$\phi(1020)$

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

ϕ(1020) MASS

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	COMMENT
1019.460±0.016 OUR AVERAGE					
1019.457±0.061	610k	KOZYREV	16	CMD3	$e^+e^- \rightarrow K^0_S K^0_L$
1019.462±0.042±0.056	28k	[1] LEES	14H	BABR	$e^+e^- \rightarrow K^0_S K^0_L \gamma$
1019.51 ±0.02 ±0.05		[2] LEES	13Q	BABR	$e^+e^- \rightarrow K^+K^-\gamma$
1019.30 ±0.02 ±0.10	105k	AKHMETSHIN	06	CMD2	0.98–1.06 $e^+e^- \rightarrow \pi^+\pi^-\pi^0$
1019.52 ±0.05 ±0.05	17.4k	AKHMETSHIN	05	CMD2	0.60-1.38 $e^+e^- \rightarrow \eta\gamma$
1019.483±0.011±0.025	272k	[3] AKHMETSHIN	04	CMD2	$e^+e^- \rightarrow K^0_L K^0_S$
1019.42 ±0.05	1900k	[4] ACHASOV	01E	SND	$e^+e^- \rightarrow K^+K^-$, $K_S K_L$, $\pi^+\pi^-\pi^0$
1019.40 ±0.04 ±0.05	23k	AKHMETSHIN	01B	CMD2	$e^+e^- \rightarrow \eta\gamma$
1019.36 ±0.12		[5] ACHASOV	00B	SND	$e^+e^- \rightarrow \eta\gamma$
1019.38 ±0.07 ±0.08	2200	[6] AKHMETSHIN	99F	CMD2	$e^+e^- \rightarrow \pi^+\pi^- \geq 2\gamma$
1019.51 ±0.07 ±0.10	11169	AKHMETSHIN	98	CMD2	$e^+e^- \rightarrow \pi^+\pi^-\pi^0$
1019.5 ±0.4		BARBERIS	98	OMEG	450 $pp \rightarrow pp2K^+2K^-$
1019.42 ±0.06	55600	AKHMETSHIN	95	CMD2	$e^+e^- \rightarrow$ hadrons
1019.7 ±0.3	2012	DAVENPORT	86	MPSF	400 pA $\rightarrow 4KX$
1019.7 ±0.1 ±0.1	5079	ALBRECHT	85D	ARG	10 $e^+e^- \rightarrow K^+K^-X$
1019.3 ±0.1	1500	ARENTON	82	AEMS	11.8 polar. $pp \rightarrow KK$
1019.67 ±0.17	25080	[7] PELLINEN	82	RVUE	
1019.52 ±0.13	3681	BUKIN	78C	OLYA	$e^+e^- \rightarrow$ hadrons
• • • We do not use the following data for averages, fits, limits, etc. • • •					
1019.48 ±0.01		LEES	13F	BABR	$D^+ \rightarrow K^+K^-\pi^+$
1019.441±0.008±0.080	542k	[8] AKHMETSHIN	08	CMD2	1.02 $e^+e^- \rightarrow K^+K^-$
1019.63 ±0.07	12540	[9] AUBERT,B	05J	BABR	$D^0 \rightarrow \overline{K}^0 K^+K^-$
1019.8 ±0.7		ARMSTRONG	86	OMEG	85 $\pi^+/pp \rightarrow \pi^+/p4Kp$
1020.1 ±0.11	5526	[9] ATKINSON	86	OMEG	20–70 γp
1019.7 ±1.0		BEBEK	86	CLEO	$e^+e^- \rightarrow \Upsilon(4S)$
1019.411±0.008	642k	[10] DIJKSTRA	86	SPEC	100–200 $\pi^\pm$, $\overline{p}$, p, $K^\pm$, on Be
1020.9 ±0.2		[9] FRAME	86	OMEG	13 $K^+p \rightarrow \phi K^+p$
1021.0 ±0.2		[9] ARMSTRONG	83B	OMEG	18.5 $K^-p \rightarrow K^-K^+\Lambda$
1020.0 ±0.5		[9] ARMSTRONG	83B	OMEG	18.5 $K^-p \rightarrow K^-K^+\Lambda$
1019.7 ±0.3		[9] BARATE	83	GOLI	190 π^-Be $\rightarrow 2\mu X$
1019.8 ±0.2 ±0.5	766	IVANOV	81	OLYA	1–1.4 $e^+e^- \rightarrow K^+K^-$

1019.4	±0.5	337	COOPER	78B	HBC	0.7–0.8 $\overline{p}p \to K^0_S K^0_L \pi^+ \pi^-$
1020	±1	383	[9] BALDI	77	CNTR	10 $\pi^- p \to \pi^- \phi p$
1018.9	±0.6	800	COHEN	77	ASPK	6 $\pi^\pm N \to K^+ K^- N$
1019.7	±0.5	454	KALBFLEISCH	76	HBC	2.18 $K^- p \to \Lambda K \overline{K}$
1019.4	±0.8	984	BESCH	74	CNTR	2 $\gamma p \to p K^+ K^-$
1020.3	±0.4	100	BALLAM	73	HBC	2.8–9.3 γp
1019.4	±0.7		BINNIE	73B	CNTR	$\pi^- p \to \phi n$
1019.6	±0.5	120	[11] AGUILAR-...	72B	HBC	3.9,4.6 $K^- p \to \Lambda K^+ K^-$
1019.9	±0.5	100	[11] AGUILAR-...	72B	HBC	3.9,4.6 $K^- p \to K^- p K^+ K^-$
1020.4	±0.5	131	COLLEY	72	HBC	10 $K^+ p \to K^+ p \phi$
1019.9	±0.3	410	STOTTLE...	71	HBC	2.9 $K^- p \to \Sigma / \Lambda K \overline{K}$

[1] Using a vector meson dominance model with contribution from ϕ(1020) and higher mass excitations of ρ(770), ω(782), and ϕ(1020).

[2] Using a phenomenological model based on KUHN 90 with a sum of Breit-Wigner resonances for ρ(770), ω(782), ϕ(1020) and their higher mass excitations.

[3] Update of AKHMETSHIN 99D

[4] From the combined fit assuming that the total ϕ(1020) production cross section is saturated by those of $K^+ K^-$, $K_S K_L$, $\pi^+ \pi^- \pi^0$, and $\eta\gamma$ decays modes and using ACHASOV 00B for the $\eta\gamma$ decay mode.

[5] Using a total width of 4.43 ± 0.05 MeV. Systematic uncertainty included.

[6] Using a total width of 4.43 ± 0.05 MeV.

[7] PELLINEN 82 review includes AKERLOF 77, DAUM 81, BALDI 77, AYRES 74, DEGROOT 74.

[8] Strongly correlated with AKHMETSHIN 04.

[9] Systematic errors not evaluated.

[10] Weighted and scaled average of 12 measurements of DIJKSTRA 86.

[11] Mass errors enlarged by us to $\Gamma/\sqrt{N}$; see the note with the $K^*(892)$ mass.

ϕ(1020) WIDTH

VALUE (MeV)	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
4.247±0.016 OUR AVERAGE	Error includes scale factor of 1.2.				
4.240±0.017	610k	KOZYREV	16	CMD3	$e^+ e^- \to K^0_S K^0_L$
4.205±0.103±0.067	28k	[1] LEES	14H	BABR	$e^+ e^- \to K^0_S K^0_L \gamma$
4.29 ±0.04 ±0.07		[2] LEES	13Q	BABR	$e^+ e^- \to K^+ K^- \gamma$
4.30 ±0.06 ±0.17	105k	AKHMETSHIN	06	CMD2	0.98–1.06 $e^+ e^- \to \pi^+ \pi^- \pi^0$
4.280±0.033±0.025	272k	[3] AKHMETSHIN	04	CMD2	$e^+ e^- \to K^0_L K^0_S$
4.21 ±0.04	1900k	[4] ACHASOV	01E	SND	$e^+ e^- \to K^+ K^-$, $K_S K_L$, $\pi^+ \pi^- \pi^0$
4.44 ±0.09	55600	AKHMETSHIN	95	CMD2	$e^+ e^- \to$ hadrons
4.5 ±0.7	1500	ARENTON	82	AEMS	11.8 polar. $pp \to K K$
4.2 ±0.6	766	[5] IVANOV	81	OLYA	1–1.4 $e^+ e^- \to K^+ K^-$

4.3	± 0.6		[5] CORDIER	80	DM1	$e^+ e^- \rightarrow \pi^+ \pi^- \pi^0$
4.36	± 0.29	3681	[5] BUKIN	78C	OLYA	$e^+ e^- \rightarrow$ hadrons
4.4	± 0.6	984	[5] BESCH	74	CNTR	$2 \gamma p \rightarrow p K^+ K^-$
4.67	± 0.72	681	[5] BALAKIN	71	OSPK	$e^+ e^- \rightarrow$ hadrons
4.09	± 0.29		BIZOT	70	OSPK	$e^+ e^- \rightarrow$ hadrons

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

4.37	± 0.02		LEES	13F	BABR	$D^+ \rightarrow K^+ K^- \pi^+$
4.24	± 0.02 ± 0.03	542k	[6] AKHMETSHIN	08	CMD2	$1.02\ e^+ e^- \rightarrow K^+ K^-$
4.28	± 0.13	12540	[7] AUBERT,B	05J	BABR	$D^0 \rightarrow \overline{K}^0 K^+ K^-$
4.45	± 0.06	271k	DIJKSTRA	86	SPEC	$100\ \pi^-$ Be
3.6	± 0.8	337	[5] COOPER	78B	HBC	$0.7\text{–}0.8\ \overline{p} p \rightarrow K_S^0 K_L^0 \pi^+ \pi^-$
4.5	± 0.50	1300	[5,7] AKERLOF	77	SPEC	$400\ p\text{A} \rightarrow K^+ K^- \text{X}$
4.5	± 0.8	500	[5,7] AYRES	74	ASPK	$3\text{–}6\ \pi^- p \rightarrow K^+ K^- n,\ K^- p \rightarrow K^+ K^- \Lambda / \Sigma^0$
3.81	± 0.37		COSME	74B	OSPK	$e^+ e^- \rightarrow K_L^0 K_S^0$
3.8	± 0.7	454	[5] BORENSTEIN	72	HBC	$2.18\ K^- p \rightarrow K \overline{K} n$

[1] Using a vector meson dominance model with contribution from $\phi(1020)$ and higher mass excitations of $\rho(770)$, $\omega(782)$, and $\phi(1020)$.

[2] Using a phenomenological model based on KUHN 90 with a sum of Breit-Wigner resonances for $\rho(770)$, $\omega(782)$, $\phi(1020)$ and their higher mass excitations.

[3] Update of AKHMETSHIN 99D

[4] From the combined fit assuming that the total $\phi(1020)$ production cross section is saturated by those of $K^+ K^-$, $K_S K_L$, $\pi^+ \pi^- \pi^0$, and $\eta\gamma$ decays modes and using ACHASOV 00B for the $\eta\gamma$ decay mode.

[5] Width errors enlarged by us to $4\Gamma/\sqrt{N}$; see the note with the $K^*(892)$ mass.

[6] Strongly correlated with AKHMETSHIN 04.

[7] Systematic errors not evaluated.

$\phi(1020)$ DECAY MODES

	Mode		Fraction (Γ_i/Γ)	Scale factor/ Confidence level
Γ_1	K^+K^-		(48.9 ± 0.5) %	S=1.1
Γ_2	$K^0_L K^0_S$		(34.2 ± 0.4) %	S=1.1
Γ_3	$\rho\pi + \pi^+\pi^-\pi^0$		(15.32 ± 0.32) %	S=1.1
Γ_4	$\rho\pi$			
Γ_5	$\pi^+\pi^-\pi^0$			
Γ_6	$\eta\gamma$		(1.309 ± 0.024) %	S=1.2
Γ_7	$\pi^0\gamma$		$(1.31 \pm 0.05) \times 10^{-3}$	
Γ_8	$\ell^+\ell^-$		—	
Γ_9	e^+e^-		$(2.955 \pm 0.029) \times 10^{-4}$	S=1.1
Γ_{10}	$\mu^+\mu^-$		$(2.87 {}^{+0.18}_{-0.20}) \times 10^{-4}$	
Γ_{11}	ηe^+e^-		$(1.08 \pm 0.04) \times 10^{-4}$	
Γ_{12}	$\pi^+\pi^-$		$(7.4 \pm 1.3) \times 10^{-5}$	
Γ_{13}	$\omega\pi^0$		$(4.7 \pm 0.5) \times 10^{-5}$	
Γ_{14}	$\omega\gamma$		< 5 %	CL=84%
Γ_{15}	$\rho\gamma$		$< 1.2 \times 10^{-5}$	CL=90%
Γ_{16}	$\pi^+\pi^-\gamma$		$(4.1 \pm 1.3) \times 10^{-5}$	
Γ_{17}	$f_0(980)\gamma$		$(3.22 \pm 0.19) \times 10^{-4}$	S=1.1
Γ_{18}	$\pi^0\pi^0\gamma$		$(1.13 \pm 0.06) \times 10^{-4}$	
Γ_{19}	$\pi^+\pi^-\pi^+\pi^-$		$(4.0 {}^{+2.8}_{-2.2}) \times 10^{-6}$	
Γ_{20}	$\pi^+\pi^+\pi^-\pi^-\pi^0$		$< 4.6 \times 10^{-6}$	CL=90%
Γ_{21}	$\pi^0 e^+e^-$		$(1.33 {}^{+0.07}_{-0.10}) \times 10^{-5}$	
Γ_{22}	$\pi^0\eta\gamma$		$(7.27 \pm 0.30) \times 10^{-5}$	S=1.5
Γ_{23}	$a_0(980)\gamma$		$(7.6 \pm 0.6) \times 10^{-5}$	
Γ_{24}	$K^0\overline{K}^0\gamma$		$< 1.9 \times 10^{-8}$	CL=90%
Γ_{25}	$\eta'(958)\gamma$		$(6.25 \pm 0.21) \times 10^{-5}$	
Γ_{26}	$\eta\pi^0\pi^0\gamma$		$< 2 \times 10^{-5}$	CL=90%
Γ_{27}	$\mu^+\mu^-\gamma$		$(1.4 \pm 0.5) \times 10^{-5}$	
Γ_{28}	$\rho\gamma\gamma$		$< 1.2 \times 10^{-4}$	CL=90%
Γ_{29}	$\eta\pi^+\pi^-$		$< 1.8 \times 10^{-5}$	CL=90%
Γ_{30}	$\eta\mu^+\mu^-$		$< 9.4 \times 10^{-6}$	CL=90%
Γ_{31}	$\eta U \to \eta e^+e^-$		$< 1 \times 10^{-6}$	CL=90%
	Lepton Family number (LF) violating modes			
Γ_{32}	$e^\pm\mu^\mp$	LF	$< 2 \times 10^{-6}$	CL=90%

CONSTRAINED FIT INFORMATION

An overall fit to 30 branching ratios uses 81 measurements and one constraint to determine 14 parameters. The overall fit has a $\chi^2 = 58.5$ for 68 degrees of freedom.

The following *off-diagonal* array elements are the correlation coefficients $\left\langle\delta x_i \delta x_j\right\rangle/(\delta x_i\cdot\delta x_j)$, in percent, from the fit to the branching fractions, $x_i \equiv \Gamma_i/\Gamma_{\text{total}}$. The fit constrains the x_i whose labels appear in this array to sum to one.

	x_1	x_2	x_3	x_6	x_7	x_9	x_{10}	x_{12}	x_{13}	x_{17}
x_2	−72									
x_3	−57	−16								
x_6	−15	11	1							
x_7	−10	9	1	7						
x_9	39	−39	−7	−31	−23					
x_{10}	−4	4	1	3	2	−11				
x_{12}	−2	2	0	2	1	−5	1			
x_{13}	−3	3	0	2	2	−7	1	0		
x_{17}	0	0	0	0	0	0	0	0	0	
x_{18}	−7	6	1	17	4	−16	2	1	1	0
x_{19}	−1	1	0	0	0	−1	0	0	0	0
x_{23}	0	0	0	0	0	0	0	0	0	0
x_{25}	−5	3	0	32	2	−10	1	0	1	0

	x_{18}	x_{19}	x_{23}
x_{19}	0		
x_{23}	0	0	
x_{25}	5	0	0

$\phi(1020)$ PARTIAL WIDTHS

$\Gamma(\eta\gamma)$ Γ_6

VALUE (keV)	*DOCUMENT ID*		*TECN*	*COMMENT*
• • • We do not use the following data for averages, fits, limits, etc. • • •				
$58.9\pm0.5\pm2.4$	ACHASOV	00	SND	$e^+e^- \to \eta\gamma$

$\Gamma(\pi^0\gamma)$ Γ_7

VALUE (keV)	*DOCUMENT ID*		*TECN*	*COMMENT*
• • • We do not use the following data for averages, fits, limits, etc. • • •				
$5.40\pm0.16^{+0.43}_{-0.40}$	ACHASOV	00	SND	$e^+e^- \to \pi^0\gamma$

$\Gamma(\ell^+\ell^-)$ — Γ_8

VALUE (keV)	DOCUMENT ID	TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •			
1.320±0.017±0.015	[1] AMBROSINO 05	KLOE	1.02 $e^+e^- \to \mu^+\mu^-$

$\Gamma(e^+e^-)$ — Γ_9

VALUE (keV)	DOCUMENT ID	TECN	COMMENT
1.27 ±0.04 OUR EVALUATION			
1.251±0.021 OUR AVERAGE Error includes scale factor of 1.1.			
1.235±0.006±0.022	[2] AKHMETSHIN 11	CMD2	1.02 $e^+e^- \to \phi$
1.32 ±0.05 ±0.03	[3] AMBROSINO 05	KLOE	1.02 $e^+e^- \to e^+e^-$
1.28 ±0.05	AKHMETSHIN 95	CMD2	1.02 $e^+e^- \to \phi$

$(\Gamma(e^+e^-) \times \Gamma(\mu^+\mu^-))^{1/2}$ — $(\Gamma_9\Gamma_{10})^{1/2}$

VALUE (keV)	DOCUMENT ID	TECN	COMMENT
1.320±0.018±0.017	AMBROSINO 05	KLOE	1.02 $e^+e^- \to \mu^+\mu^-$

[1] Weighted average of Γ_{ee} and $\sqrt{\Gamma_{ee}\Gamma_{\mu\mu}}$ from AMBROSINO 05 assuming lepton universality.

[2] Combined analysis of the CMD-2 data on $\phi \to K^+K^-$, $K^0_S K^0_L$, $\pi^+\pi^-\pi^0$, $\eta\gamma$ assuming that the sum of their branching fractions is 0.99741 ± 0.00007.

[3] From forward-backward asymmetry and using Γ_{total} = 4.26 ± 0.05 MeV from the 2004 edition of this Review.

ϕ(1020) $\Gamma(i)\Gamma(e^+e^-)/\Gamma(total)$

$\Gamma(K^+K^-) \times \Gamma(e^+e^-)/\Gamma_{total}$ — $\Gamma_1\Gamma_9/\Gamma$

VALUE (keV)	DOCUMENT ID	TECN	COMMENT
0.6340±0.0070±0.0039	[1] LEES 13Q	BABR	$e^+e^- \to K^+K^-\gamma$

[1] Using a phenomenological model based on KUHN 90 with a sum of Breit-Wigner resonances for ρ(770), ω(782), ϕ(1020) and their higher mass excitations. The first error combines statistical and systematic uncertainties. The second one is due to the parametrization of the charged kaon form factor and mass calibration.

$\Gamma(K^0_L K^0_S) \times \Gamma(e^+e^-)/\Gamma_{total}$ — $\Gamma_2\Gamma_9/\Gamma$

VALUE (keV)	EVTS	DOCUMENT ID	TECN	COMMENT
0.4200±0.0033±0.0123	28k	[1] LEES 14H	BABR	$e^+e^- \to K^0_S K^0_L \gamma$

[1] Using a vector meson dominance model with contribution from ϕ(1020) and higher mass excitations of ρ(770), ω(782), and ϕ(1020).

ϕ(1020) $\Gamma(i)\Gamma(e^+e^-)/\Gamma^2(total)$

$\Gamma(K^+K^-)/\Gamma_{total} \times \Gamma(e^+e^-)/\Gamma_{total}$ — $\Gamma_1/\Gamma \times \Gamma_9/\Gamma$

VALUE (units 10^{-5})	EVTS	DOCUMENT ID	TECN	COMMENT
14.46±0.23 OUR FIT Error includes scale factor of 1.1.				
14.24±0.30 OUR AVERAGE				
14.27±0.05±0.31	542k	AKHMETSHIN 08	CMD2	1.02 $e^+e^- \to K^+K^-$
13.93±0.14±0.99	1000k	[1] ACHASOV 01E	SND	$e^+e^- \to K^+K^-$, $K_S K_L$, $\pi^+\pi^-\pi^0$

$\Gamma(K^0_L K^0_S)/\Gamma_{total} \times \Gamma(e^+e^-)/\Gamma_{total}$ — $\Gamma_2/\Gamma \times \Gamma_9/\Gamma$

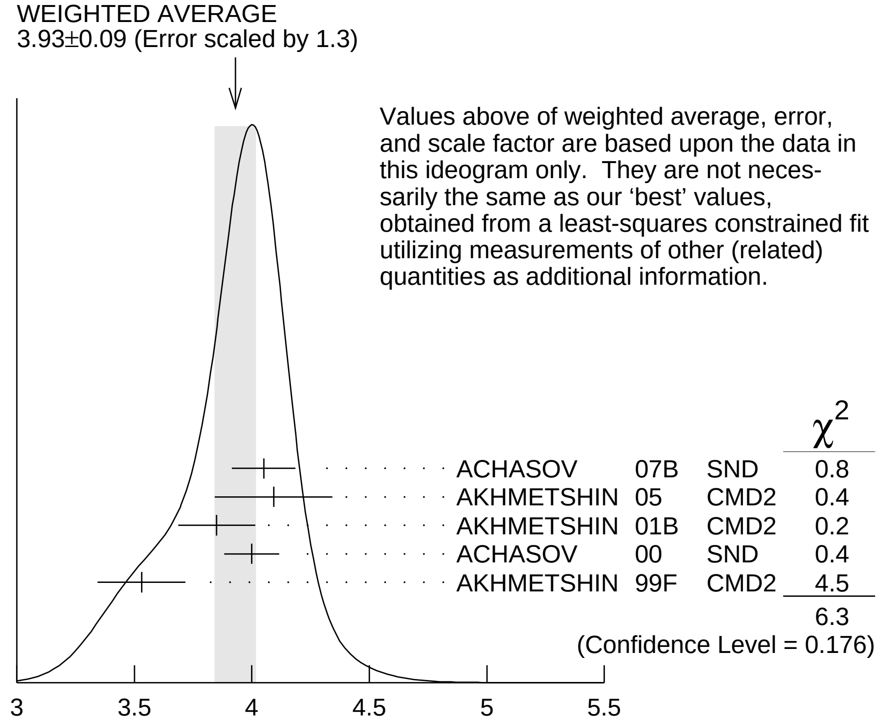
VALUE (units 10^{-5})	EVTS	DOCUMENT ID		TECN	COMMENT
10.09 ±0.12 OUR FIT					
10.07 ±0.13 OUR AVERAGE					
10.078±0.223	610k	[2] KOZYREV	16	CMD3	$e^+e^- \to K^0_S K^0_L$
10.01 ±0.04 ±0.17	272k	[3] AKHMETSHIN	04	CMD2	$e^+e^- \to K^0_L K^0_S$
10.27 ±0.07 ±0.34	500k	[1] ACHASOV	01E	SND	$e^+e^- \to K^+K^-$, $K_S K_L$, $\pi^+\pi^-\pi^0$

$[\Gamma(\rho\pi) + \Gamma(\pi^+\pi^-\pi^0)]/\Gamma_{total} \times \Gamma(e^+e^-)/\Gamma_{total}$ — $\Gamma_3/\Gamma \times \Gamma_9/\Gamma$

VALUE (units 10^{-5})	EVTS	DOCUMENT ID		TECN	COMMENT
4.53 ±0.10 OUR FIT Error includes scale factor of 1.1.					
4.46 ±0.12 OUR AVERAGE					
4.51 ±0.16 ±0.11	105k	AKHMETSHIN	06	CMD2	0.98–1.06 $e^+e^- \to \pi^+\pi^-\pi^0$
4.30 ±0.08 ±0.21		AUBERT,B	04N	BABR	10.6 $e^+e^- \to \pi^+\pi^-\pi^0\gamma$
4.665±0.042±0.261	400k	[1] ACHASOV	01E	SND	$e^+e^- \to K^+K^-$, $K_S K_L$, $\pi^+\pi^-\pi^0$
4.35 ±0.27 ±0.08	11169	[4] AKHMETSHIN	98	CMD2	$e^+e^- \to \pi^+\pi^-\pi^0$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
4.38 ±0.12		BENAYOUN	10	RVUE	0.4–1.05 e^+e^-

$\Gamma(\eta\gamma)/\Gamma_{total} \times \Gamma(e^+e^-)/\Gamma_{total}$ — $\Gamma_6/\Gamma \times \Gamma_9/\Gamma$

VALUE (units 10^{-6})	EVTS	DOCUMENT ID		TECN	COMMENT
3.87 ±0.07 OUR FIT Error includes scale factor of 1.2.					
3.93 ±0.09 OUR AVERAGE Error includes scale factor of 1.3. See the ideogram below.					
4.050±0.067±0.118	33k	[5] ACHASOV	07B	SND	0.6–1.38 $e^+e^- \to \eta\gamma$
$4.093^{+0.040}_{-0.043}$±0.247	17.4k	[6] AKHMETSHIN	05	CMD2	0.60-1.38 $e^+e^- \to \eta\gamma$
3.850±0.041±0.159	23k	[7,8] AKHMETSHIN	01B	CMD2	$e^+e^- \to \eta\gamma$
4.00 ±0.04 ±0.11		[9] ACHASOV	00	SND	$e^+e^- \to \eta\gamma$
3.53 ±0.08 ±0.17	2200	[10,11] AKHMETSHIN	99F	CMD2	$e^+e^- \to \eta\gamma$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
4.19 ±0.06		[12] BENAYOUN	10	RVUE	0.4–1.05 e^+e^-



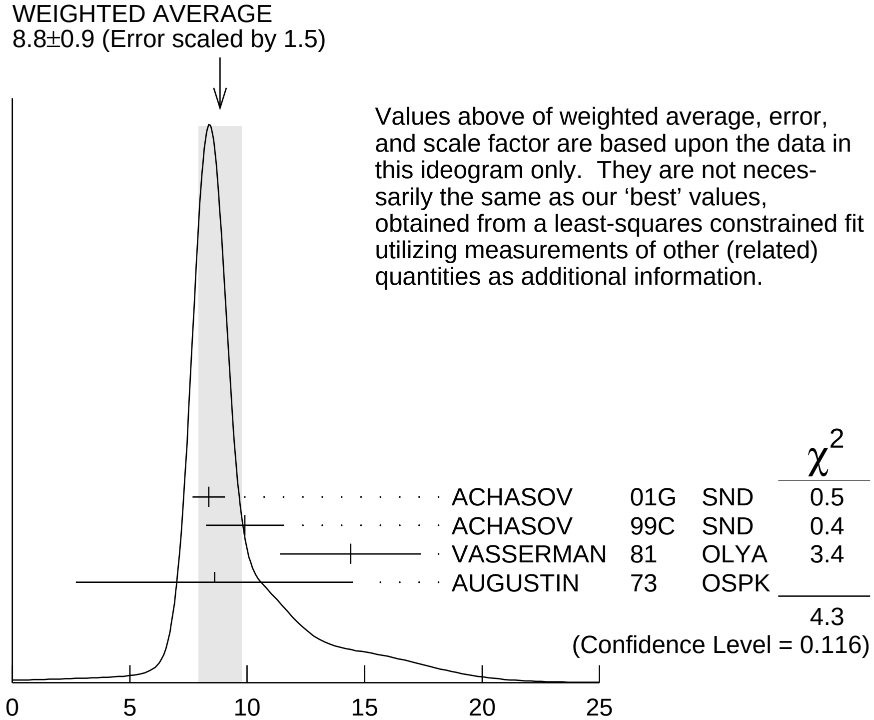
$\Gamma(\eta\gamma)/\Gamma_{total} \times \Gamma(e^+e^-)/\Gamma_{total}$ $\Gamma_6/\Gamma \times \Gamma_9/\Gamma$

$\Gamma(\pi^0\gamma)/\Gamma_{total} \times \Gamma(e^+e^-)/\Gamma_{total}$ $\Gamma_7/\Gamma \times \Gamma_9/\Gamma$

VALUE (units 10^{-7})	EVTS	DOCUMENT ID		TECN	COMMENT
3.87±0.14 OUR FIT					
3.87±0.15 OUR AVERAGE					
4.04±0.09±0.19		[13] ACHASOV	16A	SND	0.60–1.38 $e^+e^- \to \pi^0\gamma$
3.75±0.11±0.29	18k	AKHMETSHIN	05	CMD2	0.60-1.38 $e^+e^- \to \pi^0\gamma$
$3.67\pm0.10^{+0.27}_{-0.25}$		[14] ACHASOV	00	SND	$e^+e^- \to \pi^0\gamma$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
4.29±0.11		[12] BENAYOUN	10	RVUE	0.4–1.05 e^+e^-

$\Gamma(\mu^+\mu^-)/\Gamma_{total} \times \Gamma(e^+e^-)/\Gamma_{total}$ $\Gamma_{10}/\Gamma \times \Gamma_9/\Gamma$

VALUE (units 10^{-8})	DOCUMENT ID		TECN	COMMENT
8.5 ±0.6 OUR FIT				
8.8 ±0.9 OUR AVERAGE	Error includes scale factor of 1.5. See the ideogram below.			
8.36±0.59±0.37	ACHASOV	01G	SND	$e^+e^- \to \mu^+\mu^-$
9.9 ±1.4 ±0.9	[10] ACHASOV	99C	SND	$e^+e^- \to \mu^+\mu^-$
14.4 ±3.0	[4] VASSERMAN	81	OLYA	$e^+e^- \to \mu^+\mu^-$
8.6 ±5.9	[4] AUGUSTIN	73	OSPK	$e^+e^- \to \mu^+\mu^-$



$\Gamma\left(\mu^+\mu^-\right)/\Gamma_{\rm total}\times\Gamma\left(e^+e^-\right)/\Gamma_{\rm total}$ $\qquad$ $\Gamma_{10}/\Gamma\times\Gamma_9/\Gamma$

$\Gamma(\pi^+\pi^-)/\Gamma_{\rm total}\times\Gamma(e^+e^-)/\Gamma_{\rm total}$ $\qquad$ $\Gamma_{12}/\Gamma\times\Gamma_9/\Gamma$

VALUE (units 10^{-8})	*DOCUMENT ID*		*TECN*	*COMMENT*
2.2 ±0.4 OUR FIT				
2.2 ±0.4 OUR AVERAGE				
2.1 ±0.3 ±0.3	[10] ACHASOV	00C	SND	$e^+e^-\to\pi^+\pi^-$
$1.95^{+1.15}_{-0.87}$	[4] GOLUBEV	86	ND	$e^+e^-\to\pi^+\pi^-$
$6.01^{+3.19}_{-2.51}$	[4] VASSERMAN	81	OLYA	$e^+e^-\to\pi^+\pi^-$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
3.31±0.99	[15] BENAYOUN	13	RVUE	0.4–1.05 e^+e^-

$\Gamma(\omega\pi^0)/\Gamma_{\rm total}\times\Gamma(e^+e^-)/\Gamma_{\rm total}$ $\qquad$ $\Gamma_{13}/\Gamma\times\Gamma_9/\Gamma$

VALUE (units 10^{-8})	*DOCUMENT ID*		*TECN*	*COMMENT*
1.40±0.15 OUR FIT				
1.37±0.17±0.01	[16,17] AMBROSINO	08G	KLOE	$e^+e^-\to\pi^+\pi^-2\pi^0$, $2\pi^0\gamma$

$\Gamma(\pi^0\pi^0\gamma)/\Gamma_{\rm total}\times\Gamma(e^+e^-)/\Gamma_{\rm total}$ $\qquad$ $\Gamma_{18}/\Gamma\times\Gamma_9/\Gamma$

VALUE (units 10^{-8})	*DOCUMENT ID*		*TECN*	*COMMENT*
3.34±0.17 OUR FIT				
$\mathbf{3.33^{+0.04}_{-0.09}{}^{+0.19}_{-0.20}}$	[18] AMBROSINO	07	KLOE	$e^+e^-\to\pi^0\pi^0\gamma$

$\Gamma(\pi^+\pi^-\pi^+\pi^-)/\Gamma_{total} \times \Gamma(e^+e^-)/\Gamma_{total}$ — $\Gamma_{19}/\Gamma \times \Gamma_9/\Gamma$

VALUE (units 10^{-9})	EVTS	DOCUMENT ID	TECN	COMMENT
$1.2^{+0.8}_{-0.7}$ OUR FIT				
1.17±0.52±0.64	3285	[10] AKHMETSHIN 00E	CMD2	$e^+e^- \rightarrow \pi^+\pi^-\pi^+\pi^-$

[1] From the combined fit assuming that the total $\phi(1020)$ production cross section is saturated by those of K^+K^-, $K_S K_L$, $\pi^+\pi^-\pi^0$, and $\eta\gamma$ decays modes and using ACHASOV 00B for the $\eta\gamma$ decay mode.

[2] KOZYREV 16 also reports $\Gamma(e^+e^-)$ B($\phi \rightarrow K^0_S K^0_L$) = (0.428 ± 0.001 ± 0.009) keV.

[3] Update of AKHMETSHIN 99D

[4] Recalculated by us from the cross section in the peak.

[5] From a combined fit of $\sigma(e^+e^- \rightarrow \eta\gamma)$ with $\eta \rightarrow 3\pi^0$ and $\eta \rightarrow \pi^+\pi^-\pi^0$, and fixing B($\eta \rightarrow 3\pi^0$) / B($\eta \rightarrow \pi^+\pi^-\pi^0$) = 1.44 ± 0.04. Recalculated by us from the cross section at the peak. Supersedes ACHASOV 00D and ACHASOV 06A.

[6] From the $\eta \rightarrow 2\gamma$ decay and using B($\eta \rightarrow \gamma\gamma$) = 39.43 ± 0.26%.

[7] From the $\eta \rightarrow 3\pi^0$ decay and using B($\eta \rightarrow 3\pi^0$)= (32.24 ± 0.29) × 10^{-2}.

[8] The combined fit from 600 to 1380 MeV taking into account $\rho(770)$, $\omega(782)$, $\phi(1020)$, and $\rho(1450)$ (mass and width fixed at 1450 MeV and 310 MeV respectively).

[9] From the $\eta \rightarrow 2\gamma$ decay and using B($\eta \rightarrow 2\gamma$) =(39.21 ± 0.34) × 10^{-2}.

[10] Recalculated by the authors from the cross section in the peak.

[11] From the $\eta \rightarrow \pi^+\pi^-\pi^0$ decay and using B($\eta \rightarrow \pi^+\pi^-\pi^0$) =(23.1 ± 0.5) × 10^{-2}.

[12] A simultaneous fit of $e^+e^- \rightarrow \pi^+\pi^-$, $\pi^+\pi^-\pi^0$, $\pi^0\gamma$, $\eta\gamma$ data.

[13] From the VMD model with the interfering $\rho(770)$, $\omega(782)$, $\phi(1020)$ resonances, and an additional resonance describing the total contribution of the $\rho(1450)$ and $\omega(1420)$ states. Supersedes ACHASOV 00.

[14] From the $\pi^0 \rightarrow 2\gamma$ decay and using B($\pi^0 \rightarrow 2\gamma$) = (98.798 ± 0.032) × 10^{-2}.

[15] A simultaneous fit to $e^+e^- \rightarrow \pi^+\pi^-$, $\pi^+\pi^-\pi^0$, $\pi^0\gamma$, $\eta\gamma$, $K\overline{K}$, and $\tau^- \rightarrow \pi^-\pi^0\nu_\tau$ data.

[16] Recalculated by the authors from the cross section at the peak.

[17] AMBROSINO 08G reports [$\Gamma(\phi(1020) \rightarrow \omega\pi^0)/\Gamma_{total} \times \Gamma(\phi(1020) \rightarrow e^+e^-)/\Gamma_{total}$] × [B($\omega(782) \rightarrow \pi^+\pi^-\pi^0$)] = (1.22 ± 0.13 ± 0.08) × 10^{-8} which we divide by our best value B($\omega(782) \rightarrow \pi^+\pi^-\pi^0$) = (89.2 ± 0.7) × 10^{-2}. Our first error is their experiment's error and our second error is the systematic error from using our best value.

[18] Calculated by the authors from the cross section at the peak.

ϕ(1020) BRANCHING RATIOS

$\Gamma(K^+K^-)/\Gamma_{total}$ — Γ_1/Γ

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
0.489±0.005 OUR FIT Error includes scale factor of 1.1.				
0.493±0.010 OUR AVERAGE				
0.492±0.012	2913	AKHMETSHIN 95	CMD2	$e^+e^- \rightarrow K^+K^-$
0.44 ±0.05	321	KALBFLEISCH 76	HBC	2.18 $K^-p \rightarrow \Lambda K^+K^-$
0.49 ±0.06	270	DEGROOT 74	HBC	4.2 $K^-p \rightarrow \Lambda\phi$
0.540±0.034	565	BALAKIN 71	OSPK	$e^+e^- \rightarrow K^+K^-$
0.48 ±0.04	252	LINDSEY 66	HBC	2.1–2.7 $K^-p \rightarrow \Lambda K^+K^-$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.493±0.003±0.007		[1] AKHMETSHIN 11	CMD2	1.02 $e^+e^- \rightarrow K^+K^-$
0.476±0.017	1000k	[2] ACHASOV 01E	SND	$e^+e^- \rightarrow K^+K^-$, $K_S K_L$, $\pi^+\pi^-\pi^0$

$\Gamma(K^0_L K^0_S)/\Gamma_{total}$ — Γ_2/Γ

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.342±0.004 OUR FIT Error includes scale factor of 1.1.					
0.331±0.009 OUR AVERAGE					
0.335±0.010	40644	AKHMETSHIN	95	CMD2	$e^+e^- \to K^0_L K^0_S$
0.326±0.035		DOLINSKY	91	ND	$e^+e^- \to K^0_L K^0_S$
0.310±0.024		DRUZHININ	84	ND	$e^+e^- \to K^0_L K^0_S$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.336±0.002±0.006		[1] AKHMETSHIN	11	CMD2	1.02 $e^+e^- \to K^0_S K^0_L$
0.351±0.013	500k	[2] ACHASOV	01E	SND	$e^+e^- \to K^+K^-$, $K_S K_L$, $\pi^+\pi^-\pi^0$
0.27 ±0.03	133	KALBFLEISCH	76	HBC	2.18 $K^- p \to \Lambda K^0_L K^0_S$
0.257±0.030	95	BALAKIN	71	OSPK	$e^+e^- \to K^0_L K^0_S$
0.40 ±0.04	167	LINDSEY	66	HBC	2.1–2.7 $K^- p \to \Lambda K^0_L K^0_S$

$\Gamma(K^0_L K^0_S)/\Gamma(K^+K^-)$ — Γ_2/Γ_1

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.698±0.013 OUR FIT Error includes scale factor of 1.1.					
0.740±0.031 OUR AVERAGE					
0.70 ±0.06	2732	BUKIN	78C	OLYA	$e^+e^- \to K^0_L K^0_S$
0.82 ±0.08		LOSTY	78	HBC	4.2 $K^- p \to \phi$ hyperon
0.71 ±0.05		LAVEN	77	HBC	10 $K^- p \to K^+K^-\Lambda$
0.71 ±0.08		LYONS	77	HBC	3–4 $K^- p \to \Lambda\phi$
0.89 ±0.10	144	AGUILAR-...	72B	HBC	3.9,4.6 $K^- p$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.68 ±0.03		[3] AKHMETSHIN	95	CMD2	$e^+e^- \to K^0_L K^0_S$, K^+K^-

$\Gamma(K^0_L K^0_S)/\Gamma(K\overline{K})$ — $\Gamma_2/(\Gamma_1+\Gamma_2)$

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.411±0.005 OUR FIT Error includes scale factor of 1.1.					
0.45 ±0.04 OUR AVERAGE					
0.44 ±0.07		LONDON	66	HBC	2.24 $K^- p \to \Lambda K\overline{K}$
0.48 ±0.07	52	BADIER	65B	HBC	3 $K^- p$
0.40 ±0.10	34	SCHLEIN	63	HBC	1.95 $K^- p \to \Lambda K\overline{K}$

$[\Gamma(\rho\pi)+\Gamma(\pi^+\pi^-\pi^0)]/\Gamma_{total}$ — Γ_3/Γ

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.1532±0.0032 OUR FIT Error includes scale factor of 1.1.					
0.151 ±0.009 OUR AVERAGE Error includes scale factor of 1.7.					
0.161 ±0.008	11761	AKHMETSHIN	95	CMD2	$e^+e^- \to \pi^+\pi^-\pi^0$
0.143 ±0.007		DOLINSKY	91	ND	$e^+e^- \to \pi^+\pi^-\pi^0$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.155 ±0.002 ±0.005		[1] AKHMETSHIN	11	CMD2	1.02 $e^+e^- \to \pi^+\pi^-\pi^0$
0.159 ±0.008	400k	[2] ACHASOV	01E	SND	$e^+e^- \to K^+K^-$, $K_S K_L$, $\pi^+\pi^-\pi^0$
0.145 ±0.009 ±0.003	11169	[4] AKHMETSHIN	98	CMD2	$e^+e^- \to \pi^+\pi^-\pi^0$
0.139 ±0.007		[5] PARROUR	76B	OSPK	e^+e^-

$[\Gamma(\rho\pi)+\Gamma(\pi^+\pi^-\pi^0)]/\Gamma(K^+K^-)$ — Γ_3/Γ_1

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.313±0.009 OUR FIT Error includes scale factor of 1.1.					
0.28 ±0.09	34	AGUILAR-...	72B	HBC	3.9,4.6 $K^- p$

$[\Gamma(\rho\pi)+\Gamma(\pi^+\pi^-\pi^0)]/\Gamma(K\overline{K})$ — $\Gamma_3/(\Gamma_1+\Gamma_2)$

VALUE	DOCUMENT ID		TECN	COMMENT
0.184±0.005 OUR FIT Error includes scale factor of 1.1.				
0.24 ±0.04 OUR AVERAGE				
0.237±0.039	CERRADA	77B	HBC	4.2 $K^- p \to \Lambda 3\pi$
0.30 ±0.15	LONDON	66	HBC	2.24 $K^- p \to \Lambda\pi^+\pi^-\pi^0$

$[\Gamma(\rho\pi)+\Gamma(\pi^+\pi^-\pi^0)]/\Gamma(K^0_L K^0_S)$ — Γ_3/Γ_2

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.448±0.011 OUR FIT Error includes scale factor of 1.1.					
0.51 ±0.05 OUR AVERAGE					
0.56 ±0.07	3681	BUKIN	78C	OLYA	$e^+e^- \to K^0_L K^0_S$, $\pi^+\pi^-\pi^0$
0.47 ±0.06	516	COSME	74	OSPK	$e^+e^- \to \pi^+\pi^-\pi^0$

$\Gamma(\pi^+\pi^-\pi^0)/\Gamma_{total}$ — Γ_5/Γ

VALUE	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •						
$\simeq$ 0.0087		1.98M	[6,7] ALOISIO	03	KLOE	1.02 $e^+e^- \to \pi^+\pi^-\pi^0$
<0.0006	90		[8] ACHASOV	02	SND	1.02 $e^+e^- \to \pi^+\pi^-\pi^0$
<0.23	90		[8] CORDIER	80	DM1	$e^+e^- \to \pi^+\pi^-\pi^0$
<0.20	90		[8] PARROUR	76B	OSPK	$e^+e^- \to \pi^+\pi^-\pi^0$

$\Gamma(\eta\gamma)/\Gamma_{total}$ — Γ_6/Γ

VALUE (units 10^{-2})	EVTS	DOCUMENT ID		TECN	COMMENT
1.309±0.024 OUR FIT Error includes scale factor of 1.2.					
1.26 ±0.04 OUR AVERAGE					
1.246±0.025±0.057	10k	[9] ACHASOV	98F	SND	$e^+e^- \to 7\gamma$
1.18 ±0.11	279	[10] AKHMETSHIN	95	CMD2	$e^+e^- \to \pi^+\pi^- 3\gamma$
1.30 ±0.06		[11] DRUZHININ	84	ND	$e^+e^- \to 3\gamma$
1.4 ±0.2		[12] DRUZHININ	84	ND	$e^+e^- \to 6\gamma$
0.88 ±0.20	290	KURDADZE	83C	OLYA	$e^+e^- \to 3\gamma$
1.35 ±0.29		ANDREWS	77	CNTR	6.7–10 γ Cu
1.5 ±0.4	54	[11] COSME	76	OSPK	e^+e^-
• • • We do not use the following data for averages, fits, limits, etc. • • •					
1.38 ±0.02 ±0.02		[1] AKHMETSHIN	11	CMD2	1.02 $e^+e^- \to \eta\gamma$
1.37 ±0.05 ±0.01	33k	[13] ACHASOV	07B	SND	0.6–1.38 $e^+e^- \to \eta\gamma$
1.373±0.014±0.085	17.4k	[14,15] AKHMETSHIN	05	CMD2	0.60-1.38 $e^+e^- \to \eta\gamma$
1.287±0.013±0.063		[16,17] AKHMETSHIN	01B	CMD2	$e^+e^- \to \eta\gamma$
1.338±0.012±0.052		[18] ACHASOV	00	SND	$e^+e^- \to \eta\gamma$
1.18 ±0.03 ±0.06	2200	[19] AKHMETSHIN	99F	CMD2	$e^+e^- \to \eta\gamma$
1.21 ±0.07		[20] BENAYOUN	96	RVUE	0.54-1.04 $e^+e^- \to \eta\gamma$

$\Gamma(\pi^0\gamma)/\Gamma_{total}$ — Γ_7/Γ

VALUE (units 10^{-3})	EVTS	DOCUMENT ID		TECN	COMMENT
1.31 ±0.05 OUR FIT					
1.31 ±0.13 OUR AVERAGE					
1.30 ±0.13		DRUZHININ	84	ND	$e^+e^- \to 3\gamma$
1.4 ±0.5	32	COSME	76	OSPK	e^+e^-
• • • We do not use the following data for averages, fits, limits, etc. • • •					
1.367±0.072		[21] ACHASOV	16A	SND	0.60–1.38 $e^+e^- \to \pi^0\gamma$
1.258±0.037±0.077	18k	[22,23] AKHMETSHIN	05	CMD2	0.60-1.38 $e^+e^- \to \pi^0\gamma$
$1.226\pm0.036^{+0.096}_{-0.089}$		[24] ACHASOV	00	SND	$e^+e^- \to \pi^0\gamma$
1.26 ±0.17		[20] BENAYOUN	96	RVUE	0.54-1.04 $e^+e^- \to \pi^0\gamma$

$\Gamma(\eta\gamma)/\Gamma(\pi^0\gamma)$ — Γ_6/Γ_7

VALUE	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
$10.9\pm0.3^{+0.7}_{-0.8}$	ACHASOV	00	SND	$e^+e^- \to \eta\gamma, \pi^0\gamma$

$\Gamma(e^+e^-)/\Gamma_{total}$ — Γ_9/Γ

VALUE (units 10^{-4})	EVTS	DOCUMENT ID		TECN	COMMENT
2.955±0.029 OUR FIT Error includes scale factor of 1.1.					
2.98 ±0.07 OUR AVERAGE Error includes scale factor of 1.1.					
2.93 ±0.14	1900k	[25] ACHASOV	01E	SND	$e^+e^- \to K^+K^-$, $K_S K_L$, $\pi^+\pi^-\pi^0$
2.88 ±0.09	55600	AKHMETSHIN	95	CMD2	$e^+e^- \to$ hadrons
3.00 ±0.21	3681	BUKIN	78C	OLYA	$e^+e^- \to$ hadrons
3.10 ±0.14		[26] PARROUR	76	OSPK	e^+e^-
3.3 ±0.3		COSME	74	OSPK	$e^+e^- \to$ hadrons
2.81 ±0.25	681	BALAKIN	71	OSPK	$e^+e^- \to$ hadrons
3.50 ±0.27		CHATELUS	71	OSPK	e^+e^-

$\Gamma(\mu^+\mu^-)/\Gamma_{total}$ — Γ_{10}/Γ

VALUE (units 10^{-4})	DOCUMENT ID		TECN	COMMENT
$2.87^{+0.18}_{-0.20}$ OUR FIT				
2.5 ±0.4 OUR AVERAGE				
2.69±0.46	[27] HAYES	71	CNTR	8.3,9.8 $\gamma C \to \mu^+\mu^- X$
2.17±0.60	[27] EARLES	70	CNTR	6.0 $\gamma C \to \mu^+\mu^- X$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
2.87±0.20±0.14	[28] ACHASOV	01G	SND	$e^+e^- \to \mu^+\mu^-$
3.30±0.45±0.32	[4] ACHASOV	99C	SND	$e^+e^- \to \mu^+\mu^-$
4.83±1.02	[29] VASSERMAN	81	OLYA	$e^+e^- \to \mu^+\mu^-$
2.87±1.98	[29] AUGUSTIN	73	OSPK	$e^+e^- \to \mu^+\mu^-$

$\Gamma(\eta e^+ e^-)/\Gamma_{total}$ — Γ_{11}/Γ

VALUE (units 10^{-4})	EVTS	DOCUMENT ID		TECN	COMMENT
1.08 ±0.04 OUR AVERAGE					
1.075±0.007±0.038	30k	[30] BABUSCI	15	KLOE	1.02 $e^+ e^- \rightarrow \eta e^+ e^-$
1.19 ±0.19 ±0.12	213	[31] ACHASOV	01B	SND	$e^+ e^- \rightarrow \eta e^+ e^-$
1.14 ±0.10 ±0.06	355	[32] AKHMETSHIN	01	CMD2	$e^+ e^- \rightarrow \eta e^+ e^-$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
1.13 ±0.14 ±0.07	183	[33] AKHMETSHIN	01	CMD2	$e^+ e^- \rightarrow \eta e^+ e^-$
1.21 ±0.14 ±0.09	130	[34] AKHMETSHIN	01	CMD2	$e^+ e^- \rightarrow \eta e^+ e^-$
1.04 ±0.20 ±0.08	42	[35] AKHMETSHIN	01	CMD2	$e^+ e^- \rightarrow \eta e^+ e^-$
$1.3\ ^{+0.8}_{-0.6}$	7	GOLUBEV	85	ND	$e^+ e^- \rightarrow \eta e^+ e^-$

$\Gamma(\pi^+ \pi^-)/\Gamma_{total}$ — Γ_{12}/Γ

VALUE (units 10^{-4})	CL%	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.71±0.11±0.09		[4] ACHASOV	00C	SND	$e^+ e^- \rightarrow \pi^+ \pi^-$
$0.65^{+0.38}_{-0.29}$		[4] GOLUBEV	86	ND	$e^+ e^- \rightarrow \pi^+ \pi^-$
$2.01^{+1.07}_{-0.84}$		[4] VASSERMAN	81	OLYA	$e^+ e^- \rightarrow \pi^+ \pi^-$
<6.6	95	BUKIN	78B	OLYA	$e^+ e^- \rightarrow \pi^+ \pi^-$
<2.7	95	ALVENSLEB...	72	CNTR	6.7 $\gamma C \rightarrow C \pi^+ \pi^-$

$\Gamma(\omega \pi^0)/\Gamma_{total}$ — Γ_{13}/Γ

VALUE (units 10^{-5})	DOCUMENT ID		TECN	COMMENT
4.7±0.5 OUR FIT				
$\mathbf{5.2^{+1.3}_{-1.1}}$	[36,37] AULCHENKO	00A	SND	$e^+ e^- \rightarrow \pi^+ \pi^- \pi^0 \pi^0$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
4.4±0.6	[38] AMBROSINO	08G	KLOE	$e^+ e^- \rightarrow \pi^+ \pi^- 2\pi^0$, $2\pi^0 \gamma$
~ 5.4	[39] ACHASOV	00E	SND	$e^+ e^- \rightarrow \pi^0 \pi^0 \gamma$
$5.5^{+1.6}_{-1.4}\pm0.3$	[37,40] AULCHENKO	00A	SND	$e^+ e^- \rightarrow \pi^+ \pi^- \pi^0 \pi^0$
$4.8^{+1.9}_{-1.7}\pm0.8$	[39] ACHASOV	99	SND	$e^+ e^- \rightarrow \pi^+ \pi^- \pi^0 \pi^0$

$\Gamma(\omega \gamma)/\Gamma_{total}$ — Γ_{14}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.05	84	LINDSEY	66	HBC	2.1–2.7 $K^- p \rightarrow \Lambda \pi^+ \pi^-$ neutrals

$\Gamma(\rho \gamma)/\Gamma_{total}$ — Γ_{15}/Γ

VALUE (units 10^{-4})	CL%	DOCUMENT ID		TECN	COMMENT
< 0.12	90	[41] AKHMETSHIN	99B	CMD2	$e^+ e^- \rightarrow \pi^+ \pi^- \gamma$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
< 7	90	AKHMETSHIN	97C	CMD2	$e^+ e^- \rightarrow \pi^+ \pi^- \gamma$
<200	84	LINDSEY	66	HBC	2.1–2.7 $K^- p \rightarrow \Lambda \pi^+ \pi^-$ neutrals

$\Gamma(\pi^+\pi^-\gamma)/\Gamma_{total}$ — Γ_{16}/Γ

VALUE (units 10^{-4})	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
0.41±0.12±0.04		30175	[42] AKHMETSHIN	99B	CMD2	$e^+e^- \to \pi^+\pi^-\gamma$
• • • We do not use the following data for averages, fits, limits, etc. • • •						
< 0.3	90		[43] AKHMETSHIN	97C	CMD2	$e^+e^- \to \pi^+\pi^-\gamma$
<600	90		KALBFLEISCH	75	HBC	2.18 $K^- p \to \Lambda\pi^+\pi^-\gamma$
< 70	90		COSME	74	OSPK	$e^+e^- \to \pi^+\pi^-\gamma$
<400	90		LINDSEY	65	HBC	2.1–2.7 $K^- p \to \Lambda\pi^+\pi^-$ neutrals

$\Gamma(f_0(980)\gamma)/\Gamma_{total}$ — Γ_{17}/Γ

VALUE (units 10^{-4})	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
3.22±0.19 OUR FIT Error includes scale factor of 1.1.						
3.21±0.19 OUR AVERAGE						
$3.21^{+0.03}_{-0.09}\pm0.18$			[44] AMBROSINO	07	KLOE	$e^+e^- \to \pi^0\pi^0\gamma$
2.90±0.21±1.54			[45] AKHMETSHIN	99C	CMD2	$e^+e^- \to \pi^+\pi^-\gamma$, $\pi^0\pi^0\gamma$
• • • We do not use the following data for averages, fits, limits, etc. • • •						
4.47±0.21		2438	[46] ALOISIO	02D	KLOE	$e^+e^- \to \pi^0\pi^0\gamma$
$3.5\ \pm0.3\ ^{+1.3}_{-0.5}$		419	[47,48] ACHASOV	00H	SND	$e^+e^- \to \pi^0\pi^0\gamma$
1.93±0.46±0.50		27188	[49] AKHMETSHIN	99B	CMD2	$e^+e^- \to \pi^+\pi^-\gamma$
3.05±0.25±0.72		268	[50] AKHMETSHIN	99C	CMD2	$e^+e^- \to \pi^0\pi^0\gamma$
1.5 ±0.5		268	[51] AKHMETSHIN	99C	CMD2	$e^+e^- \to \pi^0\pi^0\gamma$
3.42±0.30±0.36		164	[47] ACHASOV	98I	SND	$e^+e^- \to 5\gamma$
< 1	90		[52] AKHMETSHIN	97C	CMD2	$e^+e^- \to \pi^+\pi^-\gamma$
< 7	90		[53] AKHMETSHIN	97C	CMD2	$e^+e^- \to \pi^+\pi^-\gamma$
< 20	90		DRUZHININ	87	ND	$e^+e^- \to \pi^0\pi^0\gamma$

$\Gamma(f_0(980)\gamma)/\Gamma(\eta\gamma)$ — Γ_{17}/Γ_6

VALUE (units 10^{-2})	EVTS	DOCUMENT ID		TECN	COMMENT
2.46±0.15 OUR FIT Error includes scale factor of 1.1.					
$2.6\ \pm0.2\ ^{+0.8}_{-0.3}$	419	[47] ACHASOV	00H	SND	$e^+e^- \to \pi^0\pi^0\gamma$

$\Gamma(\pi^0\pi^0\gamma)/\Gamma_{total}$ — Γ_{18}/Γ

VALUE (units 10^{-4})	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
1.07 ±0.06 OUR AVERAGE						
$1.07\ ^{+0.01}_{-0.03}\ ^{+0.06}_{-0.06}$			[54] AMBROSINO	07	KLOE	$e^+e^- \to \pi^0\pi^0\gamma$
1.08 ±0.17 ±0.09		268	AKHMETSHIN	99C	CMD2	$e^+e^- \to \pi^0\pi^0\gamma$
• • • We do not use the following data for averages, fits, limits, etc. • • •						
1.09 ±0.03 ±0.05		2438	ALOISIO	02D	KLOE	$e^+e^- \to \pi^0\pi^0\gamma$
1.158±0.093±0.052		419	[48,55] ACHASOV	00H	SND	$e^+e^- \to \pi^0\pi^0\gamma$
<10	90		DRUZHININ	87	ND	$e^+e^- \to 5\gamma$

$\Gamma(\pi^0\pi^0\gamma)/\Gamma(\eta\gamma)$ — Γ_{18}/Γ_6

VALUE (units 10^{-2})	EVTS	DOCUMENT ID		TECN	COMMENT
0.86 ±0.04 OUR FIT					
0.865±0.070±0.017	419	[55] ACHASOV	00H	SND	$e^+e^- \to \pi^0\pi^0\gamma$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.90 ±0.08 ±0.07	164	ACHASOV	98I	SND	$e^+e^- \to 5\gamma$

$\Gamma(\pi^+\pi^-\pi^+\pi^-)/\Gamma_{total}$ — Γ_{19}/Γ

VALUE (units 10^{-6})	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •						
3.93±1.74±2.14		3285	AKHMETSHIN	00E	CMD2	$e^+e^- \to \pi^+\pi^-\pi^+\pi^-$
< 870	90		CORDIER	79	WIRE	$e^+e^- \to \pi^+\pi^-\pi^+\pi^-$

$\Gamma(\pi^+\pi^+\pi^-\pi^-\pi^0)/\Gamma_{total}$ — Γ_{20}/Γ

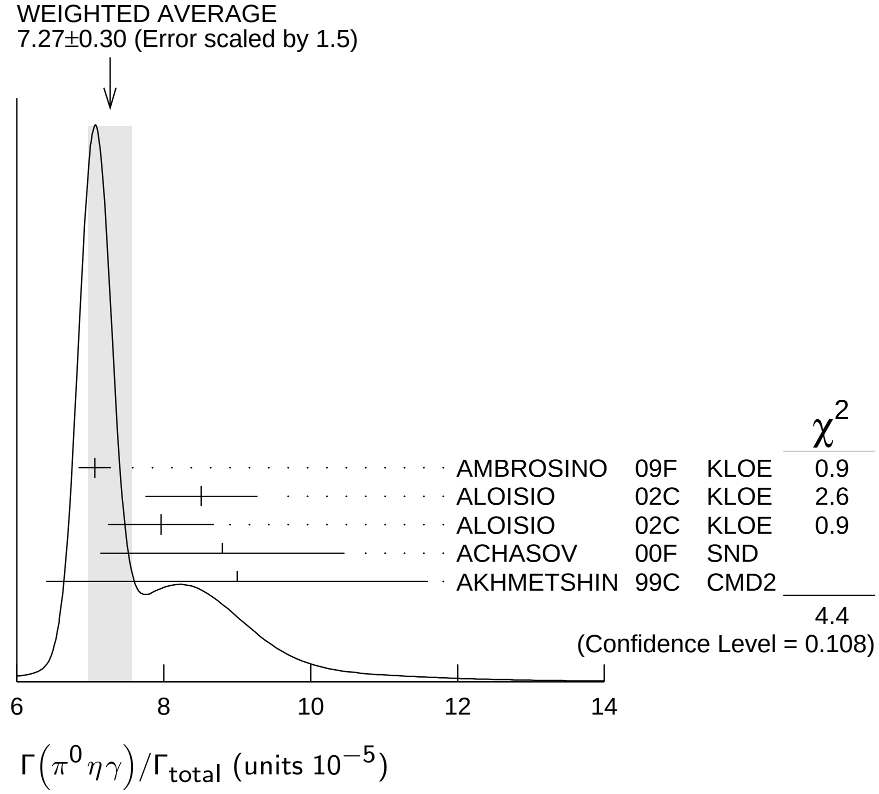
VALUE (units 10^{-6})	CL%	DOCUMENT ID		TECN	COMMENT
< 4.6	90	AKHMETSHIN	00E	CMD2	$e^+e^- \to \pi^+\pi^-\pi^+\pi^-\pi^0$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<150	95	BARKOV	88	CMD	$e^+e^- \to \pi^+\pi^-\pi^+\pi^-\pi^0$

$\Gamma(\pi^0 e^+ e^-)/\Gamma_{total}$ — Γ_{21}/Γ

VALUE (units 10^{-5})	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
$1.33^{+0.07}_{-0.10}$ OUR AVERAGE						
$1.35\pm0.05^{+0.05}_{-0.10}$		9.5k	[56] ANASTASI	16B	KLOE	$e^+e^- \to \pi^0 e^+e^-$
1.01±0.28±0.29		52	[57] ACHASOV	02D	SND	$e^+e^- \to \pi^0 e^+e^-$
1.22±0.34±0.21		46	[58] AKHMETSHIN	01C	CMD2	$e^+e^- \to \pi^0 e^+e^-$
• • • We do not use the following data for averages, fits, limits, etc. • • •						
<12	90		DOLINSKY	88	ND	$e^+e^- \to \pi^0 e^+e^-$

$\Gamma(\pi^0\eta\gamma)/\Gamma_{total}$ — Γ_{22}/Γ

VALUE (units 10^{-5})	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
7.27±0.30 OUR AVERAGE Error includes scale factor of 1.5. See the ideogram below.						
7.06±0.22		16.9k	[59] AMBROSINO	09F	KLOE	1.02 $e^+e^- \to \eta\pi^0\gamma$
8.51±0.51±0.57		607	[60] ALOISIO	02C	KLOE	$e^+e^- \to \eta\pi^0\gamma$
7.96±0.60±0.40		197	[61] ALOISIO	02C	KLOE	$e^+e^- \to \eta\pi^0\gamma$
8.8 ±1.4 ±0.9		36	[62] ACHASOV	00F	SND	$e^+e^- \to \eta\pi^0\gamma$
9.0 ±2.4 ±1.0		80	AKHMETSHIN	99C	CMD2	$e^+e^- \to \eta\pi^0\gamma$
• • • We do not use the following data for averages, fits, limits, etc. • • •						
7.01±0.10±0.20		13.3k	[60,63] AMBROSINO	09F	KLOE	1.02 $e^+e^- \to \eta\pi^0\gamma$
7.12±0.13±0.22		3.6k	[61,64] AMBROSINO	09F	KLOE	1.02 $e^+e^- \to \eta\pi^0\gamma$
8.3 ±2.3 ±1.2		20	ACHASOV	98B	SND	$e^+e^- \to 5\gamma$
<250	90		DOLINSKY	91	ND	$e^+e^- \to \pi^0\eta\gamma$



$\Gamma\left(a_0(980)\gamma\right)/\Gamma_{total}$ — Γ_{23}/Γ

VALUE (units 10^{-5})	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
7.6±0.6 OUR FIT						
7.6±0.6 OUR AVERAGE						
7.4±0.7			[65] ALOISIO	02C	KLOE	$e^+e^- \to \eta\pi^0\gamma$
8.8±1.7		36	[66] ACHASOV	00F	SND	$e^+e^- \to \eta\pi^0\gamma$
• • • We do not use the following data for averages, fits, limits, etc. • • •						
11 ±2			[67] GOKALP	02	RVUE	$e^+e^- \to \eta\pi^0\gamma$
<500	90		DOLINSKY	91	ND	$e^+e^- \to \pi^0\eta\gamma$

$\Gamma\left(f_0(980)\gamma\right)/\Gamma\left(a_0(980)\gamma\right)$ — Γ_{17}/Γ_{23}

VALUE	DOCUMENT ID		TECN	COMMENT
6.1±0.6	[68] ALOISIO	02C	KLOE	$e^+e^- \to \eta\pi^0\gamma$

$\Gamma\left(K^0\overline{K}^0\gamma\right)/\Gamma_{total}$ — Γ_{24}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<1.9 × 10^{-8}	90	AMBROSINO	09C	KLOE	$e^+e^- \to K^0_S K^0_S\gamma$

$\Gamma\left(\eta'(958)\gamma\right)/\Gamma_{total}$ — Γ_{25}/Γ

VALUE (units 10^{-5})	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
6.25±0.21 OUR FIT						
6.25±0.30 OUR AVERAGE						
6.24±0.28±0.11		3407	[69] AMBROSINO	07A	KLOE	1.02 $e^+e^- \to \pi^+\pi^-7\gamma$
6.7 $^{+2.8}_{-2.4}$ ±0.8		12	[70] AULCHENKO	03B	SND	$e^+e^- \to \eta'\gamma$

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

$6.7\ ^{+5.0}_{-4.2}\ \pm1.5$	7	AULCHENKO	03B	SND	$e^+e^- \to 7\gamma$
$6.10\pm0.61\pm0.43$	120	[71] ALOISIO	02E	KLOE	$1.02\ e^+e^- \to \pi^+\pi^-3\gamma$
$8.2\ ^{+2.1}_{-1.9}\ \pm1.1$	21	[72] AKHMETSHIN	00B	CMD2	$e^+e^- \to \pi^+\pi^-3\gamma$
$4.9\ ^{+2.2}_{-1.8}\ \pm0.6$	9	[73] AKHMETSHIN	00F	CMD2	$e^+e^- \to \pi^+\pi^-\pi^+\pi^- \geq 2\gamma$
$6.4\ \pm1.6$	30	[74] AKHMETSHIN	00F	CMD2	$e^+e^- \to \eta'(958)\gamma$
$6.7\ ^{+3.4}_{-2.9}\ \pm1.0$	5	[75] AULCHENKO	99	SND	$e^+e^- \to \pi^+\pi^-3\gamma$
<11	90 (CL%)	AULCHENKO	98	SND	$e^+e^- \to 7\gamma$
$12\ ^{+7}_{-5}\ \pm2$	6	[72] AKHMETSHIN	97B	CMD2	$e^+e^- \to \pi^+\pi^-\ 3\gamma$
<41	90 (CL%)	DRUZHININ	87	ND	$e^+e^- \to \gamma\eta\pi^+\pi^-$

$\Gamma(\eta'(958)\gamma)/\Gamma(K^0_L K^0_S)$ — Γ_{25}/Γ_2

VALUE (units 10^{-4})	EVTS	DOCUMENT ID		TECN	COMMENT
1.83±0.06 OUR FIT					
$\mathbf{1.46^{+0.64}_{-0.54}\pm0.18}$	9	[76] AKHMETSHIN	00F	CMD2	$e^+e^- \to \pi^+\pi^-\pi^+\pi^- \geq 2\gamma$

$\Gamma(\eta'(958)\gamma)/\Gamma(\eta\gamma)$ — Γ_{25}/Γ_6

VALUE (units 10^{-3})	EVTS	DOCUMENT ID		TECN	COMMENT
4.77±0.15 OUR FIT					
4.78±0.20 OUR AVERAGE					
$4.77\pm0.09\pm0.19$	3407	AMBROSINO	07A	KLOE	$1.02\ e^+e^- \to \pi^+\pi^-7\gamma$
$4.70\pm0.47\pm0.31$	120	[77] ALOISIO	02E	KLOE	$1.02\ e^+e^- \to \pi^+\pi^-3\gamma$
$6.5\ ^{+1.7}_{-1.5}\ \pm0.8$	21	AKHMETSHIN	00B	CMD2	$e^+e^- \to \pi^+\pi^-3\gamma$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$9.5\ ^{+5.2}_{-4.0}\ \pm1.4$	6	[78] AKHMETSHIN	97B	CMD2	$e^+e^- \to \pi^+\pi^-\ 3\gamma$

$\Gamma(\eta\pi^0\pi^0\gamma)/\Gamma_{total}$ — Γ_{26}/Γ

VALUE (units 10^{-5})	CL%	DOCUMENT ID		TECN	COMMENT
<2	90	AULCHENKO	98	SND	$e^+e^- \to 7\gamma$

$\Gamma(\mu^+\mu^-\gamma)/\Gamma_{total}$ — Γ_{27}/Γ

VALUE (units 10^{-5})	EVTS	DOCUMENT ID		TECN	COMMENT
1.43±0.45±0.14	27188	[49] AKHMETSHIN	99B	CMD2	$e^+e^- \to \mu^+\mu^-\gamma$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$2.3\ \pm1.0$	824 ± 33	[79] AKHMETSHIN	97C	CMD2	$e^+e^- \to \mu^+\mu^-\gamma$

$\Gamma(\rho\gamma\gamma)/\Gamma_{total}$ — Γ_{28}/Γ

VALUE (units 10^{-4})	CL%	DOCUMENT ID		TECN	COMMENT
<1.2	90	AULCHENKO	08	CMD2	$\phi \to \pi^+\pi^-\gamma\gamma$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<5	90	AKHMETSHIN	98	CMD2	$e^+e^- \to \pi^+\pi^-\gamma\gamma$

$\Gamma(\eta\pi^+\pi^-)/\Gamma_{total}$ — Γ_{29}/Γ

VALUE (units 10^{-5})	CL%	DOCUMENT ID	TECN	COMMENT
< 1.8	90	AKHMETSHIN 00E	CMD2	$e^+e^- \to \pi^+\pi^-\pi^+\pi^-\pi^0$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
< 6.1	90	AULCHENKO 08	CMD2	$\phi \to \eta\pi^+\pi^-$
<30	90	AKHMETSHIN 98	CMD2	$e^+e^- \to \pi^+\pi^-\gamma\gamma$

$\Gamma(\eta\mu^+\mu^-)/\Gamma_{total}$ — Γ_{30}/Γ

VALUE (units 10^{-6})	CL%	DOCUMENT ID	TECN	COMMENT
<9.4	90	AKHMETSHIN 01	CMD2	$e^+e^- \to \eta e^+e^-$

$\Gamma(\eta U \to \eta e^+e^-)/\Gamma_{total}$ — Γ_{31}/Γ

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
$<1 \times 10^{-6}$	90	[80] BABUSCI 13B	KLOE	1.02 $e^+e^- \to \eta e^+e^-$

[1] Combined analysis of the CMD-2 data on $\phi \to K^+K^-$, $K^0_S K^0_L$, $\pi^+\pi^-\pi^0$, $\eta\gamma$ assuming that the sum of their branching fractions is 0.99741 ± 0.00007.

[2] Using B($\phi \to e^+e^-$)= (2.93 ± 0.14) × 10^{-4}.

[3] Theoretical analysis of BRAMON 00 taking into account phase-space difference, electromagnetic radiative corrections, as well as isospin breaking, predicts 0.62. FLOREZ-BAEZ 08 predicts 0.63 considering also structure-dependent radiative corrections. FISCHBACH 02 calculates additional corrections caused by the close threshold and predicts 0.68. See also BENAYOUN 01 and DUBYNSKIY 07. BENAYOUN 12 obtains 0.71 ± 0.01 in the HLS model.

[4] Using B($\phi \to e^+e^-$)=(2.99 ± 0.08) × 10^{-4}.

[5] Using Γ(ϕ)= 4.1 MeV. If interference between the $\rho\pi$ and 3π modes is neglected, the fraction of the $\rho\pi$ is more than 80% at the 90% confidence level.

[6] From a fit without limitations on charged and neutral ρ masses and widths.

[7] Adding the direct and $\omega\pi$ contributions and considering the interference between the $\rho\pi$ and $\pi^+\pi^-\pi^0$.

[8] Neglecting the interference between the $\rho\pi$ and $\pi^+\pi^-\pi^0$.

[9] Using B($\phi \to e^+e^-$) = (2.99 ± 0.08) × 10^{-4} and B($\eta \to 3\pi^0$)= (32.2 ± 0.4) × 10^{-2}.

[10] From $\pi^+\pi^-\pi^0$ decay mode of η.

[11] From 2γ decay mode of η.

[12] From $3\pi^0$ decay mode of η.

[13] ACHASOV 07B reports [Γ($\phi(1020) \to \eta\gamma$)/$\Gamma_{total}$] × [B($\phi(1020) \to e^+e^-$)] = (4.050 ± 0.067 ± 0.118) × 10^{-6} which we divide by our best value B($\phi(1020) \to e^+e^-$) = (2.955 ± 0.029) × 10^{-4}. Our first error is their experiment's error and our second error is the systematic error from using our best value. Supersedes ACHASOV 00D and ACHASOV 06A.

[14] Using B($\phi \to e^+e^-$) = (2.98 ± 0.04) × 10^{-4} and B($\eta \to \gamma\gamma$) = 39.43 ± 0.26%.

[15] Not independent of the corresponding Γ(e^+e^-) × Γ($\eta\gamma$)/Γ^2_{total}.

[16] Using B($\phi \to e^+e^-$) = (2.99 ± 0.08) × 10^{-4} and B($\eta \to 3\pi^0$)=(32.24 ± 0.29) × 10^{-2}.

[17] The combined fit from 600 to 1380 MeV taking into account $\rho(770)$, $\omega(782)$, $\phi(1020)$, and $\rho(1450)$ (mass and width fixed at 1450 MeV and 310 MeV respectively).

[18] From the $\eta \to 2\gamma$ decay and using B($\phi \to e^+e^-$) =(2.99 ± 0.08) × 10^{-4}.

[19] From $\pi^+\pi^-\pi^0$ decay mode of η and using B($\phi \to e^+e^-$)= (2.99 ± 0.08) × 10^{-4}.

[20] Reanalysis of DRUZHININ 84, DOLINSKY 89, and DOLINSKY 91 taking into account a triangle anomaly contribution.

[21] Using B($\phi \to e^+e^-$) from PDG 15. Supersedes ACHASOV 00.

[22] Using B($\phi \to e^+e^-$) = (2.98 ± 0.04) × 10^{-4}.

[23] Not independent of the corresponding $\Gamma(e^+e^-) \times \Gamma(\pi^0\gamma)/\Gamma^2_{total}$.
[24] From the $\pi^0 \to 2\gamma$ decay and using B($\phi \to e^+e^-$) = (2.99 ± 0.08) × 10^{-4}.
[25] From the combined fit assuming that the total $\phi(1020)$ production cross section is saturated by those of K^+K^-, $K_S K_L$, $\pi^+\pi^-\pi^0$, and $\eta\gamma$ decays modes and using ACHASOV 00B for the $\eta\gamma$ decay mode.
[26] Using total width 4.2 MeV. They detect 3π mode and observe significant interference with ω tail. This is accounted for in the result quoted above.
[27] Neglecting interference between resonance and continuum.
[28] Using B($\phi \to e^+e^-$) = (2.91 ± 0.07) × 10^{-4}.
[29] Recalculated by us using B($\phi \to e^+e^-$)= (2.99 ± 0.08) × 10^{-4}.
[30] Using B($\eta \to 3\pi^0$) = (32.57 ± 0.23)% from PDG 12.
[31] Using B($\eta \to \gamma\gamma$) = (39.25 ± 0.32)%, B($\phi \to \eta\gamma$) = (1.26 ± 0.06)%, and B($\phi \to e^+e^-$) = (3.00 ± 0.06) × 10^{-4}.
[32] The average of the branching ratios separately obtained from the $\eta \to \gamma\gamma$, $3\pi^0$, $\pi^+\pi^-\pi^0$ decays.
[33] From $\eta \to \gamma\gamma$ decays and using B($\eta \to \gamma\gamma$) = (39.33 ± 0.25) × 10^{-2}, B($\eta \to \pi^+\pi^-\gamma$) = (4.75 ± 11) × 10^{-2}, and B($\phi \to \eta\gamma$) = (1.297 ± 0.033) × 10^{-2}.
[34] From $\eta \to 3\pi^0$ decays and using B($\pi^0 \to \gamma\gamma$) = (98.798 ± 0.033) × 10^{-2}, B($\eta \to 3\pi^0$) = (32.24 ± 0.29) × 10^{-2}, B($\eta \to \pi^+\pi^-\gamma$) = (4.75 ± 0.11) × 10^{-2}, and B($\phi \to \eta\gamma$) = (1.297 ± 0.033) × 10^{-2}.
[35] From $\eta \to \pi^+\pi^-\pi^0$ decays and using B($\pi^0 \to \gamma\gamma$) = (98.798 ± 0.033) × 10^{-2}, B($\pi^0 \to e^+e^-\gamma$) = (1.198 ± 0.032) × 10^{-2}, B($\eta \to \pi^+\pi^-\pi^0$) = (23.0 ± 0.4) × 10^{-2}, B($\phi \to \pi^+\pi^-\pi^0$) = (15.5 ± 0.6) × 10^{-2}, and B($\phi \to \eta\gamma$) = (1.297 ± 0.033) × 10^{-2}.
[36] Using the 1996 and 1998 data.
[37] (2.3 ± 0.3)% correction for other decay modes of the $\omega(782)$ applied.
[38] Not independent of the corresponding $\Gamma(\omega\pi^0) \times \Gamma(e^+e^-)$ / Γ^2(total).
[39] Using the 1996 data.
[40] Using the 1998 data.
[41] Supersedes AKHMETSHIN 97C.
[42] For $E_\gamma > 20$ MeV and assuming that B($\phi(1020) \to f_0(980)\gamma$) is negligible. Supersedes AKHMETSHIN 97C.
[43] For $E_\gamma > 20$ MeV and assuming that B($\phi(1020) \to f_0(980)\gamma$) is negligible.
[44] Obtained by the authors taking into account the $\pi^+\pi^-$ decay mode. Includes a component due to $\pi\pi$ production via the $f_0(500)$ meson. Supersedes ALOISIO 02D.
[45] From the combined fit of the photon spectra in the reactions $e^+e^- \to \pi^+\pi^-\gamma$, $\pi^0\pi^0\gamma$.
[46] From the negative interference with the $f_0(500)$ meson of AITALA 01B using the ACHASOV 89 parameterization for the $f_0(980)$, a Breit-Wigner for the $f_0(500)$, and ACHASOV 01F for the $\rho\pi$ contribution. Superseded by AMBROSINO 07.
[47] Assuming that the $\pi^0\pi^0\gamma$ final state is completely determined by the $f_0\gamma$ mechanism, neglecting the decay B($\phi \to K\overline{K}\gamma$) and using B($f_0 \to \pi^+\pi^-$)= 2B($f_0 \to \pi^0\pi^0$).
[48] Using the value B($\phi \to \eta\gamma$)=(1.338 ± 0.053) × 10^{-2}.
[49] For $E_\gamma > 20$ MeV. Supersedes AKHMETSHIN 97C.
[50] Neglecting other intermediate mechanisms ($\rho\pi$, $\sigma\gamma$).
[51] A narrow pole fit taking into account $f_0(980)$ and $f_0(1200)$ intermediate mechanisms.
[52] For destructive interference with the Bremsstrahlung process
[53] For constructive interference with the Bremsstrahlung process
[54] Supersedes ALOISIO 02D.
[55] Supersedes ACHASOV 98I. Excluding $\omega\pi^0$.
[56] Using B($\pi^0 \to \gamma\gamma$) from the 2014 Edition of this Review (PDG 14).

57 Using various branching ratios from the 2000 Edition of this Review (PDG 00).
58 Using B($\pi^0 \to \gamma\gamma$) = 0.98798 ± 0.00032, B($\phi \to \eta\gamma$) = (1.297 ± 0.033) × 10^{-2}, and B($\eta \to \pi^+\pi^-\gamma$) = (4.75 ± 0.11) × 10^{-2}.
59 Combined results of $\eta \to \gamma\gamma$ and $\eta \to \pi^+\pi^-\pi^0$ decay modes measurements.
60 From the decay mode $\eta \to \gamma\gamma$.
61 From the decay mode $\eta \to \pi^+\pi^-\pi^0$.
62 Supersedes ACHASOV 98B.
63 Using B($\phi \to \eta\gamma$) = (1.304 ± 0.025)%, B($\eta \to 3\pi^0$) = (32.56 ± 0.23)%, and B($\eta \to \gamma\gamma$) = (39.31 ± 0.20)%.
64 Using B($\phi \to \eta\gamma$) = (1.304 ± 0.025)%, B($\eta \to 3\pi^0$) = (32.56 ± 0.23)%, and B($\eta \to \pi^+\pi^-\pi^0$) = (22.73 ± 0.28)%.
65 Using $M_{a_0(980)}$=984.8 MeV and assuming $a_0(980)\gamma$ dominance.
66 Assuming $a_0(980)\gamma$ dominance in the $\eta\pi^0\gamma$ final state.
67 Using data of ACHASOV 00F.
68 Using results of ALOISIO 02D and assuming that $f_0(980)$ decays into $\pi\pi$ only and $a_0(980)$ into $\eta\pi$ only.
69 AMBROSINO 07A reports [Γ($\phi(1020) \to \eta'(958)\gamma$)/$\Gamma_{total}$] / [B($\phi(1020) \to \eta\gamma$)] = (4.77 ± 0.09 ± 0.19) × 10^{-3} which we multiply by our best value B($\phi(1020) \to \eta\gamma$) = (1.309 ± 0.024) × 10^{-2}. Our first error is their experiment's error and our second error is the systematic error from using our best value.
70 Averaging AULCHENKO 03B with AULCHENKO 99.
71 Using B($\phi \to \eta\gamma$)= (1.297 ± 0.033)%.
72 Using the value B($\phi \to \eta\gamma$) = (1.26 ± 0.06) × 10^{-2}.
73 Using B($\phi \to K^0_L K^0_S$) = (33.8 ± 0.6)%.
74 Averaging AKHMETSHIN 00B with AKHMETSHIN 00F.
75 Using the value B($\eta' \to \eta\pi^+\pi^-$)= (43.7 ± 1.5) × 10^{-2} and B($\eta \to \gamma\gamma$)= (39.25 ± 0.31) × 10^{-2}.
76 Using various branching ratios of K^0_S, K^0_L, η, η' from the 2000 edition (The European Physical Journal **C15** 1 (2000)) of this Review.
77 From the decay mode $\eta' \to \eta\pi^+\pi^-$, $\eta \to \gamma\gamma$.
78 Superseded by AKHMETSHIN 00B.
79 For $E_\gamma > 20$ MeV.
80 For a narrow vector U with mass between 5 and 470 MeV, from the combined analysis of $\eta \to \pi^+\pi^-\pi^0$ and $\eta \to \pi^0\pi^0\pi^0$ from ARCHILLI 12. Measured 90% CL limits as a function of m_U range from 2.2 × 10^{-8} to 10^{-6}.

Lepton Family number (LF) violating modes

$\Gamma(e^\pm\mu^\mp)/\Gamma_{total}$ **Γ_{32}/Γ**

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<2 × 10^{-6}	90	ACHASOV	10A	SND	$e^+e^- \to e^\pm\mu^\mp$

$\pi^+\pi^-\pi^0$ / $\rho\pi$ AMPLITUDE RATIO a_1 IN DECAY OF $\phi \to \pi^+\pi^-\pi^0$

NIECKNIG 12 describes final-state interactions between the three pions in a dispersive framework using data on the $\pi\pi$ P-wave scattering phase shift.

VALUE (units 10^{-2})	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
9.1±1.2 OUR AVERAGE						
10.1±4.4±1.7		80k	[1] AKHMETSHIN	06	CMD2	1.017–1.021 $e^+e^- \to \pi^+\pi^-\pi^0$
9.0±1.1±0.6		1.98M	[2,3] ALOISIO	03	KLOE	1.02 $e^+e^- \to \pi^+\pi^-\pi^0$
• • • We do not use the following data for averages, fits, limits, etc. • • •						
$-6 < a_1 < 6$		500k	[3] ACHASOV	02	SND	$e^+e^- \to \pi^+\pi^-\pi^0$
$-16 < a_1 < 11$	90	9.8k	[1,4] AKHMETSHIN	98	CMD2	$e^+e^- \to \pi^+\pi^-\gamma\gamma$

[1] Dalitz plot analysis taking into account interference between the contact and $\rho\pi$ amplitudes.
[2] From a fit without limitations on charged and neutral ρ masses and widths.
[3] Recalculated by us to match the notations of AKHMETSHIN 98.
[4] Assuming zero phase for the contact term.

PARAMETER β IN $\phi \to P e^+e^-$ DECAYS

In the one-pole approximation the electromagnetic transition form factor for $\phi \to P e^+e^-$ ($P = \pi,\eta$) is given as a function of the e^+e^- invariant mass squared, q^2, by the expression:

$$|F(q^2)|^2 = (1 - q^2/\Lambda^2)^{-2},$$

where vector meson dominance predicts parameter $\Lambda \approx 0.770$ GeV ($\Lambda^{-2} \approx 1.687$ GeV^{-2}). The slope of this form factor, $\beta = dF/dq^2(q^2{=}0)$, equals Λ^{-2} in this approximation.

The measurements below obtain β in the one-pole approximation.

PARAMETER β IN $\phi \to \pi^0 e^+e^-$ DECAY

VALUE (GeV^{-2})	EVTS	DOCUMENT ID		TECN	COMMENT
2.02±0.11	9.5k	[1] ANASTASI	16B	KLOE	1.02 $e^+e^- \to \pi^0 e^+e^-$

[1] The error combines statistical and systematic uncertainties.

PARAMETER β IN $\phi \to \eta e^+e^-$ DECAY

VALUE (GeV^{-2})	EVTS	DOCUMENT ID		TECN	COMMENT
1.29±0.13 OUR AVERAGE					
$1.28\pm0.10^{+0.09}_{-0.08}$	30k	BABUSCI	15	KLOE	1.02 $e^+e^- \to \eta e^+e^-$
3.8 ±1.8	213	[1] ACHASOV	01B	SND	1.02 $e^+e^- \to \eta e^+e^-$

[1] The uncertainty is statistical only. The systematic one is negligible, in comparison.

ϕ(1020) REFERENCES

ACHASOV	16A	PR D93 092001	M.N. Achasov *et al.*	(SND Collab.)
ANASTASI	16B	PL B757 362	A. Anastasi *et al.*	(KLOE-2 Collab.)
KOZYREV	16	PL B760 314	E.A. Kozyrev *et al.*	(CMD3 Collab.)
BABUSCI	15	PL B742 1	D. Babusci *et al.*	(KLOE-2 Collab.)
PDG	15	RPP 2015 at pdg.lbl.gov		(PDG Collab.)
LEES	14H	PR D89 092002	J.P. Lees *et al.*	(BABAR Collab)
PDG	14	CP C38 070001	K. Olive *et al.*	(PDG Collab.)
BABUSCI	13B	PL B720 111	D. Babusci *et al.*	(KLOE-2 Collab.)
BENAYOUN	13	EPJ C73 2453	M. Benayoun, P. David, L. DelBuono	(PARIN, BERLIN+)
LEES	13F	PR D87 052010	J.P. Lees *et al.*	(BABAR Collab.)
LEES	13Q	PR D88 032013	J.P. Lees *et al.*	(BABAR Collab.)
ARCHILLI	12	PL B706 251	F. Archilli *et al.*	(KLOE-2 Collab.)
BENAYOUN	12	EPJ C72 1848	M. Benayoun *et al.*	
NIECKNIG	12	EPJ C72 2014	F. Niecknig, B. Kubis, S.P. Schneider	(BONN)
PDG	12	PR D86 010001	J. Beringer *et al.*	(PDG Collab.)
AKHMETSHIN	11	PL B695 412	R. Akhmetshin *et al.*	(CMD2 Collab.)
ACHASOV	10A	PR D81 057102	M.N. Achasov *et al.*	(Novosibirsk SND Collab.)
BENAYOUN	10	EPJ C65 211	M. Benayoun *et al.*	
AMBROSINO	09C	PL B679 10	F. Ambrosino *et al.*	(KLOE Collab.)
AMBROSINO	09F	PL B681 5	F. Ambrosino *et al.*	(KLOE Collab.)
AKHMETSHIN	08	PL B669 217	R.R. Akhmetshin *et al.*	(CMD-2 Collab.)
AMBROSINO	08G	PL B669 223	F. Ambrosino *et al.*	(KLOE Collab.)
AULCHENKO	08	JETPL 88 85	V. Aulchenko *et al.*	(CMD-2 Collab.)
		Translated from ZETFP 88 93.		
FLOREZ-BAEZ	08	PR D78 077301	F.V. Florez-Baez, G. Lopez Castro	
ACHASOV	07B	PR D76 077101	M.N. Achasov *et al.*	(SND Collab.)
AMBROSINO	07	EPJ C49 473	F. Ambrosino *et al.*	(KLOE Collab.)
AMBROSINO	07A	PL B648 267	F. Ambrosino *et al.*	(KLOE Collab.)
DUBYNSKIY	07	PR D75 113001	S. Dubynskiy *et al.*	
ACHASOV	06A	PR D74 014016	M.N. Achasov *et al.*	(SND Collab.)
AKHMETSHIN	06	PL B642 203	R.R. Akhmetshin *et al.*	(CMD-2 Collab.)
AKHMETSHIN	05	PL B605 26	R.R. Akhmetshin *et al.*	(Novosibirsk CMD-2 Collab.)
AMBROSINO	05	PL B608 199	F. Ambrosino *et al.*	(KLOE Collab.)
AUBERT,B	05J	PR D72 052008	B. Aubert *et al.*	(BABAR Collab.)
AKHMETSHIN	04	PL B578 285	R.R. Akhmetshin *et al.*	(Novosibirsk CMD-2 Collab.)
AUBERT,B	04N	PR D70 072004	B. Aubert *et al.*	(BABAR Collab.)
ALOISIO	03	PL B561 55	A. Aloisio *et al.*	(KLOE Collab.)
AULCHENKO	03B	JETP 97 24	V.M. Aulchenko *et al.*	(Novosibirsk SND Collab.)
		Translated from ZETF 124 28.		
ACHASOV	02	PR D65 032002	M.N. Achasov *et al.*	(Novosibirsk SND Collab.)
ACHASOV	02D	JETPL 75 449	M.N. Achasov *et al.*	(Novosibirsk SND Collab.)
		Translated from ZETFP 75 539.		
ALOISIO	02C	PL B536 209	A. Aloisio *et al.*	(KLOE Collab.)
ALOISIO	02D	PL B537 21	A. Aloisio *et al.*	(KLOE Collab.)
ALOISIO	02E	PL B541 45	A. Aloisio *et al.*	(KLOE Collab.)
FISCHBACH	02	PL B526 355	E. Fischbach, A.W. Overhauser, B. Woodahl	
GOKALP	02	JP G28 2783	A. Gokalp *et al.*	
ACHASOV	01B	PL B504 275	M.N. Achasov *et al.*	(Novosibirsk SND Collab.)
ACHASOV	01E	PR D63 072002	M.N. Achasov *et al.*	(Novosibirsk SND Collab.)
ACHASOV	01F	PR D63 094007	N.N. Achasov, V.V. Gubin	(Novosibirsk SND Collab.)
ACHASOV	01G	PRL 86 1698	M.N. Achasov *et al.*	(Novosibirsk SND Collab.)
AITALA	01B	PRL 86 770	E.M. Aitala *et al.*	(FNAL E791 Collab.)
AKHMETSHIN	01	PL B501 191	R.R. Akhmetshin *et al.*	(Novosibirsk CMD-2 Collab.)
AKHMETSHIN	01B	PL B509 217	R.R. Akhmetshin *et al.*	(Novosibirsk CMD-2 Collab.)
AKHMETSHIN	01C	PL B503 237	R.R. Akhmetshin *et al.*	(Novosibirsk CMD-2 Collab.)
BENAYOUN	01	EPJ C22 503	M. Benayoun, H.B. O'Connell	
ACHASOV	00	EPJ C12 25	M.N. Achasov *et al.*	(Novosibirsk SND Collab.)
ACHASOV	00B	JETP 90 17	M.N. Achasov *et al.*	(Novosibirsk SND Collab.)
		Translated from ZETF 117 22.		
ACHASOV	00C	PL B474 188	M.N. Achasov *et al.*	(Novosibirsk SND Collab.)
ACHASOV	00D	JETPL 72 282	M.N. Achasov *et al.*	(Novosibirsk SND Collab.)
		Translated from ZETFP 72 411.		
ACHASOV	00E	NP B569 158	M.N. Achasov *et al.*	(Novosibirsk SND Collab.)
ACHASOV	00F	PL B479 53	M.N. Achasov *et al.*	(Novosibirsk SND Collab.)
ACHASOV	00H	PL B485 349	M.N. Achasov *et al.*	(Novosibirsk SND Collab.)
AKHMETSHIN	00B	PL B473 337	R.R. Akhmetshin *et al.*	(Novosibirsk CMD-2 Collab.)
AKHMETSHIN	00E	PL B491 81	R.R. Akhmetshin *et al.*	(Novosibirsk CMD-2 Collab.)
AKHMETSHIN	00F	PL B494 26	R.R. Akhmetshin *et al.*	(Novosibirsk CMD-2 Collab.)
AULCHENKO	00A	JETP 90 927	V.M. Aulchenko *et al.*	(Novosibirsk SND Collab.)
		Translated from ZETF 117 1067.		

BRAMON	00	PL B486 406	A. Bramon *et al.*	
PDG	00	EPJ C15 1	D.E. Groom *et al.*	(PDG Collab.)
ACHASOV	99	PL B449 122	M.N. Achasov *et al.*	
ACHASOV	99C	PL B456 304	M.N. Achasov *et al.*	
AKHMETSHIN	99B	PL B462 371	R.R. Akhmetshin *et al.*	(Novosibirsk CMD-2 Collab.)
AKHMETSHIN	99C	PL B462 380	R.R. Akhmetshin *et al.*	(Novosibirsk CMD-2 Collab.)
AKHMETSHIN	99D	PL B466 385	R.R. Akhmetshin *et al.*	
Also		PL B508 217 (errat.)	R.R. Akhmetshin *et al.*	(Novosibirsk CMD-2 Collab.)
AKHMETSHIN	99F	PL B460 242	R.R. Akhmetshin *et al.*	(Novosibirsk CMD-2 Collab.)
AULCHENKO	99	JETPL 69 97	V.M. Aulchenko *et al.*	
		Translated from ZETFP 69 87.		
ACHASOV	98B	PL B438 441	M.N. Achasov *et al.*	(Novosibirsk SND Collab.)
ACHASOV	98F	JETPL 68 573	M.N. Achasov *et al.*	(Novosibirsk SND Collab.)
ACHASOV	98I	PL B440 442	M.N. Achasov *et al.*	
AKHMETSHIN	98	PL B434 426	R.R. Akhmetshin *et al.*	(CMD-2 Collab.)
AULCHENKO	98	PL B436 199	V.M. Aulchenko *et al.*	(Novosibirsk SND Collab.)
BARBERIS	98	PL B432 436	D. Barberis *et al.*	(Omega Expt.)
AKHMETSHIN	97B	PL B415 445	R.R. Akhmetshin *et al.*	(NOVO, BOST, PITT+)
AKHMETSHIN	97C	PL B415 452	R.R. Akhmetshin *et al.*	(Novosibirsk CMD-2 Collab.)
BENAYOUN	96	ZPHY C72 221	M. Benayoun *et al.*	(IPNP, NOVO)
AKHMETSHIN	95	PL B364 199	R.R. Akhmetshin *et al.*	(Novosibirsk CMD-2 Collab.)
DOLINSKY	91	PRPL 202 99	S.I. Dolinsky *et al.*	(NOVO)
KUHN	90	ZPHY C48 445	J.H. Kuhn *et al.*	(MPIM)
ACHASOV	89	NP B315 465	N.N. Achasov, V.N. Ivanchenko	
DOLINSKY	89	ZPHY C42 511	S.I. Dolinsky *et al.*	(NOVO)
BARKOV	88	SJNP 47 248	L.M. Barkov *et al.*	(NOVO)
		Translated from YAF 47 393.		
DOLINSKY	88	SJNP 48 277	S.I. Dolinsky *et al.*	(NOVO)
		Translated from YAF 48 442.		
DRUZHININ	87	ZPHY C37 1	V.P. Druzhinin *et al.*	(NOVO)
ARMSTRONG	86	PL 166B 245	T.A. Armstrong *et al.*	(ATHU, BARI, BIRM+)
ATKINSON	86	ZPHY C30 521	M. Atkinson *et al.*	(BONN, CERN, GLAS+)
BEBEK	86	PRL 56 1893	C. Bebek *et al.*	(CLEO Collab.)
DAVENPORT	86	PR D33 2519	T.F. Davenport	(TUFTS, ARIZ, FNAL, FSU, NDAM+)
DIJKSTRA	86	ZPHY C31 375	H. Dijkstra *et al.*	(ANIK, BRIS, CERN+)
FRAME	86	NP B276 667	D. Frame *et al.*	(GLAS)
GOLUBEV	86	SJNP 44 409	V.B. Golubev *et al.*	(NOVO)
		Translated from YAF 44 633.		
ALBRECHT	85D	PL 153B 343	H. Albrecht *et al.*	(ARGUS Collab.)
GOLUBEV	85	SJNP 41 756	V.B. Golubev *et al.*	(NOVO)
		Translated from YAF 41 1183.		
DRUZHININ	84	PL 144B 136	V.P. Druzhinin *et al.*	(NOVO)
ARMSTRONG	83B	NP B224 193	T.A. Armstrong *et al.*	(BARI, BIRM, CERN+)
BARATE	83	PL 121B 449	R. Barate *et al.*	(SACL, LOIC, SHMP, IND)
KURDADZE	83C	JETPL 38 366	L.M. Kurdadze *et al.*	(NOVO)
		Translated from ZETFP 38 306.		
ARENTON	82	PR D25 2241	M.W. Arenton *et al.*	(ANL, ILL)
PELLINEN	82	PS 25 599	A. Pellinen, M. Roos	(HELS)
DAUM	81	PL 100B 439	C. Daum *et al.*	(AMST, BRIS, CERN, CRAC+)
IVANOV	81	PL 107B 297	P.M. Ivanov *et al.*	(NOVO)
Also		Private Comm.	S.I. Eidelman	(NOVO)
VASSERMAN	81	PL 99B 62	I.B. Vasserman *et al.*	(NOVO)
Also		SJNP 35 240	L.M. Kurdadze *et al.*	
		Translated from YAF 35 352.		
CORDIER	80	NP B172 13	A. Cordier *et al.*	(LALO)
CORDIER	79	PL 81B 389	A. Cordier *et al.*	(LALO)
BUKIN	78B	SJNP 27 521	A.D. Bukin *et al.*	(NOVO)
		Translated from YAF 27 985.		
BUKIN	78C	SJNP 27 516	A.D. Bukin *et al.*	(NOVO)
		Translated from YAF 27 976.		
COOPER	78B	NP B146 1	A.M. Cooper *et al.*	(TATA, CERN, CDEF+)
LOSTY	78	NP B133 38	M.J. Losty *et al.*	(CERN, AMST, NIJM+)
AKERLOF	77	PRL 39 861	C.W. Akerlof *et al.*	(FNAL, MICH, PURD)
ANDREWS	77	PRL 38 198	D.E. Andrews *et al.*	(ROCH)
BALDI	77	PL 68B 381	R. Baldi *et al.*	(GEVA)
CERRADA	77B	NP B126 241	M. Cerrada *et al.*	(AMST, CERN, NIJM+)
COHEN	77	PRL 38 269	D. Cohen *et al.*	(ANL)
LAVEN	77	NP B127 43	H. Laven *et al.*	(AACH3, BERL, CERN, LOIC+)
LYONS	77	NP B125 207	L. Lyons, A.M. Cooper, A.G. Clark	(OXF)
COSME	76	PL 63B 352	G. Cosme *et al.*	(ORSAY)
KALBFLEISCH	76	PR D13 22	G.R. Kalbfleisch, R.C. Strand, J.W. Chapman	(BNL+)
PARROUR	76	PL 63B 357	G. Parrour *et al.*	(ORSAY)
PARROUR	76B	PL 63B 362	G. Parrour *et al.*	(ORSAY)

KALBFLEISCH	75	PR D11 987	G.R. Kalbfleisch, R.C. Strand, J.W. Chapman	(BNL+)
AYRES	74	PRL 32 1463	D.S. Ayres *et al.*	(ANL)
BESCH	74	NP B70 257	H.J. Besch *et al.*	(BONN)
COSME	74	PL 48B 155	G. Cosme *et al.*	(ORSAY)
COSME	74B	PL 48B 159	G. Cosme *et al.*	(ORSAY)
DEGROOT	74	NP B74 77	A.J. de Groot *et al.*	(AMST, NIJM)
AUGUSTIN	73	PRL 30 462	J.E. Augustin *et al.*	(ORSAY)
BALLAM	73	PR D7 3150	J. Ballam *et al.*	(SLAC, LBL)
BINNIE	73B	PR D8 2789	D.M. Binnie *et al.*	(LOIC, SHMP)
AGUILAR-...	72B	PR D6 29	M. Aguilar-Benitez *et al.*	(BNL)
ALVENSLEB...	72	PRL 28 66	H. Alvensleben *et al.*	(MIT, DESY)
BORENSTEIN	72	PR D5 1559	S.R. Borenstein *et al.*	(BNL, MICH)
COLLEY	72	NP B50 1	D.C. Colley *et al.*	(BIRM, GLAS)
BALAKIN	71	PL 34B 328	V.E. Balakin *et al.*	(NOVO)
CHATELUS	71	Thesis LAL 1247	Y. Chatelus	(STRB)
Also		PL 32B 416	J.C. Bizot *et al.*	(ORSAY)
HAYES	71	PR D4 899	S. Hayes *et al.*	(CORN)
STOTTLE...	71	Thesis ORO 2504 170	A.R. Stottlemyer	(UMD)
BIZOT	70	PL 32B 416	J.C. Bizot *et al.*	(ORSAY)
Also		Liverpool Sym. 69	J.P. Perez-y-Jorba	
EARLES	70	PRL 25 1312	D.R. Earles *et al.*	(NEAS)
LINDSEY	66	PR 147 913	J.S. Lindsey, G. Smith	(LRL)
LONDON	66	PR 143 1034	G.W. London *et al.*	(BNL, SYRA) IGJPC
BADIER	65B	PL 17 337	J. Badier *et al.*	(EPOL, SACL, AMST)
LINDSEY	65	PRL 15 221	J.S. Lindsey, G.A. Smith	(LRL)
LINDSEY 65 data included in LINDSEY 66.				
SCHLEIN	63	PRL 10 368	P.E. Schlein *et al.*	(UCLA) IGJP