$\eta(1440)$

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

See also the mini-review under non-$q\overline{q}$ candidates. (See the index for the page number.)

THE $\eta(1440)$

The first observation of a meson with $I^G J^{PC} = 0^+0^{-+}$ in the 1400-MeV mass region was made in $p\overline{p} \to K\overline{K}3\pi$ annihilations at rest (BAILLON 67). The $\eta(1440)$ was reported to decay into $K\overline{K}\pi$, equally through $a_0(980)\pi$ and $K^*(892)\overline{K}$.

The $\eta(1440)$ has since also been seen in a partial-wave analysis of the $K\overline{K}\pi$ system (CHUNG 85, BIRMAN 88), in 6-GeV $p\overline{p}$ annihilations (REEVES 86), and in nonperipherally selected $\pi^- p \to K^0_S K^0_S \pi^0 n$ (RATH 89). RATH 89 favors two η resonances in the 1410-1480 MeV region. This is also observed at LEAR in $\overline{p}p \to K\overline{K}3\pi$ annihilations at rest (BERTIN 95).

In a partial-wave analysis of $\pi^- p \to \eta\pi^+\pi^-$, FUKUI 91C confirms the decay $\eta(1440) \to a_0(980)\pi$. In $\overline{p}p \to \eta\pi\pi$ annihilations at rest, AMSLER 95F finds roughly equal contributions from $a_0(980)\pi$ and $\eta(\pi\pi)_S$.

Neither the $\eta(1440)$ nor the $f_1(1420)$ are observed in the $s\bar{s}$-enriched peripheral reaction $K^- p \to K\overline{K}\pi\Lambda$ at 11 GeV/c (ASTON 87), which speaks against an $s\overline{s}$ interpretation of either state. ARMSTRONG 84, 89, studying $K\overline{K}\pi$ central production in $\pi^+ p \to \pi^+(K\overline{K}\pi)p$ and $pp \to p(K\overline{K}\pi)p$ at 85 and 300 GeV/c, observed the $f_1(1420)$ but not the $\eta(1440)$.

The $\eta(1440)$ is also seen as a broad enhancement in $J/\psi(1S)$ radiative decay. BUGG 95 has reanalyzed the MARK-III data and finds a contribution to 4π in agreement with DM2 (BISELLO 89B). The $\eta\pi^+\pi^-$ channel peaks near 1400 MeV (AUGUSTIN 90, BOLTON 92B), in agreement with observations in $\overline{p}p$ annihilation at rest (AMSLER 95F). It has been shown (TOKI 87, BAI 90C) that two pseudoscalar resonances at ≈ 1420 and ≈ 1490 MeV, together with a 1^{++} around 1440 MeV, give a better description of the $K\overline{K}\pi$ data. These results, together with RATH 89 and BERTIN 95, suggest the existence of two overlapping pseudoscalar states, one around 1400 MeV decaying into both $K\overline{K}\pi$ and $\eta\pi\pi$, the other one around 1480 MeV decaying only to $K\overline{K}\pi$.

We continue to list under the $\eta(1440)$ all the results on the 0^{-+} system in the 1380-1490 MeV region, but there is probably more than one resonance present in the observations. It is thus difficult to give reliable $\overline{K}^* K$ or $a_0\pi$ branching ratios.

The masses and widths are given separately according to the various decay modes. See also our Note on "Non-$q\overline{q}$ Mesons."

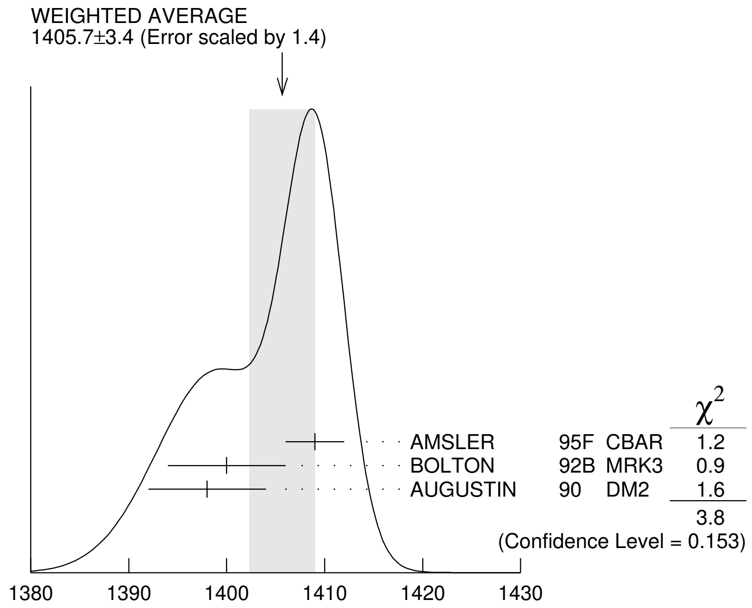
$\eta(1440)$ MASS

VALUE (MeV)	*DOCUMENT ID*
1415±10 OUR ESTIMATE	This is only an educated guess; the error given is larger than the error on the average of the published values.

$\eta\pi\pi$ MODE

VALUE (MeV)	*EVTS*	*DOCUMENT ID*	*TECN*	*COMMENT*
1405.7± 3.4 OUR AVERAGE		Error includes scale factor of 1.4. See the ideogram below.		
1409 ± 3		AMSLER 95F	CBAR	$0\ \overline{p}p \rightarrow \pi^+\pi^-\pi^0\pi^0\eta$
1400 ± 6		[1] BOLTON 92B	MRK3	$J/\psi \rightarrow \gamma\eta\pi^+\pi^-$
1398 ± 6	261	[2] AUGUSTIN 90	DM2	$J/\psi \rightarrow \gamma\eta\pi^+\pi^-$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
1385 ±15		[1] BEHREND 92	CELL	$J/\psi \rightarrow \gamma\eta\pi^+\pi^-$
1388 ± 4		FUKUI 91C	SPEC	$8.95\ \pi^- p \rightarrow \eta\pi^+\pi^- n$
1420 ± 5		ANDO 86	SPEC	$8\ \pi^- p \rightarrow n\eta\pi^+\pi^-$

[1] From fit to the $a_0(980)\pi$ 0^{-+} partial wave.
[2] Best fit with a single Breit Wigner.



$\eta(1440)$ mass, $\eta\pi\pi$ mode (MeV)

$\pi\pi\gamma$ MODE

VALUE (MeV)	*DOCUMENT ID*	*TECN*	*COMMENT*
• • • We do not use the following data for averages, fits, limits, etc. • • •			
1401±18	[3,4] AUGUSTIN 90	DM2	$J/\psi \rightarrow \pi^+\pi^-\gamma\gamma$
1440±20	[4] COFFMAN 90	MRK3	$J/\psi \rightarrow \pi^+\pi^- 2\gamma$

[3] Best fit with a single Breit Wigner.
[4] This peak in the $\gamma\rho$ channel may not be related to the $\eta(1440)$.

4π MODE

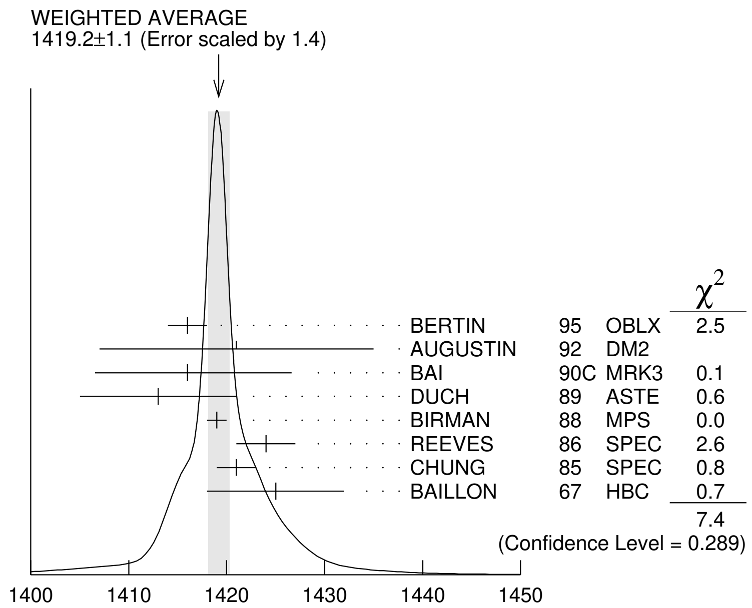
VALUE (MeV)	*EVTS*	*DOCUMENT ID*	*TECN*	*COMMENT*
• • • We do not use the following data for averages, fits, limits, etc. • • •				
1420±20		BUGG 95	MRK3	$J/\psi \rightarrow \gamma\pi^+\pi^-\pi^+\pi^-$
1489±12	3270	[5] BISELLO 89B	DM2	$J/\psi \rightarrow 4\pi\gamma$

[5] Estimated by us from various fits.

$K\overline{K}\pi$ MODE

VALUE (MeV)	EVTS	DOCUMENT ID	TECN	COMMENT
1419.2± 1.1 OUR AVERAGE		Error includes scale factor of 1.4. See the ideogram below.		
1416 ± 2		[6] BERTIN 95	OBLX	$0\ \overline{p}p \rightarrow K\overline{K}\pi\pi\pi$
1421 ±14		[7] AUGUSTIN 92	DM2	$J/\psi \rightarrow \gamma K\overline{K}\pi$
1416 ± 8 $^{+7}_{-5}$	700	[8] BAI 90C	MRK3	$J/\psi \rightarrow \gamma K^0_S K^\pm \pi^\mp$
1413 ± 8	500	DUCH 89	ASTE	$\overline{p}p \rightarrow \pi^+\pi^- K^\pm \pi^\mp K^0$
1419 ± 1	8800	[9,10] BIRMAN 88	MPS	$8\ \pi^- p \rightarrow K^+\overline{K}{}^0\pi^- n$
1424 ± 3	620	[10,11] REEVES 86	SPEC	$6.6\ p\overline{p} \rightarrow K\overline{K}\pi X$
1421 ± 2		CHUNG 85	SPEC	$8\ \pi^- p \rightarrow K\overline{K}\pi n$
1425 ± 7	800	[10,12] BAILLON 67	HBC	$0.0\ \overline{p}p \rightarrow K\overline{K}\pi\pi\pi$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
1460 ±10		[13] BERTIN 95	OBLX	$0\ \overline{p}p \rightarrow K\overline{K}\pi\pi\pi$
1459 ± 5		[9] AUGUSTIN 92	DM2	$J/\psi \rightarrow \gamma K\overline{K}\pi$
1445 ± 8	693	[10] AUGUSTIN 90	DM2	$J/\psi \rightarrow \gamma K^0_S K^\pm \pi^\mp$
1433 ± 8	296	[10] AUGUSTIN 90	DM2	$J/\psi \rightarrow \gamma K^+ K^- \pi^0$
1490 $^{+14}_{-8}$ $^{+3}_{-16}$	1100	[7] BAI 90C	MRK3	$J/\psi \rightarrow \gamma K^0_S K^\pm \pi^\mp$
1443 ± 5		[7] TAKAMATSU 90	SPEC	$8\ \pi^- p \rightarrow n K^*(892) K$
1424 ± 4		TAKAMATSU 90	SPEC	$8\ \pi^- p \rightarrow n K^0_S K^\pm \pi^\mp$
1475 ± 4		[14] RATH 89	MPS	$21.4\ \pi^- p \rightarrow n K^0_S K^0_S \pi^0$
1452.8± 6.8	170	[10] RATH 89	MPS	$21.4\ \pi^- p \rightarrow K^0_S K^0_S \pi^0 n$
1412.8± 5.4		RATH 89	MPS	$21.4\ \pi^- p \rightarrow n K^0_S K^0_S \pi^0$
1454 ± 3		WISNIEWSKI 87	MRK3	$J/\psi \rightarrow K\overline{K}\pi\gamma$
1440 $^{+20}_{-15}$	174	EDWARDS 82E	CBAL	$J/\psi \rightarrow \gamma K^+ K^- \pi^0$
1440 $^{+10}_{-15}$		SCHARRE 80	MRK2	$J/\psi \rightarrow \gamma K^0_S K^\pm \pi^\mp$

[6] Decaying into $(K\overline{K})_S\pi$, $(K\pi)_S\overline{K}$, and $a_0(980)\pi$.
[7] From fit to the $K^*(892)K$ 0^{-+} partial wave.
[8] From fit to the $a_0(980)\pi$ 1^{++} partial wave. cannot rule out a $a_0(980)\pi$ 1^{++} partial wave.
[9] From fit to the $a_0(980)\pi$ 0^{-+} partial wave.
[10] Best fit with a single Breit Wigner.
[11] From fit of the 0^{-+} partial wave , mainly $a_0(980)\pi$.
[12] From best fit of 0^{-+} partial wave , 50% $K^*(892)K$, 50% $a_0(980)\pi$.
[13] Decaying into $K^*(892)K$.
[14] From fit to the $a_0(980)\pi$ 0^{-+} partial wave , but $a_0(980)\pi$ 1^{++} cannot be excluded. The fit is also consistent with one resonance at 1453 MeV.



$\eta(1440)$ mass, $K\overline{K}\pi$ mode (MeV)

$\eta(1440)$ WIDTH

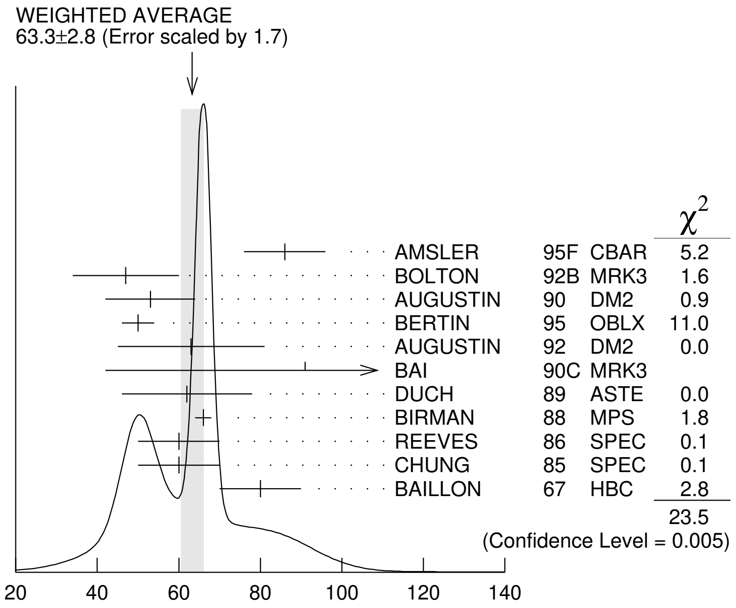
VALUE (MeV)	*DOCUMENT ID*
60±20 OUR ESTIMATE	This is only an educated guess; the error given is larger than the error on the average of the published values.

$\eta\pi\pi$ MODE

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
63.3± 2.8 OUR AVERAGE	Includes data from the datablock that follows this one. Error includes scale factor of 1.7. See the ideogram below.			
86 ±10	AMSLER	95F	CBAR	$0\ \overline{p}p \rightarrow \pi^+\pi^-\pi^0\pi^0\eta$
47 ±13	[15] BOLTON	92B	MRK3	$J/\psi \rightarrow \gamma\eta\pi^+\pi^-$
53 ±11	[16] AUGUSTIN	90	DM2	$J/\psi \rightarrow \gamma\eta\pi^+\pi^-$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
~ 50	[16] BEHREND	92	CELL	$J/\psi \rightarrow \gamma\eta\pi^+\pi^-$
59 ± 4	FUKUI	91C	SPEC	$8.95\ \pi^- p \rightarrow \eta\pi^+\pi^- n$
31 ± 7	ANDO	86	SPEC	$8\ \pi^- p \rightarrow n\eta\pi^+\pi^-$

[15] From fit to the $a_0(980)\pi$ 0^{-+} partial wave.

[16] From $\eta\pi^+\pi^-$ mass distribution - mainly $a_0(980)\pi$ - no spin–parity determination available.



$\eta(1440)$ width $\eta\pi\pi$ mode (MeV)

$\pi\pi\gamma$ MODE

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
• • • We do not use the following data for averages, fits, limits, etc. • • •				
174±44	AUGUSTIN	90	DM2	$J/\psi \rightarrow \pi^+\pi^-\gamma\gamma$
60±30	[17] COFFMAN	90	MRK3	$J/\psi \rightarrow \pi^+\pi^- 2\gamma$

[17] This peak in the $\gamma\rho$ channel may not be related to the $\eta(1440)$.

4π MODE

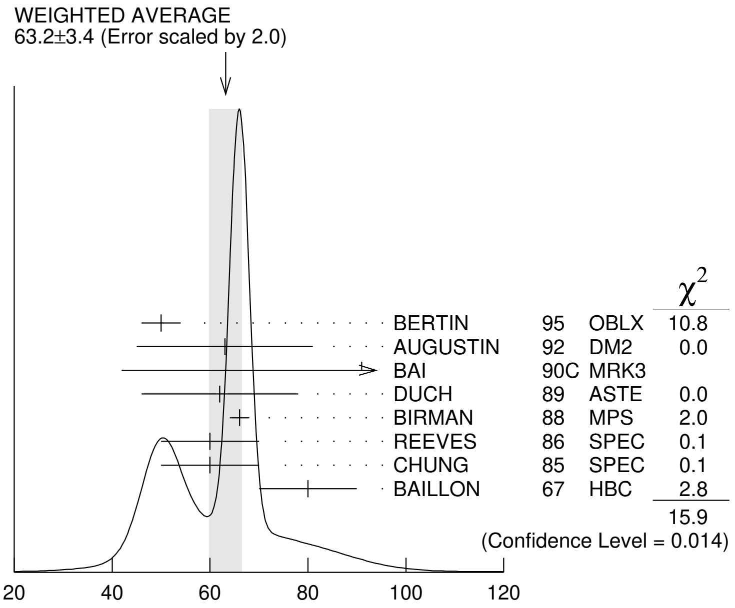
VALUE (MeV)	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
• • • We do not use the following data for averages, fits, limits, etc. • • •					
160±30		BUGG	95	MRK3	$J/\psi \rightarrow \gamma\pi^+\pi^-\pi^+\pi^-$
144±13	3270	[18] BISELLO	89B	DM2	$J/\psi \rightarrow 4\pi\gamma$

[18] Estimated by us from various fits.

$K\overline{K}\pi$ MODE

VALUE (MeV)	EVTS	DOCUMENT ID	TECN	COMMENT
The data in this block is included in the average printed for a previous datablock.				
63.2± 3.4 OUR AVERAGE		Error includes scale factor of 2.0. See the ideogram below.		
50 ± 4		[19] BERTIN	95 OBLX	$0\ \overline{p}p \to K\overline{K}\pi\pi\pi$
63 ± 18		AUGUSTIN	92 DM2	$J/\psi \to \gamma K\overline{K}\pi$
$91\ {}^{+67}_{-31}\ {}^{+15}_{-38}$		BAI	90C MRK3	$J/\psi \to \gamma K^0_S K^\pm \pi^\mp$
62 ± 16	500	DUCH	89 ASTE	$\overline{p}p \to K\overline{K}\pi\pi\pi$
66 ± 2	8800	BIRMAN	88 MPS	$8\ \pi^- p \to K^+ \overline{K}^0 \pi^- n$
60 ± 10	620	[20] REEVES	86 SPEC	$6.6\ p\overline{p} \to KK\pi X$
60 ± 10		CHUNG	85 SPEC	$8\ \pi^- p \to K\overline{K}\pi n$
80 ± 10	800	[21] BAILLON	67 HBC	$0.0\ \overline{p}p \to K\overline{K}\pi\pi\pi$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
105 ± 15		[22] BERTIN	95 OBLX	$0\ \overline{p}p \to K\overline{K}\pi\pi\pi$
75 ± 9		[23] AUGUSTIN	92 DM2	$J/\psi \to \gamma K\overline{K}\pi$
75 ± 9	693	[23] AUGUSTIN	90 DM2	$J/\psi \to \gamma K^0_S K^\pm \pi^\mp$
93 ± 14	296	AUGUSTIN	90 DM2	$J/\psi \to \gamma K^+ K^- \pi^0$
105 ± 10	693	AUGUSTIN	90 DM2	$J/\psi \to \gamma K^0_S K^\pm \pi^\mp$
$54\ {}^{+37}_{-21}\ {}^{+13}_{-24}$		[24] BAI	90C MRK3	$J/\psi \to \gamma K^0_S K^\pm \pi^\mp$
59 ± 4		[24] TAKAMATSU	90 SPEC	$9\ \pi^- p \to n\eta\pi^+\pi^-$
82 ± 8		TAKAMATSU	90 SPEC	$8\ \pi^- p \to nK^0_S K^\pm \pi^\mp$
57 ± 8		TAKAMATSU	90 SPEC	$8\ \pi^- p \to nK^*(892)K$
51 ± 13		[25] RATH	89 MPS	$21.4\ \pi^- p \to nK^0_S K^0_S \pi^0$
99.9 ± 11.4	170	[26] RATH	89 MPS	$21.4\ \pi^- p \to K^0_S K^0_S \pi^0 n$
19 ± 7		RATH	89 MPS	$21.4\ \pi^- p \to nK^0_S K^0_S \pi^0$
160 ± 11		WISNIEWSKI	87 MRK3	$J/\psi \to K\overline{K}\pi\gamma$
$55\ {}^{+20}_{-30}$	174	EDWARDS	82E CBAL	$J/\psi \to \gamma K^+ K^- \pi^0$
$50\ {}^{+30}_{-20}$		SCHARRE	80 MRK2	$J/\psi \to \gamma K^0_S K^\pm \pi^\mp$

[19] Decaying into $(K\overline{K})_S\pi$, $(K\pi)_S\overline{K}$, and $a_0(980)\pi$.
[20] From best fit to 0^{-+} partial wave , 50% $K^*(892)K$, 50% $a_0(980)\pi$.
[21] From fit to the 0^{-+} partial wave , mainly $a_0(980)\pi$.
[22] Decaying into $K^*(892)K$.
[23] From fit to the $a_0(980)\pi$ 0^{-+} partial wave.
[24] From fit to the $K^*(892)K$ 0^{-+} partial wave.
[25] From fit to the $a_0(980)\pi$ 0^{-+} partial wave , but $a_0(980)\pi$ 1^{++} cannot be excluded.
[26] The fit is also consistent with one resonance at 1453 MeV. Best fit with a single Breit Wigner.



$\eta(1440)$ width $K\overline{K}\pi$ mode (MeV)

$\eta(1440)$ DECAY MODES

	Mode	Fraction (Γ_i/Γ)
Γ_1	$K\overline{K}\pi$	seen
Γ_2	$\eta\pi\pi$	seen
Γ_3	$a_0(980)\pi$	seen
Γ_4	$\pi\pi\rho$	
Γ_5	$K\overline{K}^*(892)+$ c.c.	
Γ_6	4π	seen
Γ_7	$\gamma\gamma$	
Γ_8	$\rho^0\gamma$	

$\eta(1440)$ $\Gamma(i)\Gamma(\gamma\gamma)/\Gamma(\text{total})$

$\Gamma(K\overline{K}\pi) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$ — $\Gamma_1\Gamma_7/\Gamma$

VALUE (keV)	*CL%*	*DOCUMENT ID*		*TECN*	*COMMENT*
<1.2	95	BEHREND	89	CELL	$\gamma\gamma \to K^0_S K^{\pm}\pi^{\mp}$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<1.6	95	AIHARA	86D	TPC	$e^+e^- \to e^+e^- K^0_S K^{\pm}\pi^{\mp}$
<2.2	95	ALTHOFF	85B	TASS	$e^+e^- \to e^+e^- K\overline{K}\pi$
<8.0	95	JENNI	83	MRK2	$e^+e^- \to e^+e^- K\overline{K}\pi$

$\Gamma(\eta\pi\pi) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$ — $\Gamma_2\Gamma_7/\Gamma$

VALUE (keV)	*DOCUMENT ID*		*TECN*	*COMMENT*
• • • We do not use the following data for averages, fits, limits, etc. • • •				
<0.3	ANTREASYAN	87	CBAL	$e^+e^- \to e^+e^- \eta\pi\pi$

$\Gamma(\rho^0\gamma) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$ — $\Gamma_8\Gamma_7/\Gamma$

VALUE (keV)	*CL%*	*DOCUMENT ID*		*TECN*	*COMMENT*
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<1.5	95	ALTHOFF	84E	TASS	$e^+e^- \to e^+e^-\pi^+\pi^-\gamma$

$\eta(1440)$ BRANCHING RATIOS

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

VALUE	*CL%*	*DOCUMENT ID*		*TECN*	*COMMENT*
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<0.5	90	EDWARDS	83B	CBAL	$J/\psi \to \eta\pi\pi\gamma$
<1.1	90	SCHARRE	80	MRK2	$J/\psi \to \eta\pi\pi\gamma$
<1.5	95	FOSTER	68B	HBC	0.0 $\overline{p}p$

$\Gamma(a_0(980)\pi)/\Gamma(K\overline{K}\pi)$ — Γ_3/Γ_1

VALUE	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
$\sim$ 0.8	500	[27] DUCH	89	ASTE	$\overline{p}p \to \pi^+\pi^- K^{\pm}\pi^{\mp}K^0$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$\sim$ 0.15		[27] BERTIN	95	OBLX	0 $\overline{p}p \to K\overline{K}\pi\pi\pi$
$\sim$ 0.75		[27] REEVES	86	SPEC	6.6 $p\overline{p} \to KK\pi X$

[27] Assuming that the $a_0(980)$ decays only into $K\overline{K}$.

$\Gamma(a_0(980)\pi)/\Gamma(\eta\pi\pi)$ — Γ_3/Γ_2

VALUE	*DOCUMENT ID*		*TECN*	*COMMENT*
0.56±0.04±0.03	[28] AMSLER	95F	CBAR	0 $\overline{p}p \to \pi^+\pi^-\pi^0\pi^0\eta$

[28] Assuming that the $a_0(980)$ decays only into $\eta\pi$.

$\Gamma(K\overline{K}^*(892)+\text{c.c.})/\Gamma(K\overline{K}\pi)$ — Γ_5/Γ_1

VALUE	*DOCUMENT ID*		*TECN*	*COMMENT*
0.50±0.10	BAILLON	67	HBC	0.0 $\overline{p}p \to K\overline{K}\pi\pi$

$\Gamma(K\overline{K}^*(892)+\text{c.c.})/[\Gamma(a_0(980)\pi)+\Gamma(K\overline{K}^*(892)+\text{c.c.})]$ $\Gamma_5/(\Gamma_3+\Gamma_5)$

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
<0.25	90	EDWARDS 82E	CBAL	$J/\psi \to K^+K^-\pi^0\gamma$

$\Gamma(\rho^0\gamma)/\Gamma(K\overline{K}\pi)$ Γ_8/Γ_1

VALUE	DOCUMENT ID	TECN	COMMENT
0.0152±0.0038	[29] COFFMAN 90	MRK3	$J/\psi \to \gamma\gamma\pi^+\pi^-$

[29] Using B($J/\psi \to \gamma\eta(1440) \to \gamma K\overline{K}\pi$)=$4.2 \times 10^{-3}$ and B($J/\psi \to \gamma\eta(1440) \to \gamma\gamma\rho^0$)=$6.4 \times 10^{-5}$ and assuming that the $\gamma\rho^0$ signal does not come from the $f_1(1420)$.

η(1440) REFERENCES

AMSLER	95F	PL B358 389	+Armstrong, Urner+	(Crystal Barrel Collab.)
BERTIN	95	PL B361 187	+Bruschi+	(OBELIX Collab.)
BUGG	95	PL B353 378	+Scott, Zoli+	(LOQM, PNPI, WASH)
AUGUSTIN	92	PR D46 1951	+Cosme	(DM2 Collab.)
BEHREND	92	ZPHY C56 381		(CELLO Collab.)
BOLTON	92B	PRL 69 1328	+Brown, Bunnell+	(Mark III Collab.)
FUKUI	91C	PL B267 293	+	(SUGI, NAGO, KEK, KYOT, MIYA, AKIT)
AUGUSTIN	90	PR D42 10	+Cosme+	(DM2 Collab.)
BAI	90C	PRL 65 2507	+Blaylock+	(Mark III Collab.)
COFFMAN	90	PR D41 1410	+De Jongh+	(Mark III Collab.)
TAKAMATSU	90	Hadron 89 Conf. p 71	+Ando+	(KEK)
BEHREND	89	ZPHY C42 367	+Criegee+	(CELLO Collab.)
BISELLO	89B	PR D39 701	Busetto+	(DM2 Collab.)
DUCH	89	ZPHY 45 223	+Heel, Bailey+	(ASTERIX Collab.) JP
RATH	89	PR D40 693	+Cason+	(NDAM, BRAN, BNL, CUNY, DUKE)
BIRMAN	88	PRL 61 1557	+Chung, Peaslee+	(BNL, FSU, IND, MASD) JP
ANTREASYAN	87	PR D36 2633	+Bartels, Besset+	(Crystal Ball Collab.)
WISNIEWSKI	87	Hadron 87 Conf.		(Mark III Collab.)
AIHARA	86D	PRL 57 51	+Alston-Garnjost+	(TPC-2γ Collab.)
ANDO	86	PRL 57 1296	+Imai+	(KEK, KYOT, NIRS, SAGA, INUS, TSUK+) IJP
REEVES	86	PR 34 1960	+Chung, Crittenden+	(FLOR, BNL, IND, MASD) JP
ALTHOFF	85B	ZPHY C29 189	+Braunschweig, Kirschfink+	(TASSO Collab.)
CHUNG	85	PRL 55 779	+Fernow, Boehnlein+	(BNL, FLOR, IND, MASD) JP
ALTHOFF	84E	PL 147B 487	+Braunschweig, Kirschfink, Luebelsmeyer+	(TASSO Collab.)
EDWARDS	83B	PRL 51 859	+Partridge, Peck+	(CIT, HARV, PRIN, STAN, SLAC)
JENNI	83	PR D27 1031	+Burke, Telnov, Abrams, Blocker+	(SLAC, LBL)
EDWARDS	82E	PRL 49 259	+Partridge, Peck+	(CIT, HARV, PRIN, STAN, SLAC)
Also	83	PRL 50 219	Edwards, Partridge+	(CIT, HARV, PRIN, STAN+)
SCHARRE	80	PL 97B 329	+Trilling, Abrams, Alam, Blocker+	(SLAC, LBL)
FOSTER	68B	NP B8 174	+Gavillet, Labrosse, Montanet+	(CERN, CDEF)
BAILLON	67	NC 50A 393	+Edwards, D'Andlau, Astier+	(CERN, CDEF, IRAD)

OTHER RELATED PAPERS

GENOVESE	94	ZPHY C61 425	+Lichtenberg, Pedrazzi	(TORI, IND)
AHMAD	89	NP B (PROC.)8 50	+Amsler, Auld+	(ASTERIX Collab.)
ARMSTRONG	89	PL B221 216	+Benayoun+	(CERN, CDEF, BIRM, BARI, ATHU, CURIN+)
ZIEMINSKA	88	AIP Conf.		(IND)
ARMSTRONG	87	ZPHY C34 23	+Bloodworth+	(CERN, BIRM, BARI, ATHU, CURIN+)
ASTON	87	NP B292 693	+Awaji, D'Amore+	(SLAC, NAGO, CINC, INUS)
PROTOPOP...	87B	Hadron 87 Conf.	Protopopescu, Chung	(BNL)
TOKI	87	Hadron 87 Conf.		(SLAC)
ARMSTRONG	84	PL 146B 273	+Bloodworth, Burns+	(ATHU, BARI, BIRM, CERN)
DIONISI	80	NP B169 1	+Gavillet+	(CERN, MADR, CDEF, STOH)
DEFOIX	72	NP B44 125	+Nascimento, Bizzarri+	(CDEF, CERN)
DUBOC	72	NP B46 429	+Goldberg, Makowski, Donald+	(PARIS, LIVP)
LORSTAD	69	NP B14 63	+D'Andlau, Astier+	(CDEF, CERN)