$\eta(1440)$

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

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

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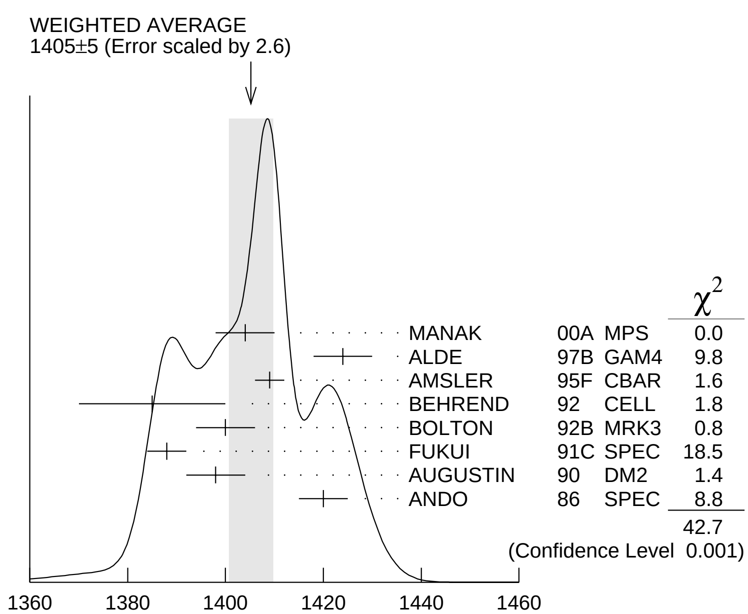
$\eta(1440)$ MASS

VALUE (MeV)	DOCUMENT ID
1400 - 1470 OUR ESTIMATE	Contains possibly two overlapping pseudoscalars.

$\eta\pi\pi$ MODE

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	COMMENT
1405± 5 OUR AVERAGE	Error includes scale factor of 2.6. See the ideogram below.				
1404± 6	9082	MANAK	00A	MPS	$18\ \pi^- p \to \eta\pi^+\pi^- n$
1424± 6	2200	ALDE	97B	GAM4	$100\ \pi^- p \to \eta\pi^0\pi^0 n$
1409± 3		AMSLER	95F	CBAR	$0\ \overline{p}p \to \pi^+\pi^-\pi^0\pi^0\eta$
1385±15		[1] BEHREND	92	CELL	$J/\psi \to \gamma\eta\pi^+\pi^-$
1400± 6		[1] BOLTON	92B	MRK3	$J/\psi \to \gamma\eta\pi^+\pi^-$
1388± 4		FUKUI	91C	SPEC	$8.95\ \pi^- p \to \eta\pi^+\pi^- n$
1398± 6	261	[2] AUGUSTIN	90	DM2	$J/\psi \to \gamma\eta\pi^+\pi^-$
1420± 5		ANDO	86	SPEC	$8\ \pi^- p \to \eta\pi^+\pi^- n$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
1385± 7		BAI	99	BES	$J/\psi \to \gamma\pi^+\pi^-$

[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	$J/\psi \rightarrow \pi^+\pi^-\gamma\gamma$
1432± 8	[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

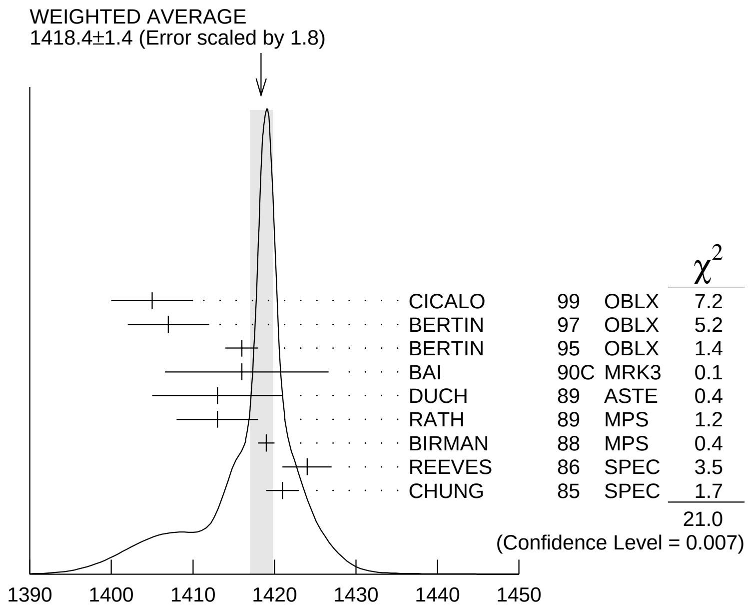
VALUE (MeV)	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
• • • We do not use the following data for averages, fits, limits, etc. • • •					
1420±20		BUGG	95	MRK3	$J/\psi \rightarrow \gamma\pi^+\pi^-\pi^+\pi^-$
1489±12	3270	[5] BISELLO	89B	DM2	$J/\psi \rightarrow 4\pi\gamma$

[5] Estimated by us from various fits.

$K\overline{K}\pi$ MODE ($a_0(980)\,\pi$ dominant)

VALUE (MeV)	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
1418.4±1.4 OUR AVERAGE	Error includes scale factor of 1.8. See the ideogram below.				
1405 ±5		[6] CICALO	99	OBLX	$0\ \overline{p}p \rightarrow K^\pm K^0_S \pi^\mp\pi^+\pi^-$
1407 ±5		[6] BERTIN	97	OBLX	$0\ \overline{p}p \rightarrow K^\pm (K^0)\pi^\mp\pi^+\pi^-$
1416 ±2		[6] BERTIN	95	OBLX	$0\ \overline{p}p \rightarrow K\overline{K}\pi\pi\pi$
1416 ±8 $^{+7}_{-5}$	700	[7] BAI	90C	MRK3	$J/\psi \rightarrow \gamma K^0_S K^\pm\pi^\mp$
1413 ±8	500	DUCH	89	ASTE	$\overline{p}p \rightarrow \pi^+\pi^- K^\pm\pi^\mp K^0$
1413 ±5		[7] RATH	89	MPS	$21.4\ \pi^- p \rightarrow n K^0_S K^0_S \pi^0$
1419 ±1	8800	BIRMAN	88	MPS	$8\ \pi^- p \rightarrow K^+\overline{K}^0\pi^- n$
1424 ±3	620	REEVES	86	SPEC	$6.6\ p\overline{p} \rightarrow K\overline{K}\pi X$
1421 ±2		CHUNG	85	SPEC	$8\ \pi^- p \rightarrow K\overline{K}\pi n$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
1459 ±5		[8] AUGUSTIN	92	DM2	$J/\psi \rightarrow \gamma K\overline{K}\pi$

[6] Decaying into $(K\overline{K})_S\pi$, $(K\pi)_S\overline{K}$, and $a_0(980)\pi$.
[7] From fit to the $a_0(980)\pi\ 0^{-+}$ partial wave. Cannot rule out a $a_0(980)\pi\ 1^{++}$ partial wave.
[8] Excluded from averaging because averaging would be meaningless.

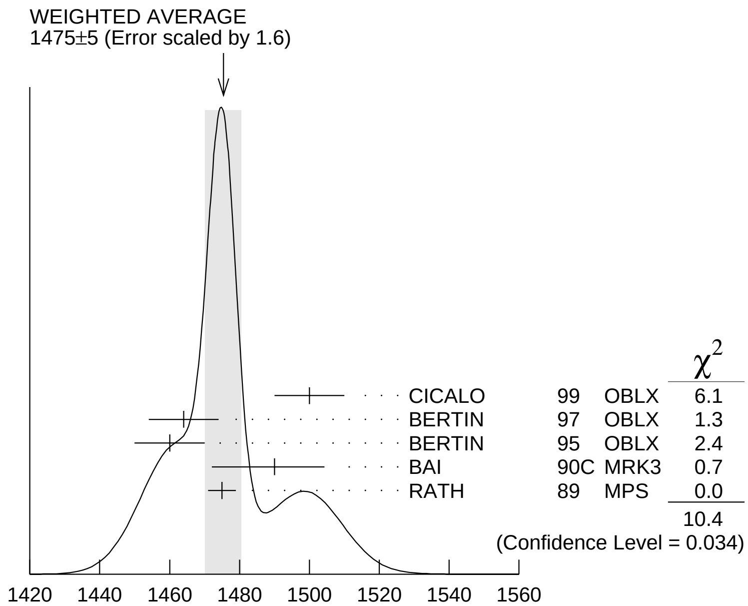


$\eta(1440)$ mass, $K\overline{K}\pi$ mode ($a_0(980)\,\pi$ dominant) (MeV)

$K\overline{K}\pi$ MODE ($K^*(892)\,K$ dominant)

VALUE (MeV)	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
1475± 5 OUR AVERAGE	Error includes scale factor of 1.6. See the ideogram below.				
1500±10		CICALO	99	OBLX	0 $\overline{p}p \rightarrow K^{\pm}K^0_S\pi^{\mp}\pi^+\pi^-$
1464±10		BERTIN	97	OBLX	0 $\overline{p}p \rightarrow K^{\pm}(K^0)\pi^{\mp}\pi^+\pi^-$
1460±10		BERTIN	95	OBLX	0 $\overline{p}p \rightarrow K\overline{K}\pi\pi\pi$
1490^{+14+3}_{-8-16}	1100	BAI	90C	MRK3	$J/\psi \rightarrow \gamma K^0_S K^{\pm}\pi^{\mp}$
1475± 4		RATH	89	MPS	21.4 $\pi^- p \rightarrow n K^0_S K^0_S \pi^0$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
1442±10	410	BAI	98C	BES	$J/\psi \rightarrow \gamma K^+K^-\pi^0$
1421±14		[9] AUGUSTIN	92	DM2	$J/\psi \rightarrow \gamma K\overline{K}\pi$

[9] Excluded from averaging because averaging would be meaningless.



$\eta(1440)$ mass, $K\overline{K}\pi$ mode ($K^*(892)$ K dominant) (MeV)

$K\overline{K}\pi$ MODE (unresolved)

VALUE (MeV)	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
• • • We do not use the following data for averages, fits, limits, etc. • • •					
1445 ± 8	693	AUGUSTIN	90	DM2	$J/\psi \rightarrow \gamma K^0_S K^\pm \pi^\mp$
1433 ± 8	296	AUGUSTIN	90	DM2	$J/\psi \rightarrow \gamma K^+ K^- \pi^0$
1453 ± 7	170	RATH	89	MPS	21.4 $\pi^- p \rightarrow K^0_S K^0_S \pi^0 n$
1440^{+20}_{-15}	174	EDWARDS	82E	CBAL	$J/\psi \rightarrow \gamma K^+ K^- \pi^0$
1440^{+10}_{-15}		SCHARRE	80	MRK2	$J/\psi \rightarrow \gamma K^0_S K^\pm \pi^\mp$
1425 ± 7	800	[10] BAILLON	67	HBC	$0\ \overline{p} p \rightarrow K\overline{K}\pi\pi\pi$

[10] From best fit of 0^{-+} partial wave , 50% $K^*(892)K$, 50% $a_0(980)\pi$.

$\eta(1440)$ WIDTH

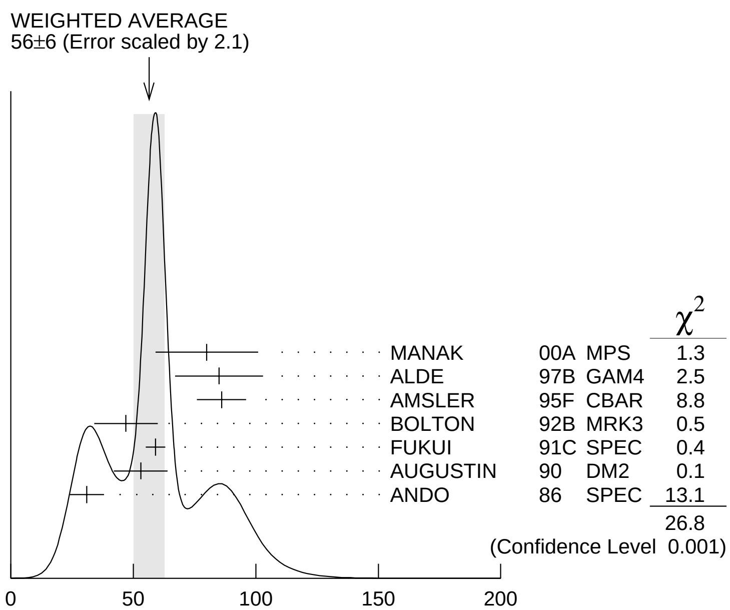
VALUE (MeV)	DOCUMENT ID
50 - 80 OUR ESTIMATE	Contains possibly two overlapping pseudoscalars.

$\eta\pi\pi$ MODE

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	COMMENT
56± 6 OUR AVERAGE	Error includes scale factor of 2.1. See the ideogram below.				
80±21	9082	MANAK	00A	MPS	18 $\pi^- p \to \eta\pi^+\pi^- n$
85±18	2200	ALDE	97B	GAM4	100 $\pi^- p \to \eta\pi^0\pi^0 n$
86±10		AMSLER	95F	CBAR	0 $\overline{p}p \to \pi^+\pi^-\pi^0\pi^0\eta$
47±13		[11] BOLTON	92B	MRK3	$J/\psi \to \gamma\eta\pi^+\pi^-$
59± 4		FUKUI	91C	SPEC	8.95 $\pi^- p \to \eta\pi^+\pi^- n$
53±11		[12] AUGUSTIN	90	DM2	$J/\psi \to \gamma\eta\pi^+\pi^-$
31± 7		ANDO	86	SPEC	8 $\pi^- p \to \eta\pi^+\pi^- n$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
~ 50		[12] BEHREND	92	CELL	$J/\psi \to \gamma\eta\pi^+\pi^-$

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

[12] 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	$J/\psi \rightarrow \pi^+\pi^-\gamma\gamma$
90±26	[13] COFFMAN	90	MRK3	$J/\psi \rightarrow \pi^+\pi^- 2\gamma$

[13] 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	[14] BISELLO	89B	DM2	$J/\psi \rightarrow 4\pi\gamma$

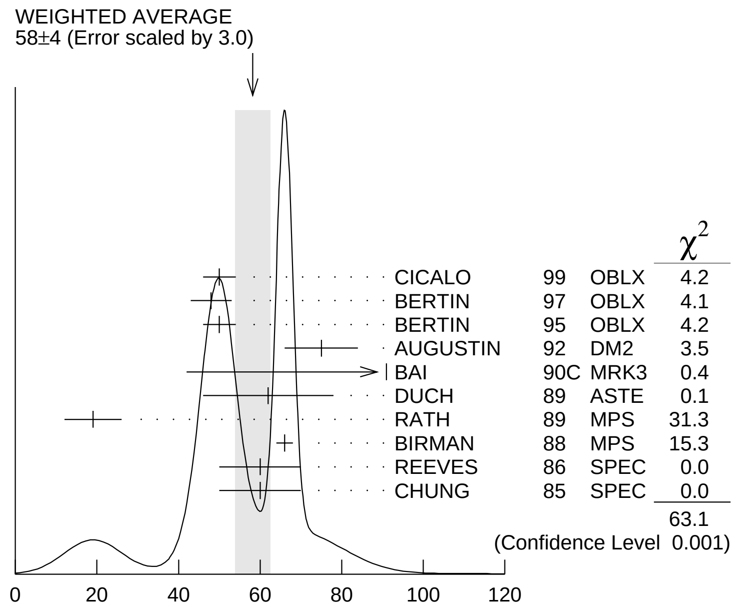
[14] Estimated by us from various fits.

$K\overline{K}\pi$ MODE ($a_0(980)\,\pi$ dominant)

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	COMMENT
58± 4 OUR AVERAGE	Error includes scale factor of 3.0. See the ideogram below.				
50± 4		CICALO	99	OBLX	$0\ \overline{p}p \rightarrow K^\pm K^0_S \pi^\mp\pi^+\pi^-$
48± 5		[15] BERTIN	97	OBLX	$0.0\ \overline{p}p \rightarrow K^\pm (K^0) \pi^\mp\pi^+\pi^-$
50± 4		[15] BERTIN	95	OBLX	$0\ \overline{p}p \rightarrow K\overline{K}\pi\pi\pi$
75± 9		AUGUSTIN	92	DM2	$J/\psi \rightarrow \gamma K\overline{K}\pi$
$91^{+67}_{-31}{}^{+15}_{-38}$		[16] BAI	90C	MRK3	$J/\psi \rightarrow \gamma K^0_S K^\pm \pi^\mp$
62±16	500	DUCH	89	ASTE	$\overline{p}p \rightarrow K\overline{K}\pi\pi\pi$
19± 7		[16] RATH	89	MPS	$21.4\ \pi^- p \rightarrow n K^0_S K^0_S \pi^0$
66± 2	8800	BIRMAN	88	MPS	$8\ \pi^- p \rightarrow K^+ \overline{K}^0 \pi^- n$
60±10	620	REEVES	86	SPEC	$6.6\ p\overline{p} \rightarrow K K \pi X$
60±10		CHUNG	85	SPEC	$8\ \pi^- p \rightarrow K\overline{K}\pi n$

[15] Decaying into $(K\overline{K})_S\pi$, $(K\pi)_S\overline{K}$, and $a_0(980)\pi$.

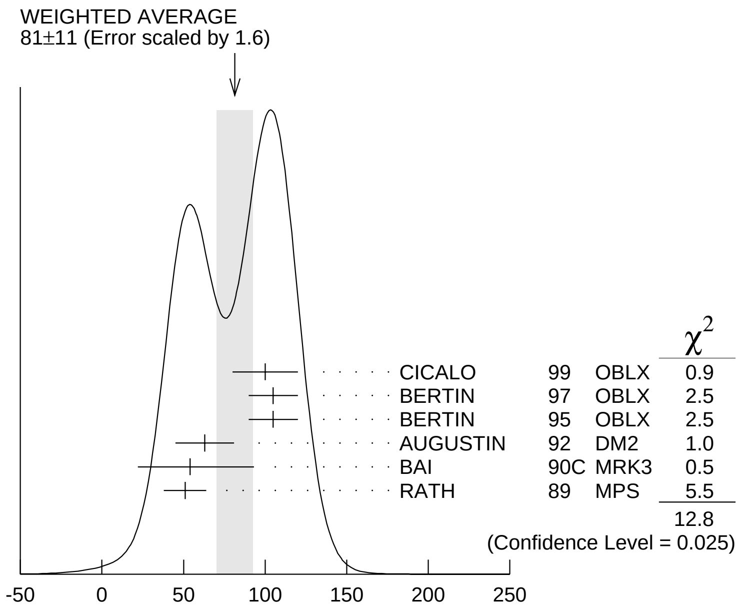
[16] From fit to the $a_0(980)\pi\ 0^{-+}$ partial wave , but $a_0(980)\pi\ 1^{++}$ cannot be excluded.



$\eta(1440)$ width $K\overline{K}\pi$ mode ($a_0(980)\ \pi$ dominant)

$K\overline{K}\pi$ MODE ($K^*(892)\ K$ dominant)

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
81±11 OUR AVERAGE	Error includes scale factor of 1.6. See the ideogram below.			
100±20	CICALO	99	OBLX	0 $\overline{p}p \to K^{\pm}K^0_S\pi^{\mp}\pi^+\pi^-$
105±15	BERTIN	97	OBLX	0.0 $\overline{p}p \to K^{\pm}(K^0)\pi^{\mp}\pi^+\pi^-$
105±15	BERTIN	95	OBLX	0 $\overline{p}p \to K\overline{K}\pi\pi\pi$
63±18	AUGUSTIN	92	DM2	$J/\psi \to \gamma K\overline{K}\pi$
$54^{+37}_{-21}{}^{+13}_{-24}$	BAI	90C	MRK3	$J/\psi \to \gamma K^0_S K^{\pm}\pi^{\mp}$
51±13	RATH	89	MPS	21.4 $\pi^- p \to nK^0_S K^0_S \pi^0$



$\eta(1440)$ width $K\overline{K}\pi$ mode ($K^*(892)$ K dominant)

$K\overline{K}\pi$ MODE (unresolved)

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
93 ± 14	296	AUGUSTIN	90	DM2	$J/\psi \to \gamma K^+ K^- \pi^0$
105 ± 10	693	AUGUSTIN	90	DM2	$J/\psi \to \gamma K^0_S K^\pm \pi^\mp$
100 ± 11	170	RATH	89	MPS	21.4 $\pi^- p \to K^0_S K^0_S \pi^0 n$
55^{+20}_{-30}	174	EDWARDS	82E	CBAL	$J/\psi \to \gamma K^+ K^- \pi^0$
50^{+30}_{-20}		SCHARRE	80	MRK2	$J/\psi \to \gamma K^0_S K^\pm \pi^\mp$
80 ± 10	800	[17] BAILLON	67	HBC	0.0 $\overline{p} p \to K\overline{K}\pi\pi\pi$

[17] From best fit to 0^{-+} partial wave , 50% $K^*(892)K$, 50% $a_0(980)\pi$.

$\eta(1440)$ DECAY MODES

	Mode	Fraction (Γ_i/Γ)
Γ_1	$K\overline{K}\pi$	seen
Γ_2	$K\overline{K}^*(892)+$ c.c.	seen
Γ_3	$\eta\pi\pi$	seen
Γ_4	$a_0(980)\pi$	seen

Γ_5	$\eta(\pi\pi)_{S\text{-wave}}$	seen
Γ_6	$f_0(980)\eta$	seen
Γ_7	4π	seen
Γ_8	$\gamma\gamma$	
Γ_9	$\rho^0\gamma$	

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

$\Gamma(K\overline{K}\pi) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$ — $\Gamma_1\Gamma_8/\Gamma$

VALUE (keV)	CL%	DOCUMENT ID		TECN	COMMENT
0.212±0.050±0.023		[18] ACCIARRI	01G	L3	183–202 $e^+e^- \to e^+e^- K^0_S K^\pm \pi^\mp$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<1.2	95	BEHREND	89	CELL	$\gamma\gamma \to K^0_S K^\pm \pi^\mp$
<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	$e^+e^- \to e^+e^- K\overline{K}\pi$

$\Gamma(\eta\pi\pi) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$ — $\Gamma_3\Gamma_8/\Gamma$

VALUE (keV)	CL%	DOCUMENT ID		TECN	COMMENT
<0.095	95	ACCIARRI	01G	L3	183–202 $e^+e^- \to e^+e^- \eta\pi^+\pi^-$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<0.3		ANTREASYAN	87	CBAL	$e^+e^- \to e^+e^- \eta\pi\pi$

$\Gamma(\rho^0\gamma) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$ — $\Gamma_9\Gamma_8/\Gamma$

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	$e^+e^- \to e^+e^- \pi^+\pi^-\gamma$

[18] Signal and mass compatible with $K^* K$ decay of high mass $\eta(1440)$ state.

$\eta(1440)$ BRANCHING RATIOS

$\Gamma(\eta\pi\pi)/\Gamma(K\overline{K}\pi)$ — Γ_3/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_4/Γ_1

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
∼ 0.15		[20] BERTIN	95	OBLX	0 $\overline{p}p \to K\overline{K}\pi\pi\pi$
∼ 0.8	500	[20] DUCH	89	ASTE	$\overline{p}p \to \pi^+\pi^- K^\pm\pi^\mp K^0$
∼ 0.75		[20] REEVES	86	SPEC	6.6 $p\overline{p} \to KK\pi X$

$\Gamma(a_0(980)\pi)/\Gamma(\eta\pi\pi)$ Γ_4/Γ_3

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.29±0.10		ABELE	98E	CBAR	0 $p\overline{p} \rightarrow \eta\pi^0\pi^0\pi^0$
0.19±0.04	2200	[21] ALDE	97B	GAM4	100 $\pi^- p \rightarrow \eta\pi^0\pi^0 n$
0.56±0.04±0.03		[21] AMSLER	95F	CBAR	0 $\overline{p}p \rightarrow \pi^+\pi^-\pi^0\pi^0\eta$

$\Gamma(a_0(980)\pi)/\Gamma(\eta(\pi\pi)_{S\text{-wave}})$ Γ_4/Γ_5

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.91±0.12		ANISOVICH	01	SPEC	0.0 $\overline{p}p \rightarrow \eta\pi^+\pi^-\pi^+\pi^-$
0.15±0.04	9082	MANAK	00A	MPS	18 $\pi^- p \rightarrow \eta\pi^+\pi^- n$
0.70±0.12±0.20		[22] BAI	99	BES	$J/\psi \rightarrow \gamma\eta\pi^+\pi^-$

$\Gamma(K\overline{K}^*(892)+\text{c.c.})/\Gamma(K\overline{K}\pi)$ Γ_2/Γ_1

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

$\Gamma(K\overline{K}^*(892)+\text{c.c.})/[\Gamma(K\overline{K}^*(892)+\text{c.c.})+\Gamma(a_0(980)\pi)]$ $\Gamma_2/(\Gamma_2+\Gamma_4)$

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

$\Gamma(\rho^0\gamma)/\Gamma(K\overline{K}\pi)$ Γ_9/Γ_1

VALUE	DOCUMENT ID		TECN	COMMENT
0.0152±0.0038	[23] COFFMAN	90	MRK3	$J/\psi \rightarrow \gamma\gamma\pi^+\pi^-$

$\Gamma(\eta(\pi\pi)_{S\text{-wave}})/\Gamma(\eta\pi\pi)$ Γ_5/Γ_3

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.81±0.04	2200	ALDE	97B	GAM4	100 $\pi^- p \rightarrow \eta\pi^0\pi^0 n$

$\Gamma(a_0(980)\pi)/\Gamma(\eta(\pi\pi)_{S\text{-wave}})$ Γ_4/Γ_5

VALUE	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.32±0.07	[19] ANISOVICH	99I	SPEC	0.9–1.2 $\overline{p}p \rightarrow \eta 3\pi^0$

[19] Using preliminary Crystal Barrel data.
[20] Assuming that the $a_0(980)$ decays only into $K\overline{K}$.
[21] Assuming that the $a_0(980)$ decays only into $\eta\pi$.
[22] Assuming that the $a_0(980)$ decays only into $\eta\pi$.
[23] Using B($J/\psi \rightarrow \gamma\eta(1440) \rightarrow \gamma K\overline{K}\pi$)=$4.2 \times 10^{-3}$ and B($J/\psi \rightarrow \gamma\eta(1440) \rightarrow \gamma\gamma\rho^0$)=$6.4\times10^{-5}$ and assuming that the $\gamma\rho^0$ signal does not come from the $f_1(1420)$.

$\eta(1440)$ REFERENCES

ACCIARRI	01G	PL B501 1	M. Acciarri *et al.*	(L3 Collab.)	
ANISOVICH	01	NP A690 567	A.V. Anisovich *et al.*		
MANAK	00A	PR D62 012003	J.J. Manak *et al.*		
ANISOVICH	99I	PL B468 304	A.V. Anisovich *et al.*		
BAI	99	PL B446 356	J.Z. Bai *et al.*	(BES Collab.)	
CICALO	99	PL B462 453	C. Cicalo *et al.*	(OBELIX Collab.)	
ABELE	98E	NP B514 45	A. Abele *et al.*	(Crystal Barrel Collab.)	
BAI	98C	PL B440 217	J.Z. Bai *et al.*	(BES Collab.)	
ALDE	97B	PAN 60 386	D. Alde *et al.*	(GAMS Collab.)	
		Translated from YAF 60 458.			
BERTIN	97	PL B400 226	A. Bertin *et al.*	(OBELIX Collab.)	
AMSLER	95F	PL B358 389	C. Amsler *et al.*	(Crystal Barrel Collab.)	
BERTIN	95	PL B361 187	A. Bertin *et al.*	(OBELIX Collab.)	
BUGG	95	PL B353 378	D.V. Bugg *et al.*	(LOQM, PNPI, WASH)	
AUGUSTIN	92	PR D46 1951	J.E. Augustin, G. Cosme	(DM2 Collab.)	
BEHREND	92	ZPHY C56 381	H.J. Behrend	(CELLO Collab.)	
BOLTON	92B	PRL 69 1328	T. Bolton *et al.*	(Mark III Collab.)	
FUKUI	91C	PL B267 293	S. Fukui *et al.*	(SUGI, NAGO, KEK, KYOT+)	
AUGUSTIN	90	PR D42 10	J.E. Augustin *et al.*	(DM2 Collab.)	
BAI	90C	PRL 65 2507	Z. Bai *et al.*	(Mark III Collab.)	
COFFMAN	90	PR D41 1410	D.M. Coffman *et al.*	(Mark III Collab.)	
BEHREND	89	ZPHY C42 367	H.J. Behrend *et al.*	(CELLO Collab.)	
BISELLO	89B	PR D39 701	G. Busetto *et al.*	(DM2 Collab.)	
DUCH	89	ZPHY C45 223	K.D. Duch *et al.*	(ASTERIX Collab.)	JP
RATH	89	PR D40 693	M.G. Rath *et al.*	(NDAM, BRAN, BNL, CUNY+)	
BIRMAN	88	PRL 61 1557	A. Birman *et al.*	(BNL, FSU, IND, MASD)	JP
ANTREASYAN	87	PR D36 2633	D. Antreasyan *et al.*	(Crystal Ball Collab.)	
AIHARA	86D	PRL 57 51	H. Aihara *et al.*	(TPC-2γ Collab.)	
ANDO	86	PRL 57 1296	A. Ando *et al.*	(KEK, KYOT, NIRS, SAGA+)	IJP
REEVES	86	PR D34 1960	D.F. Reeves *et al.*	(FLOR, BNL, IND+)	JP
ALTHOFF	85B	ZPHY C29 189	M. Althoff *et al.*	(TASSO Collab.)	
CHUNG	85	PRL 55 779	S.U. Chung *et al.*	(BNL, FLOR, IND+)	JP
ALTHOFF	84E	PL 147B 487	M. Althoff *et al.*	(TASSO Collab.)	
EDWARDS	83B	PRL 51 859	C. Edwards *et al.*	(CIT, HARV, PRIN+)	
JENNI	83	PR D27 1031	P. Jenni *et al.*	(SLAC, LBL)	
EDWARDS	82E	PRL 49 259	C. Edwards *et al.*	(CIT, HARV, PRIN+)	
Also	83	PRL 50 219	C. Edwards *et al.*	(CIT, HARV, PRIN+)	
SCHARRE	80	PL 97B 329	D.L. Scharre *et al.*	(SLAC, LBL)	
FOSTER	68B	NP B8 174	M. Foster *et al.*	(CERN, CDEF)	
BAILLON	67	NC 50A 393	P.H. Baillon *et al.*	(CERN, CDEF, IRAD)	

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NEKRASOV	98	EPJ C5 507	M.L. Nekrasov	
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BERTIN	96	PL B385 493	A. Bertin *et al.*	(Obelix Collab.)
FARRAR	96	PRL 76 4111	G.R. Farrar	(RUTG)
AMELIN	95	ZPHY C66 71	D.V. Amelin *et al.*	(VES Collab.)
GENOVESE	94	ZPHY C61 425	M. Genovese, D.B. Lichtenberg, E. Predazzi	(TORI+)
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LONGACRE	90	PR D42 874	R.S. Longacre	(BNL)
AHMAD	89	NP B (PROC.)8 50	S. Ahmad *et al.*	(ASTERIX Collab.)
ARMSTRONG	89	PL B221 216	T.A. Armstrong *et al.*	(CERN, CDEF, BIRM+)
ARMSTRONG	87	ZPHY C34 23	T.A. Armstrong *et al.*	(CERN, BIRM, BARI+)
ASTON	87	NP B292 693	D. Aston *et al.*	(SLAC, NAGO, CINC, INUS)
ARMSTRONG	84	PL 146B 273	T.A. Armstrong *et al.*	(ATHU, BARI, BIRM+)
DIONISI	80	NP B169 1	C. Dionisi *et al.*	(CERN, MADR, CDEF+)
DEFOIX	72	NP B44 125	C. Defoix *et al.*	(CDEF, CERN)
DUBOC	72	NP B46 429	J. Duboc *et al.*	(PARIS, LIVP)
LORSTAD	69	NP B14 63	B. Lorstad *et al.*	(CDEF, CERN)