

$a_0(980)$

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

See the related review(s):
 Scalar Mesons below 1 GeV

 $a_0(980)$ T-MATRIX POLE \sqrt{s} Note that $\Gamma = -2 \text{Im}(\sqrt{s})$.

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
(970–1020) – i (30–70) OUR ESTIMATE (see Fig. 64.2 in the review)			
$(1002.4 \pm 1.4 \pm 6.6)$ $-i(63.5 \pm 2.9)$	¹ ALBRECHT	20	CBAR $0.9 \bar{p}p \rightarrow \pi^0 \pi^0 \eta,$ $\pi^0 \eta \eta, \pi^0 K^+ K^-$
$(1000.7^{+12.9}_{-0.7})$ $-i(36.6^{+12.7}_{-2.6})$	² LU	20	RVUE $\gamma\gamma \rightarrow \pi^0 \eta, K_S^0 K_S^0$
$(989 \pm 5) - i(40 \pm 5)$	³ BUGG	08A	RVUE $\bar{p}p$ annihilation data
$(1117^{+24}_{-320}) - i(12^{+43}_{-12})$	⁴ PELAEZ	04A	RVUE $\pi\pi \rightarrow \pi\pi, \pi K \rightarrow \pi K$
$(982 \pm 3) - i(46 \pm 4)$	⁵ ABELE	98	CBAR $0.0 \bar{p}p \rightarrow K_L^0 K^\pm \pi^\mp$

¹ Pole mass on sheet closest to the physical axis - the more remote pole is extracted at $(1004.1 \pm 1.5 \pm 6.5) - i(48.6 \pm 1.2 \pm 3.4)$ MeV.

² T-matrix pole on sheet II.

³ T-matrix pole on sheet II. Parameterizes couplings to $\bar{K}K$, $\pi\eta$, and $\pi\eta'$. Uses AM-SLER 94D and ABELE 98.

⁴ Reanalysis of data from LINGLIN 73, ESTABROOKS 78, and ASTON 88 in the unitarized ChPT model.

⁵ 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
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. ● ● ●					
$982.5 \pm 1.6 \pm 1.1$	16.9k	¹ AMBROSINO	09F	KLOE	$1.02 e^+ e^- \rightarrow \eta \pi^0 \gamma$
986 ± 4		ANISOVICH	09	RVUE	$0.0 \bar{p}p, \pi N$
$982.3^{+0.6}_{-0.7} \quad ^{+3.1}_{-4.7}$		² UEHARA	09A	BELL	$\gamma\gamma \rightarrow \pi^0 \eta$
$985 \pm 4 \pm 6$	318	ACHARD	02B	L3	$183\text{--}209 e^+ e^- \rightarrow$ $e^+ e^- \eta \pi^+ \pi^-$
995^{+52}_{-10}	36	³ ACHASOV	00F	SND	$e^+ e^- \rightarrow \eta \pi^0 \gamma$
994^{+33}_{-8}	36	⁴ 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		⁵ OLLER	99	RVUE	$\eta \pi, K \bar{K}$

~ 1009.2		⁵ OLLER	99B	RVUE	$\pi\pi \rightarrow \pi\pi, K\bar{K}$
993.1 ± 2.1		⁶ TEIGE	99	B852	$18.3 \pi^- p \rightarrow \eta\pi^+\pi^- n$
988 ± 6		⁵ ANISOVICH	98B	RVUE	Compilation
987		TORNQVIST	96	RVUE	$\pi\pi \rightarrow \pi\pi, K\bar{K}, K\pi, \eta\pi$
991		JANSSEN	95	RVUE	$\eta\pi \rightarrow \eta\pi, K\bar{K}, K\pi, \eta\pi$
$984.45 \pm 1.23 \pm 0.34$		AMSLER	94C	CBAR	$0.0 \bar{p}p \rightarrow \omega\eta\pi^0$
982 ± 2		⁷ AMSLER	92	CBAR	$0.0 \bar{p}p \rightarrow \eta\eta\pi^0$
984 ± 4	1040	⁷ ARMSTRONG	91B	OMEG \pm	$300 pp \rightarrow p\rho\eta\pi^+\pi^-$
976 ± 6		ATKINSON	84E	OMEG \pm	$25-55 \gamma p \rightarrow \eta\pi n$
986 ± 3	500	⁸ EVANGELIS...	81	OMEG \pm	$12 \pi^- p \rightarrow \eta\pi^+\pi^-\pi^- p$
990 ± 7	145	⁸ GURTU	79	HBC \pm	$4.2 K^- p \rightarrow \Lambda\eta 2\pi$
980 ± 11	47	CONFORTO	78	OSPK $-$	$4.5 \pi^- p \rightarrow pX^-$
978 ± 16	50	CORDEN	78	OMEG \pm	$12-15 \pi^- p \rightarrow n\eta 2\pi$
977 ± 7		GRASSLER	77	HBC $-$	$16 \pi^\mp p \rightarrow p\eta 3\pi$
989 ± 4	70	WELLS	75	HBC $-$	$3.1-6 K^- p \rightarrow \Lambda\eta 2\pi$
972 ± 10	150	DEFOIX	72	HBC \pm	$0.7 \bar{p}p \rightarrow 7\pi$
970 ± 15	20	BARNES	69C	HBC $-$	$4-5 K^- p \rightarrow \Lambda\eta 2\pi$
980 ± 10		CAMPBELL	69	DBC \pm	$2.7 \pi^+ d$
980 ± 10	15	MILLER	69B	HBC $-$	$4.5 K^- N \rightarrow \eta\pi\Lambda$
980 ± 10	30	AMMAR	68	HBC \pm	$5.5 K^- p \rightarrow \Lambda\eta 2\pi$

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 Using the model of ACHASOV 89. Supersedes ACHASOV 98B.

⁴ Using the model of JAFFE 77. Supersedes ACHASOV 98B.

⁵ T-matrix pole.

⁶ Breit-Wigner fit, average between a_0^\pm and a_0^0 . The fit favors a slightly heavier a_0^\pm .

⁷ From a single Breit-Wigner fit.

⁸ From $f_1(1285)$ decay.

$K\bar{K}$ ONLY

VALUE (MeV)	EVTS	DOCUMENT ID	TECN	COMMENT
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••• We do not use the following data for averages, fits, limits, etc. •••

$947.7^+_{-5.0} \pm 6.6$		¹ AAIJ	19H	LHCB	$pp \rightarrow D^\pm X$
$925 \pm 5 \pm 8$	190k	² AAIJ	16N	LHCB	$D^0 \rightarrow K_S^0 K^\pm \pi^\mp$
~ 1053		³ OLLER	99C	RVUE	$\pi\pi \rightarrow \pi\pi, K\bar{K}$
975 ± 15		BERTIN	98B	OBLX	$0.0 \bar{p}p \rightarrow K^\pm K_S \pi^\mp$
970 ± 10	316	DEBILLY	80	HBC	$1.2-2 \bar{p}p \rightarrow f_1(1285)\omega$
1016 ± 10	100	⁴ ASTIER	67	HBC	$0.0 \bar{p}p$
1003.3 ± 7.0	143	^{5,6} ROSENFELD	65	RVUE	

¹ From the $D^\pm \rightarrow K^\pm K^+ K^-$ Dalitz plot fit with the Triple-M amplitude in the multi-meson model of AOUBE 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.

⁵Note on J^P . Main argument for 0^+ is small Q value. Isotropy of decay distribution in $\bar{p}p$ at rest proves nothing. See discussion by Rosenfeld (Oxford) and Butterworth (Heidelberg).

⁶Plus 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	$^{+17.4}_{-10.0}$	¹ UEHARA	09A	BELL	$\gamma\gamma \rightarrow \pi^0\eta$
50	± 13	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		² OLLER	99	RVUE	$\eta\pi, K\bar{K}$
~ 112		² OLLER	99B	RVUE	$\pi\pi \rightarrow \eta\pi, K\bar{K}$
71	± 7	TEIGE	99	B852	18.3 $\pi^- p \rightarrow \eta\pi^+\pi^- n$
92	± 20	² ANISOVICH	98B	RVUE	Compilation
65	± 10	³ BERTIN	98B	OBLX \pm	0.0 $\bar{p}p \rightarrow K^\pm K_s\pi^\mp$
~ 100		TORNQVIST	96	RVUE	$\pi\pi \rightarrow \pi\pi, K\bar{K}, K\pi, \eta\pi$
202		JANSSEN	95	RVUE	$\eta\pi \rightarrow \eta\pi, K\bar{K}, K\pi, \eta\pi$
$54.12 \pm 0.34 \pm 0.12$		AMSLER	94C	CBAR	0.0 $\bar{p}p \rightarrow \omega\eta\pi^0$
54	± 10	⁴ AMSLER	92	CBAR	0.0 $\bar{p}p \rightarrow \eta\eta\pi^0$
95	± 14	⁴ ARMSTRONG	91B	OMEG \pm	300 $pp \rightarrow pp\eta\pi^+\pi^-$
62	± 15	⁵ EVANGELIS...	81	OMEG \pm	12 $\pi^- p \rightarrow \eta\pi^+\pi^-\pi^- p$
60	± 20	⁵ GURTU	79	HBC \pm	4.2 $K^- p \rightarrow \Lambda\eta 2\pi$
60	$^{+50}_{-30}$	CONFORTO	78	OSPK $-$	4.5 $\pi^- p \rightarrow pX^-$
86.0	$^{+60.0}_{-50.0}$	CORDEN	78	OMEG \pm	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	⁶ FLATTE	76	RVUE $-$	4.2 $K^- p \rightarrow \Lambda\eta 2\pi$
16.0	$^{+25.0}_{-16.0}$	⁷ WELLS	75	HBC $-$	3.1–6 $K^- p \rightarrow \Lambda\eta 2\pi$
30	± 5	⁸ DEFOIX	72	HBC \pm	0.7 $\bar{p}p \rightarrow 7\pi$
40	± 15	CAMPBELL	69	DBC \pm	2.7 $\pi^+ d$
60	± 30	MILLER	69B	HBC $-$	4.5 $K^- N \rightarrow \eta\pi\Lambda$
80	± 30	AMMAR	68	HBC \pm	5.5 $K^- p \rightarrow \Lambda\eta 2\pi$

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

²T-matrix pole.

³The $\eta\pi$ width.

⁴From a single Breit-Wigner fit.

⁵ From $f_1(1285)$ decay.

⁶ Using a two-channel resonance parametrization of GAY 76B data.

⁷ Weak evidence only for $a_0(980)^+$ production.

⁸ This number has very little meaning. Error is much too small. Vlada

$K\bar{K}$ ONLY

VALUE (MeV)	EVTS	DOCUMENT ID	TECN	CHG	COMMENT
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~ 48		¹ OLLER	99C	RVUE	$\pi\pi \rightarrow \pi\pi, K\bar{K}$
~ 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 $K\bar{K}$	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
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••• We do not use the following data for averages, fits, limits, etc. •••

0.30 ± 0.10	¹ AMSLER	98	RVUE
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¹ Using $\Gamma_{\gamma\gamma} B(a_0(980) \rightarrow \eta\pi) = 0.24 \pm 0.08$ keV.

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

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

VALUE (keV)	EVTS	DOCUMENT ID	TECN	COMMENT
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0.21 $^{+0.08}_{-0.04}$ OUR AVERAGE

0.128 $^{+0.003}_{-0.002}$ $^{+0.502}_{-0.043}$		¹ UEHARA	09A	BELL $\gamma\gamma \rightarrow \pi^0\eta$
0.28 ± 0.04 ± 0.10	44	OEST	90	JADE $e^+e^- \rightarrow e^+e^-\pi^0\eta$
0.19 ± 0.07 $^{+0.10}_{-0.07}$		ANTREASYAN	86	CBAL $e^+e^- \rightarrow e^+e^-\pi^0\eta$

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

$\Gamma(\eta\pi) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$					$\Gamma_1\Gamma_6/\Gamma$
VALUE (eV)	CL%	DOCUMENT ID	TECN	COMMENT	
<1.5	90	VOROBYEV 88	ND	$e^+e^- \rightarrow \pi^0\eta$	

 $a_0(980)$ BRANCHING RATIOS

$\Gamma(K\bar{K})/\Gamma(\eta\pi)$					Γ_2/Γ_1
VALUE	DOCUMENT ID	TECN	CHG	COMMENT	
0.172±0.019 OUR AVERAGE					
0.137±0.036±0.042	¹ ABLIKIM	22AH	BES3	$D_S^+ \rightarrow K_S^0 K^+ \pi^0$	
0.23 ±0.05	² ABELE	98	CBAR	0.0 $\bar{p}p \rightarrow K_L^0 K^\pm \pi^\mp$	
0.166±0.01 ±0.02	³ BARBERIS	98C	OMEG	450 $p\rho \rightarrow \rho_f f_1(1285) p_S$	
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.138±0.001±0.035	⁴ ALBRECHT	20	CBAR	0.9 $\bar{p}p \rightarrow \pi^0\pi^0\eta,$ $\pi^0\eta\eta, \pi^0 K^+ K^-$	
1.20 ±0.15	⁵ ANISOVICH	09	RVUE	0.0 $\bar{p}p, \pi N$	
1.05 ±0.07 ±0.05	⁶ BUGG	08A	RVUE 0	$\bar{p}p \rightarrow \pi^0\pi^0\eta$	
0.57 ±0.16	⁷ BARGIOTTI	03	OBLX	$\bar{p}p$	
~0.60	OLLER	99B	RVUE	$\pi\pi \rightarrow \eta\pi, K\bar{K}$	
0.7 ±0.3	³ CORDEN	78	OMEG	12–15 $\pi^- p \rightarrow n\eta 2\pi$	
0.25 ±0.08	³ DEFOIX	72	HBC ±	0.7 $\bar{p} \rightarrow 7\pi$	

¹ Using $D_S^+ \rightarrow a_0(980)^+ \pi^0$ 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 ± 0.001 ± 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 $K^\pm K_S^0 \pi^\mp$.

$\Gamma(\eta'\pi)/\Gamma_{\text{total}}$					Γ_3/Γ
VALUE	EVTS	DOCUMENT ID	TECN	COMMENT	
seen	116k	¹ CHEN	20A	BELL	$D^0 \rightarrow K^- \pi^+ \eta$

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

$\Gamma(\rho\pi)/\Gamma(\eta\pi)$					Γ_4/Γ_1
VALUE	CL%	DOCUMENT ID	TECN	CHG	COMMENT
$\rho\pi$ forbidden.					
<0.25	70	¹ AMMAR	70	HBC ±	4.1,5.5 $K^- p \rightarrow \Lambda\eta 2\pi$

• • • We do not use the following data for averages, fits, limits, etc. • • •

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

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