \rightarrow \eta\eta\pi^0$
95 ±14	1040	[6] ARMSTRONG 91B	OMEG	±	300 $pp \rightarrow pp\eta\pi^+\pi^-$
62 ±15	500	[7] EVANGELIS... 81	OMEG	±	12 $\pi^- p \rightarrow \eta\pi^+\pi^-\pi^- p$
60 ±20	145	[7] GURTU 79	HBC	±	4.2 $K^- p \rightarrow \Lambda\eta 2\pi$
60 $^{+50}_{-30}$	47	CONFORTO 78	OSPK	−	4.5 $\pi^- p \rightarrow pX^-$
86.0 $^{+60.0}_{-50.0}$	50	CORDEN 78	OMEG	±	12–15 $\pi^- p \rightarrow n\eta 2\pi$
44 ±22		GRASSLER 77	HBC	−	16 $\pi^\mp p \rightarrow p\eta 3\pi$
80 to 300		[8] FLATTE 76	RVUE	−	4.2 $K^- p \rightarrow \Lambda\eta 2\pi$
16.0 $^{+25.0}_{-16.0}$	70	[9] WELLS 75	HBC	−	3.1–6 $K^- p \rightarrow \Lambda\eta 2\pi$
30 ± 5	150	[10] DEFOIX 72	HBC	±	0.7 $\overline{p}p \rightarrow 7\pi$
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 $K^- p \to \Lambda\eta 2\pi$

[1] T-matrix pole with 2 poles, 2 channels, pole width on adjacent sheet 127.0 ± 2.3 ± 6.7 MeV.
[2] T-matrix pole on sheet II.
[3] From a fit with the S-wave amplitude including two interfering Breit-Wigners plus a background term.
[4] T-matrix pole.
[5] The $\eta\pi$ width.
[6] From a single Breit-Wigner fit.
[7] From $f_1(1285)$ decay.
[8] Using a two-channel resonance parametrization of GAY 76B data.
[9] Weak evidence only for $a_0(980)^+$ production.
[10] This number has very little meaning. Error is much too small. Vlada

$K\overline{K}$ ONLY

VALUE (MeV)	*EVTS*	*DOCUMENT ID*		*TECN*	*CHG*	*COMMENT*
• • • We do not use the following data for averages, fits, limits, etc. • • •						
∼ 48		[1] OLLER	99C	RVUE		$\pi\pi \to \pi\pi$, $K\overline{K}$
∼ 25	100	[2] ASTIER	67	HBC	±	
57±13	143	[3] ROSENFELD	65	RVUE	±	

[1] T-matrix pole.
[2] ASTIER 67 includes data of BARLOW 67, CONFORTO 67, ARMENTEROS 65.
[3] Plus systematic errors.

$a_0(980)$ DECAY MODES

	Mode	Fraction (Γ_i/Γ)
Γ_1	$\eta\pi$	seen
Γ_2	$K\overline{K}$	seen
Γ_3	$\eta'\pi$	seen
Γ_4	$\rho\pi$	not seen
Γ_5	$\gamma\gamma$	seen
Γ_6	e^+e^-	

$a_0(980)$ PARTIAL WIDTHS

$\Gamma(\gamma\gamma)$ Γ_5

VALUE (keV)	*DOCUMENT ID*		*TECN*
• • • We do not use the following data for averages, fits, limits, etc. • • •			
0.30±0.10	[1] AMSLER	98	RVUE

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

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

$\Gamma(\eta\pi) \times \Gamma(\gamma\gamma)/\Gamma_{total}$ — $\Gamma_1\Gamma_5/\Gamma$

VALUE (keV)	EVTS	DOCUMENT ID		TECN	COMMENT
$0.21^{+0.08}_{-0.04}$ OUR AVERAGE					
$0.128^{+0.003}_{-0.002}{}^{+0.502}_{-0.043}$		[1] UEHARA	09A	BELL	$\gamma\gamma \to \pi^0\eta$
$0.28 \pm 0.04 \pm 0.10$	44	OEST	90	JADE	$e^+e^- \to e^+e^-\pi^0\eta$
$0.19 \pm 0.07 ^{+0.10}_{-0.07}$		ANTREASYAN	86	CBAL	$e^+e^- \to e^+e^-\pi^0\eta$

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

$\Gamma(\eta\pi) \times \Gamma(e^+e^-)/\Gamma_{total}$ — $\Gamma_1\Gamma_6/\Gamma$

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

$a_0(980)$ BRANCHING RATIOS

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

VALUE	DOCUMENT ID		TECN	CHG	COMMENT
0.172±0.019 OUR AVERAGE					
$0.137 \pm 0.036 \pm 0.042$	[1] ABLIKIM	22AH	BES3		$D_s^+ \to K_S^0 K^+ \pi^0$
0.23 ± 0.05	[2] ABELE	98	CBAR		$0.0\ \overline{p}p \to K_L^0 K^\pm \pi^\mp$
$0.166 \pm 0.01 \pm 0.02$	[3] BARBERIS	98C	OMEG		$450\ pp \to p_f f_1(1285) p_s$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$0.138 \pm 0.001 \pm 0.035$	[4] ALBRECHT	20	CBAR		$0.9\ \overline{p}p \to \pi^0\pi^0\eta$, $\pi^0\eta\eta$, $\pi^0K^+K^-$
1.20 ± 0.15	[5] ANISOVICH	09	RVUE		$0.0\ \overline{p}p$, πN
$1.05 \pm 0.07 \pm 0.05$	[6] BUGG	08A	RVUE	0	$\overline{p}p \to \pi^0\pi^0\eta$
0.57 ± 0.16	[7] BARGIOTTI	03	OBLX		$\overline{p}p$
~ 0.60	OLLER	99B	RVUE		$\pi\pi \to \eta\pi$, $K\overline{K}$
0.7 ± 0.3	[3] CORDEN	78	OMEG		$12\text{–}15\ \pi^- p \to n\eta 2\pi$
0.25 ± 0.08	[3] DEFOIX	72	HBC	$\pm$	$0.7\ \overline{p} \to 7\pi$

[1] Using $D_s^+ \to a_0(980)^+\pi^0$ from ABLIKIM 19BE.
[2] Using $\pi^0\pi^0\eta$ from AMSLER 94D.
[3] From the decay of $f_1(1285)$.
[4] Residues from T-matrix pole with 2 poles, 2 channels. Solution on adjacent sheet $0.149 \pm 0.001 \pm 0.039$.
[5] This is a ratio of couplings.
[6] A ratio of couplings, using AMSLER 94D and ABELE 98. Supersedes BUGG 94.
[7] Coupled channel analysis of $\pi^+\pi^-\pi^0$, $K^+K^-\pi^0$, and $K^\pm K_S^0\pi^\mp$.

$\Gamma(\eta'\pi)/\Gamma_{total}$ — Γ_3/Γ

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
seen	116k	[1] CHEN	20A	BELL	$D^0 \to K^-\pi^+\eta$

[1] From an amplitude analysis of the $D^0 \to K^-\pi^+\eta$ decay in a three-channel Flatte model with a 10.1 σ significance. Earlier observed by ABLIKIM 17K in the $\chi_{c1} \to \eta\pi^+\pi^-$ decay with a 8.9 σ significance.

$\Gamma(\rho\pi)/\Gamma(\eta\pi)$ Γ_4/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	[1] AMMAR	70	HBC	$\pm$	4.1,5.5 $K^- p \rightarrow \Lambda\eta 2\pi$

[1] Not clear if they really observed the $a_0(980)$ 3 standard deviations.

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Includes data of BARLOW 67, CONFORTO 67, and ARMENTEROS 65.				
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