

# $f_0(980)$

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

See also the minireview on scalar mesons under  $f_0(600)$ . (See the index for the page number.)

## $f_0(980)$ MASS

VALUE (MeV)	EVTS	DOCUMENT ID	TECN	COMMENT
<b>980 ± 10 OUR ESTIMATE</b>				
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
977 ± 3 ± 2	848	<sup>1</sup> AITALA	01A E791	$D_S^+ \rightarrow \pi^- \pi^+ \pi^+$
969.8 ± 4.5	419	<sup>2</sup> ACHASOV	00H SND	$e^+ e^- \rightarrow \pi^0 \pi^0 \gamma$
985 $\begin{smallmatrix} +16 \\ -12 \end{smallmatrix}$	419	<sup>3,4</sup> ACHASOV	00H SND	$e^+ e^- \rightarrow \pi^0 \pi^0 \gamma$
976 ± 5 ± 6		<sup>5</sup> AKHMETSHIN	99B CMD2	$e^+ e^- \rightarrow \pi^+ \pi^- \gamma$
977 ± 3 ± 6	268	<sup>5</sup> AKHMETSHIN	99C CMD2	$e^+ e^- \rightarrow \pi^0 \pi^0 \gamma$
975 ± 4 ± 6		<sup>6</sup> AKHMETSHIN	99C CMD2	$e^+ e^- \rightarrow \pi^0 \pi^0 \gamma$
975 ± 4 ± 6		<sup>7</sup> AKHMETSHIN	99C CMD2	$e^+ e^- \rightarrow \pi^+ \pi^- \gamma, \pi^0 \pi^0 \gamma$
985 ± 10		BARBERIS	99 OMEG	450 $pp \rightarrow p_s p_f K^+ K^-$
982 ± 3		BARBERIS	99B OMEG	450 $pp \rightarrow p_s p_f \pi^+ \pi^-$
982 ± 3		BARBERIS	99C OMEG	450 $pp \rightarrow p_s p_f \pi^0 \pi^0$
987 ± 6 ± 6		<sup>8</sup> BARBERIS	99D OMEG	450 $pp \rightarrow K^+ K^-, \pi^+ \pi^-$
989 ± 15		BELLAZZINI	99 GAM4	450 $pp \rightarrow pp \pi^0 \pi^0$
991 ± 3		<sup>9</sup> KAMINSKI	99 RVUE	$\pi\pi \rightarrow \pi\pi, K\bar{K}, \sigma\sigma$
~ 980		<sup>9</sup> OLLER	99 RVUE	$\pi\pi \rightarrow \pi\pi, K\bar{K}$
~ 993.5		OLLER	99B RVUE	$\pi\pi \rightarrow \pi\pi, K\bar{K}$
~ 987		<sup>9</sup> OLLER	99C RVUE	$\pi\pi \rightarrow \pi\pi, K\bar{K}, \eta\eta$
957 ± 6		<sup>10</sup> ACKERSTAFF	98Q OPAL	$Z \rightarrow f_0 X$
960 ± 10		ALDE	98 GAM4	
1015 ± 15		<sup>9</sup> ANISOVICH	98B RVUE	Compilation
1008		<sup>11</sup> LOCHER	98 RVUE	$\pi\pi \rightarrow \pi\pi, K\bar{K}$
955 ± 10		<sup>10</sup> ALDE	97 GAM2	450 $pp \rightarrow pp \pi^0 \pi^0$
994 ± 9		<sup>12</sup> BERTIN	97C OBLX	0.0 $\bar{p}p \rightarrow \pi^+ \pi^- \pi^0$
993.2 ± 6.5 ± 6.9		<sup>13</sup> ISHIDA	96 RVUE	$\pi\pi \rightarrow \pi\pi, K\bar{K}$
1006		TORNQVIST	96 RVUE	$\pi\pi \rightarrow \pi\pi, K\bar{K}, K\pi, \eta\pi$
997 ± 5	3k	<sup>14</sup> ALDE	95B GAM2	38 $\pi^- p \rightarrow \pi^0 \pi^0 n$
960 ± 10	10k	<sup>15</sup> ALDE	95B GAM2	38 $\pi^- p \rightarrow \pi^0 \pi^0 n$
994 ± 5		AMSLER	95B CBAR	0.0 $\bar{p}p \rightarrow 3\pi^0$
~ 996		<sup>16</sup> AMSLER	95D CBAR	0.0 $\bar{p}p \rightarrow \pi^0 \pi^0 \pi^0, \pi^0 \eta\eta, \pi^0 \pi^0 \eta$
987 ± 6		<sup>17</sup> ANISOVICH	95 RVUE	
1015		JANSSEN	95 RVUE	$\pi\pi \rightarrow \pi\pi, K\bar{K}$

983	18 BUGG	94 RVUE	$\bar{p}p \rightarrow \eta 2\pi^0$
973 $\pm 2$	19 KAMINSKI	94 RVUE	$\pi\pi \rightarrow \pi\pi, K\bar{K}$
988	20 ZOU	94B RVUE	
988 $\pm 10$	21 MORGAN	93 RVUE	$\pi\pi(K\bar{K}) \rightarrow$ $\pi\pi(K\bar{K}), J/\psi \rightarrow$ $\phi\pi\pi(K\bar{K}), D_s \rightarrow$ $\pi(\pi\pi)$
971.1 $\pm 4.0$	10 AGUILAR-...	91 EHS	400 $pp$
979 $\pm 4$	22 ARMSTRONG	91 OMEG	300 $pp \rightarrow pp\pi\pi,$ $ppK\bar{K}$
956 $\pm 12$	BREAKSTONE	90 SFM	$pp \rightarrow pp\pi^+\pi^-$
959.4 $\pm 6.5$	10 AUGUSTIN	89 DM2	$J/\psi \rightarrow \omega\pi^+\pi^-$
978 $\pm 9$	10 ABACHI	86B HRS	$e^+e^- \rightarrow \pi^+\pi^-X$
985.0 $^{+9.0}_{-39.0}$	ETKIN	82B MPS	23 $\pi^-p \rightarrow n2K_S^0$
974 $\pm 4$	22 GIDAL	81 MRK2	$J/\psi \rightarrow \pi^+\pi^-X$
975	23 ACHASOV	80 RVUE	
986 $\pm 10$	22 AGUILAR-...	78 HBC	0.7 $\bar{p}p \rightarrow K_S^0 K_S^0$
969 $\pm 5$	22 LEEPER	77 ASPK	2-2.4 $\pi^-p \rightarrow$ $\pi^+\pi^-n, K^+K^-n$
987 $\pm 7$	22 BINNIE	73 CNTR	$\pi^-p \rightarrow nMM$
1012 $\pm 6$	24 GRAYER	73 ASPK	17 $\pi^-p \rightarrow \pi^+\pi^-n$
1007 $\pm 20$	24 HYAMS	73 ASPK	17 $\pi^-p \rightarrow \pi^+\pi^-n$
997 $\pm 6$	24 PROTOPOP...	73 HBC	7 $\pi^+p \rightarrow$ $\pi^+p\pi^+\pi^-$

<sup>1</sup> Coupled-channel Breit-Wigner, couplings  $g_\pi=0.09\pm 0.01\pm 0.01$ ,  $g_K=0.02\pm 0.04\pm 0.03$ .

<sup>2</sup> Supersedes ACHASOV 98I. Using the model of ACHASOV 89.

<sup>3</sup> Supersedes ACHASOV 98I.

<sup>4</sup> In the "narrow resonance" approximation.

<sup>5</sup> Assuming  $\Gamma(f_0)=40$  MeV.

<sup>6</sup> From a narrow pole fit taking into account  $f_0(980)$  and  $f_0(1200)$  intermediate mechanisms.

<sup>7</sup> From the combined fit of the photon spectra in the reactions  $e^+e^- \rightarrow \pi^+\pi^-\gamma, \pi^0\pi^0\gamma$ .

<sup>8</sup> Supersedes BARBERIS 99 and BARBERIS 99B

<sup>9</sup> T-matrix pole.

<sup>10</sup> From invariant mass fit.

<sup>11</sup> On sheet II in a 2 pole solution. The other pole is found on sheet III at (1039-93i) MeV.

<sup>12</sup> On sheet II in a 2 pole solution. The other pole is found on sheet III at (963-29i) MeV.

<sup>13</sup> Reanalysis of data from HYAMS 73, GRAYER 74, SRINIVASAN 75, and ROSSELET 77 using the interfering amplitude method.

<sup>14</sup> At high  $|t|$ .

<sup>15</sup> At low  $|t|$ .

<sup>16</sup> On sheet II in a 4-pole solution, the other poles are found on sheet III at (953-55i) MeV and on sheet IV at (938-35i) MeV.

<sup>17</sup> Combined fit of ALDE 95B, ANISOVICH 94, AMSLER 94D.

<sup>18</sup> On sheet II in a 2 pole solution. The other pole is found on sheet III at (996-103i) MeV.

<sup>19</sup> From sheet II pole position.

<sup>20</sup> On sheet II in a 2 pole solution. The other pole is found on sheet III at (797-185i) MeV and can be interpreted as a shadow pole.

<sup>21</sup> On sheet II in a 2 pole solution. The other pole is found on sheet III at (978-28i) MeV.

<sup>22</sup> From coupled channel analysis.

<sup>23</sup> Coupled channel analysis with finite width corrections.

<sup>24</sup> Included in AGUILAR-BENITEZ 78 fit.

## $f_0(980)$ WIDTH

Width determination very model dependent. Peak width in  $\pi\pi$  is about 50 MeV, but decay width can be much larger.

VALUE (MeV)	EVTS	DOCUMENT ID	TECN	COMMENT
<b>40 to 100 OUR ESTIMATE</b>				
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
44 ± 2 ± 2	848	25 AITALA	01A E791	$D_S^+ \rightarrow \pi^- \pi^+ \pi^+$
201 ± 28	419	26 ACHASOV	00H SND	$e^+ e^- \rightarrow \pi^0 \pi^0 \gamma$
122 ± 13	419	27,28 ACHASOV	00H SND	$e^+ e^- \rightarrow \pi^0 \pi^0 \gamma$
56 ± 20		29 AKHMETSHIN	99C CMD2	$e^+ e^- \rightarrow \pi^0 \pi^0 \gamma$
65 ± 20		BARBERIS	99 OMEG	450 $pp \rightarrow$ $\rho_S \rho_f K^+ K^-$
80 ± 10		BARBERIS	99B OMEG	450 $pp \rightarrow$ $\rho_S \rho_f \pi^+ \pi^-$
80 ± 10		BARBERIS	99C OMEG	450 $pp \rightarrow$ $\rho_S \rho_f \pi^0 \pi^0$
48 ± 12 ± 8		30 BARBERIS	99D OMEG	450 $pp \rightarrow K^+ K^-$ , $\pi^+ \pi^-$
65 ± 25		BELLAZZINI	99 GAM4	450 $pp \rightarrow pp \pi^0 \pi^0$
71 ± 14		31 KAMINSKI	99 RVUE	$\pi\pi \rightarrow \pi\pi, K\bar{K}, \sigma\sigma$
~ 28		31 OLLER	99 RVUE	$\pi\pi \rightarrow \pi\pi, K\bar{K}$
~ 25		OLLER	99B RVUE	$\pi\pi \rightarrow \pi\pi, K\bar{K}$
~ 14		31 OLLER	99C RVUE	$\pi\pi \rightarrow \pi\pi, K\bar{K}, \eta\eta$
70 ± 20		ALDE	98 GAM4	
86 ± 16		31 ANISOVICH	98B RVUE	Compilation
54		32 LOCHER	98 RVUE	$\pi\pi \rightarrow \pi\pi, K\bar{K}$
69 ± 15		33 ALDE	97 GAM2	450 $pp \rightarrow pp \pi^0 \pi^0$
38 ± 20		34 BERTIN	97C OBLX	0.0 $\bar{p}p \rightarrow \pi^+ \pi^- \pi^0$
~ 100		35 ISHIDA	96 RVUE	$\pi\pi \rightarrow \pi\pi, K\bar{K}$
34		TORNQVIST	96 RVUE	$\pi\pi \rightarrow \pi\pi, K\bar{K}, K\pi,$ $\eta\pi$
48 ± 10	3k	36 ALDE	95B GAM2	38 $\pi^- p \rightarrow \pi^0 \pi^0 n$
95 ± 20	10k	37 ALDE	95B GAM2	38 $\pi^- p \rightarrow \pi^0 \pi^0 n$
26 ± 10		AMSLER	95B CBAR	0.0 $\bar{p}p \rightarrow 3\pi^0$
~ 112		38 AMSLER	95D CBAR	0.0 $\bar{p}p \rightarrow \pi^0 \pi^0 \pi^0,$ $\pi^0 \eta\eta, \pi^0 \pi^0 \eta$
80 ± 12		39 ANISOVICH	95 RVUE	
30		JANSSSEN	95 RVUE	$\pi\pi \rightarrow \pi\pi, K\bar{K}$
74		40 BUGG	94 RVUE	$\bar{p}p \rightarrow \eta 2\pi^0$
29 ± 2		41 KAMINSKI	94 RVUE	$\pi\pi \rightarrow \pi\pi, K\bar{K}$
46		42 ZOU	94B RVUE	
48 ± 12		43 MORGAN	93 RVUE	$\pi\pi(K\bar{K}) \rightarrow$ $\pi\pi(K\bar{K}), J/\psi \rightarrow$ $\phi\pi\pi(K\bar{K}), D_S \rightarrow$ $\pi(\pi\pi)$
37.4 ± 10.6		33 AGUILAR-...	91 EHS	400 $pp$
72 ± 8		44 ARMSTRONG	91 OMEG	300 $pp \rightarrow pp\pi\pi,$ $ppK\bar{K}$
110 ± 30		BREAKSTONE	90 SFM	$pp \rightarrow pp\pi^+ \pi^-$

29 ± 13	33 ABACHI	86B HRS	$e^+e^- \rightarrow \pi^+\pi^-X$
120 ± 281 ± 20	ETKIN	82B MPS	$23 \pi^-p \rightarrow n2K_S^0$
28 ± 10	44 GIDAL	81 MRK2	$J/\psi \rightarrow \pi^+\pi^-X$
70 to 300	45 ACHASOV	80 RVUE	
100 ± 80	46 AGUILAR-...	78 HBC	$0.7 \bar{p}p \rightarrow K_S^0 K_S^0$
30 ± 8	44 LEEPER	77 ASPK	$2-2.4 \pi^-p \rightarrow$ $\pi^+\pi^-n, K^+K^-n$
48 ± 14	44 BINNIE	73 CNTR	$\pi^-p \rightarrow nMM$
32 ± 10	47 GRAYER	73 ASPK	$17 \pi^-p \rightarrow \pi^+\pi^-n$
30 ± 10	47 HYAMS	73 ASPK	$17 \pi^-p \rightarrow \pi^+\pi^-n$
54 ± 16	47 PROTOPOP...	73 HBC	$7 \pi^+p \rightarrow$ $\pi^+p\pi^+\pi^-$

25 Breit-Wigner width.

26 Supersedes ACHASOV 98i. Using the model of ACHASOV 89.

27 Supersedes ACHASOV 98i.

28 In the "narrow resonance" approximation.

29 From the combined fit of the photon spectra in the reactions  $e^+e^- \rightarrow \pi^+\pi^-\gamma, \pi^0\pi^0\gamma$ .

30 Supersedes BARBERIS 99 and BARBERIS 99B

31 T-matrix pole.

32 On sheet II in a 2 pole solution. The other pole is found on sheet III at (1039–93i) MeV.

33 From invariant mass fit.

34 On sheet II in a 2 pole solution. The other pole is found on sheet III at (963–29i) MeV.

35 Reanalysis of data from HYAMS 73, GRAYER 74, SRINIVASAN 75, and ROSSELET 77 using the interfering amplitude method.

36 At high  $|t|$ .

37 At low  $|t|$ .

38 On sheet II in a 4-pole solution, the other poles are found on sheet III at (953–55i) MeV and on sheet IV at (938–35i) MeV.

39 Combined fit of ALDE 95B, ANISOVICH 94,

40 On sheet II in a 2 pole solution. The other pole is found on sheet III at (996–103i) MeV.

41 From sheet II pole position.

42 On sheet II in a 2 pole solution. The other pole is found on sheet III at (797–185i) MeV and can be interpreted as a shadow pole.

43 On sheet II in a 2 pole solution. The other pole is found on sheet III at (978–28i) MeV.

44 From coupled channel analysis.

45 Coupled channel analysis with finite width corrections.

46 From coupled channel fit to the HYAMS 73 and PROTOPOPESCU 73 data. With a simultaneous fit to the  $\pi\pi$  phase-shifts, inelasticity and to the  $K_S^0 K_S^0$  invariant mass.

47 Included in AGUILAR-BENITEZ 78 fit.

### $f_0(980)$ DECAY MODES

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

## $f_0(980)$ PARTIAL WIDTHS

$\Gamma(\gamma\gamma)$

$\Gamma_3$

VALUE (keV)	EVTS	DOCUMENT ID	TECN	COMMENT
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**$0.39^{+0.10}_{-0.13}$  OUR AVERAGE** Error includes scale factor of 1.5. See the ideogram below.

$0.28^{+0.09}_{-0.13}$		48 BOGLIONE	99 RVUE	$\gamma\gamma \rightarrow \pi^+\pi^-, \pi^0\pi^0$
$0.63 \pm 0.14$		49 MORGAN	90 RVUE	$\gamma\gamma \rightarrow \pi^+\pi^-, \pi^0\pi^0$
$0.42 \pm 0.06 \pm 0.18$	60	50 OEST	90 JADE	$e^+e^- \rightarrow e^+e^-\pi^0\pi^0$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
$0.29 \pm 0.07 \pm 0.12$		51,52 BOYER	90 MRK2	$e^+e^- \rightarrow e^+e^-\pi^+\pi^-$
$0.31 \pm 0.14 \pm 0.09$		51,52 MARSISKE	90 CBAL	$e^+e^- \rightarrow e^+e^-\pi^0\pi^0$

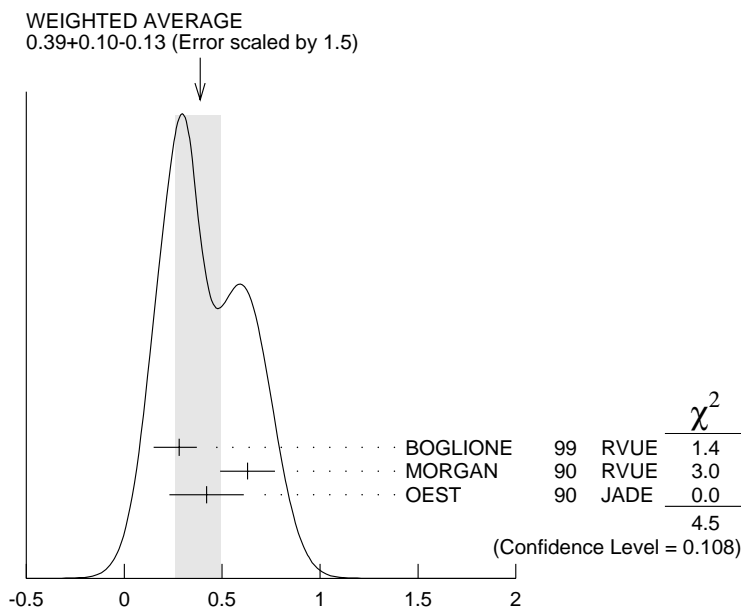
<sup>48</sup>Supersedes MORGAN 90.

<sup>49</sup>From amplitude analysis of BOYER 90 and MARSISKE 90, data corresponds to resonance parameters  $m = 989$  MeV,  $\Gamma = 61$  MeV.

<sup>50</sup>OEST 90 quote systematic errors  $^{+0.08}_{-0.18}$ . We use  $\pm 0.18$ .

<sup>51</sup>From analysis allowing arbitrary background unconstrained by unitarity.

<sup>52</sup>Data included in MORGAN 90, BOGLIONE 99 analyses.



$\Gamma(\gamma\gamma)$

$\Gamma_3$

$\Gamma(e^+e^-)$

$\Gamma_4$

VALUE (eV)	CL%	DOCUMENT ID	TECN	COMMENT
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**<8.4** 90 VOROBYEV 88 ND  $e^+e^- \rightarrow \pi^0\pi^0$

## $f_0(980)$ BRANCHING RATIOS

$$\frac{\Gamma(\pi\pi)}{[\Gamma(\pi\pi) + \Gamma(K\bar{K})]} \qquad \Gamma_1/(\Gamma_1 + \Gamma_2)$$

VALUE	DOCUMENT ID	TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •			
$\sim 0.68$	OLLER	99B RVUE	$\pi\pi \rightarrow \pi\pi, K\bar{K}$
$0.67 \pm 0.09$	<sup>53</sup> LOVERRE	80 HBC	$4 \pi^- p \rightarrow n 2K_S^0$
$0.81^{+0.09}_{-0.04}$	<sup>53</sup> CASON	78 STRC	$7 \pi^- p \rightarrow n 2K_S^0$
$0.78 \pm 0.03$	<sup>53</sup> WETZEL	76 OSPK	$8.9 \pi^- p \rightarrow n 2K_S^0$

<sup>53</sup> Measure  $\pi\pi$  elasticity assuming two resonances coupled to the  $\pi\pi$  and  $K\bar{K}$  channels only.

## $f_0(980)$ REFERENCES

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ACHASOV	00H	PL B485 349	M.N. Achasov <i>et al.</i>	(Novosibirsk SND Collab.)
AKHMETSHIN	99B	PL B462 371	R.R. Akhmetshin <i>et al.</i>	(Novosibirsk CMD-2 Collab.)
AKHMETSHIN	99C	PL B462 380	R.R. Akhmetshin <i>et al.</i>	(Novosibirsk CMD-2 Collab.)
BARBERIS	99	PL B453 305	D. Barberis <i>et al.</i>	(Omega expt.)
BARBERIS	99B	PL B453 316	D. Barberis <i>et al.</i>	(Omega expt.)
BARBERIS	99C	PL B453 325	D. Barberis <i>et al.</i>	(Omega expt.)
BARBERIS	99D	PL B462 462	D. Barberis <i>et al.</i>	(Omega expt.)
BELLAZZINI	99	PL B467 296	R. Bellazzini <i>et al.</i>	
BOGLIONE	99	EPJ C9 11	M. Boglione, M.R. Pennington	
KAMINSKI	99	EPJ C9 141	R. Kaminski, L. Lesniak, B. Loiseau	(CRAC, PARIN)
OLLER	99	PR D60 099906 (erratum)	J.A. Oller <i>et al.</i>	
OLLER	99B	NP A652 407 (erratum)	J.A. Oller, E. Oset	
OLLER	99C	PR D60 074023	J.A. Oller, E. Oset	
ACHASOV	98I	PL B440 442	M.N. Achasov <i>et al.</i>	
ACKERSTAFF	98Q	EPJ C4 19	K. Ackerstaff <i>et al.</i>	(OPAL Collab.)
ALDE	98	EPJ A3 361	D. Alde <i>et al.</i>	(GAM4 Collab.)
Also	99	PAN 62 405	D. Alde <i>et al.</i>	(GAMS Collab.)
		Translated from YAF 62 446.		
ANISOVICH	98B	UFN 41 419	V.V. Anisovich <i>et al.</i>	
LOCHER	98	EPJ C4 317	M.P. Locher <i>et al.</i>	(PSI)
ALDE	97	PL B397 350	D.M. Alde <i>et al.</i>	(GAMS Collab.)
BERTIN	97C	PL B408 476	A. Bertin <i>et al.</i>	(OBELIX Collab.)
ISHIDA	96	PTP 95 745	S. Ishida <i>et al.</i>	(TOKY, MIYA, KEK)
TORNQVIST	96	PRL 76 1575	N.A. Tornqvist, M. Roos	(HELS)
ALDE	95B	ZPHY C66 375	D.M. Alde <i>et al.</i>	(GAMS Collab.)
AMSLER	95B	PL B342 433	C. Amsler <i>et al.</i>	(Crystal Barrel Collab.)
AMSLER	95D	PL B355 425	C. Amsler <i>et al.</i>	(Crystal Barrel Collab.)
ANISOVICH	95	PL B355 363	V.V. Anisovich <i>et al.</i>	(PNPI, SERP)
JANSSEN	95	PR D52 2690	G. Janssen <i>et al.</i>	(STON, ADLD, JULI)
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BUGG	94	PR D50 4412	D.V. Bugg <i>et al.</i>	(LOQM)
KAMINSKI	94	PR D50 3145	R. Kaminski, L. Lesniak, J.P. Maillet	(CRAC+)
ZOU	94B	PR D50 591	B.S. Zou, D.V. Bugg	(LOQM)
MORGAN	93	PR D48 1185	D. Morgan, M.R. Pennington	(RAL, DURH)
AGUILAR-...	91	ZPHY C50 405	M. Aguilar-Benitez <i>et al.</i>	(LEBC-EHS Collab.)
ARMSTRONG	91	ZPHY C51 351	T.A. Armstrong <i>et al.</i>	(ATHU, BARI, BIRM+)
BOYER	90	PR D42 1350	J. Boyer <i>et al.</i>	(Mark II Collab.)
BREAKSTONE	90	ZPHY C48 569	A.M. Breakstone <i>et al.</i>	(ISU, BGNA, CERN+)
MARSISKE	90	PR D41 3324	H. Marsiske <i>et al.</i>	(Crystal Ball Collab.)
MORGAN	90	ZPHY C48 623	D. Morgan, M.R. Pennington	(RAL, DURH)
OEST	90	ZPHY C47 343	T. Oest <i>et al.</i>	(JADE Collab.)
ACHASOV	89	NP B315 465	N.N. Achasov, V.N. Ivanchenko	
AUGUSTIN	89	NP B320 1	J.E. Augustin, G. Cosme	(DM2 Collab.)
VOROBYEV	88	SJNP 48 273	P.V. Vorobiev <i>et al.</i>	(NOVO)
		Translated from YAF 48 436.		

ABACHI	86B	PRL 57 1990	S. Abachi <i>et al.</i>	(PURD, ANL, IND, MICH+)
ETKIN	82B	PR D25 1786	A. Etkin <i>et al.</i>	(BNL, CUNY, TUFTS, VAND)
GIDAL	81	PL 107B 153	G. Gidal <i>et al.</i>	(SLAC, LBL)
ACHASOV	80	SJNP 32 566	N.N. Achasov, S.A. Devyanin, G.N. Shestakov	(NOVM)
		Translated from YAF 32	1098.	
LOVERRE	80	ZPHY C6 187	P.F. Loverre <i>et al.</i>	(CERN, CDEF, MADR+ IJP)
AGUILAR-...	78	NP B140 73	M. Aguilar-Benitez <i>et al.</i>	(MADR, BOMB+)
CASON	78	PRL 41 271	N.M. Cason <i>et al.</i>	(NDAM, ANL)
LEEPER	77	PR D16 2054	R.J. Leeper <i>et al.</i>	(ISU)
ROSSELET	77	PR D15 574	L. Rosselet <i>et al.</i>	(GEVA, SACL)
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SRINIVASAN	75	PR D12 681	V. Srinivasan <i>et al.</i>	(NDAM, ANL)
GRAYAS	74	NP B75 189	G. Grayer <i>et al.</i>	(CERN, MPIM)
BINNIE	73	PRL 31 1534	D.M. Binnie <i>et al.</i>	(LOIC, SHMP)
GRAYAS	73	Tallahassee	G. Grayer <i>et al.</i>	(CERN, MPIM)
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ANISOVICH	01H	EPJ A12 103	A.V. Anisovich, V.V. Anisovich, V.A. Nikonov	
CLOSE	01	PL B515 13	F.E. Close, A. Kirk	
GOKALP	01	PR D64 053017	A. Gokalp, O. Yilmaz	
SUROVTSEV	01	PR D63 054024	Y.S. Surovtsev, D. Krupa, M. Nagy	
BEVEREN	00	PL B495 300	E. van Beveren, G. Rupp, M.D. Scadron	
Also	01	PL B509 365 (erratum)	E. van Beveren, G. Rupp, M.D. Scadron	
MARKUSHIN	00	EPJ A8 389	V.E. Markushin	
WANG	00A	PR D62 017503	Z. Wang	
ABREU	99J	PL B449 364	P. Abreu <i>et al.</i>	(DELPHI Collab.)
ANISOVICH	99D	PL B452 180	A.V. Anisovich <i>et al.</i>	
Also	99F	NP A651 253	A.V. Anisovich <i>et al.</i>	
ANISOVICH	99H	PL B467 289	A.V. Anisovich, V.V. Anisovich	
BLACK	99	PR D59 074026	D. Black <i>et al.</i>	
DELBOURGO	99	PL B446 332	R. Delbourgo, D. Liu, M. Scadron	
MARCO	99	PL B470 20	E. Marco <i>et al.</i>	
MINKOWSKI	99	EPJ C9 283	P. Minkowski, W. Ochs	
ACHASOV	98G	JETPL 67 464	N.N. Achasov <i>et al.</i>	
ACHASOV	98J	SPU 41 1149	N.N. Achasov	
CHLIAPNIK...	98	PL B423 401	P.V. Chliapnikov, V.A. Uvarov	
ACHASOV	97E	IJMP A12 5019	N.N. Achasov <i>et al.</i>	
PROKOSHKIN	97	SPD 42 117	Y.D. Prokoshkin <i>et al.</i>	(SERP)
		Translated from DANS 353	323.	
AU	87	PR D35 1633	K.L. Au, D. Morgan, M.R. Pennington	(DURH, RAL)
AKESSON	86	NP B264 154	T. Akesson <i>et al.</i>	(Axial Field Spec. Collab.)
BEVEREN	86	ZPHY C30 615	E. van Beveren <i>et al.</i>	(NIJM, BIEL)
MENNESSIER	83	ZPHY C16 241	G. Mennessier	(MONP)
BARBER	82	ZPHY C12 1	D.P. Barber <i>et al.</i>	(DARE, LANC, SHEF)
ETKIN	82C	PR D25 2446	A. Etkin <i>et al.</i>	(BNL, CUNY, TUFTS, VAND)
SRINIVASAN	75	PR D12 681	V. Srinivasan <i>et al.</i>	(NDAM, ANL)
BIGI	62	CERN Conf. 247	A. Bigi <i>et al.</i>	(CERN)
BINGHAM	62	CERN Conf. 240	H.H. Bingham <i>et al.</i>	(EPOL, CERN)
ERWIN	62	PRL 9 34	A.R. Erwin <i>et al.</i>	(WISC, BNL)
WANG	61	JETP 13 323	K.-C. Wang <i>et al.</i>	(JINR)
		Translated from ZETF 40	464.	