$a_0(980)$

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

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

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

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
(960–1030) − i (20–70) OUR ESTIMATE (see Fig. 64.2 in the review)				
• • • We do not use the following data for averages, fits, limits, etc. • • •				
$(989 \pm 5) - i(40 \pm 5)$	[1] BUGG	08A	RVUE	$\overline{p}p$ annihilation data
$(1117^{+24}_{-320}) - i(12^{+43}_{-12})$	[2] PELAEZ	04A	RVUE	$\pi\pi \to \pi\pi$, $\pi K \to \pi K$
$(982 \pm 3) - i(46 \pm 4)$	[3] ABELE	98	CBAR	0.0 $\overline{p}p \to K^0_L K^\pm \pi^\mp$

[1] T-matrix pole on sheet II. Parameterizes couplings to $\overline{K}K$, $\pi\eta$, and $\pi\eta'$. Uses AMSLER 94D and ABELE 98.
[2] Reanalysis of data from LINGLIN 73, ESTABROOKS 78, and ASTON 88 in the unitarized ChPT model.
[3] 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		TECN	COMMENT
980 ±20 OUR ESTIMATE Mass determination very model dependent				
• • • We do not use the following data for averages, fits, limits, etc. • • •				
$1000.7^{+12.9}_{-\ 0.7}$	[1] LU	20	RVUE	$\gamma\gamma \to \pi^0\eta$, $K^0_S K^0_S$

[1] T-matrix pole on sheet II.

$\eta\pi$ FINAL STATE ONLY

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	CHG	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •						
$1004.1 \pm 1.5 \pm 6.5$		[1] ALBRECHT	20	CBAR		0.9 $\overline{p}p \to \pi^0\pi^0\eta$, $\pi^0\eta\eta$, $\pi^0 K^+ K^-$
$982.5 \pm 1.6 \pm 1.1$	16.9k	[2] AMBROSINO	09F	KLOE		1.02 $e^+e^- \to \eta\pi^0\gamma$
986 ± 4		ANISOVICH	09	RVUE		0.0 $\overline{p}p$, πN
$982.3 ^{+0.6}_{-0.7} {}^{+3.1}_{-4.7}$		[3] UEHARA	09A	BELL		$\gamma\gamma \to \pi^0\eta$
$985 \pm 4 \pm 6$	318	ACHARD	02B	L3		183–209 $e^+e^- \to e^+e^-\eta\pi^+\pi^-$
$995 ^{+52}_{-10}$	36	[4] ACHASOV	00F	SND		$e^+e^- \to \eta\pi^0\gamma$
$994 ^{+33}_{-\ 8}$	36	[5] ACHASOV	00F	SND		$e^+e^- \to \eta\pi^0\gamma$
975 ± 7		BARBERIS	00H			450 $pp \to p_f \eta\pi^0 p_s$
988 ± 8		BARBERIS	00H			450 $pp \to \Delta^{++}_f \eta\pi^- p_s$
~ 1055		[6] OLLER	99	RVUE		$\eta\pi$, $K\overline{K}$
~ 1009.2		[6] OLLER	99B	RVUE		$\pi\pi \to \pi\pi$, $K\overline{K}$

993.1 $\pm$ 2.1		[7] TEIGE	99	B852	18.3 $\pi^- p \to \eta\pi^+\pi^- n$
988 $\pm$ 6		[6] 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		[8] AMSLER	92	CBAR	0.0 $\overline{p}p \to \eta\eta\pi^0$
984 $\pm$ 4	1040	[8] ARMSTRONG	91B	OMEG $\pm$	300 $pp \to pp\eta\pi^+\pi^-$
976 $\pm$ 6		ATKINSON	84E	OMEG $\pm$	25–55 $\gamma p \to \eta\pi n$
986 $\pm$ 3	500	[9] EVANGELIS...	81	OMEG $\pm$	12 $\pi^- p \to \eta\pi^+\pi^-\pi^- p$
990 $\pm$ 7	145	[9] GURTU	79	HBC $\pm$	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 $\pm$	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 $\pm$ 10	150	DEFOIX	72	HBC $\pm$	0.7 $\overline{p}p \to 7\pi$
970 $\pm$ 15	20	BARNES	69C	HBC $-$	4–5 $K^- p \to \Lambda\eta 2\pi$
980 $\pm$ 10		CAMPBELL	69	DBC $\pm$	2.7 $\pi^+ d$
980 $\pm$ 10	15	MILLER	69B	HBC $-$	4.5 $K^- N \to \eta\pi\Lambda$
980 $\pm$ 10	30	AMMAR	68	HBC $\pm$	5.5 $K^- p \to \Lambda\eta 2\pi$

[1] T-matrix pole with 2 poles, 2 channels, pole mass on adjacent sheet 1002.4 $\pm$ 1.4 $\pm$ 6.6 MeV.
[2] Using the model of ACHASOV 89 and ACHASOV 03B.
[3] From a fit with the S-wave amplitude including two interfering Breit-Wigners plus a background term.
[4] Using the model of ACHASOV 89. Supersedes ACHASOV 98B.
[5] Using the model of JAFFE 77. Supersedes ACHASOV 98B.
[6] T-matrix pole.
[7] Breit-Wigner fit, average between $a_0^\pm$ and a_0^0. The fit favors a slightly heavier $a_0^\pm$.
[8] From a single Breit-Wigner fit.
[9] From $f_1(1285)$ decay.

$K\overline{K}$ 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	$pp \to D^\pm X$
925 $\pm$ 5 $\pm$ 8	190k	[2] AAIJ	16N LHCB	$D^0 \to K^0_S K^\pm \pi^\mp$
$\sim$ 1053		[3] OLLER	99C RVUE	$\pi\pi \to \pi\pi$, $K\overline{K}$
975 $\pm$ 15		BERTIN	98B OBLX	0.0 $\overline{p}p \to K^\pm K_s \pi^\mp$
970 $\pm$ 10	316	DEBILLY	80 HBC	1.2–2 $\overline{p}p \to f_1(1285)\omega$
1016 $\pm$ 10	100	[4] ASTIER	67 HBC	0.0 $\overline{p}p$
1003.3 $\pm$ 7.0	143	[5,6] ROSENFELD	65 RVUE	

[1] From the$D^\pm \to K^\pm K^+ K^-$ Dalitz plot fit with the Triple-M amplitude in the multi-meson model of AOUDE 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.
[5] Note on J^P. Main argument for 0^+ is small Q value. Isotropy of decay distribution in $\overline{p}p$ at rest proves nothing. See discussion by Rosenfeld (Oxford) and Butterworth (Heidelberg).
[6] 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. • • •						
$97.2 \pm 1.9 \pm 5.7$		[1] ALBRECHT	20	CBAR		$0.9\ \overline{p}p \to \pi^0\pi^0\eta$, $\pi^0\eta\eta$, $\pi^0 K^+ K^-$
$73.2\ ^{+25.4}_{-5.2}$		[2] LU	20	RVUE		$\gamma\gamma \to \pi^0\eta$, $K^0_S K^0_S$
$75.6 \pm 1.6\ ^{+17.4}_{-10.0}$		[3] UEHARA	09A	BELL		$\gamma\gamma \to \pi^0\eta$
$50 \pm 13 \pm 4$	318	ACHARD	02B	L3		183–209 $e^+e^- \to e^+e^-\eta\pi^+\pi^-$
72 ± 16		BARBERIS	00H			$450\ pp \to p_f\eta\pi^0 p_s$
61 ± 19		BARBERIS	00H			$450\ pp \to \Delta_f^{++}\eta\pi^- p_s$
~ 42		[4] OLLER	99	RVUE		$\eta\pi$, $K\overline{K}$
~ 112		[4] OLLER	99B	RVUE		$\pi\pi \to \eta\pi$, $K\overline{K}$
71 ± 7		TEIGE	99	B852		$18.3\ \pi^- p \to \eta\pi^+\pi^- n$
92 ± 20		[4] ANISOVICH	98B	RVUE		Compilation
65 ± 10		[5] BERTIN	98B	OBLX	$\pm$	$0.0\ \overline{p}p \to K^\pm K_s\pi^\mp$
~ 100		TORNQVIST	96	RVUE		$\pi\pi \to \pi\pi$, $K\overline{K}$, $K\pi$, $\eta\pi$
202		JANSSEN	95	RVUE		$\eta\pi \to \eta\pi$, $K\overline{K}$, $K\pi$, $\eta\pi$
$54.12 \pm 0.34 \pm 0.12$		AMSLER	94C	CBAR		$0.0\ \overline{p}p \to \omega\eta\pi^0$
54 ± 10		[6] AMSLER	92	CBAR		$0.0\ \overline{p}p \to \eta\eta\pi^0$
95 ± 14	1040	[6] ARMSTRONG	91B	OMEG	$\pm$	$300\ pp \to pp\eta\pi^+\pi^-$
62 ± 15	500	[7] EVANGELIS...	81	OMEG	$\pm$	$12\ \pi^- p \to \eta\pi^+\pi^-\pi^- p$
60 ± 20	145	[7] GURTU	79	HBC	$\pm$	$4.2\ K^- p \to \Lambda\eta 2\pi$
$60\ ^{+50}_{-30}$	47	CONFORTO	78	OSPK	$-$	$4.5\ \pi^- p \to pX^-$
$86.0\ ^{+60.0}_{-50.0}$	50	CORDEN	78	OMEG	$\pm$	12–15 $\pi^- p \to n\eta 2\pi$
44 ± 22		GRASSLER	77	HBC	$-$	$16\ \pi^\mp p \to p\eta 3\pi$
80 to 300		[8] FLATTE	76	RVUE	$-$	$4.2\ K^- p \to \Lambda\eta 2\pi$
$16.0\ ^{+25.0}_{-16.0}$	70	[9] WELLS	75	HBC	$-$	3.1–6 $K^- p \to \Lambda\eta 2\pi$
30 ± 5	150	[10] DEFOIX	72	HBC	$\pm$	$0.7\ \overline{p}p \to 7\pi$
40 ± 15		CAMPBELL	69	DBC	$\pm$	$2.7\ \pi^+ d$
60 ± 30	15	MILLER	69B	HBC	$-$	$4.5\ K^- N \to \eta\pi\Lambda$
80 ± 30	30	AMMAR	68	HBC	$\pm$	$5.5\ K^- p \to \Lambda\eta 2\pi$

[1] T-matrix pole with 2 poles, 2 channels, pole width on adjacent sheet $127.0 \pm 2.3 \pm 6.7$ MeV.

[2] T-matrix pole on sheet II.
[3] From a fit with the S-wave amplitude including two interfering Breit-Wigners plus a background term.
[4] T-matrix pole.
[5] The $\eta\pi$ width.
[6] From a single Breit-Wigner fit.
[7] From $f_1(1285)$ decay.
[8] Using a two-channel resonance parametrization of GAY 76B data.
[9] Weak evidence only for $a_0(980)^+$ production.
[10] This number has very little meaning. Error is much too small. Vlada

$K\overline{K}$ 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		$\pi\pi \rightarrow \pi\pi$, $K\overline{K}$
~ 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	$K\overline{K}$	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
• • • 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($a0(980) \rightarrow \eta\pi$) =0.24 ± 0.08 keV.

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

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

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	$\gamma\gamma \rightarrow \pi^0\eta$
0.28 ±0.04 ±0.10	44	OEST	90	JADE	$e^+e^- \rightarrow e^+e^-\pi^0\eta$
$0.19 \pm 0.07 {}^{+0.10}_{-0.07}$		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.

$\Gamma(\eta\pi) \times \Gamma(e^+e^-)/\Gamma_{total}$ — $\Gamma_1\Gamma_6/\Gamma$

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

$a_0(980)$ BRANCHING RATIOS

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

VALUE	DOCUMENT ID		TECN	CHG	COMMENT
0.177±0.024 OUR AVERAGE Error includes scale factor of 1.2.					
0.23 ±0.05	[1] ABELE	98	CBAR		0.0 $\overline{p}p \rightarrow K^0_L K^\pm \pi^\mp$
0.166±0.01 ±0.02	[2] BARBERIS	98C	OMEG		450 $pp \rightarrow p_f f_1(1285) p_s$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.138±0.001±0.035	[3] ALBRECHT	20	CBAR		0.9 $\overline{p}p \rightarrow \pi^0\pi^0\eta$, $\pi^0\eta\eta$, $\pi^0 K^+K^-$
1.20 ±0.15	[4] ANISOVICH	09	RVUE		0.0 $\overline{p}p$, πN
1.05 ±0.07 ±0.05	[5] BUGG	08A	RVUE	0	$\overline{p}p \rightarrow \pi^0\pi^0\eta$
0.57 ±0.16	[6] BARGIOTTI	03	OBLX		$\overline{p}p$
∼ 0.60	OLLER	99B	RVUE		$\pi\pi \rightarrow \eta\pi$, $K\overline{K}$
0.7 ±0.3	[2] CORDEN	78	OMEG		12–15 $\pi^- p \rightarrow n\eta 2\pi$
0.25 ±0.08	[2] DEFOIX	72	HBC	±	0.7 $\overline{p} \rightarrow 7\pi$

[1] Using $\pi^0\pi^0\eta$ from AMSLER 94D.
[2] From the decay of $f_1(1285)$.
[3] Residues from T-matrix pole with 2 poles, 2 channels. Solution on adjacent sheet 0.149 ± 0.001 ± 0.039.
[4] This is a ratio of couplings.
[5] A ratio of couplings, using AMSLER 94D and ABELE 98. Supersedes BUGG 94.
[6] Coupled channel analysis of $\pi^+\pi^-\pi^0$, $K^+K^-\pi^0$, and $K^\pm K^0_S \pi^\mp$.

$\Gamma(\eta'\pi)/\Gamma_{total}$ — 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

$\rho\pi$ forbidden.

VALUE	CL%	DOCUMENT ID		TECN	CHG	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •						
<0.25	70	[1] AMMAR	70	HBC	±	4.1,5.5 $K^- p \rightarrow \Lambda\eta 2\pi$

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

$a_0(980)$ REFERENCES

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.)
AOUDE	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	
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. Achsaov, 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 (erratum)	J.A. Oller *et al.*	
OLLER	99B	NP A652 407 (erratum)	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. Amsler	
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. Amsler *et al.*	(Crystal Barrel Collab.)
AMSLER	94D	PL B333 277	C. Amsler *et al.*	(Crystal Barrel Collab.)
BUGG	94	PR D50 4412	D.V. Bugg *et al.*	(LOQM)
AMSLER	92	PL B291 347	C. Amsler *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, LIVP)
CONFORTO	67	NP B3 469	G. Conforto *et al.*	(CERN, CDEF, IPNP+)
ARMENTEROS	65	PL 17 344	R. Armenteros *et al.*	(CERN, CDEF)
ROSENFELD	65	Oxford Conf. 58	A.H. Rosenfeld	(LRL)