NODE=S013

K^0_L

$I(J^P) = \frac{1}{2}(0^-)$

$m_{K^0_L} - m_{K^0_S}$

NODE=S013D

For earlier measurements, beginning with GOOD 61 and FITCH 61, see our 1986 edition, Physics Letters **170B** 132 (1986).

NODE=S013D

OUR FIT is described in the note on "*CP* violation in K_L decays" in the K^0_L Particle Listings. The result labeled "OUR FIT Assuming *CPT*" ["OUR FIT Not assuming *CPT*"] includes all measurements except those with the comment "Not assuming *CPT*" ["Assuming *CPT*"]. Measurements with neither comment do not assume *CPT* and enter both fits.

NODE=S013D

VALUE (10^{10} $\hbar$ s^{-1})	*DOCUMENT ID*		*TECN*	*COMMENT*	
0.5293 ±0.0009 OUR FIT	Error includes scale factor of 1.3. Assuming *CPT*				
0.5289 ±0.0010 OUR FIT	Not assuming *CPT*				
0.52797±0.00195	[1,2] ABOUZAID	11	KTEV	Not assuming *CPT*	TYPE=noCPT
0.52699±0.00123	[1,3] ABOUZAID	11	KTEV	Assuming *CPT*	OCCUR=2;TYPE=CPT
0.5240 ±0.0044 ±0.0033	APOSTOLA...	99C	CPLR	K^0-$\overline{K}^0$ to $\pi^+\pi^-$	
0.5297 ±0.0030 ±0.0022	[4] SCHWINGEN...	95	E773	20–160 GeV *K* beams	
0.5286 ±0.0028	[5] GIBBONS	93	E731	Assuming *CPT*	TYPE=CPT
0.5257 ±0.0049 ±0.0021	[4] GIBBONS	93C	E731	Not assuming *CPT*	TYPE=noCPT
0.5340 ±0.00255±0.0015	[6] GEWENIGER	74C	SPEC	Gap method	SYCLP=A
0.5334 ±0.0040 ±0.0015	[6,7] GJESDAL	74	SPEC	Assuming *CPT*	SYCLP=A;TYPE=CPT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.5261 ±0.0015	[8] ALAVI-HARATI	03	KTEV	Assuming *CPT*	TYPE=CPT
0.5288 ±0.0043	[9] ALAVI-HARATI	03	KTEV	Not assuming *CPT*	OCCUR=2;TYPE=noCPT
0.5343 ±0.0063 ±0.0025	[10] ANGELOPO...	01	CPLR		
0.5295 ±0.0020 ±0.0003	[11] ANGELOPO...	98D	CPLR	Assuming *CPT*	TYPE=CPT
0.5307 ±0.0013	[12] ADLER	96C	RVUE		
0.5274 ±0.0029 ±0.0005	[11] ADLER	95	CPLR	Sup. by ANGELOPOULOS 98D	
0.482 ±0.014	[13] ARONSON	82B	SPEC	*E*=30–110 GeV	
0.534 ±0.007	[14] CARNEGIE	71	ASPK	Gap method	
0.542 ±0.006	[14] ARONSON	70	ASPK	Gap method	
0.542 ±0.006	CULLEN	70	CNTR		

NODE=S013D

[1] The two ABOUZAID 11 values use the same data. The first enters the "assuming *CPT*" fit and the second enters the "not assuming *CPT*" fit. NODE=S013D;LINKAGE=AB

[2] ABOUZAID 11 fit has Δm, τ_S, ϕ_ϵ, Re(ϵ'/ϵ), and Im(ϵ'/ϵ) as free parameters. See Im(ϵ'/ϵ) in the "K^0_L *CP* violation" section for correlation information. NODE=S013D;LINKAGE=AO

[3] ABOUZAID 11 fit has Δm and τ_S free but constrains ϕ_ϵ to the Superweak value, i.e. assumes *CPT*. See "K^0_S Mean Life" section for correlation information. NODE=S013D;LINKAGE=AU

[4] Fits Δm and ϕ_{+-} simultaneously. GIBBONS 93C systematic error is from B. Winstein via private communication. 20–160 GeV *K* beams. NODE=S013D;LINKAGE=CG

[5] GIBBONS 93 value assume $\phi_{+-} = \phi_{00} = \phi_{SW} = (43.7 \pm 0.2)^\circ$, i.e. assumes *CPT*. 20–160 GeV *K* beams. NODE=S013D;LINKAGE=GB

[6] These two experiments have a common systematic error due to the uncertainty in the momentum scale, as pointed out in WAHL 89. NODE=S013D;LINKAGE=G

[7] GJESDAL 74 uses charge asymmetry in $K^0_{\ell 3}$ decays. NODE=S013D;LINKAGE=GJ

[8] ALAVI-HARATI 03 fit Δm and $\tau_{K^0_S}$ simultaneously. ϕ_{+-} is constrained to the Superweak value, i.e. *CPT* is assumed. See "K^0_S Mean Life" section for correlation information. Superseded by ABOUZAID 11. NODE=S013D;LINKAGE=VI

[9] ALAVI-HARATI 03 fit Δm, ϕ_{+-}, and τ_{K_S} simultaneously. See ϕ_{+-} in the "K_L *CP* violation" section for correlation information. Superseded by ABOUZAID 11. NODE=S013D;LINKAGE=S3

[10] ANGELOPOULOS 01 uses strong interactions strangeness tagging at two different times. NODE=S013D;LINKAGE=AG

[11] Uses $\overline{K}^0_{e3}$ and K^0_{e3} strangeness tagging at production and decay. Assumes *CPT* conservation on $\Delta S = -\Delta Q$ transitions. NODE=S013D;LINKAGE=X1

[12] ADLER 96C is the result of a fit which includes nearly the same data as entered into the "OUR FIT" value above. NODE=S013D;LINKAGE=Y1

[13] ARONSON 82 find that Δm may depend on the kaon energy. NODE=S013D;LINKAGE=Z

[14] ARONSON 70 and CARNEGIE 71 use K^0_S mean life $= (0.862 \pm 0.006) \times 10^{-10}$ s. We have not attempted to adjust these values for the subsequent change in the K^0_S mean life or in η_{+-}. NODE=S013D;LINKAGE=R

K^0_L MEAN LIFE

NODE=S013T

NODE=S013T

VALUE (10^{-8} s)	EVTS	DOCUMENT ID		TECN	COMMENT
5.116±0.021 OUR FIT	Error includes scale factor of 1.1.				
5.099±0.021 OUR AVERAGE					
5.072±0.011±0.035	13M	[1] AMBROSINO	06	KLOE	$\sum_i B_i = 1$
5.092±0.017±0.025	15M	AMBROSINO	05C	KLOE	
5.154±0.044	0.4M	VOSBURGH	72	CNTR	
• • • We do not use the following data for averages, fits, limits, etc. • • •					
5.15 ±0.14		DEVLIN	67	CNTR	

[1] AMBROSINO 06 uses $\phi \rightarrow K_L K_S$ with K_L tagged by $K_S \rightarrow \pi^+\pi^-$. The four major K_L BR's are measured, the small remainder ($\pi^+\pi^-$,$\pi^0\pi^0$,$\gamma\gamma$) is taken from PDG 04. This KLOE K_L lifetime is obtained by imposing $\sum_i B_i = 1$. The correlation matrix among the four measured K_L BR's and this K_L lifetime is

NODE=S013T;LINKAGE=AM

	K_{e3}	$K_{\mu 3}$	$3\pi^0$	$\pi^+\pi^-\pi^0$	τ_{K_L}
K_{e3}	1	−0.25	−0.56	−0.07	0.25
$K_{\mu 3}$		1	−0.43	−0.20	0.33
$3\pi^0$			1	−0.39	−0.21
$\pi^+\pi^-\pi^0$				1	−0.39
τ_{K_L}					1

These correlations are taken into account in our fit. The average of this KLOE mean life measurement and the independent KLOE measurement in AMBROSINO 05C is $(5.084 \pm 0.023) \times 10^{-8}$ s.

K^0_L DECAY MODES

NODE=S013215;NODE=S013

	Mode			Fraction (Γ_i/Γ)	Scale factor/ Confidence level	
	Semileptonic modes					NODE=S013;CLUMP=A
Γ_1	$\pi^\pm e^\mp \nu_e$ Called K^0_{e3}.		[a]	(40.55 ±0.11) %	S=1.7	DESIG=4
Γ_2	$\pi^\pm \mu^\mp \nu_\mu$ Called $K^0_{\mu 3}$.		[a]	(27.04 ±0.07) %	S=1.1	DESIG=3
Γ_3	$(\pi\mu \text{atom})\nu$			(1.05 ±0.11) $\times 10^{-7}$		DESIG=19
Γ_4	$\pi^0\pi^\pm e^\mp \nu$		[a]	(5.20 ±0.11) $\times 10^{-5}$		DESIG=18
Γ_5	$\pi^\pm e^\mp \nu e^+ e^-$		[a]	(1.26 ±0.04) $\times 10^{-5}$		DESIG=51
	Hadronic modes, including Charge conjugation×Parity Violating (*CPV*) modes					NODE=S013;CLUMP=B
Γ_6	$3\pi^0$			(19.52 ±0.12) %	S=1.6	DESIG=1
Γ_7	$\pi^+\pi^-\pi^0$			(12.54 ±0.05) %		DESIG=2
Γ_8	$\pi^+\pi^-$	*CPV*	[b]	(1.967±0.010) $\times 10^{-3}$	S=1.5	DESIG=5
Γ_9	$\pi^0\pi^0$	*CPV*		(8.64 ±0.06) $\times 10^{-4}$	S=1.8	DESIG=11
	Semileptonic modes with photons					NODE=S013;CLUMP=C
Γ_{10}	$\pi^\pm e^\mp \nu_e \gamma$		[a,c,d]	(3.79 ±0.06) $\times 10^{-3}$		DESIG=12
Γ_{11}	$\pi^\pm \mu^\mp \nu_\mu \gamma$			(5.65 ±0.23) $\times 10^{-4}$		DESIG=34
	Hadronic modes with photons or $\ell\bar{\ell}$ pairs					NODE=S013;CLUMP=D
Γ_{12}	$\pi^0\pi^0\gamma$			< 2.43 $\times 10^{-7}$	CL=90%	DESIG=33
Γ_{13}	$\pi^+\pi^-\gamma$		[c,d]	(4.15 ±0.15) $\times 10^{-5}$	S=2.8	DESIG=10
Γ_{14}	$\pi^+\pi^-\gamma$(DE)			(2.84 ±0.11) $\times 10^{-5}$	S=2.0	DESIG=50
Γ_{15}	$\pi^0 2\gamma$		[c]	(1.273±0.033) $\times 10^{-6}$		DESIG=13
Γ_{16}	$\pi^0\gamma e^+ e^-$			(1.62 ±0.17) $\times 10^{-8}$		DESIG=46
	Other modes with photons or $\ell\bar{\ell}$ pairs					NODE=S013;CLUMP=E
Γ_{17}	2γ			(5.47 ±0.04) $\times 10^{-4}$	S=1.1	DESIG=9
Γ_{18}	3γ			< 7.4 $\times 10^{-8}$	CL=90%	DESIG=45
Γ_{19}	$e^+e^-\gamma$			(9.4 ±0.4) $\times 10^{-6}$	S=2.0	DESIG=14
Γ_{20}	$\mu^+\mu^-\gamma$			(3.59 ±0.11) $\times 10^{-7}$	S=1.3	DESIG=15
Γ_{21}	$\mu^+\mu^-\mu^+\mu^-$			< 2.3 $\times 10^{-9}$	CL=90%	DESIG=56
Γ_{22}	$e^+e^-\gamma\gamma$		[c]	(5.95 ±0.33) $\times 10^{-7}$		DESIG=23
Γ_{23}	$\mu^+\mu^-\gamma\gamma$		[c]	(1.0 $^{+0.8}_{-0.6}$) $\times 10^{-8}$		DESIG=47

Charge conjugation × Parity (*CP*) or Lepton Family number (*LF*) violating modes, or $\Delta S = 1$ weak neutral current (*S1*) modes

NODE=S013;CLUMP=F

	Mode			Fraction		
Γ_{24}	$\mu^+\mu^-$	*S1*		$(6.84 \pm 0.11) \times 10^{-9}$		DESIG=6
Γ_{25}	e^+e^-	*S1*		$(9 {}^{+6}_{-4}) \times 10^{-12}$		DESIG=7
Γ_{26}	$\pi^+\pi^-e^+e^-$	*S1*	[c]	$(3.11 \pm 0.19) \times 10^{-7}$		DESIG=17
Γ_{27}	$\pi^0\pi^0e^+e^-$	*S1*		$< 6.6 \times 10^{-9}$	CL=90%	DESIG=48
Γ_{28}	$\pi^0\pi^0\mu^+\mu^-$	*S1*		$< 9.2 \times 10^{-11}$	CL=90%	DESIG=54
Γ_{29}	$\mu^+\mu^-e^+e^-$	*S1*		$(2.69 \pm 0.27) \times 10^{-9}$		DESIG=21
Γ_{30}	$e^+e^-e^+e^-$	*S1*		$(3.56 \pm 0.21) \times 10^{-8}$		DESIG=22
Γ_{31}	$\pi^0\mu^+\mu^-$	*CP,S1*	[e]	$< 3.8 \times 10^{-10}$	CL=90%	DESIG=16
Γ_{32}	$\pi^0e^+e^-$	*CP,S1*	[e]	$< 2.8 \times 10^{-10}$	CL=90%	DESIG=20
Γ_{33}	$\pi^0\nu\overline{\nu}$	*CP,S1*	[f]	$< 3.0 \times 10^{-9}$	CL=90%	DESIG=43
Γ_{34}	$\pi^0\pi^0\nu\overline{\nu}$	*S1*		$< 8.1 \times 10^{-7}$	CL=90%	DESIG=52
Γ_{35}	$e^\pm\mu^\mp$	*LF*	[a]	$< 4.7 \times 10^{-12}$	CL=90%	DESIG=8
Γ_{36}	$e^\pm e^\pm\mu^\mp\mu^\mp$	*LF*	[a]	$< 4.12 \times 10^{-11}$	CL=90%	DESIG=24
Γ_{37}	$\pi^0\mu^\pm e^\mp$	*LF*	[a]	$< 7.6 \times 10^{-11}$	CL=90%	DESIG=36
Γ_{38}	$\pi^0\pi^0\mu^\pm e^\mp$	*LF*		$< 1.7 \times 10^{-10}$	CL=90%	DESIG=53

Lorentz invariance violating modes

NODE=S013;CLUMP=H

	Mode			Fraction		
Γ_{39}	$\pi^0\gamma$			$< 1.7 \times 10^{-7}$	CL=90%	DESIG=55

[a] The value is for the sum of the charge states or particle/antiparticle states indicated. LINKAGE=SG

[b] This mode includes gammas from inner bremsstrahlung but not the direct emission mode $K^0_L \to \pi^+\pi^-\gamma$(DE). LINKAGE=IBR

[c] See the Particle Listings below for the energy limits used in this measurement. LINKAGE=KDL

[d] Most of this radiative mode, the low-momentum γ part, is also included in the parent mode listed without γ's. LINKAGE=KX

[e] Allowed by higher-order electroweak interactions. LINKAGE=CE

[f] Violates *CP* in leading order. Test of direct *CP* violation since the indirect *CP*-violating and *CP*-conserving contributions are expected to be suppressed. LINKAGE=CD

CONSTRAINED FIT INFORMATION

An overall fit to the mean life and 15 branching ratios uses 27 measurements and one constraint to determine 11 parameters. The overall fit has a $\chi^2 = 37.4$ for 17 degrees of freedom.

The following *off-diagonal* array elements are the correlation coefficients $\langle \delta p_i \delta p_j \rangle / (\delta p_i \cdot \delta p_j)$, in percent, from the fit to parameters p_i, including 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_6	x_7	x_8	x_9	x_{13}	x_{14}	x_{17}	x_{19}
x_2	−21									
x_6	−77	−29								
x_7	−15	−20	−18							
x_8	53	−11	−47	4						
x_9	30	−23	−11	−12	64					
x_{13}	6	−1	−6	0	12	8				
x_{14}	6	−1	−6	0	11	7	93			
x_{17}	−46	−22	64	−14	−21	8	−3	−3		
x_{19}	−5	−2	7	−1	−3	−1	0	0	4	
Γ	−27	−9	24	15	−13	−6	−2	−2	15	2

	Mode		Rate (10^8 s^{-1})	Scale factor	
Γ_1	$\pi^\pm e^\mp \nu_e$ Called K^0_{e3}.	[a]	0.07927 ± 0.00034	1.1	DESIG=4
Γ_2	$\pi^\pm \mu^\mp \nu_\mu$ Called $K^0_{\mu3}$.	[a]	0.05286 ± 0.00025	1.1	DESIG=3

Γ_6	$3\pi^0$	0.03815 ± 0.00030	1.5	DESIG=1
Γ_7	$\pi^+\pi^-\pi^0$	0.02451 ± 0.00015		DESIG=2
Γ_8	$\pi^+\pi^-$	[b] $(3.844\pm0.023)\times10^{-4}$	1.2	DESIG=5
Γ_9	$\pi^0\pi^0$	$(1.690\pm0.013)\times10^{-4}$	1.4	DESIG=11
Γ_{13}	$\pi^+\pi^-\gamma$	[c,d] $(8.11\pm0.29)\times10^{-6}$	2.7	DESIG=10
Γ_{14}	$\pi^+\pi^-\gamma$(DE)	$(5.55\pm0.21)\times10^{-6}$	2.0	DESIG=50
Γ_{17}	2γ	$(1.069\pm0.010)\times10^{-4}$	1.2	DESIG=9
Γ_{19}	$e^+e^-\gamma$	$(1.84\pm0.08)\times10^{-6}$	1.9	DESIG=14

K^0_L DECAY RATES

NODE=S013225

$\Gamma(\pi^+\pi^-\pi^0)$ Γ_7

NODE=S013W2
NODE=S013W2

VALUE (10^6 s^{-1})	EVTS	DOCUMENT ID		TECN	COMMENT
2.451±0.015 OUR FIT					
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$2.32^{+0.13}_{-0.15}$	192	BALDO-...	75	HLBC	Assumes *CP*
2.35 ± 0.20	180	[1] JAMES	72	HBC	Assumes *CP*
2.71 ± 0.28	99	CHO	71	DBC	Assumes *CP*
2.5 ± 0.3	98	[1] JAMES	71	HBC	Assumes *CP*
2.12 ± 0.33	50	MEISNER	71	HBC	Assumes *CP*
2.20 ± 0.35	53	WEBBER	70	HBC	Assumes *CP*
$2.62^{+0.28}_{-0.27}$	136	BEHR	66	HLBC	Assumes *CP*
3.26 ± 0.77	18	ANDERSON	65	HBC	
1.4 ± 0.4	14	FRANZINI	65	HBC	

[1] JAMES 72 is a final measurement and includes JAMES 71.

NODE=S013W2;LINKAGE=J

$\Gamma(\pi^\pm e^\mp\nu_e)$ Γ_1

NODE=S013W3
NODE=S013W3

VALUE (10^6 s^{-1})	EVTS	DOCUMENT ID		TECN	COMMENT
7.927±0.034 OUR FIT Error includes scale factor of 1.1.					
• • • We do not use the following data for averages, fits, limits, etc. • • •					
7.81 ± 0.56	620	CHAN	71	HBC	
$7.52^{+0.85}_{-0.72}$		AUBERT	65	HLBC	$\Delta S=\Delta Q$, *CP* assumed

$\Gamma(\pi^\pm e^\mp\nu_e)+\Gamma(\pi^\pm\mu^\mp\nu_\mu)$ $(\Gamma_1+\Gamma_2)$

NODE=S013W5
NODE=S013W5

VALUE (10^6 s^{-1})	EVTS	DOCUMENT ID		TECN	COMMENT
13.21±0.05 OUR FIT					
• • • We do not use the following data for averages, fits, limits, etc. • • •					
12.4 ± 0.7	410	[1] BURGUN	72	HBC	$K^+p\rightarrow K^0p\pi^+$
8.47 ± 1.69	126	[1] MANN	72	HBC	$K^-p\rightarrow n\overline{K}^0$
13.1 ± 1.3	252	[1] WEBBER	71	HBC	$K^-p\rightarrow n\overline{K}^0$
11.6 ± 0.9	393	[1,2] CHO	70	DBC	$K^+n\rightarrow K^0p$
10.3 ± 0.8	335	[2] HILL	67	DBC	$K^+n\rightarrow K^0p$
$9.85^{+1.15}_{-1.05}$	109	[1] FRANZINI	65	HBC	

[1] Assumes $\Delta S=\Delta Q$ rule.
[2] CHO 70 includes events of HILL 67.

NODE=S013W5;LINKAGE=D
NODE=S013W5;LINKAGE=C

K^0_L BRANCHING RATIOS

NODE=S013230

Semileptonic modes

NODE=S013405

$\Gamma(\pi^\pm e^\mp\nu_e)/\Gamma_{total}$ Γ_1/Γ

NODE=S013R57
NODE=S013R57

VALUE	EVTS	DOCUMENT ID		TECN
0.4055±0.0011 OUR FIT Error includes scale factor of 1.7.				
0.4047±0.0028 OUR AVERAGE Error includes scale factor of 3.1.				
$0.4007\pm0.0005\pm0.0015$	13M	[1] AMBROSINO	06	KLOE
0.4067 ± 0.0011		[2] ALEXOPOU...	04	KTEV

[1] There are correlations between these five KLOE measurements: B($K_L \to \pi e \nu$), B($K_L \to \pi \mu \nu$), B($K_L \to 3\pi^0$), B($K_L \to \pi^+\pi^-\pi^0$), and τ_{K_L} measured in AMBROSINO 06. See the footnote for the τ_{K_L} measurement for the correlation matrix. NODE=S013R57;LINKAGE=AM

[2] ALEXOPOULOS 04 constrains $\sum_i B_i = 0.9993$ for the six major K_L branching fractions. The correlations among these branching fractions are taken into account in our fit. The correlation matrix is NODE=S013R57;LINKAGE=AE

	K_{e3}	$K_{\mu3}$	$3\pi^0$	$\pi^+\pi^-\pi^0$	$\pi^+\pi^-$	$\pi^0\pi^0$
K_{e3}	1					
$K_{\mu3}$	0.15	1				
$3\pi^0$	−0.77	−0.62	1			
$\pi^+\pi^-\pi^0$	0.18	0.08	−0.54	1		
$\pi^+\pi^-$	0.28	0.22	−0.48	0.49	1	
$\pi^0\pi^0$	−0.72	−0.54	0.89	−0.46	−0.39	1

$\Gamma(\pi^\pm\mu^\mp\nu_\mu)/\Gamma_{total}$ Γ_2/Γ

NODE=S013R58
NODE=S013R58

VALUE	EVTS	DOCUMENT ID		TECN
0.2704±0.0007 OUR FIT Error includes scale factor of 1.1.				
0.2700±0.0008 OUR AVERAGE				
0.2698±0.0005±0.0015	13M	[1] AMBROSINO	06	KLOE
0.2701±0.0009		[2] ALEXOPOU...	04	KTEV

[1] There are correlations between these five KLOE measurements: B($K_L \to \pi e \nu$), B($K_L \to \pi \mu \nu$), B($K_L \to 3\pi^0$), B($K_L \to \pi^+\pi^-\pi^0$), and τ_{K_L} measured in AMBROSINO 06. See the footnote for the τ_{K_L} measurement for the correlation matrix. NODE=S013R58;LINKAGE=AM

[2] For correlations with other ALEXOPOULOS 04 measurements, see the footnote with their B($K_L \to \pi e \nu$) measurement. NODE=S013R58;LINKAGE=AL

$\left[\Gamma(\pi^\pm e^\mp \nu_e) + \Gamma(\pi^\pm\mu^\mp\nu_\mu)\right]/\Gamma_{total}$ $(\Gamma_1+\Gamma_2)/\Gamma$

NODE=S013R7
NODE=S013R7

VALUE	DOCUMENT ID
0.6760±0.0012 OUR FIT Error includes scale factor of 1.6.	

$\Gamma(\pi^\pm\mu^\mp\nu_\mu)/\Gamma(\pi^\pm e^\mp \nu_e)$ Γ_2/Γ_1

NODE=S013R10
NODE=S013R10

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.6669±0.0027 OUR FIT Error includes scale factor of 1.2.					
0.666 ±0.004 OUR AVERAGE Error includes scale factor of 1.6.					
• • • We use the following data for averages but not for fits. • • •					
0.6740±0.0059	13M	[1] AMBROSINO	06	KLOE	Not in fit NOTFITTED
0.6640±0.0014±0.0022	394k	[2] ALEXOPOU...	04	KTEV	Not in fit NOTFITTED
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.702 ±0.011	33k	CHO	80	HBC	
0.662 ±0.037	10k	WILLIAMS	74	ASPK	
0.741 ±0.044	6700	BRANDENB...	73	HBC	
0.662 ±0.030	1309	EVANS	73	HLBC	
0.68 ±0.08	3548	BASILE	70	OSPK	
0.71 ±0.05	770	BUDAGOV	68	HLBC	

[1] AMBROSINO 06 enters the fit via their separate measurements of these two modes. NODE=S013R10;LINKAGE=AM

[2] ALEXOPOULOS 04 enters the fit via their separate measurements of these two modes. NODE=S013R10;LINKAGE=AL

$\Gamma((\pi\mu\text{atom})\nu)/\Gamma(\pi^\pm\mu^\mp\nu_\mu)$ Γ_3/Γ_2

NODE=S013R33
NODE=S013R33

VALUE (units 10^{-7})	EVTS	DOCUMENT ID		TECN
3.90±0.39	155	[1] ARONSON	86	SPEC
• • • We do not use the following data for averages, fits, limits, etc. • • •				
seen	18	COOMBES	76	WIRE

[1] ARONSON 86 quote theoretical value of $(4.31 \pm 0.08) \times 10^{-7}$. NODE=S013R33;LINKAGE=A

$\Gamma(\pi^0\pi^\pm e^\mp \nu)/\Gamma_{total}$ Γ_4/Γ

NODE=S013R32
NODE=S013R32

VALUE (units 10^{-5})	CL%	EVTS	DOCUMENT ID		TECN
5.20±0.11 OUR AVERAGE					
5.21±0.07±0.09		5402	BATLEY	04	NA48
5.16±0.20±0.22		729	MAKOFF	93	E731
• • • We do not use the following data for averages, fits, limits, etc. • • •					
6.2 ±2.0		16	CARROLL	80C	SPEC
< 220	90		[1] DONALDSON	74	SPEC

[1] DONALDSON 74 uses $K_L^0 \to \pi^+\pi^-\pi^0$/(all K_L^0) decays = 0.126. NODE=S013R32;LINKAGE=D

$\Gamma(\pi^{\pm} e^{\mp} \nu e^{+} e^{-})/\Gamma(\pi^{+}\pi^{-}\pi^{0})$ Γ_5/Γ_7

NODE=S013R62

VALUE (units 10^{-5})	EVTS	DOCUMENT ID	TECN	COMMENT
10.02±0.17±0.29	19k	[1] ABOUZAID 07C	KTEV	M_{ee}> 5 MeV, E^*_{ee} > 30 MeV

[1] E^*_{ee} is the energy of the $e^+ e^-$ pair in the kaon rest frame. ABOUZAID 07C reports $[\Gamma(K^0_L \to \pi^{\pm} e^{\mp} \nu e^{+} e^{-})/\Gamma(K^0_L \to \pi^{+}\pi^{-}\pi^{0})]$ / $[B(\pi^0 \to e^+ e^- \gamma)] = (8.54 \pm 0.07 \pm 0.13) \times 10^{-3}$ which we multiply by our best value $B(\pi^0 \to e^+ e^- \gamma) = (1.174 \pm 0.035) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=S013R62;LINKAGE=AB

Hadronic modes, including Charge conjugation×Parity Violating (*CPV*) modes

NODE=S013410

$\Gamma(3\pi^0)/\Gamma_{total}$ Γ_6/Γ

NODE=S013R45

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
0.1952±0.0012 OUR FIT	Error includes scale factor of 1.6.			
0.1969±0.0026 OUR AVERAGE	Error includes scale factor of 2.0.			
• • • We use the following data for averages but not for fits. • • •				
0.1997±0.0003±0.0019	13M	[1] AMBROSINO 06	KLOE	Not fitted
0.1945±0.0018		[1] ALEXOPOU... 04	KTEV	Not fitted

NOTFITTED
NOTFITTED

[1] We exclude these $B(K_L \to 3\pi^0)$ measurements from our fit because the authors have constrained K_L branching fractions to sum to one. It enters our fit via the other measurements from the experiment and their correlations, along with our constraint that the fitted branching fractions sum to one.

NODE=S013R45;LINKAGE=AB

$\Gamma(3\pi^0)/\Gamma(\pi^{\pm} e^{\mp} \nu_e)$ Γ_6/Γ_1

NODE=S013R46

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
0.481 ±0.004 OUR FIT	Error includes scale factor of 1.8.			
• • • We use the following data for averages but not for fits. • • •				
0.4782±0.0014±0.0053	209k	[1] ALEXOPOU... 04	KTEV	Not in fit
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.545 ±0.004 ±0.009	38k	KREUTZ 95	NA31	

NOTFITTED

[1] This measurement enters the fit via their separate measurements of these two modes.

NODE=S013R46;LINKAGE=AB

$\Gamma(3\pi^0)/[\Gamma(\pi^{\pm} e^{\mp} \nu_e) + \Gamma(\pi^{\pm} \mu^{\mp} \nu_\mu) + \Gamma(\pi^{+}\pi^{-}\pi^{0})]$ $\Gamma_6/(\Gamma_1+\Gamma_2+\Gamma_7)$

NODE=S013R1

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
0.2436±0.0018 OUR FIT	Error includes scale factor of 1.6.			
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.251 ±0.014	549	BUDAGOV 68	HLBC	ORSAY measur.
0.277 ±0.021	444	BUDAGOV 68	HLBC	Ecole polytec.meas
0.31 $^{+0.07}_{-0.06}$	29	KULYUKINA 68	CC	
0.24 ±0.08	24	ANIKINA 64	CC	

OCCUR=2

$\Gamma(3\pi^0)/\Gamma(\pi^{+}\pi^{-}\pi^{0})$ Γ_6/Γ_7

NODE=S013R18

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
1.557±0.012 OUR FIT	Error includes scale factor of 1.3.			
• • • We use the following data for averages but not for fits. • • •				
1.582±0.027	13M	[1] AMBROSINO 06	KLOE	Not in fit
• • • We do not use the following data for averages, fits, limits, etc. • • •				
1.611±0.014±0.034	28k	KREUTZ 95	NA31	
1.65 ±0.07	883	BARMIN 72B	HLBC	Error statistical only
1.80 ±0.13	1010	BUDAGOV 68	HLBC	
2.0 ±0.6	188	ALEKSANYAN 64B	FBC	

NOTFITTED

[1] AMBROSINO 06 enters the fit via their separate measurements of these two modes.

NODE=S013R18;LINKAGE=AM

$\Gamma(\pi^{+}\pi^{-}\pi^{0})/\Gamma_{total}$ Γ_7/Γ

NODE=S013R6

VALUE	EVTS	DOCUMENT ID	TECN
0.1254±0.0005 OUR FIT			
0.1255±0.0006 OUR AVERAGE			
0.1263±0.0004±0.0011	13M	[1] AMBROSINO 06	KLOE
0.1252±0.0007		[2] ALEXOPOU... 04	KTEV

[1] There are correlations between these five KLOE measurements: $B(K_L \to \pi e \nu)$, $B(K_L \to \pi \mu \nu)$, $B(K_L \to 3\pi^0)$, $B(K_L \to \pi^+ \pi^- \pi^0)$, and τ_{K_L} measured in AMBROSINO 06. See the footnote for the τ_{K_L} measurement for the correlation matrix.

NODE=S013R6;LINKAGE=AM

[2] For correlations with other ALEXOPOULOS 04 measurements, see the footnote with their $B(K_L \to \pi e \nu)$ measurement.

NODE=S013R6;LINKAGE=AL

$\Gamma(\pi^+\pi^-\pi^0)/\Gamma(\pi^\pm e^\mp \nu_e)$ — Γ_7/Γ_1

NODE=S013R47
NODE=S013R47

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.3092±0.0016 OUR FIT Error includes scale factor of 1.1.					
• • • We use the following data for averages but not for fits. • • •					
0.3078±0.0005±0.0017	799k	[1] ALEXOPOU...	04	KTEV	Not in fit
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.336 ±0.003 ±0.007	28k	KREUTZ	95	NA31	

NOTFITTED
NOTFITTED

[1] This measurement enters the fit via their separate measurements for the two modes.

NODE=S013R47;LINKAGE=AL

$\Gamma(\pi^+\pi^-\pi^0)/[\Gamma(\pi^\pm e^\mp \nu_e)+\Gamma(\pi^\pm \mu^\mp \nu_\mu)+\Gamma(\pi^+\pi^-\pi^0)]$ — $\Gamma_7/(\Gamma_1+\Gamma_2+\Gamma_7)$

NODE=S013R2
NODE=S013R2

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.1565±0.0006 OUR FIT Error includes scale factor of 1.1.					
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.163 ±0.003	6499	CHO	77	HBC	
0.1605±0.0038	1590	ALEXANDER	73B	HBC	
0.146 ±0.004	3200	BRANDENB...	73	HBC	
0.159 ±0.010	558	EVANS	73	HLBC	
0.167 ±0.016	1402	KULYUKINA	68	CC	
0.161 ±0.005		HOPKINS	67	HBC	
0.162 ±0.015	126	HAWKINS	66	HBC	
0.159 ±0.015	326	ASTBURY	65B	CC	
0.178 ±0.017	566	GUIDONI	65	HBC	
0.144 ±0.004	1729	HOPKINS	65	HBC	See HOPKINS 67

$\Gamma(\pi^+\pi^-)/\Gamma_{total}$ — Γ_8/Γ

NODE=S013R38

Violates *CP* conservation.

NODE=S013R38
NODE=S013R38

VALUE (units 10^{-3})	DOCUMENT ID		TECN
1.967±0.010 OUR FIT Error includes scale factor of 1.5.			
1.975±0.012	[1] ALEXOPOU...	04	KTEV

[1] For correlations with other ALEXOPOULOS 04 measurements, see the footnote with their B($K_L \to \pi e \nu$) measurement.

NODE=S013R38;LINKAGE=AL

$\Gamma(\pi^+\pi^-)/\Gamma(\pi^\pm e^\mp \nu_e)$ — Γ_8/Γ_1

NODE=S013R55
NODE=S013R55

VALUE (units 10^{-3})	EVTS	DOCUMENT ID		TECN	COMMENT
4.849±0.020 OUR FIT Error includes scale factor of 1.1.					
4.840±0.020 OUR AVERAGE					
4.826±0.022±0.016	47k	[1] LAI	07	NA48	
• • • We use the following data for averages but not for fits. • • •					
4.856±0.017±0.023	84k	[2] ALEXOPOU...	04	KTEV	Not in fit

NOTFITTED

[1] The LAI 07 central value of 4.835×10^{-3} has been reduced by 0.19% to 4.826×10^{-3} to subtract the contribution from the direct emission mode $K_L^0 \to \pi^+\pi^-\gamma$(DE).

NODE=S013R55;LINKAGE=LA

[2] This measurement enters the fit via their separate measurements for the two modes.

NODE=S013R55;LINKAGE=AL

$[\Gamma(\pi^+\pi^-)+\Gamma(\pi^+\pi^-\gamma(\mathrm{DE}))]/\Gamma(\pi^\pm \mu^\mp \nu_\mu)$ — $(\Gamma_8+\Gamma_{14})/\Gamma_2$

NODE=S013R59
NODE=S013R59

VALUE (units 10^{-3})	EVTS	DOCUMENT ID		TECN
7.38 ±0.04 OUR FIT Error includes scale factor of 1.4.				
7.275±0.042±0.054	45k	[1] AMBROSINO	06F	KLOE

[1] Fully inclusive. Taking B($K_L^0 \to \pi \mu \nu$) from KLOE, AMBROSINO 06, B($K_L^0 \to \pi^+\pi^- + \pi^+\pi^-\gamma$(DE)) = $(1.963 \pm 0.012 \pm 0.017) \times 10^{-3}$ is obtained.

NODE=S013R59;LINKAGE=AM

$\Gamma(\pi^+\pi^-)/[\Gamma(\pi^\pm e^\mp \nu_e)+\Gamma(\pi^\pm \mu^\mp \nu_\mu)]$ — $\Gamma_8/(\Gamma_1+\Gamma_2)$

NODE=S013R20

Violates *CP* conservation.

NODE=S013R20
NODE=S013R20

VALUE (units 10^{-3})	EVTS	DOCUMENT ID		TECN	COMMENT
2.909±0.013 OUR FIT Error includes scale factor of 1.3.					
• • • We do not use the following data for averages, fits, limits, etc. • • •					
3.13 ±0.14	1687	COUPAL	85	SPEC	η_{+-}=2.28 ± 0.06
3.04 ±0.14	2703	DEVOE	77	SPEC	η_{+-}=2.25 ± 0.05
2.51 ±0.23	309	[1] DEBOUARD	67	OSPK	η_{+-}=2.00 ± 0.09
2.35 ±0.19	525	[1] FITCH	67	OSPK	η_{+-}=1.94 ± 0.08

[1] Old experiments excluded from fit. See subsection on η_{+-} in section on "PARAMETERS FOR $K_L^0 \to 2\pi$ DECAY" below for average η_{+-} of these experiments and for note on discrepancy.

NODE=S013R20;LINKAGE=O

$\Gamma(\pi^{\pm} e^{\mp} \nu_e)/\Gamma(2\text{ tracks})$ $\Gamma_1/(\Gamma_1+\Gamma_2+0.03508\Gamma_6+\Gamma_7+\Gamma_8)$

NODE=S013R56

$\Gamma(2\text{ tracks}) = \Gamma(\pi^{\pm} e^{\mp} \nu_e) + \Gamma(\pi^{\pm} \mu^{\mp} \nu_\mu) + 0.03508\ \Gamma(3\pi^0) + \Gamma(\pi^+ \pi^- \pi^0) + \Gamma(\pi^+ \pi^-)$ where 0.03508 is the fraction of $3\pi^0$ events with one Dalitz decay ($\pi^0 \to \gamma e^+ e^-$).

NODE=S013R56

VALUE	EVTS	DOCUMENT ID	TECN
0.5006±0.0009 OUR FIT Error includes scale factor of 1.3.			
0.4978±0.0035	6.8M	LAI 04B	NA48

NODE=S013R56

$\Gamma(\pi^+\pi^-)/[\Gamma(\pi^{\pm} e^{\mp} \nu_e)+\Gamma(\pi^{\pm} \mu^{\mp} \nu_\mu)+\Gamma(\pi^+\pi^-\pi^0)]$ $\Gamma_8/(\Gamma_1+\Gamma_2+\Gamma_7)$

NODE=S013R9

Violates *CP* conservation.

NODE=S013R9
NODE=S013R9

VALUE (units 10^{-3})	EVTS	DOCUMENT ID	TECN	COMMENT
2.454±0.011 OUR FIT Error includes scale factor of 1.3.				
• • • We do not use the following data for averages, fits, limits, etc. • • •				
2.60 ±0.07	4200	[1] MESSNER 73	ASPK	$\eta_{+-} = 2.23 \pm 0.05$

[1] From same data as $\Gamma(\pi^+\pi^-)/\Gamma(\pi^+\pi^-\pi^0)$ MESSNER 73, but with different normalization.

NODE=S013R9;LINKAGE=M

$\Gamma(\pi^+\pi^-)/\Gamma(\pi^+\pi^-\pi^0)$ Γ_8/Γ_7

NODE=S013R27

Violates *CP* conservation.

NODE=S013R27
NODE=S013R27

VALUE (units 10^{-2})	EVTS	DOCUMENT ID	TECN	COMMENT
1.568±0.010 OUR FIT Error includes scale factor of 1.3.				
• • • We do not use the following data for averages, fits, limits, etc. • • •				
1.64 ±0.04	4200	MESSNER 73	ASPK	$\eta_{+-} = 2.23$

$\Gamma(\pi^0\pi^0)/\Gamma_{\text{total}}$ Γ_9/Γ

NODE=S013R17

Violates *CP* conservation.

NODE=S013R17
NODE=S013R17

VALUE (units 10^{-3})	DOCUMENT ID	TECN
0.864±0.006 OUR FIT Error includes scale factor of 1.8.		
0.865±0.012	[1] ALEXOPOU... 04	KTEV

[1] For correlations with other ALEXOPOULOS 04 measurements, see the footnote with their $B(K_L \to \pi e \nu)$ measurement.

NODE=S013R17;LINKAGE=AL

$\Gamma(\pi^0\pi^0)/\Gamma(\pi^+\pi^-)$ Γ_9/Γ_8

NODE=S013R39

Violates *CP* conservation.

NODE=S013R39
NODE=S013R39

VALUE	DOCUMENT ID
0.4395±0.0023 OUR FIT Error includes scale factor of 2.0.	
0.4390±0.0012	ETAFIT 16

$\Gamma(\pi^0\pi^0)/\Gamma(3\pi^0)$ Γ_9/Γ_6

NODE=S013R19

Violates *CP* conservation.

NODE=S013R19
NODE=S013R19

VALUE (units 10^{-2})	EVTS	DOCUMENT ID	TECN	COMMENT
0.443 ±0.004 OUR FIT Error includes scale factor of 2.1.				
• • • We use the following data for averages but not for fits. • • •				
0.4446±0.0016±0.0019	100k	[1] ALEXOPOU... 04	KTEV	Not in fit
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.37 ±0.08	29	BARMIN 70	HLBC	η_{00}=2.02 ± 0.23
0.32 ±0.15	30	BUDAGOV 70	HLBC	η_{00}=1.9 ± 0.5
0.46 ±0.11	57	BANNER 69	OSPK	η_{00}=2.2 ± 0.3

NOTFITTED

[1] This measurement enters the fit via their separate measurements for the two modes.

NODE=S013R19;LINKAGE=AL

Semileptonic modes with photons

NODE=S013415

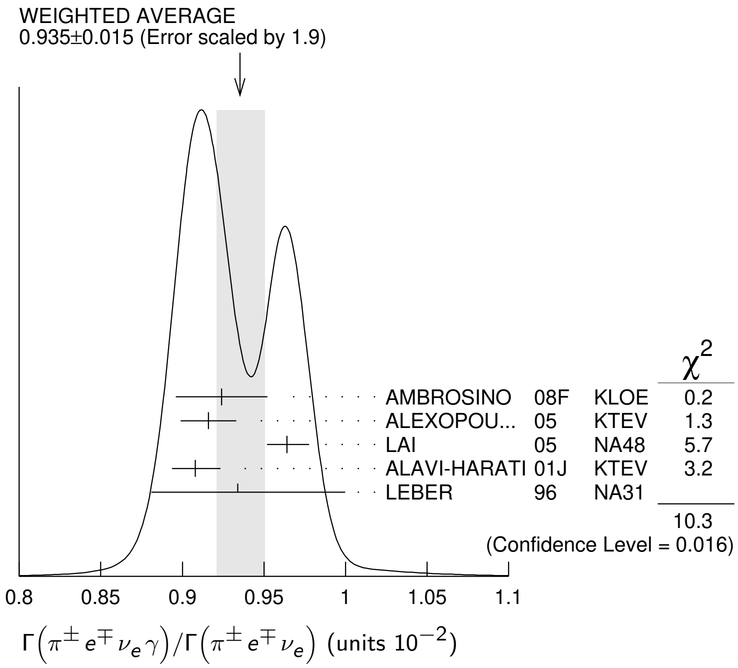
$\Gamma(\pi^{\pm} e^{\mp} \nu_e \gamma)/\Gamma(\pi^{\pm} e^{\mp} \nu_e)$ Γ_{10}/Γ_1

NODE=S013R25
NODE=S013R25

VALUE (units 10^{-2})	EVTS	DOCUMENT ID	TECN	COMMENT
0.935±0.015 OUR AVERAGE Error includes scale factor of 1.9. See the ideogram below.				
0.924±0.023±0.016	9k	[1] AMBROSINO 08F	KLOE	E^*_γ >30 MeV, $\theta^*_{e\gamma}$ >20°
0.916±0.017	4309	[2] ALEXOPOU... 05	KTEV	E^*_γ >30 MeV, $\theta^*_{e\gamma}$ >20°
$0.964\pm0.008^{+0.011}_{-0.009}$	19k	LAI 05	NA48	E^*_γ >30 MeV, $\theta^*_{e\gamma}$ >20°
$0.908\pm0.008^{+0.013}_{-0.012}$	15k	ALAVI-HARATI 01J	KTEV	$E^*_\gamma \geq$ 30 MeV, $\theta^*_{e\gamma} \geq$ 20°
$0.934\pm0.036^{+0.055}_{-0.039}$	1384	LEBER 96	NA31	$E^*_\gamma \geq$ 30 MeV, $\theta^*_{e\gamma} \geq$ 20°

[1] Direct emission contribution measured $\langle X \rangle = -2.3 \pm 1.3 \pm 1.4$. NODE=S013R25;LINKAGE=AM

[2] Also measured cut E^*_γ >10 MeV, $\theta^*_{e\gamma}$ >0° 14221 evts: $\Gamma(\pi^\pm e^\mp \nu_e \gamma)$ / $\Gamma(\pi^\pm e^\mp \nu_e)$ = (4.942 ± 0.062)%. NODE=S013R25;LINKAGE=AL



$\Gamma(\pi^\pm \mu^\mp \nu_\mu \gamma)/\Gamma(\pi^\pm \mu^\mp \nu_\mu)$ — Γ_{11}/Γ_2

NODE=S013R49
NODE=S013R49

VALUE (units 10^{-3})	EVTS	DOCUMENT ID		TECN	COMMENT
2.09±0.08 OUR AVERAGE					
2.09±0.09		[1] ALEXOPOU...	05	KTEV	E^*_γ > 30 MeV
$2.08 \pm 0.17^{+0.16}_{-0.21}$	252	BENDER	98	NA48	$E^*_\gamma \geq 30$ MeV

[1] Also measured cut E^*_γ >10 MeV, 1385 evts: $\Gamma(\pi^\pm \mu^\mp \nu_\mu \gamma)$ / $\Gamma(\pi^\pm \mu^\mp \nu_\mu)$ = (0.530 ± 0.014 ± 0.012)%. NODE=S013R49;LINKAGE=AL

Hadronic modes with photons or $\ell\overline{\ell}$ pairs

NODE=S013420

$\Gamma(\pi^0 \pi^0 \gamma)/\Gamma_{total}$ — Γ_{12}/Γ

NODE=S013R42
NODE=S013R42

VALUE (units 10^{-6})	CL%	DOCUMENT ID		TECN	COMMENT
< 0.243	90	ABOUZAID	08B	KTEV	$K^0_L \to \pi^0 \pi^0_D \gamma$, $\pi^0_D \to ee\gamma$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
< 5.6	90	BARR	94	NA31	
<230	90	ROBERTS	94	E799	

$\Gamma(\pi^+ \pi^- \gamma)/\Gamma(\pi^+ \pi^- \pi^0)$ — Γ_{13}/Γ_7

NODE=S013R12

For earlier limits see our 1992 edition Physical Review **D45** S1 (1992). NODE=S013R12

NODE=S013R12

VALUE (units 10^{-4})	EVTS	DOCUMENT ID		TECN	COMMENT	
• • • We do not use the following data for averages, fits, limits, etc. • • •						
1.23±0.13	516	[1,2] CARROLL	80B	SPEC	E^*_γ > 20 MeV	
2.33±0.23	546	[1,3] CARROLL	80B	SPEC		OCCUR=2
3.56±0.26	1062	[1,4] CARROLL	80B	SPEC	E^*_γ > 20 MeV	OCCUR=3

[1] CARROLL 80B quotes B($\pi^+ \pi^- \gamma$) using normalization B($\pi^+ \pi^- \pi^0$) = 0.1239. We divide by this value to obtain their measured $\Gamma(\pi^+ \pi^- \gamma)$ / $\Gamma(\pi^+ \pi^- \pi^0)$. NODE=S013R12;LINKAGE=CA

[2] Internal Bremsstrahlung component only. NODE=S013R12;LINKAGE=H

[3] Direct γ emission component only. NODE=S013R12;LINKAGE=J

[4] Both IB and DE components. NODE=S013R12;LINKAGE=K

$\Gamma(\pi^+\pi^-\gamma)/\Gamma(\pi^+\pi^-)$ — Γ_{13}/Γ_8

NODE=S013R53
NODE=S013R53

VALUE (units 10^{-2})	EVTS	DOCUMENT ID	TECN	COMMENT
2.11±0.08 OUR FIT Error includes scale factor of 2.9.				
2.11±0.08 OUR AVERAGE Error includes scale factor of 2.9.				
2.08±0.02±0.02	8669	[1] ALAVI-HARATI 01B	KTEV	$E^*_\gamma > 20$ MeV
2.30±0.07	3136	RAMBERG 93	E731	$E^*_\gamma > 20$ MeV

[1] ALAVI-HARATI 01B includes both Direct Emission (DE) and Inner Bremsstrahlung (IB) processes.

NODE=S013R53;LINKAGE=A

$\Gamma(\pi^+\pi^-\gamma(\text{DE}))/\Gamma(\pi^+\pi^-\gamma)$ — Γ_{14}/Γ_{13}

NODE=S013R60

These values assume that $\Gamma(K^0_L \to \pi^+\pi^-\gamma) = \Gamma(K^0_L \to \pi^+\pi^-\gamma(\text{DE})) + \Gamma(K^0_L \to \pi^+\pi^-\gamma(\text{IB}))$, the sum of widths for the direct emission (DE) and inner bremsstrahlung (IE) processes, with no IB-DE interference. DE assumes a form factor as described in RAMBERG 93.

NODE=S013R60

NODE=S013R60

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
0.684±0.009 OUR FIT				
0.684±0.009 OUR AVERAGE				
0.689±0.021	111k	ABOUZAID 06A	KTEV	$E^*_\gamma > 20$ MeV
0.683±0.011	8669	ALAVI-HARATI 01B	KTEV	$E^*_\gamma > 20$ MeV
0.685±0.041	3136	RAMBERG 93	E731	$E^*_\gamma > 20$ MeV

$\Gamma(\pi^0 2\gamma)/\Gamma_{\text{total}}$ — Γ_{15}/Γ

NODE=S013R26
NODE=S013R26

VALUE (units 10^{-6})	CL%	EVTS	DOCUMENT ID	TECN	COMMENT
1.273±0.033 OUR AVERAGE					
1.28 ±0.06 ±0.01		1.4k	[1] ABOUZAID 08	KTEV	
1.27 ±0.04 ±0.01		2.5k	[2] LAI 02B	NA48	
• • • We do not use the following data for averages, fits, limits, etc. • • •					
1.68 ±0.07 ±0.08		884	[3] ALAVI-HARATI 99B	KTEV	
1.7 ±0.2 ±0.2		63	[4] BARR 92	NA31	
1.86 ±0.60 ±0.60		60	PAPADIMITR... 91	E731	$m_{\gamma\gamma} > 280$ MeV
<5.1	90		PAPADIMITR... 91	E731	$m_{\gamma\gamma} < 264$ MeV
2.1 ±0.6		14	[5] BARR 90C	NA31	$m_{\gamma\gamma} > 280$ MeV

OCCUR=2

[1] ABOUZAID 08 reports $(1.29 \pm 0.03 \pm 0.05) \times 10^{-6}$ from a measurement of $[\Gamma(K^0_L \to \pi^0 2\gamma)/\Gamma_{\text{total}}]$ / $[B(K^0_L \to \pi^0\pi^0)]$ assuming $B(K^0_L \to \pi^0\pi^0) = (8.69 \pm 0.04) \times 10^{-4}$, which we rescale to our best value $B(K^0_L \to \pi^0\pi^0) = (8.64 \pm 0.06) \times 10^{-4}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=S013R26;LINKAGE=AB

[2] LAI 02B reports $[\Gamma(K^0_L \to \pi^0 2\gamma)/\Gamma_{\text{total}}]$ / $[B(K^0_L \to \pi^0\pi^0)] = (1.467 \pm 0.032 \pm 0.032) \times 10^{-3}$ which we multiply by our best value $B(K^0_L \to \pi^0\pi^0) = (8.64 \pm 0.06) \times 10^{-4}$. Our first error is their experiment's error and our second error is the systematic error from using our best value. They also find that $B(\pi^0 2\gamma,\ m_{\gamma\gamma} < 110 \text{ MeV}) < 0.6 \times 10^{-8}$(90% CL).

NODE=S013R26;LINKAGE=LB

[3] ALAVI-HARATI 99B finds that $\Gamma(\pi^0 2\gamma,\ m_{\gamma\gamma} < 240 \text{ MeV})) / \Gamma(\pi^0 2\gamma) = (17.3 \pm 1.3 \pm 1.5)\%$. Superseded by ABOUZAID 08.

NODE=S013R26;LINKAGE=AL

[4] BARR 92 find that $\Gamma(\pi^0 2\gamma,\ m_{\gamma\gamma} < 240 \text{ MeV})/\Gamma(\pi^0 2\gamma) < 0.09$ (90% CL).

NODE=S013R26;LINKAGE=B

[5] BARR 90C superseded by BARR 92.

NODE=S013R26;LINKAGE=A

$\Gamma(\pi^0\gamma e^+e^-)/\Gamma_{\text{total}}$ — Γ_{16}/Γ

NODE=S013R51
NODE=S013R51

VALUE (units 10^{-8})	CL%	EVTS	DOCUMENT ID	TECN
1.62±0.14±0.09		125	[1] ABOUZAID 07D	KTEV
• • • We do not use the following data for averages, fits, limits, etc. • • •				
2.34±0.35±0.13		44	ALAVI-HARATI 01E	KTEV
<71	90	0	MURAKAMI 99	SPEC

[1] ABOUZAID 07D includes 1997 (ALAVI-HARATI 01E) and 1999 data. It measures the ratio of $B(K^0_L \to \pi^0\gamma e^+e^-)$ / $B(K^0_L \to \pi^0\pi^0_D)$, where π^0_D is the Dalitz decaying π^0, and uses PDG 06 values $B(K^0_L \to \pi^0\pi^0) = (8.69 \pm 0.04) \times 10^{-4}$, and $B(\pi^0_D \to e^+e^-\gamma) = (1.198 \pm 0.032) \times 10^{-2}$. Supersedes ALAVI-HARATI 01E result.

NODE=S013R51;LINKAGE=AD

Other modes with photons or $\ell\bar{\ell}$ pairs

NODE=S013425

$\Gamma(2\gamma)/\Gamma_{total}$ Γ_{17}/Γ

NODE=S013R8
NODE=S013R8

VALUE (units 10^{-4})	EVTS	DOCUMENT ID		TECN	COMMENT
5.47±0.04 OUR FIT	Error includes scale factor of 1.1.				
• • • We do not use the following data for averages, fits, limits, etc. • • •					
4.54±0.84		[1] BANNER	72B	OSPK	
4.5 ±1.0	23	ENSTROM	71	OSPK	K^0_L 1.5–9 GeV/c
5.0 ±1.0		[2] REPELLIN	71	OSPK	
5.5 ±1.1	90	KUNZ	68	OSPK	Norm.to 3 π(C+N)

[1] This value uses $(\eta_{00}/\eta_{+-})^2 = 1.05 \pm 0.14$. In general, $\Gamma(2\gamma)/\Gamma_{total} = \left[(4.32 \pm 0.55) \times 10^{-4}\right]\left[(\eta_{00}/\eta_{+-})^2\right]$.

NODE=S013R8;LINKAGE=B

[2] Assumes regeneration amplitude in copper at 2 GeV is 22 mb. To evaluate for a given regeneration amplitude and error, multiply by (regeneration amplitude/22mb)^2.

NODE=S013R8;LINKAGE=R

$\Gamma(2\gamma)/\Gamma(3\pi^0)$ Γ_{17}/Γ_6

NODE=S013R21
NODE=S013R21

VALUE (units 10^{-3})	EVTS	DOCUMENT ID		TECN	COMMENT
2.802±0.017 OUR FIT					
2.802±0.018 OUR AVERAGE					
2.79 ±0.02 ±0.02	27k	ADINOLFI	03	KLOE	
2.81 ±0.01 ±0.02		LAI	03	NA48	
• • • We do not use the following data for averages, fits, limits, etc. • • •					
2.13 ±0.43	28	BARMIN	71	HLBC	
2.24 ±0.28	115	BANNER	69	OSPK	
2.5 ±0.7	16	ARNOLD	68B	HLBC	Vacuum decay

$\Gamma(2\gamma)/\Gamma(\pi^0\pi^0)$ Γ_{17}/Γ_9

NODE=S013R37
NODE=S013R37

VALUE	EVTS	DOCUMENT ID		TECN
0.633±0.006 OUR FIT	Error includes scale factor of 1.4.			
0.632±0.004±0.008	110k	BURKHARDT	87	NA31

$\Gamma(3\gamma)/\Gamma_{total}$ Γ_{18}/Γ

NODE=S013R44
NODE=S013R44

VALUE	CL%	DOCUMENT ID		TECN
<7.4 × 10^{-8}	90	[1] TUNG	11	K391
• • • We do not use the following data for averages, fits, limits, etc. • • •				
<2.4 × 10^{-7}	90	[2] BARR	95C	NA31

[1] TUNG 11 reports the result assuming parity violating interaction and using 2005 data (Run-II and III). Assuming parity conserving or phase space interaction, the 90% upper limits obtained are 7.5×10^{-8} and 8.6×10^{-8}, respectively.

NODE=S013R44;LINKAGE=TU

[2] Assumes a phase-space decay distribution.

NODE=S013R44;LINKAGE=A

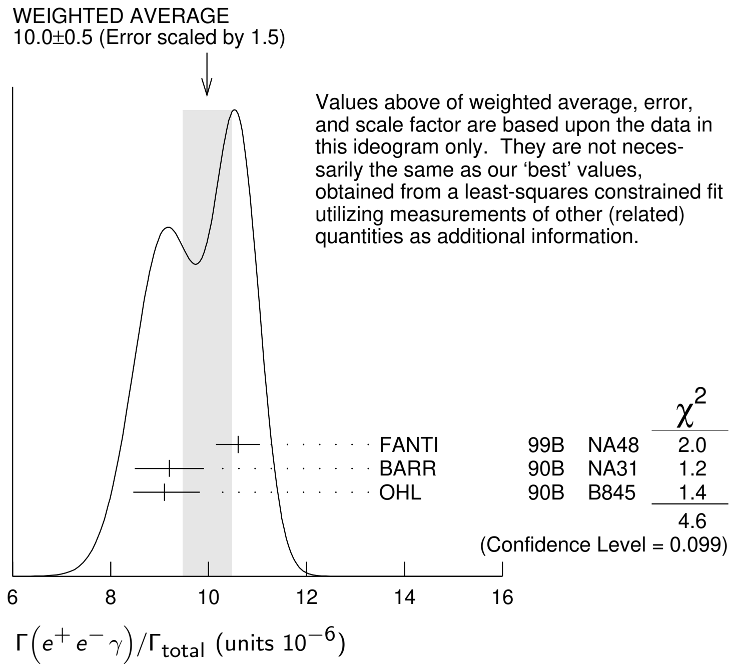
$\Gamma(e^+e^-\gamma)/\Gamma_{total}$ Γ_{19}/Γ

NODE=S013R28
NODE=S013R28

VALUE (units 10^{-6})	EVTS	DOCUMENT ID		TECN
9.4±0.4 OUR FIT	Error includes scale factor of 2.0.			
10.0±0.5 OUR AVERAGE	Error includes scale factor of 1.5. See the ideogram below.			
10.6±0.2±0.4	6864	[1] FANTI	99B	NA48
9.2±0.5±0.5	1053	BARR	90B	NA31
9.1±0.4$^{+0.6}_{-0.5}$	919	OHL	90B	B845

[1] For FANTI 99B, the ±0.4 systematic error includes for uncertainties in the calculation, primarily uncertainties in the $\pi^0 \rightarrow e^+e^-\gamma$ and $K^0_L \rightarrow \pi^0\pi^0$ branching ratios, evaluated using our 1999 Web edition values.

NODE=S013R28;LINKAGE=FR



$\Gamma(e^+e^-\gamma)/\Gamma(3\pi^0)$ Γ_{19}/Γ_6

NODE=S013R61
NODE=S013R61

VALUE (units 10^{-5})	EVTS	DOCUMENT ID		TECN
4.82±0.21 OUR FIT Error includes scale factor of 2.0.				
4.63±0.04±0.13	83k	[1] ABOUZAID	07B	KTEV

[1] ABOUZAID 07B reports $[\Gamma(K^0_L \to e^+e^-\gamma)/\Gamma(K^0_L \to 3\pi^0)]$ / $[3\Gamma(\pi^0 \to 2\gamma)/\Gamma_{total} \times \Gamma(\pi^0 \to e^+e^-\gamma)/\Gamma_{total}] = (1.3302 \pm 0.0046 \pm 0.0103) \times 10^{-3}$ which we multiply by our best value $3\Gamma(\pi^0 \to 2\gamma)/\Gamma_{total} \times \Gamma(\pi^0 \to e^+e^-\gamma)/\Gamma_{total} = 0.0348 \pm 0.0010$. Our first error is their experiment's error and our second error is the systematic error from using our best value. NODE=S013R61;LINKAGE=AB

$\Gamma(\mu^+\mu^-\gamma)/\Gamma_{total}$ Γ_{20}/Γ

NODE=S013R29
NODE=S013R29

VALUE (units 10^{-7})	EVTS	DOCUMENT ID		TECN
3.59±0.11 OUR AVERAGE Error includes scale factor of 1.3.				
3.62±0.04±0.08	9100	ALAVI-HARATI	01G	KTEV
3.4 ±0.6 ±0.4	45	FANTI	97	NA48
3.23±0.23±0.19	197	SPENCER	95	E799

$\Gamma(\mu^+\mu^-\mu^+\mu^-)/\Gamma_{total}$ Γ_{21}/Γ

NODE=S013R01
NODE=S013R01

VALUE	CL%	DOCUMENT ID		TECN
$<2.3 \times 10^{-9}$	90	[1] AAIJ	23AE	LHCB

OCCUR=2

[1] AAIJ 23AE uses 5.1 fb^{-1} of LHCb data recorded from 2016 to 2018. NODE=S013R01;LINKAGE=A

$\Gamma(e^+e^-\gamma\gamma)/\Gamma_{total}$ Γ_{22}/Γ

NODE=S013R41
NODE=S013R41

VALUE (units 10^{-7})	EVTS	DOCUMENT ID		TECN	COMMENT
5.95±0.33 OUR AVERAGE					
5.84±0.15±0.32	1543	ALAVI-HARATI	01F	KTEV	$E^*_\gamma > 5$ MeV
$8.0 \pm 1.5 {}^{+1.4}_{-1.2}$	40	SETZU	98	NA31	$E^*_\gamma > 5$ MeV
6.5 ±1.2 ±0.6	58	NAKAYA	94	E799	$E^*_\gamma > 5$ MeV
6.6 ±3.2		MORSE	92	B845	$E^*_\gamma > 5$ MeV

$\Gamma(\mu^+\mu^-\gamma\gamma)/\Gamma_{total}$ Γ_{23}/Γ

NODE=S013R52
NODE=S013R52

VALUE (units 10^{-9})	EVTS	DOCUMENT ID		TECN	COMMENT
$10.4^{+7.5}_{-5.9}\pm0.7$	4	ALAVI-HARATI	00E	KTEV	$m_{\gamma\gamma} \geq 1$ MeV/c^2

Charge conjugation × Parity (*CP*) or Lepton Family number (*LF*) violating modes, or $\Delta S = 1$ weak neutral current (*S1*) modes

NODE=S013430

$\Gamma(\mu^+\mu^-)/\Gamma(\pi^+\pi^-)$ Γ_{24}/Γ_8

NODE=S013R22

Test for $\Delta S = 1$ weak neutral current. Allowed by higher-order electroweak interaction.

NODE=S013R22
NODE=S013R22

VALUE (units 10^{-6})	EVTS	DOCUMENT ID		TECN	COMMENT
3.48 ±0.05 OUR AVERAGE					
3.474±0.057	6210	AMBROSE	00	B871	
3.87 ±0.30	179	[1] AKAGI	95	SPEC	
3.38 ±0.17	707	HEINSON	95	B791	
• • • We do not use the following data for averages, fits, limits, etc. • • •					
3.9 ±0.3 ±0.1	178	[2] AKAGI	91B	SPEC	In AKAGI 95
3.45 ±0.18 ±0.13	368	[3] HEINSON	91	SPEC	In HEINSON 95
4.1 ±0.5	54	INAGAKI	89	SPEC	In AKAGI 91B
2.8 ±0.3 ±0.2	87	MATHIAZHA...	89B	SPEC	In HEINSON 91

[1] AKAGI 95 gives this number multiplied by the PDG 1992 average for $\Gamma(K^0_L \to \pi^+\pi^-)/\Gamma(\text{total})$.

NODE=S013R22;LINKAGE=G

[2] AKAGI 91B give this number multiplied by the 1990 PDG average for $\Gamma(K^0_L \to \pi^+\pi^-)/\Gamma(\text{total})$.

NODE=S013R22;LINKAGE=D

[3] HEINSON 91 give $\Gamma(K^0_L \to \mu\mu)/\Gamma_{\text{total}}$. We divide out the $\Gamma(K^0_L \to \pi^+\pi^-)/\Gamma_{\text{total}}$ PDG average which they used.

NODE=S013R22;LINKAGE=B

$\Gamma(e^+e^-)/\Gamma_{\text{total}}$ Γ_{25}/Γ

NODE=S013R23

Test for $\Delta S = 1$ weak neutral current. Allowed by higher-order electroweak interaction.

NODE=S013R23
NODE=S013R23

VALUE (units 10^{-10})	CL%	EVTS	DOCUMENT ID		TECN
$0.087^{+0.057}_{-0.041}$		4	AMBROSE	98	B871
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<1.6	90	1	AKAGI	95	SPEC
<0.41	90	0	[1] ARISAKA	93B	B791

[1] ARISAKA 93B includes all events with <6 MeV radiated energy.

NODE=S013R23;LINKAGE=B

$\Gamma(\pi^+\pi^-e^+e^-)/\Gamma_{\text{total}}$ Γ_{26}/Γ

NODE=S013R31

Test for $\Delta S = 1$ weak neutral current. Allowed by higher-order electroweak interaction.

NODE=S013R31
NODE=S013R31

VALUE (units 10^{-7})	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
3.11±0.19 OUR AVERAGE						
3.08±0.09±0.18		1125	[1] LAI	03C	NA48	
3.2 ±0.6 ±0.4		37	ADAMS	98	KTEV	
4.4 ±1.3 ±0.5		13	TAKEUCHI	98	SPEC	
• • • We do not use the following data for averages, fits, limits, etc. • • •						
<4.6	90		NOMURA	97	SPEC	$m_{ee} > 4$ MeV

[1] LAI 03C second error is 0.15(syst)±0.10(norm) combined in quadrature. The normalization uses $\text{BR}(K_L \to \pi^+\pi^-\pi^0) * \text{BR}(\pi^0 \to e^+e^-) = (1.505 \pm 0.047) \times 10^{-3}$ from our 2000 Edition.

NODE=S013R31;LINKAGE=A

$\Gamma(\pi^0\pi^0e^+e^-)/\Gamma_{\text{total}}$ Γ_{27}/Γ

NODE=S013R54

Test for $\Delta S = 1$ weak neutral current. Allowed by higher-order electroweak interaction.

NODE=S013R54
NODE=S013R54

VALUE (units 10^{-9})	CL%	EVTS	DOCUMENT ID		TECN
<6.6	90	1	ALAVI-HARATI	02C	E799

$\Gamma(\pi^0\pi^0\mu^+\mu^-)/\Gamma_{\text{total}}$ Γ_{28}/Γ

NODE=S013R65

Test for $\Delta S = 1$ weak neutral current. Allowed by higher-order electroweak interaction.

NODE=S013R65
NODE=S013R65

VALUE	CL%	DOCUMENT ID		TECN
$<9.2 \times 10^{-11}$	90	[1] ABOUZAID	11A	E799

[1] ABOUZAID 11A also reports $\text{B}(K^0_L \to \pi^0\pi^0X^0 \to \pi^0\pi^0\mu^+\mu^-) < 1.0 \times 10^{-10}$ at 90% C.L., where the X^0 is a possible new neutral boson that was reported by PARK 05 with a mass of 214.3 ± 0.5 MeV/c^2.

NODE=S013R65;LINKAGE=AB

$\Gamma(\mu^+\mu^-e^+e^-)/\Gamma_{\text{total}}$ Γ_{29}/Γ

NODE=S013R35

Test for $\Delta S = 1$ weak neutral current. Allowed by higher-order electroweak interaction.

NODE=S013R35
NODE=S013R35

VALUE (units 10^{-9})	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
2.69±0.27 OUR AVERAGE						
2.69±0.24±0.12		131	[1] ALAVI-HARATI	03B	KTEV	
$2.9^{+6.7}_{-2.4}$		1	GU	96	E799	
• • • We do not use the following data for averages, fits, limits, etc. • • •						
2.62±0.40±0.17		43	ALAVI-HARATI	01H	KTEV	Sup. by ALAVI-HARATI 03B
<4900	90		BALATS	83	SPEC	

[1] ALAVI-HARATI 03B also measures the linear slope $\alpha = -1.59 \pm 0.37$.

NODE=S013R35;LINKAGE=AL

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

NODE=S013R36

Test for $\Delta S = 1$ weak neutral current. Allowed by higher-order electroweak interaction.

NODE=S013R36
NODE=S013R36

VALUE (units 10^{-8})	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
3.56±0.21 OUR AVERAGE					
3.30±0.24±0.25	200	[1] LAI	05B	NA48	
3.72±0.18±0.23	441	ALAVI-HARATI	01D	KTEV	
3.96±0.78±0.32	27	GU	94	E799	
3.07±1.25±0.26	6	VAGINS	93	B845	
• • • We do not use the following data for averages, fits, limits, etc. • • •					
6 ±2 ±1	18	[2] AKAGI	95	SPEC	m_{ee} >470 MeV
7 ±3 ±2	6	[2] AKAGI	95	SPEC	m_{ee} >470 MeV
10.4 ±3.7 ±1.1	8	[3] BARR	95	NA31	
6 ±2 ±1	18	AKAGI	93	CNTR	Sup. by AKAGI 95
4 ±3	2	BARR	91	NA31	Sup. by BARR 95

OCCUR=2

[1] LAI 05B uses 1998 and 1999 data. Data are normalized to the observed events of $K^0_L \to \pi^+\pi^-\pi^0$ (π^0 into Dalitz pair) and PDG 04 values are used for B($K^0_L \to \pi^+\pi^-\pi^0$) and B($\pi^0 \to e^+e^-\gamma$). The systematic error includes a normalization error of ±0.10.

NODE=S013R36;LINKAGE=LA

[2] Values are for the total branching fraction, acceptance-corrected for the m_{ee} cuts shown.

NODE=S013R36;LINKAGE=C

[3] Distribution of angles between two e^+e^- pair planes favors CP=−1 for K^0_L.

NODE=S013R36;LINKAGE=A

$\Gamma(\pi^0\mu^+\mu^-)/\Gamma_{total}$ Γ_{31}/Γ

NODE=S013R30

Violates CP in leading order. Test for $\Delta S = 1$ weak neutral current. Allowed by higher-order electroweak interaction.

NODE=S013R30

NODE=S013R30

VALUE (units 10^{-9})	*CL%*	*EVTS*	*DOCUMENT ID*		*TECN*
<0.38	90		ALAVI-HARATI	00D	KTEV
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<5.1	90	0	HARRIS	93	E799

$\Gamma(\pi^0 e^+e^-)/\Gamma_{total}$ Γ_{32}/Γ

NODE=S013R34

Violates CP in leading order. Direct and indirect CP-violating contributions are expected to be comparable and to dominate the CP-conserving part. LAI 02B result suggests that CP-violation effects dominate. Test for $\Delta S = 1$ weak neutral current. Allowed by higher-order electroweak interaction.

NODE=S013R34

NODE=S013R34

VALUE (units 10^{-10})	*CL%*	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
< 2.8	90		[1] ALAVI-HARATI	04A	KTEV	combined result
• • • We do not use the following data for averages, fits, limits, etc. • • •						
< 3.5	90		ALAVI-HARATI	04A	KTEV	
$0.0047^{+0.0022}_{-0.0018}$			[2] LAI	02B	NA48	CP-conserving part
< 5.1	90	2	ALAVI-HARATI	01	KTEV	
0.01 to 0.02			ALAVI-HARATI	99B	KTEV	CP-conserving part
< 43	90	0	HARRIS	93B	E799	
< 75	90	0	BARKER	90	E731	
< 55	90	0	OHL	90	B845	
< 400	90		BARR	88	NA31	
<3200	90		JASTRZEM...	88	SPEC	

OCCUR=2

[1] Combined result of ALAVI-HARATI 04A 1999-2000 data set and ALAVI-HARATI 01 1997 data set.

NODE=S013R34;LINKAGE=AL

[2] LAI 02B uses the absence of a signal in $K^0_L \to \pi^0\gamma\gamma$ with $m(\gamma\gamma)<m(\pi^0)$ and their a_V value to predict this value.

NODE=S013R34;LINKAGE=LB

$\Gamma(\pi^0\nu\overline{\nu})/\Gamma_{total}$ Γ_{33}/Γ

NODE=S013R40

Violates CP in leading order. Test of direct CP violation since the indirect CP-violating and CP-conserving contributions are expected to be suppressed. Test of $\Delta S = 1$ weak neutral current.

NODE=S013R40

NODE=S013R40

VALUE (units 10^{-8})	*CL%*	*DOCUMENT ID*		*TECN*
< 0.49	90	[1] AHN	21	KOTO
< 0.30	90	[2] AHN	19	KOTO
• • • We do not use the following data for averages, fits, limits, etc. • • •				
< 5.1	90	[3] AHN	17	KOTO
< 2.6	90	[4] AHN	10	K391
< 6.7	90	[5] AHN	08	K391
<21	90	[6] AHN	06	K391
<59	90	ALAVI-HARATI	00	KTEV

OCCUR=2

[1] AHN 21 result is based on data collected in 2016, 2017 and 2018, which corresponds to 3.05×10^{19} protons on target. A single event sensitivity of $(7.20 \pm 0.05 \pm 0.66) \times 10^{-10}$ was achieved with 3 candidate events observed and total 1.22 ± 0.26 background events. NODE=S013R40;LINKAGE=E

[2] AHN 19 result is based on data collected in 2015, which corresponds to 2.2×10^{19} protons on target. A single event sensitivity of $(1.30 \pm 0.01 \pm 0.14) \times 10^{-9}$ was achieved with no candidate events observed. An upper limit of $< 2.4 \times 10^{-9}$ at the 90% C.L. for the $K_L \rightarrow \pi^0 X^0$ decay was also set, where X^0 is an invisible particle with a mass of 135 MeV/c^2. NODE=S013R40;LINKAGE=D

[3] AHN 17 result is based on the first 100 hours of physics running in 2013. One candidate event was observed with an expected background of 0.34 ± 0.16 events. An upper limit of $< 3.7 \times 10^{-8}$ at the 90% C.L. for the $K_L \rightarrow \pi^0 X^0$ decay was also set, where X^0 is an invisible particle with a mass of 135 MeV/c^2. NODE=S013R40;LINKAGE=B

[4] Obtained combining Run-2 (AHN 08) and Run-3 data. NODE=S013R40;LINKAGE=NA

[5] Value obtained using data from February to April 2005. NODE=S013R40;LINKAGE=AN

[6] Value obtained analyzing 10% of data of RUN 1 (performed in 2004). NODE=S013R40;LINKAGE=AH

$\Gamma(\pi^0\pi^0\nu\overline{\nu})/\Gamma_{total}$ Γ_{34}/Γ

NODE=S013R63
NODE=S013R63

VALUE	CL%	DOCUMENT ID		TECN
$<8.1 \times 10^{-7}$	90	[1] OGATA	11	K391
• • • We do not use the following data for averages, fits, limits, etc. • • •				
$<4.7 \times 10^{-5}$	90	[2] NIX	07	K391

[1] Using 2005 Run-I data. OGATA 11 also sets a limit on the $K^0_L \rightarrow \pi^0\pi^0 X \rightarrow$ invisible particles process: the limit on the branching fraction varied from 7.0×10^{-7} to 4.0×10^{-5} for the mass of X ranging from 50 to 200 MeV/c^2. NODE=S013R63;LINKAGE=OG

[2] Observed 1 event with expected background of 0.43 ± 0.35 events. NIX 07 also measured $B(K^0_L \rightarrow \pi^0\pi^0 P) < 1.2 \times 10^{-6}$ at 90% CL, where P is the pseudoscalar particle and $m_P < 100$ MeV. NODE=S013R63;LINKAGE=NI

$\Gamma(e^{\pm}\mu^{\mp})/\Gamma_{total}$ Γ_{35}/Γ

NODE=S013R24

Test of lepton family number conservation.

NODE=S013R24
NODE=S013R24

VALUE (units 10^{-11})	CL%	EVTS	DOCUMENT ID		TECN	
<0.47	90		AMBROSE	98B	B871	
• • • We do not use the following data for averages, fits, limits, etc. • • •						
<9.4	90	0	AKAGI	95	SPEC	
<3.9	90	0	ARISAKA	93	B791	
<3.3	90	0	[1] ARISAKA	93	B791	OCCUR=2

[1] This is the combined result of ARISAKA 93 and MATHIAZHAGAN 89. NODE=S013R24;LINKAGE=B

$\Gamma(e^{\pm}e^{\pm}\mu^{\mp}\mu^{\mp})/\Gamma_{total}$ Γ_{36}/Γ

NODE=S013R48

Test of lepton family number conservation.

NODE=S013R48
NODE=S013R48

VALUE (units 10^{-11})	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
< 4.12	90	0	ALAVI-HARATI	03B	KTEV	
• • • We do not use the following data for averages, fits, limits, etc. • • •						
< 12.3	90	0	[1] ALAVI-HARATI	01H	KTEV	Sup. by ALAVI-HARATI 03B
<610	90	0	[1] GU	96	E799	

[1] Assuming uniform phase space distribution. NODE=S013R48;LINKAGE=A

$\Gamma(\pi^0\mu^{\pm}e^{\mp})/\Gamma_{total}$ Γ_{37}/Γ

NODE=S013R50

Test of lepton family number conservation.

NODE=S013R50
NODE=S013R50

VALUE (units 10^{-10})	CL%	DOCUMENT ID		TECN
< 0.76	90	ABOUZAID	08C	KTEV
• • • We do not use the following data for averages, fits, limits, etc. • • •				
<62	90	ARISAKA	98	E799

$\Gamma(\pi^0\pi^0\mu^{\pm}e^{\mp})/\Gamma_{total}$ Γ_{38}/Γ

NODE=S013R64

Test of lepton family number conservation.

NODE=S013R64
NODE=S013R64

VALUE (units 10^{-10})	CL%	DOCUMENT ID		TECN
<1.7	90	ABOUZAID	08C	KTEV

Lorentz invariance violating modes

NODE=S013440

$\Gamma(\pi^0\gamma)/\Gamma_{total}$ Γ_{39}/Γ

NODE=S013R00
NODE=S013R00

VALUE	CL%	DOCUMENT ID		TECN
<1.7 × 10^{-7}	90	[1] SHIMIZU	20	KOTO

[1] SHIMIZU 20 uses data collected from 2016 to 2018 at the J-PARC KOTO experiment. The single event sensitivity is $(7.1 \pm 0.3 \pm 1.6) \times 10^{-8}$. No candidate event was observed.

NODE=S013R00;LINKAGE=A

See the related review(s):

V_{ud}, V_{us} the Cabibbo Angle, and CKM Unitarity

ENERGY DEPENDENCE OF K^0_L DALITZ PLOT

NODE=S013235

For discussion, see note on Dalitz plot parameters in the $K^\pm$ section of the Particle Listings above. For definitions of a_v, a_t, a_u, and a_y, see the earlier version of the same note in the 1982 edition of this *Review* published in Physics Letters **111B** 70 (1982).

NODE=S013235

$|\text{matrix element}|^2 = 1 + gu + hu^2 + jv + kv^2 + fuv$
where $u = (s_3 - s_0) / m^2_\pi$ and $v = (s_2 - s_1) / m^2_\pi$

LINEAR COEFFICIENT g FOR $K^0_L \to \pi^+\pi^-\pi^0$

NODE=S013GT0
NODE=S013GT0

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.678 ±0.008 OUR AVERAGE	Error includes scale factor of 1.5. See the ideogram below.				
0.6823±0.0044±0.0044	500k	ANGELOPO...	98C	CPLR	
0.681 ±0.024	6499	CHO	77	HBC	
0.620 ±0.023	4709	PEACH	77	HBC	
0.677 ±0.010	509k	MESSNER	74	ASPK	$a_y = -0.917 \pm 0.013$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.69 ±0.07	192	[1] BALDO-...	75	HLBC	
0.590 ±0.022	56k	[1] BUCHANAN	75	SPEC	$a_u = -0.277 \pm 0.010$
0.619 ±0.027	20k	[1,2] BISI	74	ASPK	$a_t = -0.282 \pm 0.011$
0.612 ±0.032		[1] ALEXANDER	73B	HBC	
0.73 ±0.04	3200	[1] BRANDENB...	73	HBC	
0.608 ±0.043	1486	[1] KRENZ	72	HLBC	$a_t = -0.277 \pm 0.018$
0.650 ±0.012	29k	[1] ALBROW	70	ASPK	$a_y = -0.858 \pm 0.015$
0.593 ±0.022	36k	[1,3] BUCHANAN	70	SPEC	$a_u = -0.278 \pm 0.010$
0.664 ±0.056	4400	[1] SMITH	70	OSPK	$a_t = -0.306 \pm 0.024$
0.400 ±0.045	2446	[1] BASILE	68B	OSPK	$a_t = -0.188 \pm 0.020$
0.649 ±0.044	1350	[1] HOPKINS	67	HBC	$a_t = -0.294 \pm 0.018$
0.428 ±0.055	1198	[1] NEFKENS	67	OSPK	$a_u = -0.204 \pm 0.025$

[1] Quadratic dependence required by some experiments. (See sections on "QUADRATIC COEFFICIENT h" and "QUADRATIC COEFFICIENT k" below.) Correlations prevent us from averaging results of fits not including g, h, and k terms.

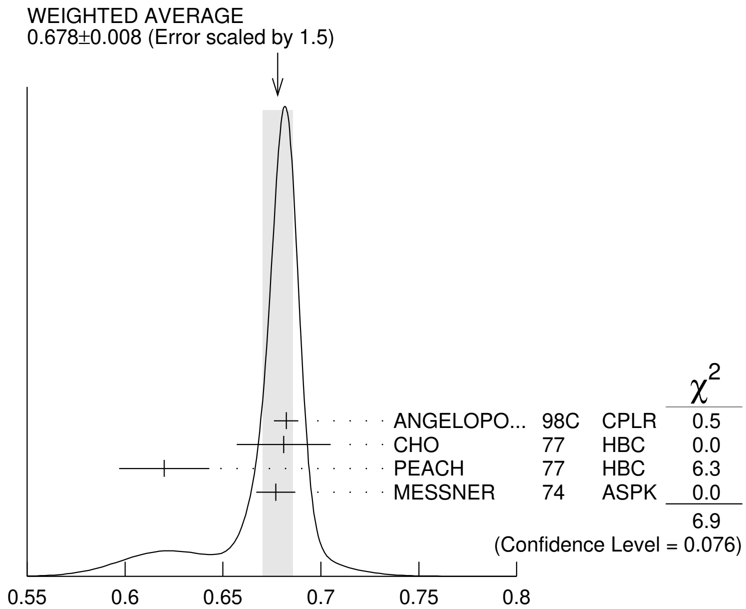
NODE=S013GT0;LINKAGE=Q

[2] BISI 74 value comes from quadratic fit with quad. term consistent with zero. g error is thus larger than if linear fit were used.

NODE=S013GT0;LINKAGE=C

[3] BUCHANAN 70 result revised by BUCHANAN 75 to include radiative correlations and to use more reliable K^0_L momentum spectrum of second experiment (had same beam).

NODE=S013GT0;LINKAGE=B



Linear coeff. g for $K^0_L \rightarrow \pi^+\pi^-\pi^0$ matrix element squared

QUADRATIC COEFFICIENT h FOR $K^0_L \rightarrow \pi^+\pi^-\pi^0$

NODE=S013HT0

See notes in section "LINEAR COEFFICIENT g FOR $K^0_L \rightarrow \pi^+\pi^-\pi^0$ $|$MATRIX ELEMENT$|^2$" above.

NODE=S013HT0

NODE=S013HT0

VALUE	EVTS	DOCUMENT ID		TECN
0.076±0.006 OUR AVERAGE				
0.061±0.004±0.015	500k	ANGELOPO...	98C	CPLR
0.095±0.032	6499	CHO	77	HBC
0.048±0.036	4709	PEACH	77	HBC
0.079±0.007	509k	MESSNER	74	ASPK
• • • We do not use the following data for averages, fits, limits, etc. • • •				
−0.011±0.018	29k	[1] ALBROW	70	ASPK
0.043±0.052	4400	[1] SMITH	70	OSPK

[1] Quadratic coefficients h and k required by some experiments. (See section on "QUADRATIC COEFFICIENT k" below.) Correlations prevent us from averaging results of fits not including g, h, and k terms.

NODE=S013HT0;LINKAGE=Q

QUADRATIC COEFFICIENT k FOR $K^0_L \rightarrow \pi^+\pi^-\pi^0$

NODE=S013KT0
NODE=S013KT0

VALUE	EVTS	DOCUMENT ID		TECN
0.0099±0.0015 OUR AVERAGE				
0.0104±0.0017±0.0024	500k	ANGELOPO...	98C	CPLR
0.024 ±0.010	6499	CHO	77	HBC
−0.008 ±0.012	4709	PEACH	77	HBC
0.0097±0.0018	509k	MESSNER	74	ASPK

LINEAR COEFFICIENT j FOR $K^0_L \rightarrow \pi^+\pi^-\pi^0$ (CP-VIOLATING TERM)

NODE=S013JTR

Listed in CP-violation section below.

NODE=S013JTR

NODE=S013JTR

QUADRATIC COEFFICIENT f FOR $K^0_L \rightarrow \pi^+\pi^-\pi^0$ (CP-VIOLATING TERM)

NODE=S013FTR

Listed in CP-violation section below.

NODE=S013FTR

NODE=S013FTR

QUADRATIC COEFFICIENT h FOR $K^0_L \rightarrow \pi^0\pi^0\pi^0$

NODE=S013HTZ

We do not average measurements that do not account for the effect of final state rescattering.

NODE=S013HTZ

NODE=S013HTZ

VALUE (units 10^{-3})	EVTS	DOCUMENT ID		TECN
+0.59±0.20±1.16	68M	[1] ABOUZAID	08A	KTEV
• • • We do not use the following data for averages, fits, limits, etc. • • •				
−6.1 ±0.9 ±0.5	14.7M	[2] LAI	01B	NA48
−3.3 ±1.1 ±0.7	5M	[2,3] SOMALWAR	92	E731

[1] Result obtained using CI3pI model of CABIBBO 05 to include $\pi\pi$ rescattering effects. The systematic error includes an external error of 1.06×10^{-3} from the parametrization input of $(a_0 - a_2)\ m_{\pi^+} = 0.268 \pm 0.017$ from BATLEY 06B. NODE=S013HTZ;LINKAGE=AB

[2] LAI 01B and SOMALWAR 92 results do not include $\pi\pi$ final state rescattering effects. NODE=S013HTZ;LINKAGE=RE

[3] SOMALWAR 92 chose m_{π^+} as normalization to make it compatible with the Particle Data Group $K^0_L \to \pi^+\pi^-\pi^0$ definitions. NODE=S013HTZ;LINKAGE=A

K^0_L FORM FACTORS

NODE=S013240

For discussion, see note on form factors in the $K^{\pm}$ section of the Particle Listings above. NODE=S013240

In the form factor comments, the following symbols are used.

f_+ and f_- are form factors for the vector matrix element.

f_S and f_T refer to the scalar and tensor term.

$f_0(t) = f_+(t) + f_-(t)\ t/(m^2_{K^0} - m^2_{\pi^+})$.

t = momentum transfer to the π.

λ_+ and λ_0 are the linear expansion coefficients of f_+ and f_0:

$f_+(t) = f_+(0)\ (1 + \lambda_+ t\ /m^2_{\pi^+})$

For quadratic expansion

$f_+(t) = f_+(0)\ (1 + \lambda'_+ t\ /m^2_{\pi^+} + \frac{\lambda''_+}{2}\ t^2/m^4_{\pi^+}\ )$

as used by KTeV. If there is a non-vanishing quadratic term, then λ_+ represents an average slope, which is then different from λ'_+.

NA48 (K_{e3}) and ISTRA quadratic expansion coefficients are converted with

$\lambda'_+{}^{PDG} = \lambda_+{}^{NA48}$ and $\lambda''_+{}^{PDG} = 2\ \lambda'_+{}^{NA48}$

$\lambda'_+{}^{PDG} = (\frac{m_{\pi^\pm}}{m_{\pi^0}})^2\ \lambda_+{}^{ISTRA}$ and

$\lambda''_+{}^{PDG} = 2\ (\frac{m_{\pi^\pm}}{m_{\pi^0}})^4\ \lambda'_+{}^{ISTRA}$

ISTRA linear expansion coefficients are converted with

$\lambda_+{}^{PDG} = (\frac{m_{\pi^\pm}}{m_{\pi^0}})^2\ \lambda_+{}^{ISTRA}$ and $\lambda_0{}^{PDG} = (\frac{m_{\pi^\pm}}{m_{\pi^0}})^2\ \lambda_0{}^{ISTRA}$

The pole parametrization is

$f_+(t) = f_+(0)\ (\frac{M^2_V}{M^2_V - t}\ )$

$f_0(t) = f_0(0)\ (\frac{M^2_S}{M^2_S - t}\ )$

where M_V and M_S are the vector and scalar pole masses.

The dispersive parametrization is

$f_+(t) = f_+(0)\ \exp[\ \frac{t}{m^2_\pi}\ (\Lambda_+ + H(t))\ ]$;

$f_0(t) = f_+(0)\ \exp[\ \frac{t}{m^2_K - m^2_\pi}\ (\ln[C] - G(t))\ ]$,

where Λ_+ is the slope parameter and $\ln[C] = \ln[\ f_0\ (m^2_K - m^2_\pi\ )\ ]$ is the logarithm of the scalar form factor at the Callan-Treiman point.

H(t) and *G(t)* are dispersive integrals.

The following abbreviations are used:

DP = Dalitz plot analysis.

PI = π spectrum analysis.

MU = μ spectrum analysis.

POL= μ polarization analysis.

BR = $K^0_{\mu3}/K^0_{e3}$ branching ratio analysis.

E = positron or electron spectrum analysis.

RC = radiative corrections.

λ_+ (LINEAR ENERGY DEPENDENCE OF f_+ IN K^0_{e3} DECAY)

NODE=S013L+E

For radiative correction of K^0_{e3} DP, see GINSBERG 67, BECHERRAWY 70, CIRIGLIANO 02, CIRIGLIANO 04, and ANDRE 07. Results labeled OUR FIT are discussed in the review "$K^{\pm}_{\ell3}$ and $K^0_{\ell3}$ Form Factors" in the $K^{\pm}$ Listings. For earlier, NODE=S013L+E lower statistics results, see the 2004 edition of this review, Physics Letters **B592** 1 (2004).

NODE=S013L+E

VALUE (units 10^{-2})	EVTS	DOCUMENT ID		TECN	COMMENT	
2.82 ±0.04 OUR FIT		Error includes scale factor of 1.1. Assuming μ-e universality				
2.85 ±0.04 OUR AVERAGE						
2.86 ±0.05 ±0.04	2M	AMBROSINO	06D	KLOE		
2.832±0.037±0.043	1.9M	ALEXOPOU...	04A	KTEV	PI, no $\mu = e$	TYPE=noUNIV
2.88 ±0.04 ±0.11	5.6M	[1] LAI	04C	NA48	DP	OCCUR=2
• • • We do not use the following data for averages, fits, limits, etc. • • •						
2.84 ±0.07 ±0.13	5.6M	[2] LAI	04C	NA48	DP	
2.45 ±0.12 ±0.22	366k	APOSTOLA...	00	CPLR	DP	
3.06 ±0.34	74k	BIRULEV	81	SPEC	DP	
3.12 ±0.25	500k	GJESDAL	76	SPEC	DP	
2.70 ±0.28	25k	BLUMENTHAL	75	SPEC	DP	

[1] Results from linear fit and assuming only vector and axial couplings. NODE=S013L+E;LINKAGE=LI

[2] Results from linear fit with $|f_S/f_+|$ and $|f_T/f_+|$ free. NODE=S013L+E;LINKAGE=LA

λ_+ (LINEAR ENERGY DEPENDENCE OF f_+ IN $K^0_{\mu 3}$ DECAY)

NODE=S013L+M

Results labeled OUR FIT are discussed in the review "$K^\pm_{\ell 3}$ and $K^0_{\ell 3}$ Form Factors" in the $K^\pm$ Listings. For earlier, lower statistics results, see the 2004 edition of this review, Physics Letters **B592** 1 (2004).

NODE=S013L+M

NODE=S013L+M

VALUE (units 10^{-2})	EVTS	DOCUMENT ID		TECN	COMMENT	
2.82 ±0.04 OUR FIT		Error includes scale factor of 1.1. Assuming μ-e universality				
2.71 ±0.10 OUR FIT		Error includes scale factor of 1.4. Not assuming μ-e universality				
2.67 ±0.06 ±0.08	2.3M	[1] LAI	07A	NA48	DP	
2.745±0.088±0.063	1.5M	ALEXOPOU...	04A	KTEV	DP, no $\mu = e$	TYPE=noUNIV
2.813±0.051	3.4M	ALEXOPOU...	04A	KTEV	PI, DP, $\mu = e$	OCCUR=2;TYPE=UNIV
3.0 ±0.3	1.6M	DONALDSON	74B	SPEC	DP	
• • • We do not use the following data for averages, fits, limits, etc. • • •						
4.27 ±0.44	150k	BIRULEV	81	SPEC	DP	

[1] LAI 07A gives a correlation −0.40 between their λ_0 and λ_+ measurements. NODE=S013L+M;LINKAGE=LI

λ_0 (LINEAR ENERGY DEPENDENCE OF f_0 IN $K^0_{\mu 3}$ DECAY)

NODE=S013L0

Wherever possible, we have converted the above values of $\xi(0)$ into values of λ_0 using the associated λ^{μ}_+ and $d\xi(0)/d\lambda_+$. Results labeled OUR FIT are discussed in the review "$K^\pm_{\ell 3}$ and $K^0_{\ell 3}$ Form Factors" in the $K^\pm$ Listings. For earlier, lower statistics results, see the 2004 edition of this review, Physics Letters **B592** 1 (2004).

NODE=S013L0

NODE=S013L0

VALUE (units 10^{-2})	$d\lambda_0/d\lambda_+$	EVTS	DOCUMENT ID		TECN	COMMENT	
1.38 ±0.18 OUR FIT			Error includes scale factor of 2.2. Assuming μ-e universality				
1.42 ±0.23 OUR FIT			Error includes scale factor of 2.8. Not assuming μ-e universality				
1.17 ±0.07 ±0.10		2.3M	[1] LAI	07A	NA48	DP	
1.657±0.125	−0.44	1.5M	[2] ALEXOPOU...	04A	KTEV	DP, no $\mu = e$	TYPE=noUNIV
1.635±0.121	−0.85	3.4M	[3] ALEXOPOU...	04A	KTEV	PI, DP, $\mu = e$	OCCUR=2;TYPE=UNIV
+1.9 ±0.4	−0.47	1.6M	[4] DONALDSON	74B	SPEC	DP	
• • • We do not use the following data for averages, fits, limits, etc. • • •							
3.41 ±0.67	unknown	150k	[5] BIRULEV	81	SPEC	DP	

[1] LAI 07A gives a correlation −0.40 between their λ_0 and λ_+ measurements. NODE=S013L0;LINKAGE=LI

[2] ALEXOPOULOS 04A gives a correlation −0.38 between their λ_0 and λ_+ measurements. NODE=S013L0;LINKAGE=AL

[3] ALEXOPOULOS 04A gives a correlation −0.36 between their λ_0 and λ_+ measurements. NODE=S013L0;LINKAGE=AE

[4] DONALDSON 74B $d\lambda_0/d\lambda_+$ obtained from figure 18. NODE=S013L0;LINKAGE=E

[5] BIRULEV 81 gives $d\lambda_0/d\lambda_+ = -1.5$, giving an unreasonably narrow error ellipse which dominates all other results. We use $d\lambda_0/d\lambda_+ = 0$. NODE=S013L0;LINKAGE=H

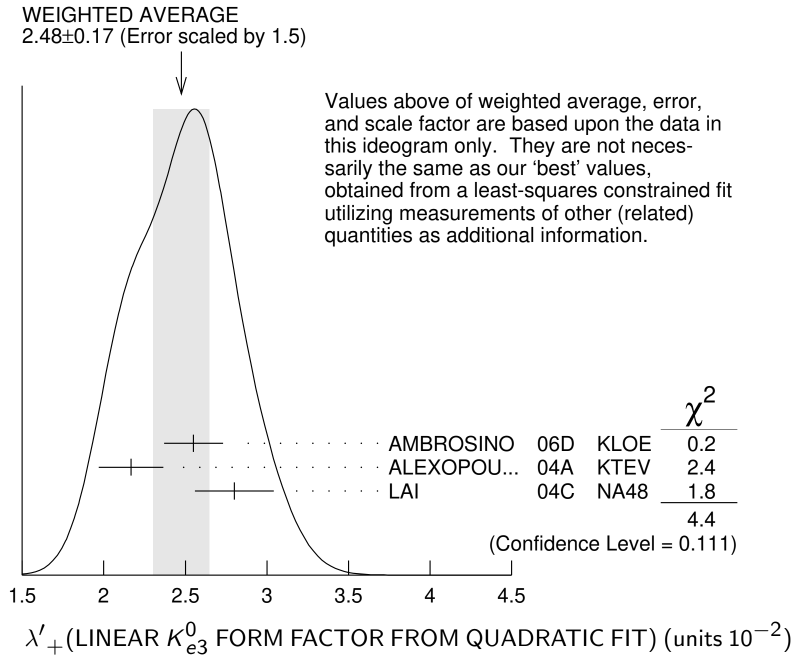
λ'_+(LINEAR K^0_{e3} FORM FACTOR FROM QUADRATIC FIT)

NODE=S013LPE

NODE=S013LPE

VALUE (units 10^{-2})	EVTS	DOCUMENT ID		TECN	COMMENT	
2.40 ±0.12 OUR FIT		Error includes scale factor of 1.2. Assuming μ-e universality				
2.49 ±0.13 OUR FIT		Error includes scale factor of 1.1. Not assuming μ-e universality				
2.48 ±0.17 OUR AVERAGE		Error includes scale factor of 1.5. See the ideogram below.				
2.55 ±0.15 ±0.10	2M	[1] AMBROSINO	06D	KLOE		TYPE=noUNIV
2.167±0.137±0.143	1.9M	[2] ALEXOPOU...	04A	KTEV	PI, no $\mu = e$	TYPE=noUNIV
2.80 ±0.19 ±0.15	5.6M	[3] LAI	04C	NA48	DP	

[1] We use AMBROSINO 06D result in the fit not assuming $\mu-e$ universality. This result enters the fit assuming $\mu-e$ universality via AMBROSINO 07C measurement of λ'_+ in $K_{\mu3}$ decays. AMBROSINO 06D gives a correlation −0.95 between their λ'_+ and λ''_+. NODE=S013LPE;LINKAGE=AM
[2] ALEXOPOULOS 04A gives a correlation −0.97 between their λ'_+ and λ''_+. NODE=S013LPE;LINKAGE=AL
[3] For LAI 04C we calculate a correlation −0.88 between their λ'_+ and λ''_+. NODE=S013LPE;LINKAGE=LA

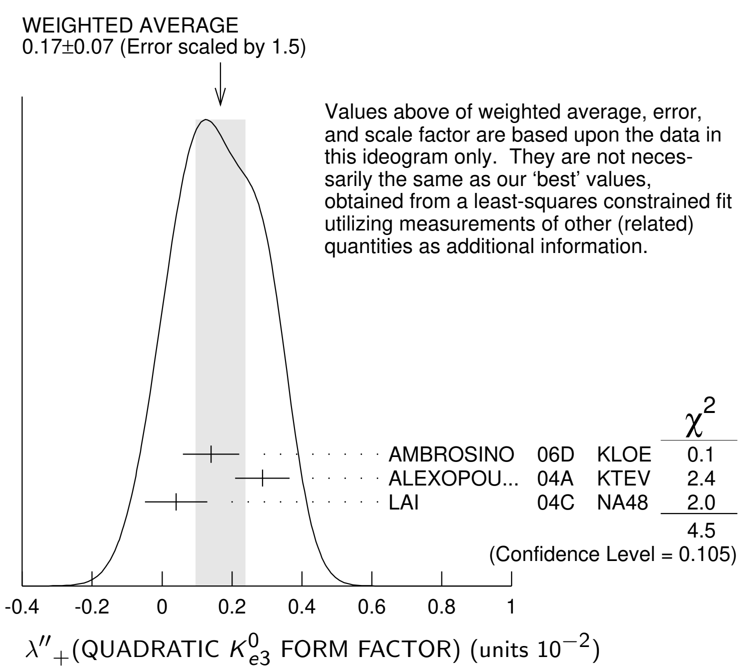


λ''_+(QUADRATIC K^0_{e3} FORM FACTOR)

NODE=S013LQE

VALUE (units 10^{-2})	EVTS	DOCUMENT ID	TECN	COMMENT	
0.20 ±0.05	**OUR FIT**	Error includes scale factor of 1.2. Assuming μ-e universality			
0.16 ±0.05	**OUR FIT**	Error includes scale factor of 1.1. Not assuming μ-e universality			
0.17 ±0.07	**OUR AVERAGE**	Error includes scale factor of 1.5. See the ideogram below.			
0.14 ±0.07 ±0.04	2M	[1] AMBROSINO 06D	KLOE		TYPE=noUNIV
0.287±0.057±0.053	1.9M	[2] ALEXOPOU... 04A	KTEV	PI, no $\mu = e$	TYPE=noUNIV
0.04 ±0.08 ±0.04	5.6M	[3,4] LAI 04C	NA48	DP	

[1] We use AMBROSINO 06D result in the fit not assuming $\mu-e$ universality. This result enters the fit assuming $\mu-e$ universality via AMBROSINO 07C measurement of λ''_+ in $K_{\mu3}$ decays. AMBROSINO 06D gives a correlation −0.95 between their λ'_+ and λ''_+. NODE=S013LQE;LINKAGE=AM
[2] ALEXOPOULOS 04A gives a correlation −0.97 between their λ'_+ and λ''_+. NODE=S013LQE;LINKAGE=AL
[3] Values doubled to agree with PDG conventions described above. NODE=S013LQE;LINKAGE=DB
[4] LAI 04C gives a correlation −0.88 between their λ'_+ and λ''_+. NODE=S013LQE;LINKAGE=LA



λ'_+(LINEAR $K^0_{\mu 3}$ FORM FACTOR FROM QUADRATIC FIT)

NODE=S013LPM
NODE=S013LPM

VALUE (units 10^{-2})	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*	
2.40 ±0.12 OUR FIT					Error includes scale factor of 1.2. Assuming μ-e universality	
1.89 ±0.24 OUR FIT					Not assuming μ-e universality	
2.23 ±0.98 ±0.37	1.8M	[1] AMBROSINO	07C	KLOE	no $\mu = e$	TYPE=noUNIV
2.56 ±0.15 ±0.09	3.8M	[1] AMBROSINO	07C	KLOE	$\mu = e$	OCCUR=2;TYPE=UNIV
2.05 ±0.22 ±0.24	2.3M	[1] LAI	07A	NA48	DP	
1.703±0.319±0.177	1.5M	[1] ALEXOPOU...	04A	KTEV	DP, no $\mu = e$	TYPE=noUNIV
2.064±0.175	3.4M	[1] ALEXOPOU...	04A	KTEV	PI, DP, $\mu = e$	OCCUR=2;TYPE=UNIV

[1] See section λ_0 below for correlations.

NODE=S013LPM;LINKAGE=AL

λ''_+(QUADRATIC $K^0_{\mu 3}$ FORM FACTOR)

NODE=S013LQM
NODE=S013LQM

VALUE (units 10^{-2})	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*	
0.20 ±0.05 OUR FIT					Error includes scale factor of 1.2. Assuming μ-e universality	
0.37 ±0.12 OUR FIT					Error includes scale factor of 1.3. Not assuming μ-e universality	
0.48 ±0.49 ±0.16	1.8M	[1] AMBROSINO	07C	KLOE	no $\mu = e$	TYPE=noUNIV
0.15 ±0.07 ±0.04	3.8M	[1] AMBROSINO	07C	KLOE	$\mu = e$	OCCUR=2;TYPE=UNIV
0.26 ±0.09 ±0.10	2.3M	[1] LAI	07A	NA48	DP	
0.443±0.131±0.072	1.5M	[1] ALEXOPOU...	04A	KTEV	DP, no $\mu = e$	TYPE=noUNIV
0.320±0.069	3.4M	[1] ALEXOPOU...	04A	KTEV	PI, DP, $\mu = e$	OCCUR=2;TYPE=UNIV

[1] See section λ_0 below for correlations.

NODE=S013LQM;LINKAGE=AL

λ_0(LINEAR f_0 $K^0_{\mu 3}$ FORM FACTOR FROM QUADRATIC FIT)

NODE=S013LZ
NODE=S013LZ

VALUE (units 10^{-2})	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*	
1.16 ±0.09 OUR FIT					Error includes scale factor of 1.2. Assuming μ-e universality	
1.07 ±0.14 OUR FIT					Error includes scale factor of 1.3. Not assuming μ-e universality	
0.91 ±0.59 ±0.26	1.8M	[1] AMBROSINO	07C	KLOE	no $\mu = e$	TYPE=noUNIV
1.54 ±0.18 ±0.13	3.8M	[2] AMBROSINO	07C	KLOE	$\mu = e$	OCCUR=2;TYPE=UNIV
0.95 ±0.11 ±0.08	2.3M	[3] LAI	07A	NA48	DP	
1.281±0.136±0.122	1.5M	[4] ALEXOPOU...	04A	KTEV	DP, no $\mu = e$	TYPE=noUNIV
1.372±0.131	3.4M	[5] ALEXOPOU...	04A	KTEV	PI, DP, $\mu = e$	OCCUR=2;TYPE=UNIV

[1] AMBROSINO 07C, not assuming μ-e universality, gives a correlation matrix

NODE=S013LZ;LINKAGE=AM

	λ'_+	λ''_+
λ''_+	−0.97	1
λ_0	0.81	−0.91

[2] AMBROSINO 07C, assuming μ-e universality, gives a correlation matrix

NODE=S013LZ;LINKAGE=AN

	λ'_+	λ''_+
λ''_+	−0.95	1
λ_0	0.29	−0.38

[3] LAI 07A gives a correlation matrix

NODE=S013LZ;LINKAGE=LA

	λ'_+	λ''_+
λ''_+	−0.96	1
λ_0	0.63	−0.73

[4] ALEXOPOULOS 04A, not assuming μ-e universality, gives a correlation matrix

NODE=S013LZ;LINKAGE=AL

	λ'_+	λ''_+	λ_0
λ'_+	1		
λ''_+	−0.96	1	
λ_0	0.65	−0.75	1

[5] ALEXOPOULOS 04A, assuming μ-e universality, gives a correlation matrix

NODE=S013LZ;LINKAGE=AE

	λ'_+	λ''_+	λ_0
λ'_+	1		
λ''_+	−0.97	1	
λ_0	0.34	−0.44	1

M^e_V (POLE MASS FOR K^0_{e3} DECAY)

NODE=S013MVE
NODE=S013MVE

VALUE (MeV)	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*	
878 ± 6 OUR FIT					Error includes scale factor of 1.1. Assuming μ-e universality	
875 ± 5 OUR AVERAGE						
870 ± 6 ±7	2M	AMBROSINO	06D	KLOE		
881.03± 5.12±4.94	1.9M	ALEXOPOU...	04A	KTEV	PI, no $\mu = e$	TYPE=noUNIV
859 ±18	5.6M	LAI	04C	NA48		

M_V^μ (POLE MASS FOR $K^0_{\mu 3}$ DECAY)

NODE=S013MVM
NODE=S013MVM

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	COMMENT
878 ± 6	**OUR FIT**	Error includes scale factor of 1.1. Assuming μ-e universality			
900 ±21	**OUR FIT**	Error includes scale factor of 1.7. Not assuming μ-e universality			
905 ± 9 ±17	2.3M	[1] LAI	07A	NA48	DP
889.19±12.81± 9.92	1.5M	[1] ALEXOPOU...	04A	KTEV	DP, no $\mu = e$
882.32± 6.54	3.4M	[1] ALEXOPOU...	04A	KTEV	PI, DP, $\mu = e$

TYPE=noUNIV
OCCUR=2;TYPE=UNIV

[1] See section M_S^μ below for correlations.

NODE=S013MVM;LINKAGE=AL

M_S^μ (POLE MASS FOR $K^0_{\mu 3}$ DECAY)

NODE=S013MSM
NODE=S013MSM

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	COMMENT
1250 ±90	**OUR FIT**	Error includes scale factor of 2.6. Assuming μ-e universality			
1220 ±80	**OUR FIT**	Error includes scale factor of 2.3. Not assuming μ-e universality			
1400 ±46 ±53	2.3M	[1] LAI	07A	NA48	DP
1167.14±28.30±31.04	1.5M	[2] ALEXOPOU...	04A	KTEV	PI, no $\mu = e$
1173.80±39.47	3.4M	[3] ALEXOPOU...	04A	KTEV	PI, DP, $\mu = e$

TYPE=noUNIV
OCCUR=2;TYPE=UNIV

[1] LAI 07A gives a correlation −0.47 between their M_S^μ and M_V^μ measurements, not assuming μ-e universality.

NODE=S013MSM;LINKAGE=LA

[2] ALEXOPOULOS 04A gives a correlation −0.46 between their M_S^μ and M_V^μ and measurements, not assuming μ-e universality.

NODE=S013MSM;LINKAGE=AL

[3] ALEXOPOULOS 04A gives a correlation −0.40 between their M_S^μ and M_V^μ and measurements, assuming μ-e universality.

NODE=S013MSM;LINKAGE=AE

Λ_+ (DISPERSIVE VECTOR FORM FACTOR FOR $K^0_{\mu 3}$ DECAY)

NODE=S013LAM

See the review on "$K^\pm_{\ell 3}$ and $K^0_{\ell 3}$ Form Factors" for details of the dispersive parametrization.

NODE=S013LAM
NODE=S013LAM

VALUE (units 10^{-2})	EVTS	DOCUMENT ID		TECN	COMMENT
2.51 ±0.06	**OUR AVERAGE**	Error includes scale factor of 1.5. See the ideogram below.			
2.509±0.035±0.043	3.4M	[1] ABOUZAID	10	KTEV	$\mu = e$
2.57 ±0.04 ±0.04	3.8M	[2] AMBROSINO	07C	KLOE	$\mu = e$
2.33 ±0.05 ±0.08	2.3M	[3] LAI	07A	NA48	DP

TYPE=UNIV
TYPE=UNIV

[1] Obtained from a sample of 1.9 M K_{e3} and 1.5 M $K_{\mu 3}$. The correlation between Λ_+ and ln(C) is −0.269.

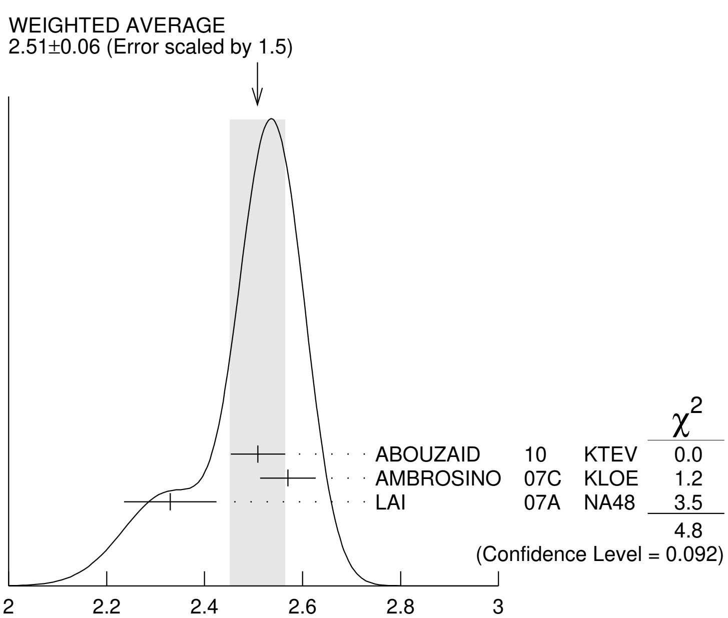
NODE=S013LAM;LINKAGE=AB

[2] AMBROSINO 07C results include 2M K_{e3} events from AMBROSINO 06D. The correlation between Λ_+ and ln(C) is −0.26.

NODE=S013LAM;LINKAGE=AM

[3] LAI 07A gives a correlation −0.44 between their Λ_+ and ln(C) measurements.

NODE=S013LAM;LINKAGE=LA



Λ_+ (DISPERSIVE VECTOR FORM FACTOR FOR $K^0_{\mu 3}$ DECAY) (units 10^{-2})

ln(*C*) (DISPERSIVE SCALAR FORM FACTOR FOR $K^0_{\mu 3}$ DECAY)

NODE=S013LCM

See the review on "$K^{\pm}_{\ell 3}$ and $K^0_{\ell 3}$ Form Factors" for details of the dispersive parametrization.

NODE=S013LCM

VALUE (units 10^{-1})	EVTS	DOCUMENT ID		TECN	COMMENT
1.75 ±0.18 OUR AVERAGE		Error includes scale factor of 2.0. See the ideogram below.			
1.915±0.078±0.094	3.4M	[1] ABOUZAID	10	KTEV	$\mu = e$
2.04 ±0.19 ±0.15	3.8M	[2] AMBROSINO	07C	KLOE	$\mu = e$
1.438±0.080±0.112	2.3M	[3] LAI	07A	NA48	DP

NODE=S013LCM

TYPE=UNIV
TYPE=UNIV

[1] Obtained from a sample of 1.9 M K_{e3} and 1.5 M $K_{\mu 3}$. The correlation between Λ_+ and ln(C) is −0.269.

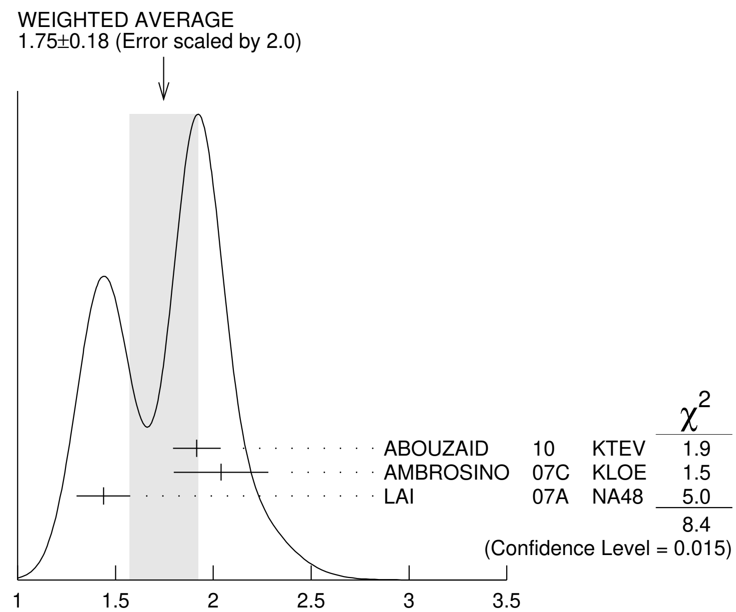
NODE=S013LCM;LINKAGE=AB

[2] AMBROSINO 07C results include 2M K_{e3} events from AMBROSINO 06D. We convert (Λ_+, Λ_0) to $(\Lambda_+, \ln(C))$ parametrization using $\ln(C) = (\Lambda_0 \cdot 11.713 + 0.0398) \pm 0.0041$, where the error is due to theory parametrization of the form factor. The correlation between Λ_+ and ln(C) is −0.26.

NODE=S013LCM;LINKAGE=AM

[3] LAI 07A gives a correlation −0.44 between their Λ_+ and ln(C) measurements.

NODE=S013LCM;LINKAGE=LA



ln(C) (DISPERSIVE SCALAR FORM FACTOR FOR $K^0_{\mu 3}$ DECAY) (units 10^{-1})

$a_1(t_0, Q^2)$ FORM FACTOR PARAMETER

NODE=S013HA1

See HILL 06 for a definition of this parameter.

NODE=S013HA1

VALUE	EVTS	DOCUMENT ID		TECN
1.023±0.028±0.029	2M	[1] ABOUZAID	06C	KTEV

NODE=S013HA1

[1] $Q^2 = 2$ GeV^2, $t_0 = 0.49\,(m_K - m_\pi)^2$. Correlation between a_1 and a_2: $\rho_{12} = -0.064$.

NODE=S013HA1;LINKAGE=AB

$a_2(t_0, Q^2)$ FORM FACTOR PARAMETER

NODE=S013HA2

See HILL 06 for a definition of this parameter.

NODE=S013HA2

VALUE	EVTS	DOCUMENT ID		TECN
0.75±1.58±1.47	2M	[1] ABOUZAID	06C	KTEV

NODE=S013HA2

[1] $Q^2 = 2$ GeV^2, $t_0 = 0.49\,(m_K - m_\pi)^2$. Correlation between a_1 and a_2: $\rho_{12} = -0.064$.

NODE=S013HA2;LINKAGE=AB

$|f_S/f_+|$ FOR K^0_{e3} DECAY

NODE=S013FS

Ratio of scalar to f_+ couplings.

NODE=S013FS
NODE=S013FS

VALUE (units 10^{-2})	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
$1.5^{+0.7}_{-1.0}$±1.2		5.6M	[1] LAI	04C	NA48	
• • • We do not use the following data for averages, fits, limits, etc. • • •						
<9.5	95	18k	HILL	78	STRC	
<7.	68	48k	BIRULEV	76	SPEC	See also BIRULEV 81
<4.	68	25k	BLUMENTHAL	75	SPEC	

[1] Results from linear fit with $|f_S/f_+|$ and $|f_T/f_+|$ free.

NODE=S013FS;LINKAGE=LA

$|f_T/f_+|$ FOR K^0_{e3} DECAY

NODE=S013FT

Ratio of tensor to f_+ couplings.

NODE=S013FT
NODE=S013FT

VALUE (units 10^{-2})	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
$\mathbf{5^{+3}_{-4}\pm3}$		5.6M	[1] LAI	04C	NA48	
• • • We do not use the following data for averages, fits, limits, etc. • • •						
<40.	95	18k	HILL	78	STRC	
<34.	68	48k	BIRULEV	76	SPEC	See also BIRULEV 81
<23.	68	25k	BLUMENTHAL	75	SPEC	

[1] Results from linear fit with $|f_S/f_+|$ and $|f_T/f_+|$ free.

NODE=S013FT;LINKAGE=LA

$|f_T/f_+|$ FOR $K^0_{\mu3}$ DECAY

NODE=S013FTM

Ratio of tensor to f_+ couplings.

NODE=S013FTM
NODE=S013FTM

VALUE (units 10^{-2})	DOCUMENT ID		TECN
12.±12.	BIRULEV	81	SPEC

α_{K^*} DECAY FORM FACTOR FOR $K_L \to \ell^+\ell^-\gamma$, $K^0_L \to \ell^+\ell^-\ell'^+\ell'^-$

NODE=S013ALA

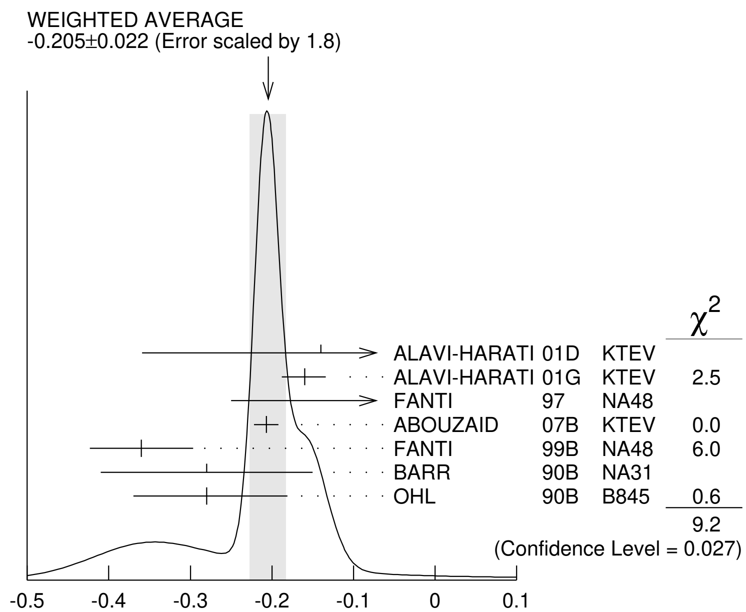
Average of all α_{K^*} measurements (from each of three datablocks following this one) assuming lepton universality.

NODE=S013ALA

VALUE	DOCUMENT ID

NODE=S013ALA

−0.205±0.022 OUR AVERAGE Includes data from the 3 datablocks that follow this one. Error includes scale factor of 1.8. See the ideogram below.



α_{K^*} DECAY FORM FACTOR FOR $K_L \to \ell^+\ell^-\gamma$, $K^0_L \to \ell^+\ell^-\ell'^+\ell'^-$

α_{K^*} DECAY FORM FACTOR FOR $K_L \to e^+e^-\gamma$

NODE=S013ALP

α_{K^*} is the constant in the model of BERGSTROM 83 which measures the relative strength of the vector-vector transition $K_L \to K^*\gamma$ with $K^* \to \rho, \omega, \phi \to \gamma^*$ and the pseudoscalar-pseudoscalar transition $K_L \to \pi, \eta, \eta' \to \gamma\gamma^*$.

NODE=S013ALP

VALUE	EVTS	DOCUMENT ID		TECN
The data in this block is included in the average printed for a previous datablock.				
−0.217±0.034 OUR AVERAGE Error includes scale factor of 2.4.				
−0.207±0.012±0.009	83k	[1] ABOUZAID	07B	KTEV
−0.36 ±0.06 ±0.02	6864	FANTI	99B	NA48
−0.28 ±0.13		BARR	90B	NA31
$-0.280^{+0.099}_{-0.090}$		OHL	90B	B845

NODE=S013ALP

[1] ABOUZAID 07B measures $C\cdot \alpha_{K^*} = -0.517 \pm 0.030 \pm 0.022$. We assume $C = 2.5$, as in all other measurements.

NODE=S013ALP;LINKAGE=AB

α_{K^*} DECAY FORM FACTOR FOR $K_L \to \mu^+ \mu^- \gamma$ NODE=S013ALM

α_{K^*} is the constant in the model of BERGSTROM 83 described in the previous section. NODE=S013ALM

VALUE	EVTS	DOCUMENT ID	TECN
The data in this block is included in the average printed for a previous datablock.			
−0.158±0.027 OUR AVERAGE			
$-0.160^{+0.026}_{-0.028}$	9100	ALAVI-HARATI 01G	KTEV
$-0.04\ ^{+0.24}_{-0.21}$		FANTI 97	NA48

NODE=S013ALM

$\alpha^{\text{eff}}_{K^*}$ DECAY FORM FACTOR FOR $K_L \to e^+ e^- e^+ e^-$ NODE=S013ALE

$\alpha^{\text{eff}}_{K^*}$ is the parameter describing the relative strength of an intermediate pseudoscalar decay amplitude and a vector meson decay amplitude in the model of BERGSTROM 83. It takes into account both the radiative effects and the form factor. Since there are two $e^+ e^-$ pairs here compared with one in $e^+ e^- \gamma$ decays, a factorized expression is used for the $e^+ e^- e^+ e^-$ decay form factor. NODE=S013ALE

VALUE	EVTS	DOCUMENT ID	TECN
The data in this block is included in the average printed for a previous datablock.			
−0.14±0.16±0.15	441	ALAVI-HARATI 01D	KTEV

NODE=S013ALE

α_{DIP} DECAY FORM FACTOR FOR $K^0_L \to \ell^+ \ell^- \gamma$, $K^0_L \to \ell^+ \ell^- \ell'^+ \ell'^-$ NODE=S013ADA

Average of all α_{DIP} measurements (from each of three datablocks following this one) assuming lepton universality. NODE=S013ADA

VALUE	DOCUMENT ID
−1.69±0.08 OUR AVERAGE Includes data from the 3 datablocks that follow this one. Error includes scale factor of 1.7.	

NODE=S013ADA

α_{DIP} DECAY FORM FACTOR FOR $K^0_L \to e^+ e^- \gamma$ NODE=S013ADP

α_{DIP} parameter in $K^0_L \to \gamma^* \gamma^*$ form factor by DAMBROSIO 98, motivated by vector meson dominance and a proper short distance behavior. NODE=S013ADP

VALUE	EVTS	DOCUMENT ID	TECN
The data in this block is included in the average printed for a previous datablock.			
−1.729±0.043±0.028	83k	ABOUZAID 07B	KTEV

NODE=S013ADP

α_{DIP} DECAY FORM FACTOR FOR $K^0_L \to \mu^+ \mu^- \gamma$ NODE=S013ADM

α_{DIP} is a constant in the model of DAMBROSIO 98 described in the previous section. NODE=S013ADM

VALUE	EVTS	DOCUMENT ID	TECN
The data in this block is included in the average printed for a previous datablock.			
−1.54±0.10	9100	ALAVI-HARATI 01G	KTEV

NODE=S013ADM

α_{DIP} DECAY FORM FACTOR FOR $K^0_L \to e^+ e^- \mu^+ \mu^-$ NODE=S013ADE

α_{DIP} is a constant in the model of DAMBROSIO 98 described in the previous section. NODE=S013ADE

VALUE	EVTS	DOCUMENT ID	TECN
The data in this block is included in the average printed for a previous datablock.			
−1.59±0.37	131	ALAVI-HARATI 03B	KTEV

NODE=S013ADE

a_1/a_2 FORM FACTOR FOR M1 DIRECT EMISSION AMPLITUDE NODE=S013A12

Form factor $= \tilde{g}_{M1}\left[1+\frac{a_1/a_2}{(M^2_\rho - M^2_K)+2M_K E^*_\gamma}\right]$ as described in ALAVI-HARATI 00B. NODE=S013A12

VALUE (GeV^2)	EVTS	DOCUMENT ID	TECN	COMMENT
−0.737±0.014 OUR AVERAGE				
−0.744±0.027±0.032	5241	[1] ABOUZAID 06	KTEV	$\pi^+ \pi^- e^+ e^-$
−0.738±0.007±0.018	111k	[2] ABOUZAID 06A	KTEV	$\pi^+ \pi^+ \gamma$
$-0.81\ ^{+0.07}_{-0.13}\ \pm 0.02$		[3] LAI 03C	NA48	$\pi^+ \pi^- e^+ e^-$
−0.737±0.026±0.022		[4] ALAVI-HARATI 01B		$\pi^+ \pi^- \gamma$
−0.720±0.028±0.009	1766	[5] ALAVI-HARATI 00B	KTEV	$\pi^+ \pi^- e^+ e^-$

NODE=S013A12

[1] ABOUZAID 06 also measured $|\tilde{g}_{M1}| = 1.11 \pm 0.14$. NODE=S013A12;LINKAGE=AZ

[2] ABOUZAID 06A also measured $|\tilde{g}_{M1}| = 1.198 \pm 0.035 \pm 0.086$. NODE=S013A12;LINKAGE=AB

[3] LAI 03C also measured $\tilde{g}_{M1} = 0.99^{+0.28}_{-0.27} \pm 0.07$. NODE=S013A12;LINKAGE=LA

[4] ALAVI-HARATI 01B fit gives $\chi^2/\text{DOF} = 38.8/27$. Linear and quadratic fits give $\chi^2/\text{DOF} = 43.2/27$ and $37.6/26$ respectively. NODE=S013A12;LINKAGE=AH

[5] ALAVI-HARATI 00B also measured $|\tilde{g}_{M1}| = 1.35^{+0.20}_{-0.17} \pm 0.04$. NODE=S013A12;LINKAGE=AL

$\overline{f}_S$ DECAY FORM FACTOR FOR $K^0_L \to \pi^\pm \pi^0 e^\mp \nu_e$

NODE=S013FSB
NODE=S013FSB

VALUE	DOCUMENT ID		TECN
0.049±0.011 OUR AVERAGE	Error includes scale factor of 1.7.		
0.052±0.006±0.002	BATLEY	04	NA48
0.010±0.016±0.017	MAKOFF	93	E731

$\overline{f}_P$ DECAY FORM FACTOR FOR $K^0_L \to \pi^\pm \pi^0 e^\mp \nu_e$

NODE=S013FPB
NODE=S013FPB

VALUE	DOCUMENT ID		TECN
−0.052±0.012 OUR AVERAGE			
−0.051±0.011±0.005	BATLEY	04	NA48
−0.079±0.049±0.022	MAKOFF	93	E731

λ_g DECAY FORM FACTOR FOR $K^0_L \to \pi^\pm \pi^0 e^\mp \nu_e$

NODE=S013LMG
NODE=S013LMG

VALUE	DOCUMENT ID		TECN
0.085±0.020 OUR AVERAGE			
0.087±0.019±0.006	BATLEY	04	NA48
0.014±0.087±0.070	MAKOFF	93	E731

$\overline{h}$ DECAY FORM FACTOR FOR $K^0_L \to \pi^\pm \pi^0 e^\mp \nu_e$

NODE=S013HB
NODE=S013HB

VALUE	DOCUMENT ID		TECN
−0.30±0.13 OUR AVERAGE			
−0.32±0.12±0.07	BATLEY	04	NA48
−0.07±0.31±0.31	MAKOFF	93	E731

L_3 CHIRAL PERT. THEO. PARAM. FOR $K^0_L \to \pi^\pm \pi^0 e^\mp \nu_e$

NODE=S013L3
NODE=S013L3

VALUE (units 10^{-3})	DOCUMENT ID		TECN
−3.96±0.28 OUR AVERAGE	Error includes scale factor of 1.6.		
−4.1 ±0.2	BATLEY	04	NA48
−3.4 ±0.4	[1] MAKOFF	93	E731

[1] MAKOFF 93 sign has been changed to negative to agree with the sign convention used in BATLEY 04. NODE=S013L3;LINKAGE=MA

a_V, VECTOR MESON EXCHANGE CONTRIBUTION

NODE=S013AV
NODE=S013AV

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
−0.43±0.06 OUR AVERAGE		Error includes scale factor of 1.5.			
−0.31±0.05±0.07	1.4k	[1] ABOUZAID	08	KTEV	
−0.46±0.03±0.04		LAI	02B	NA48	$K^0_L \to \pi^0 2\gamma$
−0.67±0.21±0.12		ALAVI-HARATI	01E	KTEV	$K^0_L \to \pi^0 e^+ e^- \gamma$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
−0.72±0.05±0.06		[2] ALAVI-HARATI	99B	KTEV	$K^0_L \to \pi^0 2\gamma$

[1] Using KTeV dataset collected in 1996, 1997, and 1999. NODE=S013AV;LINKAGE=AB
[2] Superseded by ABOUZAID 08. NODE=S013AV;LINKAGE=AL

See the related review(s):

CP Violation in K^0_L Decays

CP-VIOLATION PARAMETERS IN K^0_L DECAYS

NODE=S013245

——— CHARGE ASYMMETRY IN $K^0_{\ell 3}$ DECAYS ———

NODE=S013310

Such asymmetry violates *CP*. It is related to Re(ϵ).

NODE=S013310

A_L = weighted average of $A_L(\mu)$ and $A_L(e)$

NODE=S013AL

In previous editions and in the literature the symbol used for this asymmetry was δ_L or δ. We use A_L for consistency with B^0 asymmetry notation and with recent K^0_S notation.

NODE=S013AL

NODE=S013AL

VALUE (%)	EVTS	DOCUMENT ID		TECN	COMMENT
0.332±0.006 OUR AVERAGE		Includes data from the 2 datablocks that follow this one.			
0.333±0.050	33M	WILLIAMS	73	ASPK	$K_{\mu 3} + K_{e3}$

$A_L(\mu) = [\Gamma(\pi^- \mu^+ \nu_\mu) - \Gamma(\pi^+ \mu^- \overline{\nu}_\mu)]$/SUM

NODE=S013A1

Only the combined value below is put into the Meson Summary Table.

NODE=S013A1
NODE=S013A1

The data in this block is included in the average printed for a previous datablock.

VALUE (%)	EVTS	DOCUMENT ID		TECN
0.304±0.025 OUR AVERAGE				
0.313±0.029	15M	GEWENIGER	74	ASPK
0.278±0.051	7.7M	PICCIONI	72	ASPK
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.60 ±0.14	4.1M	MCCARTHY	73	CNTR
0.57 ±0.17	1M	[1] PACIOTTI	69	OSPK
0.403±0.134	1M	[1] DORFAN	67	OSPK

[1] PACIOTTI 69 is a reanalysis of DORFAN 67 and is corrected for $\mu^+ \mu^-$ range difference in MCCARTHY 72.

NODE=S013A1;LINKAGE=D

$A_L(e) = [\Gamma(\pi^- e^+ \nu_e) - \Gamma(\pi^+ e^- \overline{\nu}_e)]$/SUM

NODE=S013A2

Only the combined value below is put into the Meson Summary Table.

NODE=S013A2
NODE=S013A2

The data in this block is included in the average printed for a previous datablock.

VALUE (%)	EVTS	DOCUMENT ID		TECN
0.334 ±0.007 OUR AVERAGE				
0.3322±0.0058±0.0047	298M	ALAVI-HARATI	02	
0.341 ±0.018	34M	GEWENIGER	74	ASPK
0.318 ±0.038	40M	FITCH	73	ASPK
0.346 ±0.033	10M	MARX	70	CNTR
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.36 ±0.18	600k	ASHFORD	72	ASPK
0.246 ±0.059	10M	[1] SAAL	69	CNTR
0.224 ±0.036	10M	[1] BENNETT	67	CNTR

[1] SAAL 69 is a reanalysis of BENNETT 67.

NODE=S013A2;LINKAGE=B

PARAMETERS FOR $K^0_L \rightarrow 2\pi$ DECAY

NODE=S013315

η_{+-} = A($K^0_L \rightarrow \pi^+\pi^-$) / A($K^0_S \rightarrow \pi^+\pi^-$)
η_{00} = A($K^0_L \rightarrow \pi^0\pi^0$) / A($K^0_S \rightarrow \pi^0\pi^0$)

NODE=S013315

The fitted values of $|\eta_{+-}|$ and $|\eta_{00}|$ given below are the results of a fit to $|\eta_{+-}|$, $|\eta_{00}|$, $|\eta_{00}/\eta_{+-}|$, and Re(ϵ'/ϵ). Independent information on $|\eta_{+-}|$ and $|\eta_{00}|$ can be obtained from the fitted values of the $K^0_L \rightarrow \pi\pi$ and $K^0_S \rightarrow \pi\pi$ branching ratios and the K^0_L and K^0_S lifetimes. This information is included as data in the $|\eta_{+-}|$ and $|\eta_{00}|$ sections with a Document ID "BRFIT." See the note "*CP* violation in K_L decays" above for details.

$|\eta_{00}| = |A(K^0_L \rightarrow 2\pi^0) / A(K^0_S \rightarrow 2\pi^0)|$

NODE=S013E00
NODE=S013E00

VALUE (units 10^{-3})	DOCUMENT ID		TECN	COMMENT
2.222±0.012 OUR FIT Error includes scale factor of 1.7. [$(2.220 \pm 0.011) \times 10^{-3}$ OUR 2025 FIT Scale factor = 1.8]				
2.243±0.014	BRFIT	16		
• • • We do not use the following data for averages, fits, limits, etc. • • •				
2.47 ±0.31 ±0.24	ANGELOPO...	98	CPLR	
2.49 ±0.40	[1] ADLER	96B	CPLR	Sup. by ANGELOPOULOS 98
2.33 ±0.18	CHRISTENS...	79	ASPK	
2.71 ±0.37	[2] WOLFF	71	OSPK	Cu reg., 4γ's
2.95 ±0.63	[2] CHOLLET	70	OSPK	Cu reg., 4γ's

NEW

[1] Error is statistical only.

NODE=S013E00;LINKAGE=X

[2] CHOLLET 70 gives $|\eta_{00}|$ = (1.23 ± 0.24)×(regeneration amplitude, 2 GeV/c Cu)/10000mb. WOLFF 71 gives $|\eta_{00}|$ = (1.13 ± 0.12)×(regeneration amplitude, 2 GeV/c Cu)/10000mb. We compute both $|\eta_{00}|$ values for (regeneration amplitude, 2 GeV/c Cu) = 24 ± 2mb. This regeneration amplitude results from averaging over FAISSNER 69, extrapolated using optical-model calculations of Bohm et al., Physics Letters **27B** 594 (1968) and the data of BALATS 71. (From H. Faissner, private communication).

NODE=S013E00;LINKAGE=C

$|\eta_{+-}| = |A(K^0_L \to \pi^+\pi^-) / A(K^0_S \to \pi^+\pi^-)|$ NODE=S013E+-

NODE=S013E+-

VALUE (units 10^{-3})	EVTS	DOCUMENT ID	TECN	COMMENT
2.233±0.012 OUR FIT Error includes scale factor of 1.7. [$(2.232 \pm 0.011) \times 10^{-3}$ OUR 2025 FIT Scale factor = 1.8]				
2.226±0.008 OUR AVERAGE [$(2.226 \pm 0.007) \times 10^{-3}$ OUR 2025 AVERAGE]				
2.226±0.008		BRFIT	16	
• • • We do not use the following data for averages, fits, limits, etc. • • •				
2.223±0.012		[1] LAI	07	NA48
2.219±0.013		[2] AMBROSINO	06F	KLOE
2.228±0.010		[3] ALEXOPOU...	04	KTEV
2.286±0.023±0.026	70M	[4] APOSTOLA...	99C	CPLR K^0-$\overline{K}^0$ asymmetry
2.310±0.043±0.031		[5] ADLER	95B	CPLR K^0-$\overline{K}^0$ asymmetry
2.32 ±0.14 ±0.03	10^5	ADLER	92B	CPLR K^0-$\overline{K}^0$ asymmetry
2.30 ±0.035		GEWENIGER	74B	ASPK

NEW

NEW

[1] Value obtained from the NA48 measurements of $\Gamma(K^0_L \to \pi^+\pi^-)/\Gamma(K^0_L \to \pi e \nu_e)$ and $\tau_{K^0_S}$ and KLOE measurements of $B(K^0_S \to \pi^+\pi^-)$ and $\tau_{K^0_L}$. $\Gamma(K^0_L \to \pi^+\pi^-)$ is defined to include the inner bremsstrahlung component $\Gamma(K^0_L \to \pi^+\pi^-\gamma(\text{IB}))$ but exclude the direct emission component $B(K^0_S \to \pi^+\pi^-(\text{DE}))$. Their $|\eta_{+-}|$ value is not directly used in our fit, but enters the fit via their branching ratio and lifetime measurements. NODE=S013E+-;LINKAGE=LA

[2] AMBROSINO 06F uses KLOE branching ratios and τ_L together with τ_S from PDG 04. Their $|\eta_{+-}|$ value is not directly used in our fit, but enters the fit via their branching ratio and lifetime measurements. NODE=S013E+-;LINKAGE=AM

[3] ALEXOPOULOS 04 $|\eta_{+-}|$ uses their $K^0_L \to \pi\pi$ branching fractions, $\tau_S = (0.8963 \pm 0.0005) \times 10^{-10}$ s from the average of KTeV and NA48 τ_S measurements, and assumes that $\Gamma(K^0_S \to \pi \ell \nu_\ell) = \Gamma(K^0_L \to \pi \ell \nu_\ell)$ giving $B(K^0_S \to \pi \ell \nu_\ell) = 0.118\%$. Their η_{+-} is not directly used in our fit, but enters our fit via their branching ratio measurements. NODE=S013E+-;LINKAGE=AL

[4] APOSTOLAKIS 99C report $(2.264 \pm 0.023 \pm 0.026 + 9.1[\tau_S - 0.8934]) \times 10^{-3}$. We evaluate for our 2006 best value $\tau_S = (0.8958 \pm 0.0005) \times 10^{-10}$ s. NODE=S013E+-;LINKAGE=VA

[5] ADLER 95B report $(2.312 \pm 0.043 \pm 0.030 - 1[\Delta m - 0.5274] + 9.1[\tau_S - 0.8926]) \times 10^{-3}$. We evaluate for our 1996 best values $\Delta m = (0.5304 \pm 0.0014) \times 10^{-10}\ \hbar s^{-1}$ and $\tau_S = (0.8927 \pm 0.0009) \times 10^{-10}$ s. Superseded by APOSTOLAKIS 99C. NODE=S013E+-;LINKAGE=D

$|\epsilon| = (2|\eta_{+-}| + |\eta_{00}|)/3$ NODE=S013EP

This expression is a very good approximation, good to about one part in 10^{-4} because of the small measured value of $\phi_{00} - \phi_{+-}$ and small theoretical ambiguities. NODE=S013EP

NODE=S013EP

VALUE (units 10^{-3})	DOCUMENT ID
2.229±0.012 OUR FIT Error includes scale factor of 1.7. [$(2.228 \pm 0.011) \times 10^{-3}$ OUR 2025 FIT Scale factor = 1.8]	

NEW

$|\eta_{00}/\eta_{+-}|$ NODE=S013ER

NODE=S013ER

VALUE	EVTS	DOCUMENT ID	TECN
0.9950±0.0007 OUR FIT Error includes scale factor of 1.6.			
0.9930±0.0020 OUR AVERAGE			
0.9931±0.0020		[1,2] BARR 93D	NA31
0.9904±0.0084±0.0036		[3] WOODS 88	E731
• • • We do not use the following data for averages, fits, limits, etc. • • •			
0.9939±0.0013±0.0015	1M	[1] BARR 93D	NA31
0.9899±0.0020±0.0025		[1] BURKHARDT 88	NA31

OCCUR=2

[1] This is the square root of the ratio R given by BURKHARDT 88 and BARR 93D. NODE=S013ER;LINKAGE=A

[2] This is the combined results from BARR 93D and BURKHARDT 88, taking into account a common systematic uncertainty of 0.0014. NODE=S013ER;LINKAGE=E

[3] We calculate $|\eta_{00}/\eta_{+-}| = 1-3(\epsilon'/\epsilon)$ from WOODS 88 (ϵ'/ϵ) value. NODE=S013ER;LINKAGE=B

$\text{Re}(\epsilon'/\epsilon) = (1-|\eta_{00}/\eta_{+-}|)/3$ NODE=S013EPS

We have neglected terms of order $\omega \cdot \text{Re}(\epsilon'/\epsilon)$, where $\omega = \text{Re}(A_2)/\text{Re}(A_0) \simeq 1/22$. If included, this correction would lower $\text{Re}(\epsilon'/\epsilon)$ by about 0.04×10^{-3}. See SOZZI 04. NODE=S013EPS

NODE=S013EPS

VALUE (units 10^{-3})	DOCUMENT ID	TECN	COMMENT
1.67 ±0.23 OUR FIT Error includes scale factor of 1.6. [$(1.66 \pm 0.23) \times 10^{-3}$ OUR 2025 FIT Scale factor = 1.6]			
1.68 ±0.20 OUR AVERAGE Error includes scale factor of 1.4. See the ideogram below.			
1.92 ±0.21	[1] ABOUZAID 11	KTEV	Assuming *CPT*
1.47 ±0.22	BATLEY 02	NA48	
0.74 ±0.52 ±0.29	GIBBONS 93B	E731	
• • • We use the following data for averages but not for fits. • • •			
2.3 ±0.65	[2,3] BARR 93D	NA31	

NEW

OCCUR=2

OCCUR=2;NOTFITTED

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

2.110±0.343		[1,4] ABOUZAID	11	KTEV	Not assuming *CPT*	TYPE=noCPT
2.07 ±0.28		ALAVI-HARATI	03	KTEV	In ABOUZAID 11	
1.53 ±0.26		LAI	01C	NA48	Incl. in BATLEY 02	
2.80 ±0.30	±0.28	ALAVI-HARATI	99D	KTEV	In ALAVI-HARATI 03	OCCUR=2
1.85 ±0.45	±0.58	FANTI	99C	NA48	In LAI 01C	
2.0 ±0.7		[5] BARR	93D	NA31		
−0.4 ±1.4	±0.6	PATTERSON	90	E731	in GIBBONS 93B	
3.3 ±1.1		[5] BURKHARDT	88	NA31		
3.2 ±2.8	±1.2	[2] WOODS	88	E731		NOTFITTED

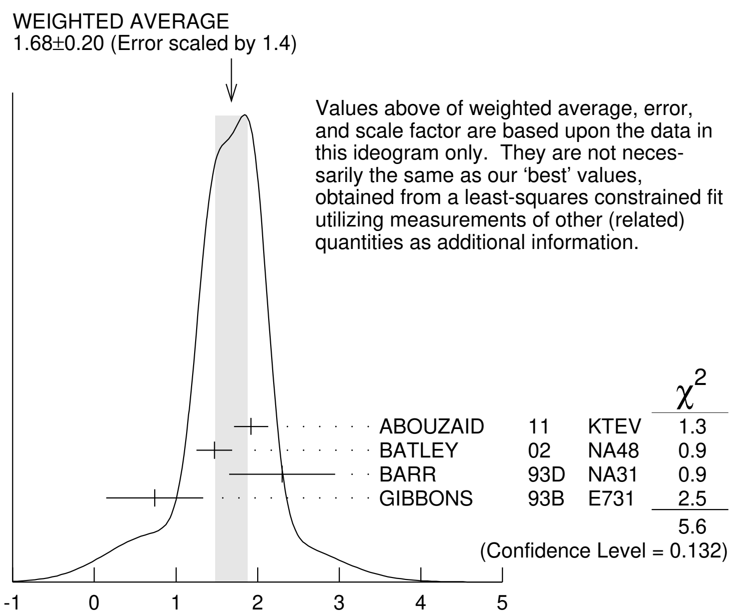
[1] The two ABOUZAID 11 values use the same data. The fits are performed with and without *CPT* invariance requirement. NODE=S013EPS;LINKAGE=AB

[2] These values are derived from $|\eta_{00}/\eta_{+-}|$ measurements. They enter the average in this section but enter the fit via the $|\eta_{00}/\eta_{+-}|$ only. NODE=S013EPS;LINKAGE=A

[3] This is the combined results from BARR 93D and BURKHARDT 88, taking into account their common systematic uncertainty. NODE=S013EPS;LINKAGE=E

[4] We use ABOUZAID 11 Re(ϵ'/ϵ) value with *CPT* assumption in our fits for $|\eta_{+-}|$, $|\eta_{00}|$, and Re(ϵ'/ϵ). NODE=S013EPS;LINKAGE=AU

[5] These values are derived from $|\eta_{00}/\eta_{+-}|$ measurements. NODE=S013EPS;LINKAGE=AO



Re(ϵ'/ϵ) = $(1-|\eta_{00}/\eta_{+-}|)/3$

ϕ_{+-}, PHASE of η_{+-}

NODE=S013F+-

The dependence of the phase on Δm and τ_S is given for each experiment in the comments below, where Δm is the K^0_L − K^0_S mass difference in units 10^{10} $\hbar s^{-1}$ and τ_S is the K_S mean life in units 10^{-10} s. We also give the regeneration phase ϕ_f in the comments below. NODE=S013F+-

OUR FIT is described in the note on "*CP* violation in K_L decays" in the K^0_L Particle Listings. Most experiments in this section are included in both the "Not Assuming *CPT*" and "Assuming *CPT*" fits. In the latter fit, they have little direct influence on ϕ_{+-} because their errors are large compared to that assuming *CPT*, but they influence Δm and τ_S through their dependencies on these parameters, which are given in the footnotes.

VALUE (°)		*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*	
43.51±0.05 OUR FIT			Error includes scale factor of 1.2. Assuming *CPT*				NODE=S013F+-
43.4 ±0.5 OUR FIT			Error includes scale factor of 1.2. Not assuming *CPT*				
42.9 ±0.6	±0.3	70M	[1] APOSTOLA...	99C	CPLR	K^0-$\overline{K}^0$ asymmetry	
42.9 ±0.8	±0.2		[2,3] SCHWINGEN...	95	E773	$CH_{1.1}$ regenerator	
41.4 ±0.9	±0.2		[3,4] GIBBONS	93	E731	B_4C regenerator	
44.5 ±1.6	±0.5		[5] CAROSI	90	NA31	Vacuum regen.	
43.3 ±1.0	±0.5		[6] GEWENIGER	74B	ASPK	Vacuum regen.	

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

43.76±0.64		[7] ABOUZAID	11	KTEV	Not assuming *CPT*	TYPE=noCPT
44.12±0.72±1.20		[8] ALAVI-HARATI	03	KTEV	Not assuming *CPT*	TYPE=noCPT
42.5 ±0.4 ±0.3		[9,10] ADLER	96C	RVUE		
43.4 ±1.1 ±0.3		[11] ADLER	95B	CPLR	K^0-$\overline{K}^0$ asymmetry	
42.3 ±4.4 ±1.4	100k	[12] ADLER	92B	CPLR	K^0-$\overline{K}^0$ asymmetry	
47.7 ±2.0 ±0.9		[3,13] KARLSSON	90	E731		
44.3 ±2.8 ±0.2		[14] CARITHERS	75	SPEC	C regenerator	

[1] APOSTOLAKIS 99C measures ϕ_{+-} = (43.19 ± 0.53 ± 0.28) + 300 [$\Delta m -$ 0.5301] (°). We have adjusted the measurement to use our best values of (Δm = 0.5293 ± 0.0009) (10^{10} $\hbar$ s^{-1}). Our first error is their experiment's error and our second error is the systematic error from using our best values. NODE=S013F+-;LINKAGE=FG

[2] SCHWINGENHEUER 95 measures ϕ_{+-} = (43.53 ± 0.76) + 173 [$\Delta m -$ 0.5282] − 275 [$\tau_s -$ 0.8926] (°). We have adjusted the measurement to use our best values of (Δm = 0.5293 ± 0.0009) (10^{10} $\hbar$ s^{-1}), (τ_s = 0.8954 ± 0.0004) (10^{-10} s). Our first error is their experiment's error and our second error is the systematic error from using our best values. NODE=S013F+-;LINKAGE=S1

[3] These experiments measure ϕ_{+-}–ϕ_f and calculate the regeneration phase from the power law momentum dependence of the regeneration amplitude using analyticity and dispersion relations. SCHWINGENHEUER 95 [GIBBONS 93] includes a systematic error of 0.35° [0.5°] for uncertainties in their modeling of the regeneration amplitude. NODE=S013F+-;LINKAGE=S2

[4] GIBBONS 93 measures ϕ_{+-} = (42.21 ± 0.9) + 189 [$\Delta m -$ 0.5257] − 460 [$\tau_s -$ 0.8922] (°). We have adjusted the measurement to use our best values of (Δm = 0.5293 ± 0.0009) (10^{10} $\hbar$ s^{-1}), (τ_s = 0.8954 ± 0.0004) (10^{-10} s). Our first error is their experiment's error and our second error is the systematic error from using our best values. This is actually reported in SCHWINGENHEUER 95, footnote 8. GIBBONS 93 reports ϕ_{+-} (42.2 ± 1.4)°. They measure ϕ_{+}–ϕ_f and calculate the regeneration phase ϕ_f from the power law momentum dependence of the regeneration amplitude using analyticity. An error of 0.6° is included for possible uncertainties in the regeneration phase. NODE=S013F+-;LINKAGE=GF

[5] CAROSI 90 measures ϕ_{+-} = (46.9 ± 1.4 ± 0.7) + 579 [$\Delta m -$ 0.5351] + 303 [$\tau_s -$ 0.8922] (°). We have adjusted the measurement to use our best values of (Δm = 0.5293 ± 0.0009) (10^{10} $\hbar$ s^{-1}), (τ_s = 0.8954 ± 0.0004) (10^{-10} s). Our first error is their experiment's error and our second error is the systematic error from using our best values. NODE=S013F+-;LINKAGE=I

[6] GEWENIGER 74B measures ϕ_{+-} = (49.4 ± 1.0) + 565 [$\Delta m -$ 0.540] (°). We have adjusted the measurement to use our best values of (Δm = 0.5293 ± 0.0009) (10^{10} $\hbar$ s^{-1}). Our first error is their experiment's error and our second error is the systematic error from using our best values. NODE=S013F+-;LINKAGE=G

[7] Not independent of other phase parameters reported in ABOUZAID 11. NODE=S013F+-;LINKAGE=AB

[8] ALAVI-HARATI 03 ϕ_{+-} is correlated with their $\Delta m = m_{K^0_L} - m_{K^0_S}$ and τ_{K_S} measurements in the K^0_L and K^0_S sections respectively. The correlation coefficients are $\rho(\phi_{+-},\Delta m)$=+0.955, $\rho(\phi_{+-},\tau_S)$=−0.871, and $\rho(\tau_S,\Delta m)$=−0.840. *CPT* is not assumed. Uses scintillator Pb regenerator. Superseded by ABOUZAID 11. NODE=S013F+-;LINKAGE=KF

[9] ADLER 96C measures ϕ_{+-} = (43.82 ± 0.41) + 339 [$\Delta m -$ 0.5307] − 252 [$\tau_s -$ 0.8922] (°). We have adjusted the measurement to use our best values of (Δm = 0.5293 ± 0.0009) (10^{10} $\hbar$ s^{-1}), (τ_s = 0.8954 ± 0.0004) (10^{-10} s). Our first error is their experiment's error and our second error is the systematic error from using our best values. NODE=S013F+-;LINKAGE=R

[10] ADLER 96C is the result of a fit which includes nearly the same data as entered into the "OUR FIT" value in the 1996 edition of this Review (Physical Review **D54** 1 (1996)). NODE=S013F+-;LINKAGE=Y1

[11] ADLER 95B measures ϕ_{+-} = (42.7 ± 0.9 ± 0.6) + 316 [$\Delta m -$ 0.5274] + 30 [$\tau_s -$ 0.8926] (°). We have adjusted the measurement to use our best values of (Δm = 0.5293 ± 0.0009) (10^{10} $\hbar$ s^{-1}), (τ_s = 0.8954 ± 0.0004) (10^{-10} s). Our first error is their experiment's error and our second error is the systematic error from using our best values. NODE=S013F+-;LINKAGE=DD

[12] ADLER 92B quote separately two systematic errors: ±0.4 from their experiment and ±1.0 degrees due to the uncertainty in the value of Δm. NODE=S013F+-;LINKAGE=M

[13] KARLSSON 90 systematic error does not include regeneration phase uncertainty. NODE=S013F+-;LINKAGE=Q

[14] CARITHERS 75 measures ϕ_{+-} = (45.5 ± 2.8) + 224 [$\Delta m -$ 0.5348] (°). We have adjusted the measurement to use our best values of (Δm = 0.5293 ± 0.0009) (10^{10} $\hbar$ s^{-1}). Our first error is their experiment's error and our second error is the systematic error from using our best values. ϕ_f = −40.9 ± 2.6°. NODE=S013F+-;LINKAGE=H

ϕ_{00}, PHASE OF η_{00}

NODE=S013FOO

See comment in ϕ_{+-} header above for treatment of Δm and τ_s dependence, as well as for the inclusion of data in both the "Assuming *CPT*" and "Not Assuming *CPT*" fits.

NODE=S013FOO

OUR FIT is described in the note on "*CP* violation in K_L decays" in the K_L^0 Particle Listings.

NODE=S013FOO

VALUE (°)	*DOCUMENT ID*		*TECN*	*COMMENT*	
43.52±0.05 OUR FIT	Error includes scale factor of 1.2.			Assuming *CPT*	
43.7 ±0.6 OUR FIT	Error includes scale factor of 1.2.			Not assuming *CPT*	
44.5 ±2.3 ±0.5	[1] CAROSI	90	NA31		
• • • We do not use the following data for averages, fits, limits, etc. • • •					
44.06±0.68	[2] ABOUZAID	11	KTEV	Not assuming *CPT*	TYPE=noCPT
41.7 ±5.9 ±0.2	[3] ANGELOPO...	98	CPLR		
50.8 ±7.1 ±1.7	[4] ADLER	96B	CPLR	Sup. by ANGELOPOULOS 98	
47.4 ±1.4 ±0.9	[5] KARLSSON	90	E731		

[1] CAROSI 90 measures ϕ_{00} = (47.1 ± 2.1 ± 1.0) + 579 [Δm − 0.5351] + 252 [τ_s − 0.8922] (°). We have adjusted the measurement to use our best values of (Δm = 0.5293 ± 0.0009) (10^{10} $\hbar$ s^{-1}), (τ_s = 0.8954 ± 0.0004) (10^{-10} s). Our first error is their experiment's error and our second error is the systematic error from using our best values. NODE=S013FOO;LINKAGE=I

[2] Not independent of other phase parameters reported in ABOUZAID 11. NODE=S013FOO;LINKAGE=AB

[3] ANGELOPOULOS 98 measures ϕ_{00} = (42.0 ± 5.6 ± 1.9) + 240 [Δm − 0.5307] (°). We have adjusted the measurement to use our best values of (Δm = 0.5293 ± 0.0009) (10^{10} $\hbar$ s^{-1}). Our first error is their experiment's error and our second error is the systematic error from using our best values. The τ_s dependence is negligible. NODE=S013FOO;LINKAGE=K1

[4] ADLER 96B identified initial neutral kaon individually as being a K^0 or a $\overline{K}^0$. The systematic uncertainty is ±1.5° combined in quadrature with ±0.8° due to Δm. NODE=S013FOO;LINKAGE=A

[5] KARLSSON 90 systematic error does not include regeneration phase uncertainty. NODE=S013FOO;LINKAGE=Q

$\phi_\epsilon = (2\phi_{+-} + \phi_{00})/3$

NODE=S013EPH

This expression is a very good approximation, good to about 10^{-3} degrees because of the small measured values of $\phi_{00} - \phi_{+-}$ and Re ϵ'/ϵ, and small theoretical ambiguities.

NODE=S013EPH

NODE=S013EPH

VALUE (°)	*DOCUMENT ID*		*TECN*	*COMMENT*	
43.52 ±0.04 OUR FIT	Error includes scale factor of 1.2.			Assuming *CPT*	
43.5 ±0.5 OUR FIT	Error includes scale factor of 1.3.			Not assuming *CPT*	
43.5164±0.0002±0.0509	[1] SUPERWEAK	16		Assuming *CPT*	TYPE=CPT
43.86 ±0.63	[2] ABOUZAID	11	KTEV	Not assuming *CPT*	TYPE=noCPT

[1] SUPERWEAK 16 is a fake measurement used to impose the *CPT* or Superweak constraint $\phi_{+-} = \phi_{SW} = \tan^{-1}[2 \frac{\Delta m}{\hbar} (\frac{\tau_S \tau_L}{\tau_L - \tau_S})]$. This "measurement" is linearized using values near the PDG 04 edition values of Δm, τ_S and τ_L, and then adjusted to our current values as described in the following "measurement". SUPERWEAK 16 measures ϕ_ϵ = (43.50258 ± 0.00021) + 54.1 [Δm − 0.5289] + 32.0 [τ_s − 0.89564] (°). We have adjusted the measurement to use our best values of (Δm = 0.5293 ± 0.0009) (10^{10} $\hbar$ s^{-1}), (τ_s = 0.8954 ± 0.0004) (10^{-10} s). Our first error is their experiment's error and our second error is the systematic error from using our best values. NODE=S013EPH;LINKAGE=SW

[2] ABOUZAID 11 uses the full KTeV dataset collected in 1996, 1997, and 1999. See Im(ϵ'/ϵ) section for correlation information. NODE=S013EPH;LINKAGE=AB

$\mathrm{Im}(\epsilon'/\epsilon) = -(\phi_{00} - \phi_{+-})/3$

NODE=S013EPI

For small $|\epsilon'/\epsilon|$, Im(ϵ'/ϵ) is related to the phases of η_{00} and η_{+-} by the above expression.

NODE=S013EPI

NODE=S013EPI

VALUE (°)	*DOCUMENT ID*		*TECN*	*COMMENT*	
−0.002 ±0.005 OUR FIT	Error includes scale factor of 1.7.			Assuming *CPT*	
−0.11 ±0.11 OUR FIT				Not assuming *CPT*	
−0.0985±0.1157	[1] ABOUZAID	11	KTEV	Not assuming *CPT*	TYPE=noCPT

[1] ABOUZAID 11 uses the full KTeV dataset collected in 1996, 1997, and 1999. The fit has Δm, τ_s, ϕ_ϵ, Re(ϵ'/ϵ), and Im(ϵ'/ϵ) as free parameters. The reported value of Im(ϵ'/ϵ) = (−17.20 ± 20.20) × 10^{-4} rad. The correlation coefficients are $\rho(\phi_\epsilon, \Delta m)$ = 0.828, $\rho(\phi_\epsilon, \tau_s)$ = −0.765, $\rho(\Delta m, \tau_s)$ = −0.858, $\rho(\mathrm{Im}(\epsilon'/\epsilon), \phi_\epsilon)$ = −0.041, $\rho(\mathrm{Im}(\epsilon'/\epsilon), \Delta m)$ = 0.026, $\rho(\mathrm{Im}(\epsilon'/\epsilon), \tau_s)$ = −0.010. NODE=S013EPI;LINKAGE=AB

DECAY-PLANE ASYMMETRY IN $\pi^+\pi^-e^+e^-$ DECAYS

NODE=S013303

This is the *CP*-violating asymmetry

NODE=S013303

$$A= \frac{N_{\sin\phi\cos\phi>0.0} - N_{\sin\phi\cos\phi<0.0}}{N_{\sin\phi\cos\phi>0.0} + N_{\sin\phi\cos\phi<0.0}}$$

where ϕ is the angle between the e^+e^- and $\pi^+\pi^-$ planes in the K_L^0 rest frame.

CP ASYMMETRY *A* in $K_L^0 \to \pi^+\pi^-e^+e^-$

NODE=S013DPA
NODE=S013DPA

VALUE (%)	DOCUMENT ID		TECN
13.7±1.5 OUR AVERAGE			
13.6±1.4±1.5	ABOUZAID	06	KTEV
14.2±3.0±1.9	LAI	03C	NA48
13.6±2.5±1.2	ALAVI-HARATI	00B	KTEV

PARAMETERS FOR $e^+e^-e^+e^-$ DECAYS

NODE=S013304

These are the *CP*-violating parameters in the ϕ distribution, where ϕ is the angle between the planes of the two e^+e^- pairs in the kaon rest frame:

NODE=S013304

$$d\Gamma/d\phi \propto 1 + \beta_{CP}\cos(2\phi) + \gamma_{CP}\sin(2\phi)$$

where $\beta_{CP} = -0.20$ and $\gamma_{CP} = 0$ values correspond to no *CP* violation.

β_{CP} from $K_L^0 \to e^+e^-e^+e^-$

NODE=S013BCP
NODE=S013BCP

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
−0.19±0.07 OUR AVERAGE					
−0.13±0.10±0.03	200	[1] LAI	05B	NA48	
−0.23±0.09±0.02	441	ALAVI-HARATI	01D	KTEV	$M_{ee} > 8$ MeV/c^2

[1] LAI 05B obtains $\beta_{CP} = -0.13 \pm 0.10$ (stat) if $\gamma_{CP} = 0$ is assumed.

NODE=S013BCP;LINKAGE=LA

γ_{CP} from $K_L^0 \to e^+e^-e^+e^-$

NODE=S013GCP
NODE=S013GCP

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.01±0.11 OUR AVERAGE	Error includes scale factor of 1.6.				
+0.13±0.10±0.03	200	LAI	05B	NA48	
−0.09±0.09±0.02	441	ALAVI-HARATI	01D	KTEV	$M_{ee} > 8$ MeV/c^2

CHARGE ASYMMETRY IN $\pi^+\pi^-\pi^0$ DECAYS

NODE=S013305

These are *CP*-violating charge-asymmetry parameters, defined at beginning of section "LINEAR COEFFICIENT *g* FOR $K_L^0 \to \pi^+\pi^-\pi^0$ above. See also note on Dalitz plot parameters in $K^\pm$ section and note on "*CP* violation in K_L decays" above.

NODE=S013305

LINEAR COEFFICIENT *j* FOR $K_L^0 \to \pi^+\pi^-\pi^0$

NODE=S013JT0
NODE=S013JT0

VALUE	EVTS	DOCUMENT ID		TECN
0.0012±0.0008 OUR AVERAGE				
0.0010±0.0024±0.0030	500k	ANGELOPO...	98C	CPLR
−0.001 ±0.011	6499	CHO	77	
0.001 ±0.003	4709	PEACH	77	
0.0013±0.0009	3M	SCRIBANO	70	
0.0 ±0.017	4400	SMITH	70	OSPK
0.001 ±0.004	238k	BLANPIED	68	

QUADRATIC COEFFICIENT *f* FOR $K_L^0 \to \pi^+\pi^-\pi^0$

NODE=S013FT0
NODE=S013FT0

VALUE	EVTS	DOCUMENT ID		TECN
0.0045±0.0024±0.0059	500k	ANGELOPO...	98C	CPLR

PARAMETERS for $K_L^0 \to \pi^+\pi^-\gamma$ DECAY

NODE=S013307

$|\eta_{+-\gamma}| = |A(K_L^0 \to \pi^+\pi^-\gamma$, *CP* violating$)/A(K_S^0 \to \pi^+\pi^-\gamma)|$

NODE=S013E+G
NODE=S013E+G

VALUE (units 10^{-3})	EVTS	DOCUMENT ID		TECN
2.35 ±0.07 OUR AVERAGE				
2.359±0.062±0.040	9045	MATTHEWS	95	E773
2.15 ±0.26 ±0.20	3671	RAMBERG	93B	E731

$\phi_{+-\gamma}$ = phase of $\eta_{+-\gamma}$

NODE=S013P+G
NODE=S013P+G

VALUE (°)	EVTS	DOCUMENT ID		TECN
44 ± 4 OUR AVERAGE				
43.8± 3.5± 1.9	9045	MATTHEWS	95	E773
72 ±23 ±17	3671	RAMBERG	93B	E731

$|\epsilon'_{+-\gamma}|/\epsilon$ for $K^0_L \to \pi^+\pi^-\gamma$

NODE=S013EPG
NODE=S013EPG

VALUE	CL%	EVTS	DOCUMENT ID		TECN
<0.3	90	3671	[1] RAMBERG	93B	E731

[1] RAMBERG 93B limit on $|\epsilon'_{+-\gamma}|/\epsilon$ assumes than any difference between η_{+-} and $\eta_{+-\gamma}$ is due to direct *CP* violation. NODE=S013EPG;LINKAGE=A

$|g_{E1}|$ for $K^0_L \to \pi^+\pi^-\gamma$

NODE=S013GE1

This parameter is the amplitude of the direct emission of a *CP* violating E1 electric dipole photon. NODE=S013GE1

NODE=S013GE1

VALUE	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
<0.21	90	111k	ABOUZAID	06A	KTEV	$E^*_\gamma > 20$ MeV

T VIOLATION TESTS IN K^0_L DECAYS

NODE=S013280

Im(ξ) in $K^0_{\mu 3}$ DECAY (from transverse μ pol.)

NODE=S013IXI

Test of *T* reversal invariance. NODE=S013IXI

NODE=S013IXI

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
−0.007±0.026 OUR AVERAGE					
0.009±0.030	12M	MORSE	80	CNTR	Polarization
0.35 ±0.30	207k	[1] CLARK	77	SPEC	POL, t=0
−0.085±0.064	2.2M	[2] SANDWEISS	73	CNTR	POL, t=0
−0.02 ±0.08		LONGO	69	CNTR	POL, t=3.3
−0.2 ±0.6		ABRAMS	68B	OSPK	Polarization
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.012±0.026		SCHMIDT	79	CNTR	Repl. by MORSE 80

OCCUR=2

[1] CLARK 77 value has additional $\xi(0)$ dependence $+0.21\text{Re}[\xi(0)]$. NODE=S013IXI;LINKAGE=C

[2] SANDWEISS 73 value corrected from value quoted in their paper due to new value of Re(ξ). See footnote 4 of SCHMIDT 79. NODE=S013IXI;LINKAGE=S

CPT-INVARIANCE TESTS IN K^0_L DECAYS

NODE=S013246

PHASE DIFFERENCE $\phi_{00} - \phi_{+-}$

NODE=S013DF

Test of *CPT*. NODE=S013DF

OUR FIT is described in the note on "*CP* violation in K_L decays" in the K^0_L Particle Listings.

NODE=S013DF

VALUE (°)	DOCUMENT ID		TECN	COMMENT
0.006±0.014 OUR FIT Error includes scale factor of 1.7. Assuming *CPT*				
0.34 ±0.32 OUR FIT Not assuming *CPT*				
0.006±0.008	[1] SUPERWEAK	16		Assuming *CPT*
−0.30 ±0.88	[2] SCHWINGEN...	95		Combined E731, E773
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.30 ±0.35	[3] ABOUZAID	11	KTEV	Not assuming *CPT*
0.39 ±0.22 ±0.45	[4] ALAVI-HARATI	03	KTEV	
0.62 ±0.71 ±0.75	SCHWINGEN...	95	E773	
−1.6 ±1.2	[5] GIBBONS	93	E731	
0.2 ±2.6 ±1.2	[6] CAROSI	90	NA31	
−0.3 ±2.4 ±1.2	KARLSSON	90	E731	

TYPE=CPT
OCCUR=2
TYPE=noCPT
NOTFITTED

[1] SUPERWEAK 16 is a fake experiment to constrain $\phi_{00} - \phi_{+-}$ to a small value as described in the note "*CP* violation in K_L decays." NODE=S013DF;LINKAGE=SW

[2] This SCHWINGENHEUER 95 values is the combined result of SCHWINGENHEUER 95 and GIBBONS 93, accounting for correlated systematic errors. NODE=S013DF;LINKAGE=A

[3] Not independent of other phase parameters reported in ABOUZAID 11. NODE=S013DF;LINKAGE=AB

[4] ALAVI-HARATI 03 fit Re(ϵ'/ϵ), Im(ϵ'/ϵ), Δm, τ_S, and ϕ_{+-} simultaneously, not assuming *CPT*. Phase difference is obtained from $\phi_{00} - \phi_{+-} \approx -3\text{Im}(\epsilon'/\epsilon)$ for small $|\epsilon'/\epsilon|$. Superseded by ABOUZAID 11. NODE=S013DF;LINKAGE=AP

[5] GIBBONS 93 give detailed dependence of systematic error on lifetime (see the section on the K^0_S mean life) and mass difference (see the section on $m_{K^0_L} - m_{K^0_S}$). NODE=S013DF;LINKAGE=GB

[6] CAROSI 90 is excluded from the fit because it it is not independent of ϕ_{+-} and ϕ_{00} values. NODE=S013DF;LINKAGE=CC

PHASE DIFFERENCE $\phi_{+-} - \phi_{SW}$

NODE=S013DFS

Test of *CPT*. The Superweak phase $\phi_{SW} \equiv \tan^{-1}(2\Delta m/\Delta\Gamma)$ where $\Delta m = m_{K_L^0} - m_{K_S^0}$ and $\Delta\Gamma = \hbar(\tau_L - \tau_S)/(\tau_L \tau_S)$.

NODE=S013DFS

VALUE (°)	DOCUMENT ID	TECN
0.61±0.62±1.01	[1] ALAVI-HARATI 03	KTEV

NODE=S013DFS

[1] ALAVI-HARATI 03 fit is the same as their ϕ_{+-}, τ_{K_S}, Δm fit, except that the parameter $\phi_{+-} - \phi_{SW}$ is used in place of ϕ.

NODE=S013DFS;LINKAGE=A

$\mathrm{Re}(\frac{2}{3}\eta_{+-} + \frac{1}{3}\eta_{00}) - \frac{A_L}{2}$

NODE=S013CPT
NODE=S013CPT
NODE=S013CPT

Test of *CPT*

VALUE (units 10^{-6})	DOCUMENT ID	TECN	COMMENT
−3±35	[1] ALAVI-HARATI 02	E799	Uses A_L from K_{e3} decays

[1] ALAVI-HARATI 02 uses PDG 00 values of η_{+-} and η_{00}.

NODE=S013CPT;LINKAGE=A

NODE=S013249

$\Delta S = \Delta Q$ IN K^0 DECAYS

The relative amount of $\Delta S \neq \Delta Q$ component present is measured by the parameter x, defined as

$$x = A(\overline{K}^0 \to \pi^-\ell^+\nu)/A(K^0 \to \pi^-\ell^+\nu) .$$

We list Re$\{x\}$ and Im$\{x\}$ for K_{e3} and $K_{\mu3}$ combined.

$x = A(\overline{K}^0 \to \pi^-\ell^+\nu)/A(K^0 \to \pi^-\ell^+\nu) = A(\Delta S{=}-\Delta Q)/A(\Delta S{=}\Delta Q)$

NODE=S013250

REAL PART OF x

NODE=S013REX
NODE=S013REX

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
−0.0018±0.0041±0.0045		ANGELOPO...	98D	CPLR	K_{e3} from K^0
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$0.10\ ^{+0.18}_{-0.19}$	79	SMITH	75B	WIRE	$\pi^- p \to K^0 \Lambda$
0.04 ±0.03	4724	NIEBERGALL	74	ASPK	$K^+ p \to K^0 p \pi^+$
−0.008 ±0.044	1757	FACKLER	73	OSPK	K_{e3} from K^0
−0.03 ±0.07	1367	HART	73	OSPK	K_{e3} from $K^0 \Lambda$
−0.070 ±0.036	1079	MALLARY	73	OSPK	K_{e3} from $K^0 \Lambda X$
0.03 ±0.06	410	[1] BURGUN	72	HBC	$K^+ p \to K^0 p \pi^+$
$0.04\ ^{+0.10}_{-0.13}$	100	[2] GRAHAM	72	OSPK	$K_{\mu3}$ from $K^0 \Lambda$
−0.05 ±0.09	442	[2] GRAHAM	72	OSPK	$\pi^- p \to K^0 \Lambda$ OCCUR=2
$0.26\ ^{+0.10}_{-0.14}$	126	MANN	72	HBC	$K^- p \to n \overline{K}^0$
−0.13 ±0.11	342	[2] MANTSCH	72	OSPK	K_{e3} from $K^0 \Lambda$
$0.04\ ^{+0.07}_{-0.08}$	222	[1] BURGUN	71	HBC	$K^+ p \to K^0 p \pi^+$
$0.25\ ^{+0.07}_{-0.09}$	252	WEBBER	71	HBC	$K^- p \to n \overline{K}^0$
0.12 ±0.09	215	[3] CHO	70	DBC	$K^+ d \to K^0 p p$
−0.020 ±0.025		[4] BENNETT	69	CNTR	Charge asym+ Cu regen.
$0.09\ ^{+0.14}_{-0.16}$	686	LITTENBERG	69	OSPK	$K^+ n \to K^0 p$
0.03 ±0.03		[4] BENNETT	68	CNTR	
$0.09\ ^{+0.07}_{-0.09}$	121	JAMES	68	HBC	$\overline{p} p$
$0.17\ ^{+0.16}_{-0.35}$	116	FELDMAN	67B	OSPK	$\pi^- p \to K^0 \Lambda$
0.17 ±0.10	335	[3] HILL	67	DBC	$K^+ d \to K^0 p p$
$0.035\ ^{+0.11}_{-0.13}$	196	AUBERT	65	HLBC	K^+ charge exch.
$0.06\ ^{+0.18}_{-0.44}$	152	[5] BALDO-...	65	HLBC	K^+ charge exch.
$-0.08\ ^{+0.16}_{-0.28}$	109	[6] FRANZINI	65	HBC	$\overline{p} p$

[1] BURGUN 72 is a final result which includes BURGUN 71. NODE=S013REX;LINKAGE=U
[2] First GRAHAM 72 value is second GRAHAM 72 value combined with MANTSCH 72. NODE=S013REX;LINKAGE=G
[3] CHO 70 is analysis of unambiguous events in new data and HILL 67. NODE=S013REX;LINKAGE=N
[4] BENNETT 69 is a reanalysis of BENNETT 68. NODE=S013REX;LINKAGE=B
[5] BALDO-CEOLIN 65 gives x and θ converted by us to Re(x) and Im(x). NODE=S013REX;LINKAGE=C
[6] FRANZINI 65 gives x and θ for Re(x) and Im(x). See SCHMIDT 67. NODE=S013REX;LINKAGE=F

IMAGINARY PART OF *x*

NODE=S013IMX

Assumes $m_{K_L^0} - m_{K_S^0}$ positive. See Listings above.

NODE=S013IMX
NODE=S013IMX

VALUE		EVTS	DOCUMENT ID		TECN	COMMENT
0.0012±0.0019±0.0009		640k	ANGELOPO...	01B	CPLR	K_{e3} from K^0
• • • We do not use the following data for averages, fits, limits, etc. • • •						
0.0012±0.0019		640k	[1] ANGELOPO...	98E	CPLR	K_{e3} from K^0
−0.10	$^{+0.16}_{-0.19}$	79	SMITH	75B	WIRE	$\pi^- p \to K^0 \Lambda$
−0.06	±0.05	4724	NIEBERGALL	74	ASPK	$K^+ p \to K^0 p \pi^+$
−0.017	±0.060	1757	FACKLER	73	OSPK	K_{e3} from K^0
0.09	±0.07	1367	HART	73	OSPK	K_{e3} from $K^0 \Lambda$
0.107	$^{+0.092}_{-0.074}$	1079	MALLARY	73	OSPK	K_{e3} from $K^0 \Lambda X$
0.07	$^{+0.06}_{-0.07}$	410	[2] BURGUN	72	HBC	$K^+ p \to K^0 p \pi^+$
0.12	$^{+0.17}_{-0.16}$	100	[3] GRAHAM	72	OSPK	$K_{\mu 3}$ from $K^0 \Lambda$
0.05	±0.13	442	[3] GRAHAM	72	OSPK	$\pi^- p \to K^0 \Lambda$
0.21	$^{+0.15}_{-0.12}$	126	MANN	72	HBC	$K^- p \to n \overline{K}^0$
−0.04	±0.16	342	[3] MANTSCH	72	OSPK	K_{e3} from $K^0 \Lambda$
0.12	$^{+0.08}_{-0.09}$	222	[2] BURGUN	71	HBC	$K^+ p \to K^0 p \pi^+$
0.0	±0.08	252	WEBBER	71	HBC	$K^- p \to n \overline{K}^0$
−0.08	±0.07	215	[4] CHO	70	DBC	$K^+ d \to K^0 p p$
−0.11	$^{+0.10}_{-0.11}$	686	LITTENBERG	69	OSPK	$K^+ n \to K^0 p$
+0.22	$^{+0.37}_{-0.29}$	121	JAMES	68	HBC	$\overline{p} p$
0.0	±0.25	116	FELDMAN	67B	OSPK	$\pi^- p \to K^0 \Lambda$
−0.20	±0.10	335	[4] HILL	67	DBC	$K^+ d \to K^0 p p$
−0.21	$^{+0.11}_{-0.15}$	196	AUBERT	65	HLBC	K^+ charge exch.
−0.44	$^{+0.32}_{-0.19}$	152	[5] BALDO-...	65	HLBC	K^+ charge exch.
+0.24	$^{+0.40}_{-0.30}$	109	[6] FRANZINI	65	HBC	$\overline{p} p$

OCCUR=2

[1] Superseded by ANGELOPOULOS 01B. NODE=S013IMX;LINKAGE=A
[2] BURGUN 72 is a final result which includes BURGUN 71. NODE=S013IMX;LINKAGE=U
[3] First GRAHAM 72 value is second GRAHAM 72 value combined with MANTSCH 72. NODE=S013IMX;LINKAGE=G
[4] Footnote 10 of HILL 67 should read +0.58, not −0.58 (private communication) CHO 70 is analysis of unambiguous events in new data and HILL 67. NODE=S013IMX;LINKAGE=N
[5] BALDO-CEOLIN 65 gives x and θ converted by us to Re(x) and Im(x). NODE=S013IMX;LINKAGE=C
[6] FRANZINI 65 gives x and θ for Re(x) and Im(x). See SCHMIDT 67. NODE=S013IMX;LINKAGE=F

K_L^0 REFERENCES

NODE=S013

AAIJ	23AE	PR D108 L031102	R. Aaij *et al.*	(LHCb Collab.)	REFID=62337
AHN	21	PRL 126 121801	J.K. Ahn *et al.*	(KOTO Collab.)	REFID=61174
SHIMIZU	20	PR D102 051103	N. Shimizu *et al.*	(KOTO Collab.)	REFID=60714
AHN	19	PRL 122 021802	J.K. Ahn *et al.*	(KOTO Collab.)	REFID=59556
AHN	17	PTEP 2017 021C01	J.K. Ahn *et al.*	(KOTO Collab.)	REFID=57782
BRFIT	16	RPP 2016 edition	C.-J. Lin	(PDG Collab.)	REFID=54995
ETAFIT	16	RPP 2016 edition	C.-J. Lin	(PDG Collab.)	REFID=54994
SUPERWEAK	16	RPP 2016 edition	C.-J. Lin	(PDG Collab.)	REFID=54996
ABOUZAID	11	PR D83 092001	E. Abouzaid *et al.*	(FNAL KTeV Collab.)	REFID=53712
ABOUZAID	11A	PRL 107 201803	E. Abouzaid *et al.*	(KTeV Collab.)	REFID=53842
OGATA	11	PR D84 052009	R. Ogata *et al.*	(KEK E391a Collab.)	REFID=53803
TUNG	11	PR D83 031101	Y.C. Tung *et al.*	(KEK E391a Collab.)	REFID=16423
ABOUZAID	10	PR D81 052001	E. Abouzaid *et al.*	(FNAL KTeV Collab.)	REFID=53276
AHN	10	PR D81 072004	J.K. Ahn *et al.*	(KEK E391a Collab.)	REFID=53279
ABOUZAID	08	PR D77 112004	E. Abouzaid *et al.*	(FNAL KTeV Collab.)	REFID=52382
ABOUZAID	08A	PR D78 032009	E. Abouzaid *et al.*	(FNAL KTeV Collab.)	REFID=52383
ABOUZAID	08B	PR D78 032014	E. Abouzaid *et al.*	(FNAL KTeV Collab.)	REFID=52384
ABOUZAID	08C	PRL 100 131803	E. Abouzaid *et al.*	(FNAL KTeV Collab.)	REFID=52385
AHN	08	PRL 100 201802	J.K. Ahn *et al.*	(KEK E391a Collab.)	REFID=52437
AMBROSINO	08F	EPJ C55 539	F. Ambrosino *et al.*	(KLOE Collab.)	REFID=52467
ABOUZAID	07B	PRL 99 051804	E. Abouzaid *et al.*	(FNAL KTeV Collab.)	REFID=51869
ABOUZAID	07C	PRL 99 081803	E. Abouzaid *et al.*	(FNAL KTeV Collab.)	REFID=51873
ABOUZAID	07D	PR D76 052001	E. Abouzaid *et al.*	(FNAL KTeV Collab.)	REFID=51934
AMBROSINO	07C	JHEP 0712 105	F. Ambrosino *et al.*	(KLOE Collab.)	REFID=52113
ANDRE	07	ANP 322 2518	T. Andre	(EFI)	REFID=50524
LAI	07	PL B645 26	A. Lai *et al.*	(CERN NA48 Collab.)	REFID=51665
LAI	07A	PL B647 341	A. Lai *et al.*	(CERN NA48 Collab.)	REFID=51758
NIX	07	PR D76 011101	J. Nix *et al.*	(KEK E391a Collab.)	REFID=51849
ABOUZAID	06	PRL 96 101801	E. Abouzaid *et al.*	(KTeV Collab.)	REFID=51111
ABOUZAID	06A	PR D74 032004	E. Abouzaid *et al.*	(KTeV Collab.)	REFID=51333
Also		PR D74 039905 (errat.)	E. Abouzaid *et al.*	(KTeV Collab.)	REFID=51446
ABOUZAID	06C	PR D74 097101	E. Abouzaid *et al.*	(KTeV Collab.)	REFID=51505
AHN	06	PR D74 051105	J.K. Ahn *et al.*	(KEK E391a Collab.)	REFID=51339
Also		PR D74 079901 (errat.)	J.K. Ahn *et al.*	(KEK E391a Collab.)	REFID=51466

AMBROSINO	06	PL B632 43	F. Ambrosino *et al.*	(KLOE Collab.)	REFID=51011
AMBROSINO	06D	PL B636 166	F. Ambrosino *et al.*	(KLOE Collab.)	REFID=51072
AMBROSINO	06F	PL B638 140	F. Ambrosino *et al.*	(KLOE Collab.)	REFID=51074
BATLEY	06B	PL B633 173	J.R. Batley *et al.*	(CERN NA48/2 Collab.)	REFID=51071
HILL	06	PR D74 096006	R.J. Hill	(FNAL)	REFID=51545
PDG	06	JP G33 1	W.-M. Yao *et al.*	(PDG Collab.)	REFID=51004
ALEXOPOU...	05	PR D71 012001	T. Alexopoulos *et al.*	(FNAL KTeV Collab.)	REFID=50390
AMBROSINO	05C	PL B626 15	F. Ambrosino *et al.*	(KLOE Collab.)	REFID=50881
CABIBBO	05	JHEP 0503 021	N. Cabibbo, G. Isidori	(CERN, ROMAI, FRAS)	REFID=51070
LAI	05	PL B605 247	A. Lai *et al.*	(CERN NA48 Collab.)	REFID=50384
LAI	05B	PL B615 31	A. Lai *et al.*	(CERN NA48 Collab.)	REFID=50603
PARK	05	PRL 94 021801	H.K. Park *et al.*	(FNAL HyperCP Collab.)	REFID=50480
ALAVI-HARATI	04A	PRL 93 021805	A. Alavi-Harati *et al.*	(FNAL KTeV/E799 Collab.)	REFID=50060
ALEXOPOU...	04	PR D70 092006	T. Alexopoulos *et al.*	(FNAL KTeV Collab.)	REFID=50242
ALEXOPOU...	04A	PR D70 092007	T. Alexopoulos *et al.*	(FNAL KTeV Collab.)	REFID=50243
BATLEY	04	PL B595 75	J.R. Batley *et al.*	(CERN NA48 Collab.)	REFID=49979
CIRIGLIANO	04	EPJ C35 53	V. Cirigliano, H. Neufeld, H. Pichl	(CIT, VALE+)	REFID=49972
LAI	04B	PL B602 41	A. Lai *et al.*	(CERN NA48 Collab.)	REFID=50285
LAI	04C	PL B604 1	A. Lai *et al.*	(CERN NA48 Collab.)	REFID=50289
PDG	04	PL B592 1	S. Eidelman *et al.*	(PDG Collab.)	REFID=49653
SOZZI	04	EPJ C36 37	M. Sozzi	(PISA)	REFID=51122
ADINOLFI	03	PL B566 61	M. Adinolfi *et al.*	(KLOE Collab.)	REFID=49491
ALAVI-HARATI	03	PR D67 012005	A. Alavi-Harati *et al.*	(FNAL KTeV Collab.)	REFID=49244
Also		PR D70 079904 (errat.)	A. Alavi-Harati *et al.*	(FNAL KTeV Collab.)	REFID=50236
ALAVI-HARATI	03B	PRL 90 141801	A. ALavi-Harati *et al.*	(FNAL KTeV Collab.)	REFID=49355
LAI	03	PL B551 7	A. Lai *et al.*	(CERN NA48 Collab.)	REFID=49148
LAI	03C	EPJ C30 33	A. Lai *et al.*	(CERN NA48 Collab.)	REFID=49502
ALAVI-HARATI	02	PRL 88 181601	A. Alavi-Harati *et al.*	(FNAL KTeV Collab.)	REFID=48706
ALAVI-HARATI	02C	PRL 89 211801	A. Alavi-Harati *et al.*	(FNAL KTeV Collab.)	REFID=48996
BATLEY	02	PL B544 97	J.R. Batley *et al.*	(CERN NA48 Collab.)	REFID=48919
CIRIGLIANO	02	EPJ C23 121	V. Cirigliano *et al.*	(VIEN, VALE, MARS)	REFID=50523
LAI	02B	PL B536 229	A. Lai *et al.*	(CERN NA48 Collab.)	REFID=48763
ALAVI-HARATI	01	PRL 86 397	A. Alavi-Harati *et al.*	(FNAL KTeV Collab.)	REFID=48025
ALAVI-HARATI	01B	PRL 86 761	A. Alavi-Harati *et al.*	(FNAL KTeV Collab.)	REFID=48034
ALAVI-HARATI	01D	PRL 86 5425	A. Alavi-Harati *et al.*	(FNAL KTeV Collab.)	REFID=48148
ALAVI-HARATI	01E	PRL 87 021801	A. Alavi-Harati *et al.*	(FNAL KTeV Collab.)	REFID=48176
ALAVI-HARATI	01F	PR D64 012003	A. Alavi-Harati *et al.*	(FNAL KTeV Collab.)	REFID=48178
ALAVI-HARATI	01G	PRL 87 071801	A. Alavi-Harati *et al.*	(FNAL KTeV Collab.)	REFID=48209
ALAVI-HARATI	01H	PRL 87 111802	A. Alavi-Harati *et al.*	(FNAL KTeV Collab.)	REFID=48250
ALAVI-HARATI	01J	PR D64 112004	A. Alavi-Harati *et al.*	(FNAL KTeV Collab.)	REFID=48424
ANGELOPO...	01	PL B503 49	A. Angelopoulos *et al.*	(CPLEAR Collab.)	REFID=48097
ANGELOPO...	01B	EPJ C22 55	A. Angelopoulos *et al.*	(CPLEAR Collab.)	REFID=48507
LAI	01B	PL B515 261	A. Lai *et al.*	(CERN NA48 Collab.)	REFID=48280
LAI	01C	EPJ C22 231	A. Lai *et al.*	(CERN NA48 Collab.)	REFID=48510
ALAVI-HARATI	00	PR D61 072006	A. Alavi-Harati *et al.*	(FNAL KTeV Collab.)	REFID=47541
ALAVI-HARATI	00B	PRL 84 408	A. Alavi-Harati *et al.*	(FNAL KTeV Collab.)	REFID=47543
ALAVI-HARATI	00D	PRL 84 5279	A. Alavi-Harati *et al.*	(FNAL KTeV Collab.)	REFID=47632
ALAVI-HARATI	00E	PR D62 112001	A. Alavi-Harati *et al.*	(FNAL KTeV Collab.)	REFID=47821
AMBROSE	00	PRL 84 1389	D. Ambrose *et al.*	(BNL E871 Collab.)	REFID=47540
APOSTOLA...	00	PL B473 186	A. Apostolakis *et al.*	(CPLEAR Collab.)	REFID=47542
PDG	00	EPJ C15 1	D.E. Groom *et al.*	(PDG Collab.)	REFID=47469
ALAVI-HARATI	99B	PRL 83 917	A. Alavi-Harati *et al.*	(FNAL KTeV Collab.)	REFID=47074
ALAVI-HARATI	99D	PRL 83 22	A. Alavi-Harati *et al.*	(FNAL KTeV Collab.)	REFID=47095
APOSTOLA...	99C	PL B458 545	A. Apostolakis *et al.*	(CPLEAR Collab.)	REFID=47042
Also		EPJ C18 41	A. Apostolakis *et al.*	(CPLEAR Collab.)	REFID=48038
FANTI	99B	PL B458 553	V. Fanti *et al.*	(CERN NA48 Collab.)	REFID=47043
FANTI	99C	PL B465 335	V. Fanti *et al.*	(CERN NA48 Collab.)	REFID=47251
MURAKAMI	99	PL B463 333	K. Murakami *et al.*	(KEK E162 Collab.)	REFID=47228
ADAMS	98	PRL 80 4123	J. Adams *et al.*	(FNAL KTeV Collab.)	REFID=46014
AMBROSE	98	PRL 81 4309	D. Ambrose *et al.*	(BNL E871 Collab.)	REFID=46494
AMBROSE	98B	PRL 81 5734	D. Ambrose *et al.*	(BNL E871 Collab.)	REFID=46696
ANGELOPO...	98	PL B420 191	A. Angelopoulos *et al.*	(CPLEAR Collab.)	REFID=46030
ANGELOPO...	98C	EPJ C5 389	A. Angelopoulos *et al.*	(CPLEAR Collab.)	REFID=46264
ANGELOPO...	98D	PL B444 38	A. Angelopoulos *et al.*	(CPLEAR Collab.)	REFID=46539
Also		EPJ C22 55	A. Angelopoulos *et al.*	(CPLEAR Collab.)	REFID=48507
ANGELOPO...	98E	PL B444 43	A. Angelopoulos *et al.*	(CPLEAR Collab.)	REFID=46540
ARISAKA	98	PL B432 230	K. Arisaka *et al.*	(FNAL E799 Collab.)	REFID=46071
BENDER	98	PL B418 411	M. Bender *et al.*	(CERN NA48 Collab.)	REFID=46025
DAMBROSIO	98	PL B423 385	G. D'Ambrosio, G. Isidori, J. Portoles		REFID=52185
SETZU	98	PL B420 205	M.G. Setzu *et al.*		REFID=46031
TAKEUCHI	98	PL B443 409	Y. Takeuchi *et al.*	(KYOT, KEK, HIRO)	REFID=46537
FANTI	97	ZPHY C76 653	V. Fanti *et al.*	(CERN NA48 Collab.)	REFID=45792
NOMURA	97	PL B408 445	T. Nomura *et al.*	(KYOT, KEK, HIRO)	REFID=45660
ADLER	96B	ZPHY C70 211	R. Adler *et al.*	(CPLEAR Collab.)	REFID=44818
ADLER	96C	PL B369 367	R. Adler *et al.*	(CPLEAR Collab.)	REFID=44836
GU	96	PRL 76 4312	P. Gu *et al.*	(RUTG, UCLA, EFI, COLO+)	REFID=44805
LEBER	96	PL B369 69	F. Leber *et al.*	(MAINZ, CERN, EDIN, ORSAY+)	REFID=44829
PDG	96	PR D54 1	R. M. Barnett *et al.*	(PDG Collab.)	REFID=44495
ADLER	95	PL B363 237	R. Adler *et al.*	(CPLEAR Collab.)	REFID=44561
ADLER	95B	PL B363 243	R. Adler *et al.*	(CPLEAR Collab.)	REFID=44562
AKAGI	95	PR D51 2061	T. Akagi *et al.*	(TOHOK, TOKY, KYOT, KEK)	REFID=44147
BARR	95	ZPHY C65 361	G.D. Barr *et al.*	(CERN, EDIN, MAINZ, LALO+)	REFID=44179
BARR	95C	PL B358 399	G.D. Barr *et al.*	(CERN, EDIN, MAINZ, LALO+)	REFID=44473
HEINSON	95	PR D51 985	A.P. Heinson *et al.*	(BNL E791 Collab.)	REFID=44138
KREUTZ	95	ZPHY C65 67	A. Kreutz *et al.*	(SIEG, EDIN, MAINZ, ORSAY+)	REFID=44159
MATTHEWS	95	PRL 75 2803	J.N. Matthews *et al.*	(RUTG, EFI, ELMT+)	REFID=44487
SCHWINGEN...	95	PRL 74 4376	B. Schwingenheuer *et al.*	(EFI, CHIC+)	REFID=44259
SPENCER	95	PRL 74 3323	M.B. Spencer *et al.*	(UCLA, EFI, COLO+)	REFID=44198
BARR	94	PL B328 528	G.D. Barr *et al.*	(CERN, EDIN, MAINZ, LALO+)	REFID=43828
GU	94	PRL 72 3000	P. Gu *et al.*	(RUTG, UCLA, EFI, COLO+)	REFID=43825
NAKAYA	94	PRL 73 2169	T. Nakaya *et al.*	(OSAK, UCLA, EFI, COLU+)	REFID=43993
ROBERTS	94	PR D50 1874	D. Roberts *et al.*	(UCLA, EFI, COLU+)	REFID=43867
AKAGI	93	PR D47 2644	T. Akagi *et al.*	(TOHOK, TOKY, KYOT, KEK)	REFID=43283
ARISAKA	93	PRL 70 1049	K. Arisaka *et al.*	(BNL E791 Collab.)	REFID=43206
ARISAKA	93B	PRL 71 3910	K. Arisaka *et al.*	(BNL E791 Collab.)	REFID=43637
BARR	93D	PL B317 233	G.D. Barr *et al.*	(CERN, EDIN, MAINZ, LALO+)	REFID=43581
GIBBONS	93	PRL 70 1199	L.K. Gibbons *et al.*	(FNAL E731 Collab.)	REFID=43209
Also		PR D55 6625	L.K. Gibbons *et al.*	(FNAL E731 Collab.)	REFID=45465
GIBBONS	93B	PRL 70 1203	L.K. Gibbons *et al.*	(FNAL E731 Collab.)	REFID=43210

GIBBONS	93C	Thesis RX-1487	L.K. Gibbons	(CHIC)	REFID=43829
Also		PR D55 6625	L.K. Gibbons *et al.*	(FNAL E731 Collab.)	REFID=45465
HARRIS	93	PRL 71 3914	D.A. Harris *et al.*	(EFI, UCLA, COLO+)	REFID=43638
HARRIS	93B	PRL 71 3918	D.A. Harris *et al.*	(EFI, UCLA, COLO+)	REFID=43639
MAKOFF	93	PRL 70 1591	G. Makoff *et al.*	(FNAL E731 Collab.)	REFID=43270
Also		PRL 75 2069 (errat.)	G. Makoff *et al.*		REFID=44426
RAMBERG	93	PRL 70 2525	E. Ramberg *et al.*	(FNAL E731 Collab.)	REFID=43263
RAMBERG	93B	PRL 70 2529	E.J. Ramberg *et al.*	(FNAL E731 Collab.)	REFID=43264
VAGINS	93	PRL 71 35	M.R. Vagins *et al.*	(BNL E845 Collab.)	REFID=43364
ADLER	92B	PL B286 180	R. Adler *et al.*	(CPLEAR Collab.)	REFID=42122
Also		SJNP 55 840	R. Adler *et al.*	(CPLEAR Collab.)	REFID=42110
BARR	92	PL B284 440	G.D. Barr *et al.*	(CERN, EDIN, MAINZ, LALO+)	REFID=42092
MORSE	92	PR D45 36	W.M. Morse *et al.*	(BNL, YALE, VASS)	REFID=41922
PDG	92	PR D45 S1	K. Hikasa *et al.*	(KEK, LBL, BOST+)	REFID=41900
SOMALWAR	92	PRL 68 2580	S.V. Somalwar *et al.*	(FNAL E731 Collab.)	REFID=41971
AKAGI	91B	PRL 67 2618	T. Akagi *et al.*	(TOHOK, TOKY, KYOT, KEK)	REFID=41756
BARR	91	PL B259 389	G.D. Barr *et al.*	(CERN, EDIN, MAINZ, LALO+)	REFID=41489
HEINSON	91	PR D44 1	A.P. Heinson *et al.*	(UCI, UCLA, LANL+)	REFID=41517
PAPADIMITR...	91	PR D44 573	V. Papadimitriou *et al.*	(FNAL E731 Collab.)	REFID=41556
BARKER	90	PR D41 3546	A.R. Barker *et al.*	(FNAL E731 Collab.)	REFID=41257
Also		PRL 61 2661	L.K. Gibbons *et al.*	(FNAL E731 Collab.)	REFID=40624
BARR	90B	PL B240 283	G.D. Barr *et al.*	(CERN, EDIN, MAINZ, LALO+)	REFID=41212
BARR	90C	PL B242 523	G.D. Barr *et al.*	(CERN, EDIN, MAINZ, LALO+)	REFID=41316
CAROSI	90	PL B237 303	R. Carosi *et al.*	(CERN, EDIN, MAINZ, LALO+)	REFID=41118
KARLSSON	90	PRL 64 2976	M. Karlsson *et al.*	(FNAL E731 Collab.)	REFID=41186
OHL	90	PRL 64 2755	K.E. Ohl *et al.*	(BNL E845 Collab.)	REFID=41180
OHL	90B	PRL 65 1407	K.E. Ohl *et al.*	(BNL E845 Collab.)	REFID=41303
PATTERSON	90	PRL 64 1491	J.R. Patterson *et al.*	(FNAL E731 Collab.)	REFID=41129
INAGAKI	89	PR D40 1712	T. Inagaki *et al.*	(KEK, TOKY, KYOT)	REFID=40851
MATHIAZHA...	89	PRL 63 2181	C. Mathiazhagan *et al.*	(UCI, UCLA, LANL+)	REFID=40975
MATHIAZHA...	89B	PRL 63 2185	C. Mathiazhagan *et al.*	(UCI, UCLA, LANL+)	REFID=40976
WAHL	89	CERN-EP/89-86	H. Wahl	(CERN)	REFID=41130
BARR	88	PL B214 303	G.D. Barr *et al.*	(CERN, EDIN, MAINZ, LALO+)	REFID=40658
BURKHARDT	88	PL B206 169	H. Burkhardt *et al.*	(CERN, EDIN, MAINZ+)	REFID=40545
JASTRZEM...	88	PRL 61 2300	E. Jastrzembski *et al.*	(BNL, YALE)	REFID=40622
WOODS	88	PRL 60 1695	M. Woods *et al.*	(FNAL E731 Collab.)	REFID=40546
BURKHARDT	87	PL B199 139	H. Burkhardt *et al.*	(CERN, EDIN, MAINZ+)	REFID=40237
ARONSON	86	PR D33 3180	S.H. Aronson *et al.*	(BNL, CHIC, STAN+)	REFID=11410
Also		PRL 48 1078	S.H. Aronson *et al.*	(BNL, CHIC, STAN+)	REFID=11411
PDG	86C	PL 170B 132	M. Aguilar-Benitez *et al.*	(CERN, CIT+)	REFID=41169
COUPAL	85	PRL 55 566	D.P. Coupal *et al.*	(CHIC, SACL)	REFID=11409
BALATS	83	SJNP 38 556	M.Y. Balats *et al.*	(ITEP)	REFID=11405
		Translated from YAF 38 927.			
BERGSTROM	83	PL 131B 229	L. Bergstrom, E. Masso, P. Singer	(CERN)	REFID=41926
ARONSON	82	PRL 48 1078	S.H. Aronson *et al.*	(BNL, CHIC, STAN+)	REFID=11411
ARONSON	82B	PRL 48 1306	S.H. Aronson *et al.*	(BNL, CHIC, PURD)	REFID=11401
Also		PL 116B 73	E. Fischbach *et al.*	(PURD, BNL, CHIC)	REFID=11402
Also		PR D28 476	S.H. Aronson *et al.*	(BNL, CHIC, PURD)	REFID=11403
Also		PR D28 495	S.H. Aronson *et al.*	(BNL, CHIC, PURD)	REFID=11404
PDG	82B	PL 111B 70	M. Roos *et al.*	(HELS, CIT, CERN)	REFID=41156
BIRULEV	81	NP B182 1	V.K. Birulev *et al.*	(JINR)	REFID=11399
Also		SJNP 31 622	V.K. Birulev *et al.*	(JINR)	REFID=11400
		Translated from YAF 31 1204.			
CARROLL	80B	PRL 44 529	A.S. Carroll *et al.*	(BNL, ROCH)	REFID=11395
CARROLL	80C	PL 96B 407	A.S. Carroll *et al.*	(BNL, ROCH)	REFID=11396
CHO	80	PR D22 2688	Y. Cho *et al.*	(ANL, CMU)	REFID=11397
MORSE	80	PR D21 1750	W.M. Morse *et al.*	(BNL, YALE)	REFID=11398
CHRISTENS...	79	PRL 43 1209	J.H. Christenson *et al.*	(NYU)	REFID=11388
SCHMIDT	79	PRL 43 556	M.P. Schmidt *et al.*	(YALE, BNL)	REFID=11391
HILL	78	PL 73B 483	D.G. Hill *et al.*	(BNL, SLAC, SBER)	REFID=11386
CHO	77	PR D15 587	Y. Cho *et al.*	(ANL, CMU)	REFID=11379
CLARK	77	PR D15 553	A.R. Clark *et al.*	(LBL)	REFID=11380
Also		Thesis LBL-4275	G. Shen	(LBL)	REFID=11381
DEVOE	77	PR D16 565	R. Devoe *et al.*	(EFI, ANL)	REFID=11382
PEACH	77	NP B127 399	K.J. Peach *et al.*	(BGNA, EDIN, GLAS+)	REFID=11384
BIRULEV	76	SJNP 24 178	V.K. Birulev *et al.*	(JINR)	REFID=11371
		Translated from YAF 24 340.			
COOMBES	76	PRL 37 249	R.W. Coombes *et al.*	(STAN, NYU)	REFID=11372
GJESDAL	76	NP B109 118	G. Gjesdal *et al.*	(CERN, HEIDH)	REFID=11376
BALDO-...	75	NC 25A 688	M. Baldo-Ceolin *et al.*	(PADO, WISC)	REFID=11108
BLUMENTHAL	75	PRL 34 164	R.B. Blumenthal *et al.*	(PENN, CHIC, TEMP)	REFID=11367
BUCHANAN	75	PR D11 457	C.D. Buchanan *et al.*	(UCLA, SLAC, JHU)	REFID=11368
CARITHERS	75	PRL 34 1244	W.C.J. Carithers *et al.*	(COLU, NYU)	REFID=11109
SMITH	75B	Thesis UCSD unpub.	J.G. Smith	(UCSD)	REFID=11370
BISI	74	PL 50B 504	V. Bisi, M.I. Ferrero	(TORI)	REFID=11346
DONALDSON	74	Thesis SLAC-0184	G. Donaldson	(SLAC)	REFID=11374
Also		PR D14 2839	G. Donaldson *et al.*	(SLAC)	REFID=11373
DONALDSON	74B	PR D9 2960	G. Donaldson *et al.*	(SLAC, UCSC)	REFID=11351
Also		PRL 31 337	G. Donaldson *et al.*	(SLAC, UCSC)	REFID=11352
GEWENIGER	74	PL 48B 483	C. Geweniger *et al.*	(CERN, HEIDH)	REFID=11355
Also		Thesis CERN Int. 74-4	V. Luth	(CERN)	REFID=11356
GEWENIGER	74B	PL 48B 487	C. Geweniger *et al.*	(CERN, HEIDH)	REFID=11357
Also		PL 52B 119	S. Gjesdal *et al.*	(CERN, HEIDH)	REFID=11358
GEWENIGER	74C	PL 52B 108	C. Geweniger *et al.*	(CERN, HEIDH)	REFID=11359
GJESDAL	74	PL 52B 113	S. Gjesdal *et al.*	(CERN, HEIDH)	REFID=11360
MESSNER	74	PRL 33 1458	R. Messner *et al.*	(COLO, SLAC, UCSC)	REFID=11361
NIEBERGALL	74	PL 49B 103	F. Niebergall *et al.*	(CERN, ORSAY, VIEN)	REFID=11362
WILLIAMS	74	PRL 33 240	H.H. Williams *et al.*	(BNL, YALE)	REFID=11364
ALEXANDER	73B	NP B65 301	G. Alexander *et al.*	(TELA, HEID)	REFID=11324
BRANDENB...	73	PR D8 1978	G.W. Brandenburg *et al.*	(SLAC)	REFID=11327
EVANS	73	PR D7 36	G.R. Evans *et al.*	(EDIN, CERN)	REFID=11330
Also		PRL 23 427	G.R. Evans *et al.*	(EDIN, CERN)	REFID=11242
FACKLER	73	PRL 31 847	O. Fackler *et al.*	(MIT)	REFID=11100
FITCH	73	PRL 31 1524	V.L. Fitch *et al.*	(PRIN)	REFID=11333
Also		Thesis COO-3072-13	R.C. Webb	(PRIN)	REFID=11334
HART	73	NP B66 317	J.C. Hart *et al.*	(CAVE, RHEL)	REFID=11335
MALLARY	73	PR D7 1953	M.L. Mallary *et al.*	(CIT)	REFID=11103
Also		PRL 25 1214	F.J. Sciulli *et al.*	(CIT)	REFID=11337
MCCARTHY	73	PR D7 687	R.L. McCarthy *et al.*	(LBL)	REFID=11338
Also		PL 42B 291	R.L. McCarthy *et al.*	(LBL)	REFID=11339
Also		Thesis LBL-550	R.L. McCarthy	(LBL)	REFID=11340
MESSNER	73	PRL 30 876	R. Messner *et al.*	(COLO, SLAC, UCSC)	REFID=11341
SANDWEISS	73	PRL 30 1002	J. Sandweiss *et al.*	(YALE, ANL)	REFID=11343
WILLIAMS	73	PRL 31 1521	H.H. Williams *et al.*	(BNL, YALE)	REFID=11344
ASHFORD	72	PL 38B 47	V.A. Ashford *et al.*	(UCSD)	REFID=11301
BANNER	72B	PRL 29 237	M. Banner *et al.*	(PRIN)	REFID=11303
BARMIN	72B	SJNP 15 638	V.V. Barmin *et al.*	(ITEP)	REFID=11305
		Translated from YAF 15 1152.			

BURGUN	72	NP B50 194	G. Burgun *et al.*	(SACL, CERN, OSLO)	REFID=11306
GRAHAM	72	NC 9A 166	M.F. Graham *et al.*	(ILL, NEAS)	REFID=11311
JAMES	72	NP B49 1	F. James *et al.*	(CERN, SACL, OSLO)	REFID=11090
KRENZ	72	LNC 4 213	W. Krenz *et al.*	(AACH, CERN, EDIN)	REFID=11314
MANN	72	PR D6 137	W.A. Mann *et al.*	(MASA, BNL, YALE)	REFID=11315
MANTSCH	72	NC 9A 160	P.M. Mantsch *et al.*	(ILL, NEAS)	REFID=11316
MCCARTHY	72	PL 42B 291	R.L. McCarthy *et al.*	(LBL)	REFID=11339
PICCIONI	72	PRL 29 1412	R. Piccioni *et al.*	(SLAC)	REFID=11319
Also		PR D9 2939	R. Piccioni *et al.*	(SLAC, UCSC, COLO)	REFID=11320
VOSBURGH	72	PR D6 1834	K.G. Vosburgh *et al.*	(RUTG, MASA)	REFID=11321
Also		PRL 26 866	K.G. Vosburgh *et al.*	(RUTG, MASA)	REFID=11322
BALATS	71	SJNP 13 53	M.Y. Balats *et al.*	(ITEP)	REFID=11276
		Translated from YAF 13 93.			
BARMIN	71	PL 35B 604	V.V. Barmin *et al.*	(ITEP)	REFID=11277
BURGUN	71	LNC 2 1169	G. Burgun *et al.*	(SACL, CERN, OSLO)	REFID=11279
CARNEGIE	71	PR D4 1	R.K. Carnegie *et al.*	(PRIN)	REFID=11280
CHAN	71	Thesis LBL-350	J.H.S. Chan	(LBL)	REFID=11281
CHO	71	PR D3 1557	Y. Cho *et al.*	(CMU, BNL, CASE)	REFID=11084
ENSTROM	71	PR D4 2629	J. Enstrom *et al.*	(SLAC, STAN)	REFID=11289
Also		Thesis SLAC-0125	J.E. Enstrom	(STAN)	REFID=11290
JAMES	71	PL 35B 265	F. James *et al.*	(CERN, SACL, OSLO)	REFID=11085
MEISNER	71	PR D3 59	G.W. Meisner *et al.*	(MASA, BNL, YALE)	REFID=11086
REPELLIN	71	PL 36B 603	J.P. Repellin *et al.*	(ORSAY, CERN)	REFID=11087
WEBBER	71	PR D3 64	B.R. Webber *et al.*	(LRL)	REFID=11296
Also		PRL 21 498	B.R. Webber *et al.*	(LRL)	REFID=11297
Also		Thesis UCRL 19226	B.R. Webber	(LRL)	REFID=11081
WOLFF	71	PL 36B 517	B. Wolff *et al.*	(ORSAY, CERN)	REFID=11299
ALBROW	70	PL 33B 516	M.G. Albrow *et al.*	(MCHS, DARE)	REFID=11252
ARONSON	70	PRL 25 1057	S.H. Aronson *et al.*	(EFI, ILLC, SLAC)	REFID=11253
BARMIN	70	PL 33B 377	V.V. Barmin *et al.*	(ITEP, JINR)	REFID=11254
BASILE	70	PR D2 78	P. Basile *et al.*	(SACL)	REFID=11255
BECHERRAWY	70	PR D1 1452	T. Becherrawy	(ROCH)	REFID=11033
BUCHANAN	70	PL 33B 623	C.D. Buchanan *et al.*	(SLAC, JHU, UCLA)	REFID=11256
Also		Private Comm.	A.J. Cox		REFID=11257
BUDAGOV	70	PR D2 815	I.A. Budagov *et al.*	(CERN, ORSAY, EPOL)	REFID=11258
Also		PL 28B 215	I.A. Budagov *et al.*	(CERN, ORSAY, EPOL)	REFID=11225
CHO	70	PR D1 3031	Y. Cho *et al.*	(CMU, BNL, CASE)	REFID=11262
Also		PRL 19 668	D.G. Hill *et al.*	(BNL, CMU)	REFID=11263
CHOLLET	70	PL 31B 658	J.C. Chollet *et al.*	(CERN)	REFID=11264
CULLEN	70	PL 32B 523	M. Cullen *et al.*	(AACH, CERN, TORI)	REFID=11265
MARX	70	PL 32B 219	J. Marx *et al.*	(COLU, HARV, CERN)	REFID=11270
Also		Thesis Nevis 179	J. Marx	(COLU)	REFID=11271
SCRIBANO	70	PL 32B 224	A. Scribano *et al.*	(PISA, COLU, HARV)	REFID=11272
SMITH	70	PL 32B 133	R.C. Smith *et al.*	(UMD, BNL)	REFID=11273
WEBBER	70	PR D1 1967	B.R. Webber *et al.*	(LRL)	REFID=11080
Also		Thesis UCRL 19226	B.R. Webber	(LRL)	REFID=11081
BANNER	69	PR 188 2033	M. Banner *et al.*	(PRIN)	REFID=11071
Also		PRL 21 1103	M. Banner *et al.*	(PRIN)	REFID=11234
Also		PRL 21 1107	J.W. Cronin, J.K. Liu, J.E. Pilcher	(PRIN)	REFID=11235
BENNETT	69	PL 29B 317	S. Bennett *et al.*	(COLU, BNL)	REFID=11237
FAISSNER	69	PL 30B 204	H. Faissner *et al.*	(AACH3, CERN, TORI)	REFID=11243
LITTENBERG	69	PRL 22 654	L.S. Littenberg *et al.*	(UCSD)	REFID=11248
LONGO	69	PR 181 1808	M.J. Longo, K.K. Young, J.A. Helland	(MICH, UCLA)	REFID=11249
PACIOTTI	69	Thesis UCRL 19446	M.A. Paciotti	(LRL)	REFID=11250
SAAL	69	Thesis	H.J. Saal	(COLU)	REFID=11251
ABRAMS	68B	PR 176 1603	R.J. Abrams *et al.*	(ILL)	REFID=11213
ARNOLD	68B	PL 28B 56	R.G. Arnold *et al.*	(CERN, ORSAY)	REFID=11214
BASILE	68B	PL 28B 58	P. Basile *et al.*	(SACL)	REFID=11220
BENNETT	68	PL 27B 244	S. Bennett *et al.*	(COLU, CERN)	REFID=11221
BLANPIED	68	PRL 21 1650	W.A. Blanpied *et al.*	(CASE, HARV, MCGI)	REFID=11223
BOHM	68B	PL 27B 594	A. Bohm *et al.*		REFID=41164
BUDAGOV	68	NC 57A 182	I.A. Budagov *et al.*	(CERN, ORSAY, IPNP)	REFID=11224
Also		PL 28B 215	I.A. Budagov *et al.*	(CERN, ORSAY, EPOL)	REFID=11225
JAMES	68	NP B8 365	F. James, H. Briand	(IPNP, CERN)	REFID=11227
Also		PRL 21 257	J.A. Helland, M.J. Longo, K.K. Young	(UCLA, MICH)	REFID=11228
KULYUKINA	68	JETP 26 20	L.A. Kulyukina *et al.*	(JINR)	REFID=11229
		Translated from ZETF 53 29.			
KUNZ	68	Thesis PU-68-46	P.F. Kunz	(PRIN)	REFID=11230
BENNETT	67	PRL 19 993	S. Bennett *et al.*	(COLU)	REFID=11188
DEBOUARD	67	NC 52A 662	X. de Bouard *et al.*	(CERN)	REFID=11196
Also		PL 15 58	X. de Bouard *et al.*	(CERN, ORSAY, MPIM)	REFID=11197
DEVLIN	67	PRL 18 54	T.J. Devlin *et al.*	(PRIN, UMD)	REFID=11198
Also		PR 169 1045	G.A. Sayer *et al.*	(UMD, PPA, PRIN)	REFID=11199
DORFAN	67	PRL 19 987	D.E. Dorfan *et al.*	(SLAC, LRL)	REFID=11200
FELDMAN	67B	PR 155 1611	L. Feldman *et al.*	(PENN)	REFID=11201
FITCH	67	PR 164 1711	V.L. Fitch *et al.*	(PRIN)	REFID=11045
GINSBERG	67	PR 162 1570	E.S. Ginsberg	(MASB)	REFID=11028
HILL	67	PRL 19 668	D.G. Hill *et al.*	(BNL, CMU)	REFID=11263
HOPKINS	67	PRL 19 185	H.W.K. Hopkins, T.C. Bacon, F.R. Eisler	(BNL)	REFID=11206
NEFKENS	67	PR 157 1233	B.M.K. Nefkens *et al.*	(ILL)	REFID=11211
SCHMIDT	67	Thesis Nevis 160	P. Schmidt	(COLU)	REFID=11423
BEHR	66	PL 22 540	L. Behr *et al.*	(EPOL, MILA, PADO, ORSAY)	REFID=11064
HAWKINS	66	PL 21 238	C.J.B. Hawkins	(YALE)	REFID=11180
Also		PR 156 1444	C.J.B. Hawkins	(YALE)	REFID=11181
ANDERSON	65	PRL 14 475	J.A. Anderson *et al.*	(LRL, WISC)	REFID=11059
ASTBURY	65B	PL 18 175	P. Astbury *et al.*	(CERN, ZURI)	REFID=11149
AUBERT	65	PL 17 59	B. Aubert *et al.*	(EPOL, ORSAY)	REFID=11151
Also		PL 24B 75	J.P. Lowys *et al.*	(EPOL, ORSAY)	REFID=11152
BALDO-...	65	NC 38 684	M. Baldo-Ceolin *et al.*	(PADO)	REFID=11153
FRANZINI	65	PR 140 B127	P. Franzini *et al.*	(COLU, RUTG)	REFID=11157
GUIDONI	65	Argonne Conf. 49	P. Guidoni *et al.*	(BNL, YALE)	REFID=11159
HOPKINS	65	Argonne Conf. 67	H.W.K. Hopkins, T.C. Bacon, F. Eisler	(VAND+)	REFID=11160
ALEKSANYAN	64B	Dubna Conf. 2 102	A.S. Aleksanyan *et al.*	(YERE)	REFID=11139
Also		JETP 19 1019	A.S. Aleksanyan *et al.*	(LEBD, MPEI, YERE)	REFID=11140
		Translated from ZETF 46 1504.			
ANIKINA	64	JETP 19 42	M.K. Anikina *et al.*	(GEOR, JINR)	REFID=11141
		Translated from ZETF 46 59.			
FITCH	61	NC 22 1160	V.L. Fitch, P.A. Piroue, R.B. Perkins	(PRIN+)	REFID=11124
GOOD	61	PR 124 1223	R.H. Good *et al.*	(LRL)	REFID=11125

OTHER RELATED PAPERS

HAYAKAWA	93	PR D48 1150	M. Hayakawa, A.I. Sanda	(NAGO)	REFID=43448
"Searching for T, CP, CPT, $\Delta S = \Delta Q$ Rule Violations in the Neutral K Meson System: A Guide"					
LITTENBERG	93	ARNPS 43 729	L.S. Littenberg, G. Valencia	(BNL, FNAL)	REFID=43652
Rare and Radiative Kaon Decays					
RITCHIE	93	RMP 65 1149	J.L. Ritchie, S.G. Wojcicki		REFID=43622
"Rare K Decays"					
WINSTEIN	93	RMP 65 1113	B. Winstein, L. Wolfenstein		REFID=43621
"The Search for Direct CP Violation"					
BATTISTON	92	PRPL 214 293	R. Battiston *et al.*	(PGIA, CERN, TRSTT)	REFID=42063
Status and Perspectives of K Decay Physics					
DIB	92	PR D46 2265	C.O. Dib, R.D. Peccei	(UCLA)	REFID=42104
Tests of CPT conservation in the neutral kaon system.					
KLEINKNECHT	92	CNPP 20 281	K. Kleinknecht	(MAINZ)	REFID=41925
New Results on CP Violation in Decays of Neutral K Mesons.					
KLEINKNECHT	90	ZPHY C46 S57	K. Kleinknecht	(MAINZ)	REFID=41226
PEACH	90	JP G16 131	K.J. Peach	(EDIN)	REFID=41279
BRYMAN	89	IJMP A4 79	D.A. Bryman	(TRIU)	REFID=40709
"Rare Kaon Decays"					
KLEINKNECHT	76	ARNS 26 1	K. Kleinknecht	(DORT)	REFID=11429
GINSBERG	73	PR D8 3887	E.S. Ginsberg, J. Smith	(MIT, STON)	REFID=11428
GINSBERG	70	PR D1 229	E.S. Ginsberg	(HAIF)	REFID=11036
HEUSSE	70	LNC 3 449	P. Heusse *et al.*	(ORSAY)	REFID=11427
CRONIN	68C	Vienna Conf. 281	J.W. Cronin	(PRIN)	REFID=11424
RUBBIA	67	PL 24B 531	C. Rubbia, J. Steinberger	(CERN, COLU)	REFID=11419
Also		PL 23 167	C. Rubbia, J. Steinberger	(CERN, COLU)	REFID=11422
Also		PL 20 207	C. Alff-Steinberger *et al.*	(CERN)	REFID=11420
Also		PL 21 595	C. Alff-Steinberger *et al.*	(CERN)	REFID=11421
AUERBACH	66	PR 149 1052	L.B. Auerbach *et al.*	(PENN)	REFID=11061
Also		PRL 14 192	L.B. Auerbach *et al.*	(PENN)	REFID=11062
FIRESTONE	66B	PRL 17 116	A. Firestone *et al.*	(YALE, BNL)	REFID=11178
BEHR	65	Argonne Conf. 59	L. Behr *et al.*	(EPOL, MILA, PADO)	REFID=11415
MESTVIRISH...	65	JINR P 2449	A.N. Mestvirishvili *et al.*	(JINR)	REFID=11416
TRILLING	65B	UCRL 16473	G.N. Trilling	(LRL)	REFID=10887
Updated from 1965 Argonne Conference, page 115.					
JOVANOV...	63	BNL Conf. 42	J.V. Jovanovich *et al.*	(BNL, UMD)	REFID=11413