

$a_0(980)$

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

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

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

Note that $\Gamma = -2 \operatorname{Im}(\sqrt{s})$.

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		$0.0 \bar{p} p, \pi N$
$982.3^{+0.6}_{-0.7} {}^{+3.1}_{-4.7}$		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		$450 p p \rightarrow p_f \eta \pi^0 p_s$
988 ± 8		BARBERIS	00H		$450 p p \rightarrow \Delta_f^{++} \eta \pi^- p_s$
~ 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 $\pm$	$300 p p \rightarrow$ $p p \eta \pi^+ \pi^-$
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
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
$947.7^{+5.5}_{-5.0} \pm 6.6$		¹ AAIJ	19H	LHCB $p p \rightarrow D^\pm X$
$925 \pm 5 \pm 8$	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 $0.0 \bar{p}p \rightarrow K^\pm K_S^0 \pi^\mp$
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

- ¹From the $D^\pm \rightarrow K^\pm K^+ K^-$ Dalitz plot fit with the Triple-M amplitude in the multi-meson model of AOUDE 18.
- ²Using a two-channel resonance parametrization with couplings fixed to ABELE 98.
- ³T-matrix pole.
- ⁴ASTIER 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 $\pm$ 1.6 $^{+17.4}_{-10.0}$		¹ UEHARA	09A	BELL	$\gamma\gamma \rightarrow \pi^0 \eta$
50 $\pm$ 13 $\pm$ 4	318	ACHARD	02B	L3	183–209 $e^+ e^- \rightarrow e^+ e^- \eta \pi^+ \pi^-$
72 $\pm$ 16		BARBERIS	00H		450 $p p \rightarrow p_f \eta \pi^0 p_s$
61 $\pm$ 19		BARBERIS	00H		450 $p p \rightarrow \Delta_f^{++} \eta \pi^- p_s$
$\sim$ 42		² OLLER	99	RVUE	$\eta\pi, K\bar{K}$
$\sim$ 112		² OLLER	99B	RVUE	$\pi\pi \rightarrow \eta\pi, K\bar{K}$
71 $\pm$ 7		TEIGE	99	B852	18.3 $\pi^- p \rightarrow \eta \pi^+ \pi^- n$
92 $\pm$ 20		² ANISOVICH	98B	RVUE	Compilation
65 $\pm$ 10		³ BERTIN	98B	OBLX $\pm$	0.0 $\bar{p}p \rightarrow K^\pm K_s \pi^\mp$
$\sim$ 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 $\pm$ 10		⁴ AMSLER	92	CBAR	0.0 $\bar{p}p \rightarrow \eta \eta \pi^0$
95 $\pm$ 14	1040	⁴ ARMSTRONG	91B	OMEG $\pm$	300 $p p \rightarrow p p \eta \pi^+ \pi^-$
62 $\pm$ 15	500	⁵ EVANGELIS...	81	OMEG $\pm$	12 $\pi^- p \rightarrow \eta \pi^+ \pi^- \pi^- p$
60 $\pm$ 20	145	⁵ GURTU	79	HBC $\pm$	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 $\pm$	12–15 $\pi^- p \rightarrow n \eta 2\pi$
44 $\pm$ 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 $^{+25.0}_{-16.0}$	70	⁷ WELLS	75	HBC $-$	3.1–6 $K^- p \rightarrow \Lambda \eta 2\pi$
30 $\pm$ 5	150	⁸ DEFOIX	72	HBC $\pm$	0.7 $\bar{p}p \rightarrow 7\pi$
40 $\pm$ 15		CAMPBELL	69	DBC $\pm$	2.7 $\pi^+ d$
60 $\pm$ 30	15	MILLER	69B	HBC $-$	4.5 $K^- N \rightarrow \eta \pi \Lambda$
80 $\pm$ 30	30	AMMAR	68	HBC $\pm$	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 T-matrix pole.
³ The $\eta\pi$ width.
⁴ From 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
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●					
~ 48		¹ OLLER	99C	RVUE	$\pi\pi \rightarrow \pi\pi, K\bar{K}$
~ 25	100	² ASTIER	67	HBC	$\pm$
57 ± 13	143	³ ROSENFELD	65	RVUE	$\pm$
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)
$\Gamma_1 \quad \eta\pi$	seen
$\Gamma_2 \quad K\bar{K}$	seen
$\Gamma_3 \quad \eta'\pi$	seen
$\Gamma_4 \quad \rho\pi$	not seen
$\Gamma_5 \quad \gamma\gamma$	seen
$\Gamma_6 \quad e^+e^-$	

$a_0(980)$ PARTIAL WIDTHS

$\Gamma(\gamma\gamma)$	Γ_5		
<u>VALUE (keV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
0.30 ± 0.10	¹ AMSLER	98	RVUE
¹ Using $\Gamma_{\gamma\gamma} B(a_0(980) \rightarrow \eta\pi) = 0.24 \pm 0.08$ 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	
0.21 $\begin{smallmatrix} +0.08 \\ -0.04 \end{smallmatrix}$ OUR AVERAGE					
$0.128 \begin{smallmatrix} +0.003+0.502 \\ -0.002-0.043 \end{smallmatrix}$		¹ UEHARA	09A	BELL	$\gamma\gamma \rightarrow \pi^0\eta$
$0.28 \pm 0.04 \pm 0.10$	44	OEST	90	JADE	$e^+e^- \rightarrow e^+e^-\pi^0\eta$
$0.19 \pm 0.07 \begin{smallmatrix} +0.10 \\ -0.07 \end{smallmatrix}$		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	$450 p p \rightarrow p_f f_1(1285) p_s$
● ● ● 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	$12\text{--}15 \pi^- p \rightarrow n \eta 2\pi$
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 $0.149 \pm 0.001 \pm 0.039$.

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 $K^\pm K_S^0 \pi^\mp$.

$\Gamma(\eta'\pi)/\Gamma_{\text{total}}$			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 10.1σ significance. Earlier observed by ABLIKIM 17K in the $\chi_{c1} \rightarrow \eta \pi^+ \pi^-$ decay with a 8.9σ significance.

$\Gamma(\rho\pi)/\Gamma(\eta\pi)$	Γ_4/Γ_1
$\rho\pi$ forbidden.	

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

<0.25	70	¹ AMMAR	70	HBC	± 4.1,5.5 $K^- p \rightarrow \Lambda \eta 2\pi$
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¹ Not clear if they really observed the $a_0(980)$ 3 standard deviations.

$a_0(980)$ REFERENCES

- ABLIKIM 22AH PRL 129 182001 M. Ablikim *et al.* (BESIII Collab.)
 ALBRECHT 20 EPJ C80 453 M. Albrecht *et al.* (Crystal Barrel Collab.)
 CHEN 20A PR D102 012002 Y.Q. Chen *et al.* (BELLE Collab.)
 LU 20 EPJ C80 436 J. Lu, B. Moussallam
 AAIJ 19H JHEP 1904 063 R. Aaij *et al.* (LHCb Collab.)
 ABLIKIM 19BE PRL 123 112001 M. Ablikim *et al.* (BESIII Collab.)
 AOUE 18 PR D98 056021 R.T. Aoude *et al.*
 ABLIKIM 17K PR D95 032002 M. Ablikim *et al.* (BESIII Collab.)
 AAIJ 16N PR D93 052018 R. Aaij *et al.* (LHCb Collab.)
 AMBROSINO 09F PL B681 5 F. Ambrosino *et al.* (KLOE Collab.)
 ANISOVICH 09 IJMP A24 2481 V.V. Anisovich, A.V. Sarantsev (PNPI)
 UEHARA 09A PR D80 032001 S. Uehara *et al.* (BELLE Collab.)
 BUGG 08A PR D78 074023 D.V. Bugg (LOQM)
 PELAEZ 04A MPL A19 2879 J.R. Pelaez (MADU)
 ACHASOV 03B PR D68 014006 N.N. Achasov, A.V. Kiselev
 BARGIOTTI 03 EPJ C26 371 M. Bargiotti *et al.* (OBELIX Collab.)
 ACHARD 02B PL B526 269 P. Achard *et al.* (L3 Collab.)
 ACHASOV 00F PL B479 53 M.N. Achasov *et al.* (Novosibirsk SND Collab.)
 BARBERIS 00H PL B488 225 D. Barberis *et al.* (WA 102 Collab.)
 OLLER 99 PR D60 099906 (errat.) J.A. Oller *et al.*
 OLLER 99B NP A652 407 (errat.) J.A. Oller, E. Oset
 OLLER 99C PR D60 074023 J.A. Oller, E. Oset
 TEIGE 99 PR D59 012001 S. Teige *et al.* (BNL E852 Collab.)
 ABELE 98 PR D57 3860 A. Abele *et al.* (Crystal Barrel Collab.)
 ACHASOV 98B PL B438 441 M.N. Achasov *et al.* (Novosibirsk SND Collab.)
 AMSLER 98 RMP 70 1293 C. Amshler
 ANISOVICH 98B SPU 41 419 V.V. Anisovich *et al.*
 Translated from UFN 168 481.
 BARBERIS 98C PL B440 225 D. Barberis *et al.* (WA 102 Collab.)
 BERTIN 98B PL B434 180 A. Bertin *et al.* (OBELIX Collab.)
 TORNQVIST 96 PRL 76 1575 N.A. Tornqvist, M. Roos (HELs)
 JANSSEN 95 PR D52 2690 G. Janssen *et al.* (STON, ADLD, JULI)
 AMSLER 94C PL B327 425 C. Amshler *et al.* (Crystal Barrel Collab.)
 AMSLER 94D PL B333 277 C. Amshler *et al.* (Crystal Barrel Collab.)
 BUGG 94 PR D50 4412 D.V. Bugg *et al.* (LOQM)
 AMSLER 92 PL B291 347 C. Amshler *et al.* (Crystal Barrel Collab.)
 ARMSTRONG 91B ZPHY C52 389 T.A. Armstrong *et al.* (ATHU, BARI, BIRM+)
 OEST 90 ZPHY C47 343 T. Oest *et al.* (JADE Collab.)
 ACHASOV 89 NP B315 465 N.N. Achasov, V.N. Ivanchenko
 ASTON 88 NP B296 493 D. Aston *et al.* (SLAC, NAGO, CINC, INUS)
 VOROBYEV 88 SJNP 48 273 P.V. Vorobiev *et al.* (NOVO)
 Translated from YAF 48 436.
 ANTREASYAN 86 PR D33 1847 D. Antreasyan *et al.* (Crystal Ball Collab.)
 ATKINSON 84E PL 138B 459 M. Atkinson *et al.* (BONN, CERN, GLAS+)
 EVANGELIS... 81 NP B178 197 C. Evangelista *et al.* (BARI, BONN, CERN+)
 DEBILLY 80 NP B176 1 L. de Billy *et al.* (CURIN, LAUS, NEUC+)
 GURTU 79 NP B151 181 A. Gurtu *et al.* (CERN, ZEEM, NIJM, OXF)
 CONFORTO 78 LNC 23 419 B. Conforto *et al.* (RHEL, TNTO, CHIC+)
 CORDEN 78 NP B144 253 M.J. Corden *et al.* (BIRM, RHEL, TELA+)
 ESTABROOKS 78 NP B133 490 P.G. Estabrooks *et al.* (MCGI, CARL, DURH+)
 GRASSLER 77 NP B121 189 H. Grassler *et al.* (AACH3, BERL, BONN+)
 JAFFE 77 PR D15 267,281 R. Jaffe (MIT)
 FLATTE 76 PL 63B 224 S.M. Flatte (CERN)
 GAY 76B PL 63B 220 J.B. Gay *et al.* (CERN, AMST, NIJM) JP
 WELLS 75 NP B101 333 J. Wells *et al.* (OXF)
 LINGLIN 73 NP B55 408 D. Linglin (CERN)
 DEFOIX 72 NP B44 125 C. Defoix *et al.* (CDEF, CERN)
 AMMAR 70 PR D2 430 R. Ammar *et al.* (KANS, NWES, ANL, WISC)
 BARNES 69C PRL 23 610 V.E. Barnes *et al.* (BNL, SYRA)
 CAMPBELL 69 PRL 22 1204 J.H. Campbell *et al.* (PURD)
 MILLER 69B PL 29B 255 D.H. Miller *et al.* (PURD)
 Also PR 188 2011 W.L. Yen *et al.* (PURD)
 AMMAR 68 PRL 21 1832 R. Ammar *et al.* (NWES, ANL)
 ASTIER 67 PL 25B 294 A. Astier *et al.* (CDEF, CERN, IRAD)
 Includes data of BARLOW 67, CONFORTO 67, and ARMENTEROS 65.
 BARLOW 67 NC 50A 701 J. Barlow *et al.* (CERN, CDEF, IRAD, LVP)
 CONFORTO 67 NP B3 469 G. Conforto *et al.* (CERN, CDEF, IPNP+)

ARMENTEROS 65	PL 17 344	R. Armenteros <i>et al.</i>	(CERN, CDEF)
ROSENFELD 65	Oxford Conf. 58	A.H. Rosenfeld	(LRL)
