# $a_0(980)$

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

See our minireview on scalar mesons under $f_0(500)$. (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. • • • | | | | | | |
| $982.5 \pm 1.6 \pm 1.1$ | 16.9k | [1] AMBROSINO | 09F | KLOE | | $1.02\ e^+e^- \to \eta\pi^0\gamma$ |
| $986 \pm 4$ | | ANISOVICH | 09 | RVUE | | $0.0\ \overline{p}p,\ \pi N$ |
| $982.3\ ^{+0.6}_{-0.7}\ ^{+3.1}_{-4.7}$ | | [2] UEHARA | 09A | BELL | | $\gamma\gamma \to \pi^0\eta$ |
| $987.4 \pm 1.0 \pm 3.0$ | | [3,4] BUGG | 08A | RVUE | 0 | $\overline{p}p \to \pi^0\pi^0\eta$ |
| $989.1 \pm 1.0 \pm 3.0$ | | [4,5] BUGG | 08A | RVUE | 0 | $\overline{p}p \to \pi^0\pi^0\eta$ |
| $985 \pm 4 \pm 6$ | 318 | ACHARD | 02B | L3 | | $183–209\ e^+e^- \to e^+e^-\eta\pi^+\pi^-$ |
| $995\ ^{+52}_{-10}$ | 36 | [6] ACHASOV | 00F | SND | | $e^+e^- \to \eta\pi^0\gamma$ |
| $994\ ^{+33}_{-8}$ | 36 | [7] ACHASOV | 00F | SND | | $e^+e^- \to \eta\pi^0\gamma$ |
| $975 \pm 7$ | | BARBERIS | 00H | | | $450\ pp \to p_f\eta\pi^0 p_s$ |
| $988 \pm 8$ | | BARBERIS | 00H | | | $450\ pp \to \Delta_f^{++}\eta\pi^- p_s$ |
| $\sim 1055$ | | [8] OLLER | 99 | RVUE | | $\eta\pi,\ K\overline{K}$ |
| $\sim 1009.2$ | | [8] OLLER | 99B | RVUE | | $\pi\pi \to \pi\pi,\ K\overline{K}$ |
| $993.1 \pm 2.1$ | | [9] TEIGE | 99 | B852 | | $18.3\ \pi^- p \to \eta\pi^+\pi^- n$ |
| $988 \pm 6$ | | [8] ANISOVICH | 98B | RVUE | | Compilation |
| 987 | | TORNQVIST | 96 | RVUE | | $\pi\pi \to \pi\pi,\ K\overline{K},\ K\pi,\ \eta\pi$ |
| 991 | | JANSSEN | 95 | RVUE | | $\eta\pi \to \eta\pi,\ K\overline{K},\ K\pi,\ \eta\pi$ |
| $984.45 \pm 1.23 \pm 0.34$ | | AMSLER | 94C | CBAR | | $0.0\ \overline{p}p \to \omega\eta\pi^0$ |
| $982 \pm 2$ | | [10] AMSLER | 92 | CBAR | | $0.0\ \overline{p}p \to \eta\eta\pi^0$ |
| $984 \pm 4$ | 1040 | [10] ARMSTRONG | 91B | OMEG | ± | $300\ pp \to pp\eta\pi^+\pi^-$ |
| $976 \pm 6$ | | ATKINSON | 84E | OMEG | ± | $25–55\ \gamma p \to \eta\pi n$ |
| $986 \pm 3$ | 500 | [11] EVANGELIS... | 81 | OMEG | ± | $12\ \pi^- p \to \eta\pi^+\pi^-\pi^- p$ |
| $990 \pm 7$ | 145 | [11] GURTU | 79 | HBC | ± | $4.2\ K^- p \to \Lambda\eta 2\pi$ |
| $980 \pm 11$ | 47 | CONFORTO | 78 | OSPK | − | $4.5\ \pi^- p \to pX^-$ |
| $978 \pm 16$ | 50 | CORDEN | 78 | OMEG | ± | $12–15\ \pi^- p \to n\eta 2\pi$ |
| $977 \pm 7$ | | GRASSLER | 77 | HBC | − | $16\ \pi^\mp p \to p\eta 3\pi$ |
| $989 \pm 4$ | 70 | WELLS | 75 | HBC | − | $3.1–6\ K^- p \to \Lambda\eta 2\pi$ |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 972 ±10 | 150 | DEFOIX | 72 | HBC | ± | 0.7 $\overline{p}p \rightarrow 7\pi$ |
| 970 ±15 | 20 | BARNES | 69C | HBC | − | 4–5 $K^- p \rightarrow \Lambda\eta 2\pi$ |
| 980 ±10 | | CAMPBELL | 69 | DBC | ± | 2.7 $\pi^+ d$ |
| 980 ±10 | 15 | MILLER | 69B | HBC | − | 4.5 $K^- N \rightarrow \eta\pi\Lambda$ |
| 980 ±10 | 30 | AMMAR | 68 | HBC | ± | 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] 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 |
|---|---|---|---|---|---|---|
| **925 ± 5 ±8** | 190k | [1] AAIJ | 16N | LHCB | | $D^0 \rightarrow K_S^0 K^{\pm}\pi^{\mp}$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | | |
| ∼ 1053 | | [2] OLLER | 99C | RVUE | | $\pi\pi \rightarrow \pi\pi, K\overline{K}$ |
| 982 ± 3 | | [3] ABELE | 98 | CBAR | | 0.0 $\overline{p}p \rightarrow K_L^0 K^{\pm}\pi^{\mp}$ |
| 975 ±15 | | BERTIN | 98B | OBLX | ± | 0.0 $\overline{p}p \rightarrow K^{\pm} K_s \pi^{\mp}$ |
| 976 ± 6 | 316 | DEBILLY | 80 | HBC | ± | 1.2–2 $\overline{p}p \rightarrow f_1(1285)\omega$ |
| 1016 ±10 | 100 | [4] ASTIER | 67 | HBC | ± | 0.0 $\overline{p}p$ |
| 1003.3± 7.0 | 143 | [5] ROSENFELD | 65 | RVUE | ± | |

[1] Using a two-channel resonance parametrization with couplings fixed to ABELE 98.
[2] T-matrix pole.
[3] T-matrix pole on sheet II, the pole on sheet III is at 1006-i49 MeV.
[4] ASTIER 67 includes data of BARLOW 67, CONFORTO 67, ARMENTEROS 65.
[5] 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 $^{+17.4}_{-10.0}$ | | [1] UEHARA | 09A | BELL | | $\gamma\gamma \rightarrow \pi^0\eta$ |
| 80.2 ± 3.8 ± 5.4 | | [2] BUGG | 08A | RVUE | 0 | $\overline{p}p \rightarrow \pi^0\pi^0\eta$ |
| 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 | | [3] OLLER | 99 | RVUE | | $\eta\pi, K\overline{K}$ |
| ∼ 112 | | [3] 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 | | [3] ANISOVICH | 98B | RVUE | | Compilation |
| 65 ± 10 | | [4] 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 | | [5] AMSLER | 92 | CBAR | | 0.0 $\overline{p} p \rightarrow \eta \eta \pi^0$ |
| 95 ± 14 | 1040 | [5] ARMSTRONG | 91B | OMEG | ± | 300 $p p \rightarrow p p \eta \pi^+ \pi^-$ |
| 62 ± 15 | 500 | [6] EVANGELIS... | 81 | OMEG | ± | 12 $\pi^- p \rightarrow \eta \pi^+ \pi^- \pi^- p$ |
| 60 ± 20 | 145 | [6] GURTU | 79 | HBC | ± | 4.2 $K^- p \rightarrow \Lambda \eta 2\pi$ |
| 60 $^{+50}_{-30}$ | 47 | CONFORTO | 78 | OSPK | − | 4.5 $\pi^- p \rightarrow p X^-$ |
| 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 | | [7] FLATTE | 76 | RVUE | − | 4.2 $K^- p \rightarrow \Lambda \eta 2\pi$ |
| 16.0 $^{+25.0}_{-16.0}$ | 70 | WELLS | 75 | HBC | − | 3.1–6 $K^- p \rightarrow \Lambda \eta 2\pi$ |
| 30 ± 5 | 150 | 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 $K^- N \rightarrow \eta \pi \Lambda$ |
| 80 ± 30 | 30 | AMMAR | 68 | HBC | ± | 5.5 $K^- p \rightarrow \Lambda \eta 2\pi$ |

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

## $K\overline{K}$ ONLY

| *VALUE* (MeV) | *EVTS* | *DOCUMENT ID* | | *TECN* | *CHG* | *COMMENT* |
|---|---|---|---|---|---|---|
| **92 ± 8** | | [1] ABELE | 98 | CBAR | | 0.0 $\overline{p} p \rightarrow K^0_L K^{\pm} \pi^{\mp}$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | | |
| ∼ 24 | | [2] OLLER | 99C | RVUE | | $\pi\pi \rightarrow \pi\pi$, $K\overline{K}$ |
| ∼ 25 | 100 | [3] ASTIER | 67 | HBC | ± | |
| 57 ± 13 | 143 | [4] ROSENFELD | 65 | RVUE | ± | |

[1] T-matrix pole on sheet II, the pole on sheet III is at 1006-i49 MeV.
[2] T-matrix pole.
[3] ASTIER 67 includes data of BARLOW 67, CONFORTO 67, ARMENTEROS 65.
[4] Plus systematic errors.

## $a_0(980)$ DECAY MODES

| | Mode | Fraction ($\Gamma_i/\Gamma$) |
|---|---|---|
| $\Gamma_1$ | $\eta\pi$ | dominant |
| $\Gamma_2$ | $K\overline{K}$ | seen |
| $\Gamma_3$ | $\rho\pi$ | |
| $\Gamma_4$ | $\gamma\gamma$ | seen |
| $\Gamma_5$ | $e^+e^-$ | |

## $a_0(980)$ PARTIAL WIDTHS

### $\Gamma(\gamma\gamma)$ — $\Gamma_4$

| VALUE (keV) | DOCUMENT ID | | TECN |
|---|---|---|---|
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | |
| $0.30\pm0.10$ | [1] AMSLER | 98 | RVUE |

[1] Using $\Gamma_{\gamma\gamma}B(a0(980) \to \eta\pi)$ =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** | | | | | |
| $0.128^{+0.003}_{-0.002}{}^{+0.502}_{-0.043}$ | | [1] UEHARA | 09A | BELL | $\gamma\gamma \to \pi^0\eta$ |
| $0.28\ \pm0.04\ \pm0.10$ | 44 | OEST | 90 | JADE | $e^+e^- \to e^+e^-\pi^0\eta$ |
| $0.19\ \pm0.07\ ^{+0.10}_{-0.07}$ | | 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.

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

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

## $a_0(980)$ BRANCHING RATIOS

### $\Gamma(K\overline{K})/\Gamma(\eta\pi)$ — $\Gamma_2/\Gamma_1$

| VALUE | DOCUMENT ID | | TECN | CHG | COMMENT |
|---|---|---|---|---|---|
| **0.183±0.024 OUR AVERAGE** Error includes scale factor of 1.2. | | | | | |
| $0.57\ \pm0.16$ | [1] BARGIOTTI | 03 | OBLX | | $\overline{p}p$ |
| $0.23\ \pm0.05$ | [2] ABELE | 98 | CBAR | | $0.0\ \overline{p}p \to K^0_L K^\pm\pi^\mp$ |
| $0.166\pm0.01\ \pm0.02$ | [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. • • • | | | | | |
| $1.20\ \pm0.15$ | [4] ANISOVICH | 09 | RVUE | | $0.0\ \overline{p}p,\ \pi N$ |
| $1.05\ \pm0.07\ \pm0.05$ | [5] BUGG | 08A | RVUE | 0 | $\overline{p}p \to \pi^0\pi^0\eta$ |
| $\sim 0.60$ | OLLER | 99B | RVUE | | $\pi\pi \to \eta\pi,\ K\overline{K}$ |
| $0.7\ \ \pm0.3$ | [3] CORDEN | 78 | OMEG | | 12–15 $\pi^- p \to n\eta 2\pi$ |
| $0.25\ \pm0.08$ | [3] DEFOIX | 72 | HBC | ± | $0.7\ \overline{p} \to 7\pi$ |

## $\Gamma(\rho\pi)/\Gamma(\eta\pi)$ — $\Gamma_3/\Gamma_1$

$\rho\pi$ 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 $K^- p \to \Lambda \eta 2\pi$ |

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

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

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

[4] This is a ratio of couplings.

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

## $a_0(980)$ REFERENCES


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