$K^{\pm}$

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

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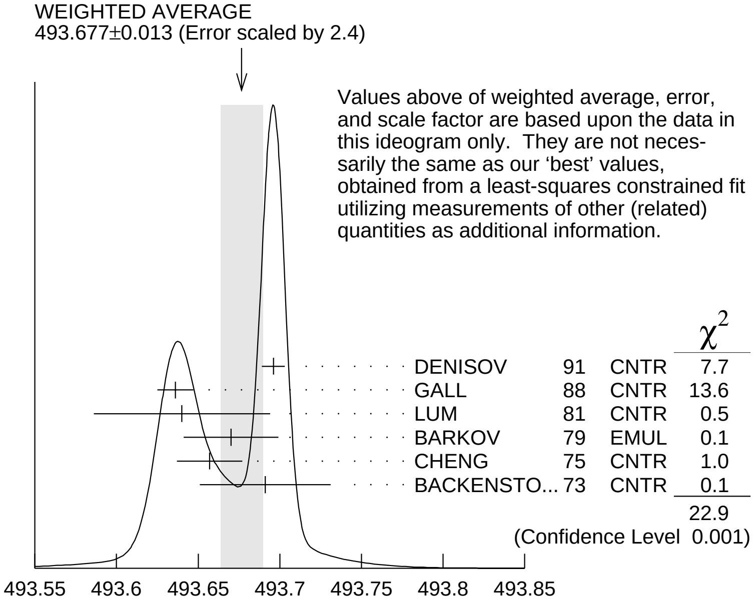
$K^{\pm}$ MASS

VALUE (MeV)	DOCUMENT ID		TECN	CHG	COMMENT
493.677±0.016 OUR FIT	Error includes scale factor of 2.8.				
493.677±0.013 OUR AVERAGE	Error includes scale factor of 2.4. See the ideogram below.				
493.696±0.007	[1] DENISOV	91	CNTR	−	Kaonic atoms
493.636±0.011	[2] GALL	88	CNTR	−	Kaonic atoms
493.640±0.054	LUM	81	CNTR	−	Kaonic atoms
493.670±0.029	BARKOV	79	EMUL	±	$e^+ e^- \rightarrow K^+ K^-$
493.657±0.020	[2] CHENG	75	CNTR	−	Kaonic atoms
493.691±0.040	BACKENSTO...	73	CNTR	−	Kaonic atoms
• • • We do not use the following data for averages, fits, limits, etc. • • •					
493.631±0.007	GALL	88	CNTR	−	K^- Pb (9→ 8)
493.675±0.026	GALL	88	CNTR	−	K^- Pb (11→ 10)
493.709±0.073	GALL	88	CNTR	−	K^- W (9→ 8)
493.806±0.095	GALL	88	CNTR	−	K^- W (11→ 10)
493.640±0.022±0.008	[3] CHENG	75	CNTR	−	K^- Pb (9→ 8)
493.658±0.019±0.012	[3] CHENG	75	CNTR	−	K^- Pb (10→ 9)
493.638±0.035±0.016	[3] CHENG	75	CNTR	−	K^- Pb (11→ 10)
493.753±0.042±0.021	[3] CHENG	75	CNTR	−	K^- Pb (12→ 11)
493.742±0.081±0.027	[3] CHENG	75	CNTR	−	K^- Pb (13→ 12)
493.662±0.19	KUNSELMAN	74	CNTR	−	Kaonic atoms
493.78 ±0.17	GREINER	65	EMUL	+	
493.7 ±0.3	BARKAS	63	EMUL	−	
493.9 ±0.2	COHEN	57	RVUE	+	

[1] Error increased from 0.0059 based on the error analysis in IVANOV 92.

[2] This value is the authors' combination of all of the separate transitions listed for this paper.

[3] The CHENG 75 values for separate transitions were calculated from their Table 7 transition energies. The first error includes a 20% systematic error in the noncircular contaminant shift. The second error is due to a ±5 eV uncertainty in the theoretical transition energies.



$m_{K^\pm}$ (MeV)

$m_{K^+} - m_{K^-}$

Test of *CPT*.

VALUE (MeV)	*EVTS*	*DOCUMENT ID*		*TECN*	*CHG*
−0.032±0.090	1.5M	[4] FORD	72	ASPK	±

[4] FORD 72 uses $m_{\pi^+} - m_{\pi^-} = +28 \pm 70$ keV.

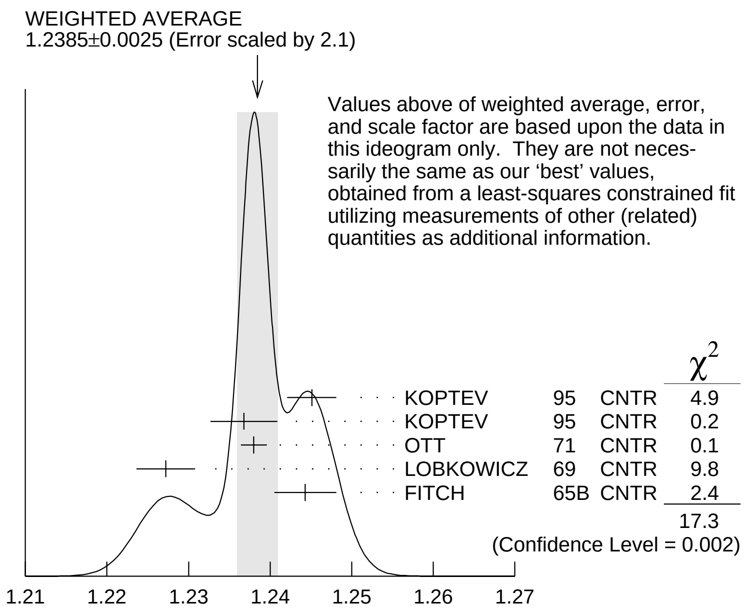
$K^\pm$ MEAN LIFE

VALUE (10^{-8} s)	*EVTS*	*DOCUMENT ID*		*TECN*	*CHG*	*COMMENT*
1.2386±0.0024 OUR FIT Error includes scale factor of 2.0.						
1.2385±0.0025 OUR AVERAGE Error includes scale factor of 2.1. See the ideogram below.						
1.2451±0.0030	250k	KOPTEV	95	CNTR		*K* at rest, U target
1.2368±0.0041	150k	KOPTEV	95	CNTR		*K* at rest, Cu target
1.2380±0.0016	3M	OTT	71	CNTR	+	*K* at rest
1.2272±0.0036		LOBKOWICZ	69	CNTR	+	*K* in flight
1.2443±0.0038		FITCH	65B	CNTR	+	*K* at rest

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

1.2415±0.0024	400k	[5] KOPTEV	95	CNTR		K at rest
1.221 ±0.011		FORD	67	CNTR	±	
1.231 ±0.011		BOYARSKI	62	CNTR	+	
1.25 $^{+0.22}_{-0.17}$		BARKAS	61	EMUL		
1.27 $^{+0.36}_{-0.23}$	51	BHOWMIK	61	EMUL		
1.31 ±0.08	293	NORDIN	61	HBC	−	
1.24 ±0.07		NORDIN	61	RVUE	−	
1.38 ±0.24	33	FREDEN	60B	EMUL		
1.21 ±0.06		BURROWES	59	CNTR		
1.60 ±0.3	52	EISENBERG	58	EMUL		
0.95 $^{+0.36}_{-0.25}$		ILOFF	56	EMUL		

[5] KOPTEV 95 report this weighted average of their U-target and Cu-target results, where they have weighted by $1/\sigma$ rather than $1/\sigma^2$.



$K^{\pm}$ mean life (10^{-8} s)

$(\tau_{K^+} - \tau_{K^-})\ /\ \tau_{\text{average}}$

This quantity is a measure of *CPT* invariance in weak interactions.

VALUE (%)	*DOCUMENT ID*		*TECN*
0.11 ±0.09 OUR AVERAGE	Error includes scale factor of 1.2.		
0.090±0.078	LOBKOWICZ	69	CNTR
0.47 ±0.30	FORD	67	CNTR

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K^+ DECAY MODES

K^- modes are charge conjugates of the modes below.

	Mode		Fraction (Γ_i/Γ)	Scale factor/ Confidence level
Γ_1	$\mu^+\nu_\mu$		(63.51 ± 0.18) %	S=1.3
Γ_2	$e^+\nu_e$		$(1.55\pm0.07)\times10^{-5}$	
Γ_3	$\pi^+\pi^0$		(21.16 ± 0.14) %	S=1.1
Γ_4	$\pi^+\pi^+\pi^-$		(5.59 ± 0.05) %	S=1.8
Γ_5	$\pi^+\pi^0\pi^0$		(1.73 ± 0.04) %	S=1.2
Γ_6	$\pi^0\mu^+\nu_\mu$ Called $K^+_{\mu3}$.		(3.18 ± 0.08) %	S=1.5
Γ_7	$\pi^0 e^+\nu_e$ Called K^+_{e3}.		(4.82 ± 0.06) %	S=1.3
Γ_8	$\pi^0\pi^0 e^+\nu_e$		$(2.1\pm0.4)\times10^{-5}$	
Γ_9	$\pi^+\pi^- e^+\nu_e$		$(3.91\pm0.17)\times10^{-5}$	
Γ_{10}	$\pi^+\pi^-\mu^+\nu_\mu$		$(1.4\pm0.9)\times10^{-5}$	
Γ_{11}	$\pi^0\pi^0\pi^0 e^+\nu_e$		$< 3.5\times10^{-6}$	CL=90%
Γ_{12}	$\pi^+\gamma\gamma$	[a]	$(1.10\pm0.32)\times10^{-6}$	
Γ_{13}	$\pi^+ 3\gamma$	[a]	$< 1.0\times10^{-4}$	CL=90%
Γ_{14}	$\mu^+\nu_\mu\nu\overline{\nu}$		$< 6.0\times10^{-6}$	CL=90%
Γ_{15}	$e^+\nu_e\nu\overline{\nu}$		$< 6\times10^{-5}$	CL=90%
Γ_{16}	$\mu^+\nu_\mu e^+e^-$		$(1.3\pm0.4)\times10^{-7}$	
Γ_{17}	$e^+\nu_e e^+e^-$		$(3.0^{+3.0}_{-1.5})\times10^{-8}$	
Γ_{18}	$e^+\nu_e\mu^+\mu^-$		$< 5\times10^{-7}$	CL=90%
Γ_{19}	$\mu^+\nu_\mu\mu^+\mu^-$		$< 4.1\times10^{-7}$	CL=90%
Γ_{20}	$\mu^+\nu_\mu\gamma$	[a,b]	$(5.50\pm0.28)\times10^{-3}$	
Γ_{21}	$\pi^+\pi^0\gamma$	[a,b]	$(2.75\pm0.15)\times10^{-4}$	
Γ_{22}	$\pi^+\pi^0\gamma$(DE)	[a,c]	$(1.8\pm0.4)\times10^{-5}$	
Γ_{23}	$\pi^+\pi^+\pi^-\gamma$	[a,b]	$(1.04\pm0.31)\times10^{-4}$	
Γ_{24}	$\pi^+\pi^0\pi^0\gamma$	[a,b]	$(7.5^{+5.5}_{-3.0})\times10^{-6}$	
Γ_{25}	$\pi^0\mu^+\nu_\mu\gamma$	[a,b]	$< 6.1\times10^{-5}$	CL=90%
Γ_{26}	$\pi^0 e^+\nu_e\gamma$	[a,b]	$(2.62\pm0.20)\times10^{-4}$	
Γ_{27}	$\pi^0 e^+\nu_e\gamma$(SD)	[d]	$< 5.3\times10^{-5}$	CL=90%
Γ_{28}	$\pi^0\pi^0 e^+\nu_e\gamma$		$< 5\times10^{-6}$	CL=90%

Lepton Family number (*LF*), Lepton number (*L*), $\Delta S = \Delta Q$ (*SQ*) violating modes, or $\Delta S = 1$ weak neutral current (*S1*) modes

Γ_{29}	$\pi^+ \pi^+ e^- \overline{\nu}_e$	*SQ*	$<$ 1.2	$\times 10^{-8}$	CL=90%
Γ_{30}	$\pi^+ \pi^+ \mu^- \overline{\nu}_\mu$	*SQ*	$<$ 3.0	$\times 10^{-6}$	CL=95%
Γ_{31}	$\pi^+ e^+ e^-$	*S1*	(2.74$\pm$0.23)	$\times 10^{-7}$	
Γ_{32}	$\pi^+ \mu^+ \mu^-$	*S1*	(5.0 $\pm$1.0)	$\times 10^{-8}$	
Γ_{33}	$\pi^+ \nu \overline{\nu}$	*S1*	($4.2\ ^{+9.7}_{-3.5}$)	$\times 10^{-10}$	
Γ_{34}	$\mu^- \nu e^+ e^+$	*LF*	$<$ 2.0	$\times 10^{-8}$	CL=90%
Γ_{35}	$\mu^+ \nu_e$	*LF*	[*e*] $<$ 4	$\times 10^{-3}$	CL=90%
Γ_{36}	$\pi^+ \mu^+ e^-$	*LF*	$<$ 2.1	$\times 10^{-10}$	CL=90%
Γ_{37}	$\pi^+ \mu^- e^+$	*LF*	$<$ 7	$\times 10^{-9}$	CL=90%
Γ_{38}	$\pi^- \mu^+ e^+$	*L*	$<$ 7	$\times 10^{-9}$	CL=90%
Γ_{39}	$\pi^- e^+ e^+$	*L*	$<$ 1.0	$\times 10^{-8}$	CL=90%
Γ_{40}	$\pi^- \mu^+ \mu^+$	*L*	[*e*] $<$ 1.5	$\times 10^{-4}$	CL=90%
Γ_{41}	$\mu^+ \overline{\nu}_e$	*L*	[*e*] $<$ 3.3	$\times 10^{-3}$	CL=90%
Γ_{42}	$\pi^0 e^+ \overline{\nu}_e$	*L*	$<$ 3	$\times 10^{-3}$	CL=90%
Γ_{43}	$\pi^+ \gamma$				

[*a*] See the Particle Listings below for the energy limits used in this measurement.

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

[*c*] Direct-emission branching fraction.

[*d*] Structure-dependent part.

[*e*] Derived from an analysis of neutrino-oscillation experiments.

CONSTRAINED FIT INFORMATION

An overall fit to the mean life, 2 decay rate, and 20 branching ratios uses 60 measurements and one constraint to determine 8 parameters. The overall fit has a $\chi^2 = 78.1$ for 53 degrees of freedom.

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

x_3	−58						
x_4	−41	−12					
x_5	−27	−4	21				
x_6	−48	−17	14	2			
x_7	−50	−16	34	6	39		
x_8	−3	−1	2	0	2	6	
Γ	7	2	−18	−4	−2	−6	0
	x_1	x_3	x_4	x_5	x_6	x_7	x_8

	Mode	Rate (10^8 s^{-1})	Scale factor
Γ_1	$\mu^+ \nu_\mu$	0.5128 ±0.0018	1.5
Γ_3	$\pi^+ \pi^0$	0.1708 ±0.0012	1.1
Γ_4	$\pi^+ \pi^+ \pi^-$	0.0452 ±0.0004	1.8
Γ_5	$\pi^+ \pi^0 \pi^0$	0.01399±0.00032	1.2
Γ_6	$\pi^0 \mu^+ \nu_\mu$ Called $K^+_{\mu3}$.	0.0257 ±0.0006	1.5
Γ_7	$\pi^0 e^+ \nu_e$ Called K^+_{e3}.	0.0389 ±0.0005	1.3
Γ_8	$\pi^0 \pi^0 e^+ \nu_e$	$(1.69 \ ^{+0.34}_{-0.29}) \times 10^{-5}$	

$K^\pm$ DECAY RATES

$\Gamma(\mu^+ \nu_\mu)$ — Γ_1

VALUE (10^6 s^{-1})	*DOCUMENT ID*		*TECN*	*CHG*
51.28±0.18 OUR FIT Error includes scale factor of 1.5.				
51.2 ±0.8	FORD	67	CNTR	±

$\Gamma(\pi^+ \pi^+ \pi^-)$ — Γ_4

VALUE (10^6 s^{-1})	*EVTS*	*DOCUMENT ID*		*TECN*	*CHG*
4.52 ±0.04 OUR FIT Error includes scale factor of 1.8.					
4.511±0.024		[6] FORD	70	ASPK	

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

4.529±0.032	3.2M	[6] FORD	70	ASPK		
4.496±0.030		[6] FORD	67	CNTR	±	

[6] First FORD 70 value is second FORD 70 combined with FORD 67.

$(\Gamma(K^+) - \Gamma(K^-)) / \Gamma(K)$

$K^\pm \rightarrow \mu^\pm \nu_\mu$ RATE DIFFERENCE/AVERAGE

Test of *CPT* conservation.

VALUE (%)	*DOCUMENT ID*		*TECN*
−0.54±0.41	FORD	67	CNTR

$K^\pm \rightarrow \pi^\pm \pi^+ \pi^-$ RATE DIFFERENCE/AVERAGE

Test of *CP* conservation.

VALUE (%)	*EVTS*	*DOCUMENT ID*		*TECN*	*CHG*
0.07±0.12 OUR AVERAGE					
0.08±0.12		[7] FORD	70	ASPK	
−0.50±0.90		FLETCHER	67	OSPK	
• • • We do not use the following data for averages, fits, limits, etc. • • •					
−0.02±0.16		[8] SMITH	73	ASPK	±
0.10±0.14	3.2M	[7] FORD	70	ASPK	
−0.04±0.21		[7] FORD	67	CNTR	

[7] First FORD 70 value is second FORD 70 combined with FORD 67.
[8] SMITH 73 value of $K^\pm \rightarrow \pi^\pm \pi^+ \pi^-$ rate difference is derived from SMITH 73 value of $K^\pm \rightarrow \pi^\pm 2\pi^0$ rate difference.

$K^\pm \rightarrow \pi^\pm \pi^0 \pi^0$ RATE DIFFERENCE/AVERAGE

Test of *CP* conservation.

VALUE (%)	*EVTS*	*DOCUMENT ID*		*TECN*	*CHG*
0.0 ±0.6 OUR AVERAGE					
0.08±0.58		SMITH	73	ASPK	±
−1.1 ±1.8	1802	HERZO	69	OSPK	

$K^\pm \rightarrow \pi^\pm \pi^0$ RATE DIFFERENCE/AVERAGE

Test of *CPT* conservation.

VALUE (%)	*DOCUMENT ID*		*TECN*
0.8±1.2	HERZO	69	OSPK

$K^\pm \rightarrow \pi^\pm \pi^0 \gamma$ RATE DIFFERENCE/AVERAGE

Test of *CP* conservation.

VALUE (%)	*EVTS*	*DOCUMENT ID*		*TECN*	*CHG*	*COMMENT*
0.9± 3.3 OUR AVERAGE						
0.8± 5.8	2461	SMITH	76	WIRE	±	E_π 55–90 MeV
1.0± 4.0	4000	ABRAMS	73B	ASPK	±	E_π 51–100 MeV
0.0±24.0	24	EDWARDS	72	OSPK		E_π 58–90 MeV

K^+ BRANCHING RATIOS

$\Gamma(\mu^+\nu_\mu)/\Gamma_{total}$ — Γ_1/Γ

VALUE (units 10^{-2})	EVTS	DOCUMENT ID		TECN	CHG	COMMENT
63.51±0.18 OUR FIT	Error includes scale factor of 1.3.					
63.24±0.44	62k	CHIANG	72	OSPK	+	1.84 GeV/c K^+
• • • We do not use the following data for averages, fits, limits, etc. • • •						
56.9 ±2.6		[9] ALEXANDER	57	EMUL	+	
58.5 ±3.0		[9] BIRGE	56	EMUL	+	

[9] Old experiments not included in averaging.

$\Gamma(\mu^+\nu_\mu)/\Gamma(\pi^+\pi^+\pi^-)$ — Γ_1/Γ_4

VALUE	EVTS	DOCUMENT ID		TECN	CHG
11.35±0.12 OUR FIT	Error includes scale factor of 1.8.				
• • • We do not use the following data for averages, fits, limits, etc. • • •					
10.38±0.82	427	[10] YOUNG	65	EMUL	+

[10] Deleted from overall fit because YOUNG 65 constrains his results to add up to 1. Only YOUNG 65 measured $(\mu\nu)$ directly.

$\Gamma(e^+\nu_e)/\Gamma_{total}$ — Γ_2/Γ

VALUE (units 10^{-5})	CL%	EVTS	DOCUMENT ID		TECN	CHG
• • • We do not use the following data for averages, fits, limits, etc. • • •						
$2.1^{+1.8}_{-1.3}$		4	BOWEN	67B	OSPK	+
<160.0	95		BORREANI	64	HBC	+

$\Gamma(e^+\nu_e)/\Gamma(\mu^+\nu_\mu)$ — Γ_2/Γ_1

VALUE (units 10^{-5})	EVTS	DOCUMENT ID		TECN	CHG
2.45±0.11 OUR AVERAGE					
2.51±0.15	404	HEINTZE	76	SPEC	+
2.37±0.17	534	HEARD	75B	SPEC	+
2.42±0.42	112	CLARK	72	OSPK	+
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$1.8^{+0.8}_{-0.6}$	8	MACEK	69	ASPK	+
$1.9^{+0.7}_{-0.5}$	10	BOTTERILL	67	ASPK	+

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

VALUE (units 10^{-2})	EVTS	DOCUMENT ID		TECN	CHG	COMMENT
21.16±0.14 OUR FIT	Error includes scale factor of 1.1.					
21.18±0.28	16k	CHIANG	72	OSPK	+	1.84 GeV/c K^+
• • • We do not use the following data for averages, fits, limits, etc. • • •						
21.0 ±0.6		CALLAHAN	65	HLBC		See $\Gamma(\pi^+\pi^0)/\Gamma(\pi^+\pi^+\pi^-)$
21.6 ±0.6		TRILLING	65B	RVUE		
23.2 ±2.2		[11] ALEXANDER	57	EMUL	+	
27.7 ±2.7		[11] BIRGE	56	EMUL	+	

[11] Earlier experiments not averaged.

$\Gamma(\pi^+\pi^0)/\Gamma(\mu^+\nu_\mu)$ — Γ_3/Γ_1

VALUE	EVTS	DOCUMENT ID		TECN	CHG	COMMENT
0.3331±0.0028 OUR FIT Error includes scale factor of 1.1.						
0.3316±0.0032 OUR AVERAGE						
0.3329±0.0047±0.0010	45k	USHER	92	SPEC	+	$p\overline{p}$ at rest
0.3355±0.0057		[12] WEISSENBE...	76	SPEC	+	
0.305 ±0.018	1600	ZELLER	69	ASPK	+	
0.3277±0.0065	4517	[13] AUERBACH	67	OSPK	+	
• • • We do not use the following data for averages, fits, limits, etc. • • •						
0.328 ±0.005	25k	[12] WEISSENBE...	74	STRC	+	

[12] WEISSENBERG 76 revises WEISSENBERG 74.
[13] AUERBACH 67 changed from 0.3253 ± 0.0065. See comment with ratio $\Gamma(\pi^0\mu^+\nu_\mu)/\Gamma(\mu^+\nu_\mu)$.

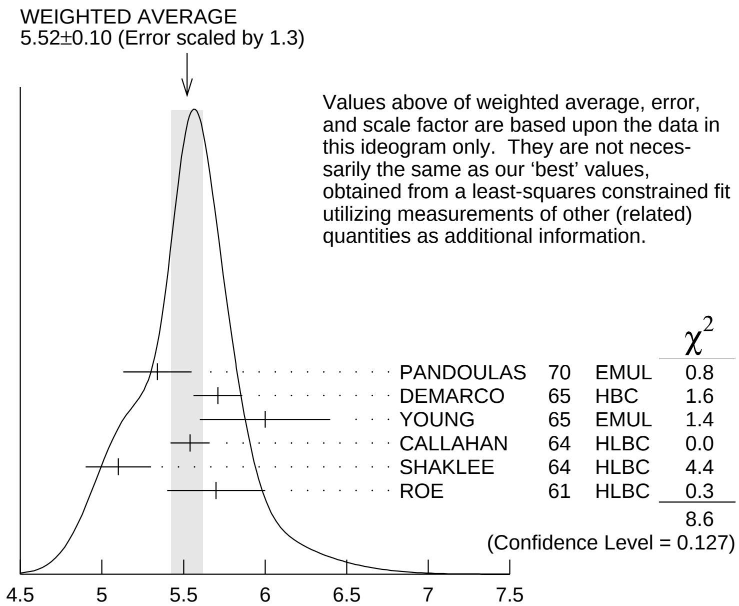
$\Gamma(\pi^+\pi^0)/\Gamma(\pi^+\pi^+\pi^-)$ — Γ_3/Γ_4

VALUE	EVTS	DOCUMENT ID		TECN	CHG
3.78±0.04 OUR FIT Error includes scale factor of 1.5.					
3.84±0.27 OUR AVERAGE Error includes scale factor of 1.9.					
3.96±0.15	1045	CALLAHAN	66	FBC	+
3.24±0.34	134	YOUNG	65	EMUL	+

$\Gamma(\pi^+\pi^+\pi^-)/\Gamma_{total}$ — Γ_4/Γ

VALUE (units 10^{-2})	EVTS	DOCUMENT ID		TECN	CHG	COMMENT
5.59±0.05 OUR FIT Error includes scale factor of 1.8.						
5.52±0.10 OUR AVERAGE Error includes scale factor of 1.3. See the ideogram below.						
5.34±0.21	693	[14] PANDOULAS	70	EMUL	+	
5.71±0.15		DEMARCO	65	HBC		
6.0 ±0.4	44	YOUNG	65	EMUL	+	
5.54±0.12	2332	CALLAHAN	64	HLBC	+	
5.1 ±0.2	540	SHAKLEE	64	HLBC	+	
5.7 ±0.3		ROE	61	HLBC	+	
• • • We do not use the following data for averages, fits, limits, etc. • • •						
5.56±0.20	2330	[15] CHIANG	72	OSPK	+	1.84 GeV/c K^+
5.2 ±0.3		[16] TAYLOR	59	EMUL	+	
6.8 ±0.4		[16] ALEXANDER	57	EMUL	+	
5.6 ±0.4		[16] BIRGE	56	EMUL	+	

[14] Includes events of TAYLOR 59.
[15] Value is not independent of CHIANG 72 $\Gamma(\mu^+\nu_\mu)/\Gamma_{total}$, $\Gamma(\pi^+\pi^0)/\Gamma_{total}$, $\Gamma(\pi^+\pi^0\pi^0)/\Gamma_{total}$, $\Gamma(\pi^0\mu^+\nu_\mu)/\Gamma_{total}$, and $\Gamma(\pi^0 e^+\nu_e)/\Gamma_{total}$.
[16] Earlier experiments not averaged.

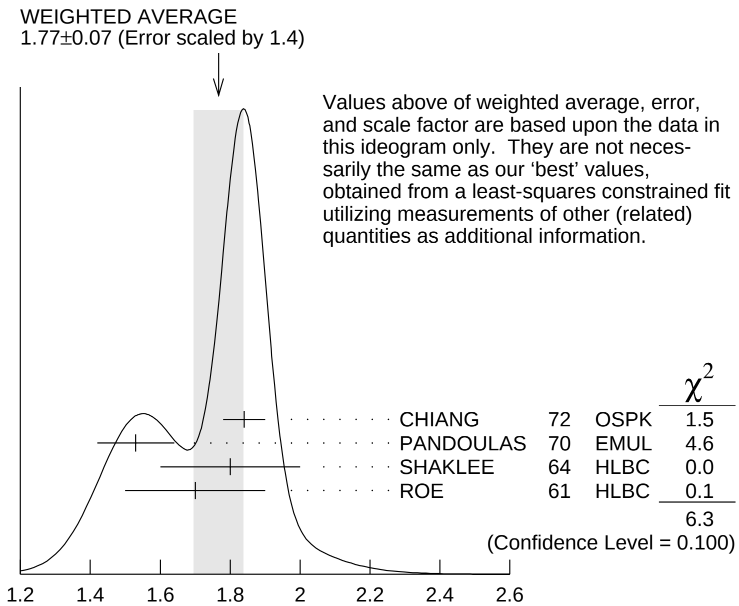


$\Gamma\left(\pi^+\pi^+\pi^-\right)/\Gamma_{total}$ (units 10^{-2})

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

VALUE (units 10^{-2})	*EVTS*	*DOCUMENT ID*		*TECN*	*CHG*	*COMMENT*
1.73±0.04 OUR FIT	Error includes scale factor of 1.2.					
1.77±0.07 OUR AVERAGE	Error includes scale factor of 1.4. See the ideogram below.					
1.84±0.06	1307	CHIANG	72	OSPK	+	1.84 GeV/c K^+
1.53±0.11	198	[17] PANDOULAS	70	EMUL	+	
1.8 ±0.2	108	SHAKLEE	64	HLBC	+	
1.7 ±0.2		ROE	61	HLBC	+	
• • • We do not use the following data for averages, fits, limits, etc. • • •						
1.5 ±0.2		[18] TAYLOR	59	EMUL	+	
2.2 ±0.4		[18] ALEXANDER	57	EMUL	+	
2.1 ±0.5		[18] BIRGE	56	EMUL	+	

[17] Includes events of TAYLOR 59.
[18] Earlier experiments not averaged.



$\Gamma\left(\pi^+\pi^0\pi^0\right)/\Gamma_{total}$ (units 10^{-2})

$\Gamma(\pi^+\pi^0\pi^0)/\Gamma(\pi^+\pi^0)$ — Γ_5/Γ_3

VALUE	EVTS	DOCUMENT ID		TECN	CHG	COMMENT
0.0819±0.0020 OUR FIT Error includes scale factor of 1.2.						
0.081 ±0.005	574	[19] LUCAS	73B	HBC	−	Dalitz pairs only

[19] LUCAS 73B gives N($\pi 2\pi^0$) = 574 ± 5.9%, N(2π) = 3564 ± 3.1%. We quote 0.5N($\pi 2\pi^0$)/N(2π) where 0.5 is because only Dalitz pair π^0's were used.

$\Gamma(\pi^+\pi^0\pi^0)/\Gamma(\pi^+\pi^+\pi^-)$ — Γ_5/Γ_4

VALUE	EVTS	DOCUMENT ID		TECN	CHG	COMMENT
0.310±0.007 OUR FIT Error includes scale factor of 1.2.						
0.304±0.009 OUR AVERAGE						
0.303±0.009	2027	BISI	65	BC	+	HBC+HLBC
0.393±0.099	17	YOUNG	65	EMUL	+	

$\Gamma(\pi^0\mu^+\nu_\mu)/\Gamma_{total}$ — Γ_6/Γ

VALUE (units 10^{-2})	EVTS	DOCUMENT ID		TECN	CHG	COMMENT
3.18±0.08 OUR FIT Error includes scale factor of 1.5.						
3.33±0.16	2345	CHIANG	72	OSPK	+	1.84 GeV/c K^+
• • • We do not use the following data for averages, fits, limits, etc. • • •						
2.8 ±0.4		[20] TAYLOR	59	EMUL	+	
5.9 ±1.3		[20] ALEXANDER	57	EMUL	+	
2.8 ±1.0		[20] BIRGE	56	EMUL	+	

[20] Earlier experiments not averaged.

$\Gamma(\pi^0\mu^+\nu_\mu)/\Gamma(\mu^+\nu_\mu)$ Γ_6/Γ_1

VALUE	EVTS	DOCUMENT ID		TECN	CHG
0.0501±0.0013 OUR FIT Error includes scale factor of 1.5.					
0.0488±0.0026 OUR AVERAGE					
0.054 ±0.009	240	ZELLER	69	ASPK	+
0.0480±0.0037	424	[21] GARLAND	68	OSPK	+
0.0486±0.0040	307	[22] AUERBACH	67	OSPK	+

[21] GARLAND 68 changed from 0.055 ± 0.004 in agreement with μ-spectrum calculation of GAILLARD 70 appendix B. L.G.Pondrom, (private communication 73).

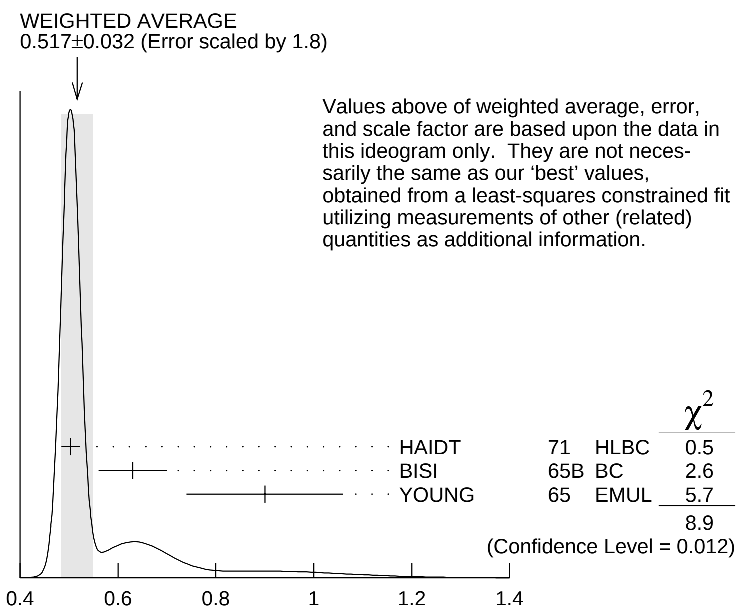
[22] AUERBACH 67 changed from 0.0602 ± 0.0046 by erratum which brings the μ-spectrum calculation into agreement with GAILLARD 70 appendix B.

$\Gamma(\pi^0\mu^+\nu_\mu)/\Gamma(\pi^+\pi^+\pi^-)$ Γ_6/Γ_4

VALUE	EVTS	DOCUMENT ID		TECN	CHG	COMMENT
0.569±0.014 OUR FIT Error includes scale factor of 1.5.						
0.517±0.032 OUR AVERAGE Error includes scale factor of 1.8. See the ideogram below.						
0.503±0.019	1505	[23] HAIDT	71	HLBC	+	
0.63 ±0.07	2845	[24] BISI	65B	BC	+	HBC+HLBC
0.90 ±0.16	38	YOUNG	65	EMUL	+	
• • • We do not use the following data for averages, fits, limits, etc. • • •						
0.510±0.017	1505	[23] EICHTEN	68	HLBC	+	

[23] HAIDT 71 is a reanalysis of EICHTEN 68.

[24] Error enlarged for background problems. See GAILLARD 70.



$\Gamma\left(\pi^0\mu^+\nu_\mu\right)/\Gamma\left(\pi^+\pi^+\pi^-\right)$

$\Gamma(\pi^0\mu^+\nu_\mu)/\Gamma(\pi^0 e^+\nu_e)$ — Γ_6/Γ_7

VALUE	EVTS	DOCUMENT ID		TECN	CHG	COMMENT
0.660±0.015 OUR FIT	Error includes scale factor of 1.5.					
0.680±0.013 OUR AVERAGE						
0.705±0.063	554	[25] LUCAS	73B	HBC	−	Dalitz pairs only
0.698±0.025	3480	[26] CHIANG	72	OSPK	+	1.84 GeV/c K^+
0.667±0.017	5601	BOTTERILL	68B	ASPK	+	
0.703±0.056	1509	[27] CALLAHAN	66B	HLBC		
• • • We do not use the following data for averages, fits, limits, etc. • • •						
0.670±0.014		[28] HEINTZE	77	SPEC	+	
0.67 ±0.12		WEISSENBE...	76	SPEC	+	
0.608±0.014	1585	[29] BRAUN	75	HLBC	+	
0.596±0.025		[30] HAIDT	71	HLBC	+	
0.604±0.022	1398	[30] EICHTEN	68	HLBC		

[25] LUCAS 73B gives N($K_{\mu3}$) = 554 ± 7.6%, N(K_{e3}) = 786 ± 3.1%. We divide.

[26] CHIANG 72 $\Gamma(\pi^0\mu^+\nu_\mu)/\Gamma(\pi^0 e^+\nu_e)$ is statistically independent of CHIANG 72 $\Gamma(\pi^0\mu^+\nu_\mu)/\Gamma_{total}$ and $\Gamma(\pi^0 e^+\nu_e)/\Gamma_{total}$.

[27] From CALLAHAN 66B we use only the $K_{\mu3}/K_{e3}$ ratio and do not include in the fit the ratios $K_{\mu3}/(\pi\pi^+\pi^0)$ and $K_{e3}/(\pi\pi^+\pi^0)$, since they show large disagreements with the rest of the data.

[28] HEINTZE 77 value from fit to λ_0. Assumes μ-e universality.

[29] BRAUN 75 value is from form factor fit. Assumes μ-e universality.

[30] HAIDT 71 is a reanalysis of EICHTEN 68. Only individual ratios included in fit (see $\Gamma(\pi^0\mu^+\nu_\mu)/\Gamma(\pi^+\pi^+\pi^-)$ and $\Gamma(\pi^0 e^+\nu_e)/\Gamma(\pi^+\pi^+\pi^-)$).

$\left[\Gamma(\pi^+\pi^0)+\Gamma(\pi^0\mu^+\nu_\mu)\right]/\Gamma_{total}$ — $(\Gamma_3+\Gamma_6)/\Gamma$

We combine these two modes for experiments measuring them in xenon bubble chamber because of difficulties of separating them there.

VALUE (units 10^{-2})	EVTS	DOCUMENT ID		TECN	CHG
24.34±0.15 OUR FIT	Error includes scale factor of 1.2.				
24.6 ±1.0 OUR AVERAGE	Error includes scale factor of 1.4.				
25.4 ±0.9	886	SHAKLEE	64	HLBC	+
23.4 ±1.1		ROE	61	HLBC	+

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

VALUE (units 10^{-2})	EVTS	DOCUMENT ID		TECN	CHG	COMMENT
4.82±0.06 OUR FIT	Error includes scale factor of 1.3.					
4.85±0.09 OUR AVERAGE						
4.86±0.10	3516	CHIANG	72	OSPK	+	1.84 GeV/c K^+
4.7 ±0.3	429	SHAKLEE	64	HLBC	+	
5.0 ±0.5		ROE	61	HLBC	+	
• • • We do not use the following data for averages, fits, limits, etc. • • •						
5.1 ±1.3		[31] ALEXANDER	57	EMUL	+	
3.2 ±1.3		[31] BIRGE	56	EMUL	+	

[31] Earlier experiments not averaged.

$\Gamma(\pi^0 e^+ \nu_e)/\Gamma(\mu^+ \nu_\mu)$ — Γ_7/Γ_1

VALUE	EVTS	DOCUMENT ID		TECN	CHG
0.0759±0.0011 OUR FIT Error includes scale factor of 1.4.					
0.0752±0.0024 OUR AVERAGE					
0.069 ±0.006	350	ZELLER	69	ASPK	+
0.0775±0.0033	960	BOTTERILL	68C	ASPK	+
0.069 ±0.006	561	GARLAND	68	OSPK	+
0.0791±0.0054	295	[32] AUERBACH	67	OSPK	+

[32] AUERBACH 67 changed from 0.0797 ± 0.0054. See comment with ratio $\Gamma(\pi^0 \mu^+ \nu_\mu)/\Gamma(\mu^+ \nu_\mu)$. The value 0.0785 ± 0.0025 given in AUERBACH 67 is an average of AUERBACH 67 $\Gamma(\pi^0 e^+ \nu_e)/\Gamma(\mu^+ \nu_\mu)$ and CESTER 66 $\Gamma(\pi^0 e^+ \nu_e)/\left[\Gamma(\mu^+ \nu_\mu) + \Gamma(\pi^+ \pi^0)\right]$.

$\Gamma(\pi^0 e^+ \nu_e)/\Gamma(\pi^+ \pi^0)$ — Γ_7/Γ_3

VALUE	EVTS	DOCUMENT ID		TECN	CHG	COMMENT
0.2280±0.0035 OUR FIT Error includes scale factor of 1.3.						
0.221 ±0.012	786	[33] LUCAS	73B	HBC	−	Dalitz pairs only

[33] LUCAS 73B gives N(K_{e3}) = 786 ± 3.1%, N(2π) = 3564 ± 3.1%. We divide.

$\Gamma(\pi^0 e^+ \nu_e)/\Gamma(\pi^+ \pi^+ \pi^-)$ — Γ_7/Γ_4

VALUE	EVTS	DOCUMENT ID		TECN	CHG
0.862±0.011 OUR FIT Error includes scale factor of 1.3.					
0.860±0.014 OUR AVERAGE					
0.867±0.027	2768	BARMIN	87	XEBC	+
0.856±0.040	2827	BRAUN	75	HLBC	+
0.850±0.019	4385	[34] HAIDT	71	HLBC	+
0.94 ±0.09	854	BELLOTTI	67B	HLBC	
0.90 ±0.06	230	BORREANI	64	HBC	+
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.846±0.021	4385	[34] EICHTEN	68	HLBC	+
0.90 ±0.16	37	YOUNG	65	EMUL	+

[34] HAIDT 71 is a reanalysis of EICHTEN 68.

$\Gamma(\pi^0 e^+ \nu_e)/\left[\Gamma(\mu^+ \nu_\mu) + \Gamma(\pi^+ \pi^0)\right]$ — $\Gamma_7/(\Gamma_1+\Gamma_3)$

VALUE (units 10^{-2})	EVTS	DOCUMENT ID		TECN	CHG
5.70±0.08 OUR FIT Error includes scale factor of 1.4.					
6.01±0.15 OUR AVERAGE					
5.92±0.65		[35] WEISSENBE...	76	SPEC	+
6.16±0.22	5110	ESCHSTRUTH	68	OSPK	+
5.89±0.21	1679	CESTER	66	OSPK	+

[35] Value calculated from WEISSENBERG 76 ($\pi^0 e \nu$), ($\mu \nu$), and ($\pi \pi^0$) values to eliminate dependence on our 1974 ($\pi 2\pi^0$) and ($\pi \pi^+ \pi^-$) fractions.

$\Gamma(\pi^0\pi^0 e^+\nu_e)/\Gamma(\pi^0 e^+\nu_e)$ — Γ_8/Γ_7

VALUE (units 10^{-4})	CL%	EVTS	DOCUMENT ID		TECN	CHG
$4.3^{+0.9}_{-0.7}$ OUR FIT						
$4.1^{+1.0}_{-0.7}$ OUR AVERAGE						
$4.2^{+1.0}_{-0.9}$		25	BOLOTOV	86B	CALO	−
$3.8^{+5.0}_{-1.2}$		2	LJUNG	73	HLBC	+
• • • We do not use the following data for averages, fits, limits, etc. • • •						
<37.0	90	0	ROMANO	71	HLBC	+

$\Gamma(\pi^0\pi^0 e^+\nu_e)/\Gamma_{total}$ — Γ_8/Γ

VALUE (units 10^{-5})	EVTS	DOCUMENT ID		TECN	CHG
2.1 ±0.4 OUR FIT					
2.54±0.89	10	BARMIN	88B	HLBC	+

$\Gamma(\pi^+\pi^- e^+\nu_e)/\Gamma(\pi^+\pi^+\pi^-)$ — Γ_9/Γ_4

VALUE (units 10^{-4})	EVTS	DOCUMENT ID		TECN	CHG
6.99±0.30 OUR AVERAGE Error includes scale factor of 1.2.					
7.21±0.32	30k	ROSSELET	77	SPEC	+
7.36±0.68	500	BOURQUIN	71	ASPK	
7.0 ±0.9	106	SCHWEINB...	71	HLBC	+
5.83±0.63	269	ELY	69	HLBC	+
• • • We do not use the following data for averages, fits, limits, etc. • • •					
6.7 ±1.5	69	BIRGE	65	FBC	+

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

VALUE (units 10^{-5})	EVTS	DOCUMENT ID		TECN	CHG
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$0.77^{+0.54}_{-0.50}$	1	CLINE	65	FBC	+

$\Gamma(\pi^+\pi^-\mu^+\nu_\mu)/\Gamma(\pi^+\pi^+\pi^-)$ — Γ_{10}/Γ_4

VALUE (units 10^{-4})	EVTS	DOCUMENT ID		TECN	CHG
2.57±1.55	7	BISI	67	DBC	+
• • • We do not use the following data for averages, fits, limits, etc. • • •					
∼ 2.5	1	GREINER	64	EMUL	+

$\Gamma(\pi^0\pi^0\pi^0 e^+\nu_e)/\Gamma_{total}$ — Γ_{11}/Γ

VALUE (units 10^{-6})	CL%	EVTS	DOCUMENT ID		TECN	CHG
<3.5	90	0	BOLOTOV	88	SPEC	−
• • • We do not use the following data for averages, fits, limits, etc. • • •						
<9	90	0	BARMIN	92	XEBC	+

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

All values given here assume a phase space pion energy spectrum.

VALUE (units 10^{-7})	CL%	EVTS	DOCUMENT ID		TECN	CHG	COMMENT
11 ± 3 ±1		31	[36] KITCHING	97	B787		
• • • We do not use the following data for averages, fits, limits, etc. • • •							
< 10	90	0	ATIYA	90B	B787		$T\pi$ 117–127 MeV
< 84	90	0	ASANO	82	CNTR	+	$T\pi$ 117–127 MeV
−420 ±520		0	ABRAMS	77	SPEC	+	$T\pi$ <92 MeV
< 350	90	0	LJUNG	73	HLBC	+	6–102, 114–127 MeV
< 500	90	0	KLEMS	71	OSPK	+	$T\pi$ <117 MeV
−100 ±600			CHEN	68	OSPK	+	$T\pi$ 60–90 MeV

[36] KITCHING 97 is extrapolated from their model-independent branching fraction $(6.0 \pm 1.5 \pm 0.7) \times 10^{-7}$ for 100 MeV/c<P_{π^+} < 180 MeV/c using Chiral Perturbation Theory.

$\Gamma(\pi^+3\gamma)/\Gamma_{total}$ — Γ_{13}/Γ

Values given here assume a phase space pion energy spectrum.

VALUE (units 10^{-4})	CL%	DOCUMENT ID		TECN	CHG	COMMENT
<1.0	90	ASANO	82	CNTR	+	$T(\pi)$ 117–127 MeV
• • • We do not use the following data for averages, fits, limits, etc. • • •						
<3.0	90	KLEMS	71	OSPK	+	$T(\pi)$ >117 MeV

$\Gamma(\mu^+\nu_\mu\nu\overline{\nu})/\Gamma_{total}$ — Γ_{14}/Γ

VALUE (units 10^{-6})	CL%	EVTS	DOCUMENT ID		TECN	CHG
<6.0	90	0	[37] PANG	73	CNTR	+

[37] PANG 73 assumes μ spectrum from ν-ν interaction of BARDIN 70.

$\Gamma(e^+\nu_e\nu\overline{\nu})/\Gamma(e^+\nu_e)$ — Γ_{15}/Γ_2

VALUE	CL%	EVTS	DOCUMENT ID		TECN	CHG
<3.8	90	0	HEINTZE	79	SPEC	+

$\Gamma(\mu^+\nu_\mu e^+e^-)/\Gamma(\pi^+\pi^-e^+\nu_e)$ — Γ_{16}/Γ_9

VALUE (units 10^{-3})	EVTS	DOCUMENT ID		TECN	CHG	COMMENT
3.3±0.9	14	[38] DIAMANT-...	76	SPEC	+	$m_{e^+e^-}$ >140 MeV
• • • We do not use the following data for averages, fits, limits, etc. • • •						
27. ±8.	14	[38] DIAMANT-...	76	SPEC	+	Extrapolated BR

[38] DIAMANT-BERGER 76 gives this result times our 1975 $\pi^+\pi^-e\nu$ BR ratio. The second DIAMANT-BERGER 76 value is the first value extrapolated to 0 to include low mass e^+e^- pairs. More recent calculations (BIJNENS 93) of this extrapolation disagree with those of DIAMANT-BERGER 76.

$\Gamma(e^+ \nu_e e^+ e^-)/\Gamma(\pi^+ \pi^- e^+ \nu_e)$ — Γ_{17}/Γ_9

VALUE (units 10^{-3})	EVTS	DOCUMENT ID		TECN	CHG	COMMENT
$0.76^{+0.76}_{-0.38}$	4	[39] DIAMANT-...	76	SPEC	+	$m_{e^+e^-}$ >140 MeV
• • • We do not use the following data for averages, fits, limits, etc. • • •						
$5.4\ ^{+5.4}_{-2.7}$	4	[39] DIAMANT-...	76	SPEC	+	Extrapolated BR

[39] DIAMANT-BERGER 76 gives this result times our 1975 $\pi^+ \pi^- e \nu$ BR ratio. The second DIAMANT-BERGER 76 value is the first value extrapolated to 0 to include low mass $e^+ e^-$ pairs. More recent calculations (BIJNENS 93) of this extrapolation disagree with those of DIAMANT-BERGER 76.

$\Gamma(e^+ \nu_e \mu^+ \mu^-)/\Gamma_{total}$ — Γ_{18}/Γ

VALUE	CL%	DOCUMENT ID		TECN
$<5 \times 10^{-7}$	90	ADLER	98	B787

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

VALUE (units 10^{-7})	CL%	DOCUMENT ID		TECN	CHG
<4.1	90	ATIYA	89	B787	+

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

VALUE (units 10^{-3})	EVTS	DOCUMENT ID		TECN	CHG	COMMENT
5.50±0.28 OUR AVERAGE						
6.6 ±1.5		[40,41] DEMIDOV	90	XEBC		P(μ) <231.5 MeV/c
6.0 ±0.9		BARMIN	88	HLBC	+	P(μ) <231.5 MeV/c
5.4 ±0.3		[42] AKIBA	85	SPEC		P(μ) <231.5 MeV/c
• • • We do not use the following data for averages, fits, limits, etc. • • •						
3.5 ±0.8		[41,43] DEMIDOV	90	XEBC		E(γ) > 20 MeV
3.2 ±0.5	57	[44] BARMIN	88	HLBC	+	$E(\gamma)$ >20 MeV
5.8 ±3.5	12	WEISSENBE...	74	STRC	+	$E(\gamma)$ >9 MeV

[40] P(μ) cut given in DEMIDOV 90 paper, 235.1 MeV/c, is a misprint according to authors (private communication).
[41] DEMIDOV 90 quotes only inner bremsstrahlung (IB) part.
[42] Assumes μ-e universality and uses constraints from $K \rightarrow e \nu \gamma$.
[43] Not independent of above DEMIDOV 90 value. Cuts differ.
[44] Not independent of above BARMIN 88 value. Cuts differ.

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

VALUE (units 10^{-4})	CL%	EVTS	DOCUMENT ID		TECN	CHG	COMMENT
2.75±0.15 OUR AVERAGE							
2.71±0.45		140	BOLOTOV	87	WIRE	−	Tπ^- 55–90 MeV
2.87±0.32		2461	SMITH	76	WIRE	±	T$\pi^\pm$ 55–90 MeV
2.71±0.19		2100	ABRAMS	72	ASPK	±	Tπ^+ 55–90 MeV

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

$1.5\ ^{+1.1}_{-0.6}$			[45] LJUNG	73	HLBC	+	$T\pi^+$ 55–80 MeV
$2.6\ ^{+1.5}_{-1.1}$			[45] LJUNG	73	HLBC	+	$T\pi^+$ 55–90 MeV
$6.8\ ^{+3.7}_{-2.1}$		17	[45] LJUNG	73	HLBC	+	$T\pi^+$ 55–102 MeV
$2.4\ \pm0.8$		24	EDWARDS	72	OSPK		$T\pi^+$ 58–90 MeV
<1.0		0	[46] MALTSEV	70	HLBC	+	$T\pi^+$ $<$55 MeV
<1.9	90	0	EMMERSON	69	OSPK		$T\pi^+$ 55–80 MeV
$2.2\ \pm0.7$		18	CLINE	64	FBC	+	$T\pi^+$ 55–80 MeV

[45] The LJUNG 73 values are not independent.

[46] MALTSEV 70 selects low π^+ energy to enhance direct emission contribution.

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

Direct emission part of $\Gamma(\pi^+\pi^0\gamma)/\Gamma_{\text{total}}$.

VALUE (units 10^{-5})	*DOCUMENT ID*		*TECN*	*CHG*	*COMMENT*
1.8 ±0.4 OUR AVERAGE					
$2.05\pm0.46^{+0.39}_{-0.23}$	BOLOTOV	87	WIRE	−	$T\pi^-$ 55–90 MeV
$2.3\ \pm3.2$	SMITH	76	WIRE	±	$T\pi^\pm$ 55–90 MeV
$1.56\pm0.35\pm0.5$	ABRAMS	72	ASPK	±	$T\pi^\pm$ 55–90 MeV

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

VALUE (units 10^{-4})	*EVTS*	*DOCUMENT ID*		*TECN*	*CHG*	*COMMENT*
1.04±0.31 OUR AVERAGE						
1.10 ± 0.48	7	BARMIN	89	XEBC		$E(\gamma) > 5$ MeV
$1.0\ \pm0.4$		STAMER	65	EMUL	+	$E(\gamma) >11$ MeV

$\Gamma(\pi^+\pi^0\pi^0\gamma)/\Gamma(\pi^+\pi^0\pi^0)$ — Γ_{24}/Γ_5

VALUE (units 10^{-4})	*DOCUMENT ID*		*TECN*	*CHG*	*COMMENT*
$\mathbf{4.3^{+3.2}_{-1.7}}$	BOLOTOV	85	SPEC	−	$E(\gamma) > 10$ MeV

$\Gamma(\pi^0\mu^+\nu_\mu\gamma)/\Gamma_{\text{total}}$ — Γ_{25}/Γ

VALUE (units 10^{-5})	*CL%*	*EVTS*	*DOCUMENT ID*		*TECN*	*CHG*	*COMMENT*
<6.1	90	0	LJUNG	73	HLBC	+	$E(\gamma) >30$ MeV

$\Gamma(\pi^0 e^+\nu_e\gamma)/\Gamma(\pi^0 e^+\nu_e)$ — Γ_{26}/Γ_7

VALUE (units 10^{-2})	*EVTS*	*DOCUMENT ID*		*TECN*	*CHG*	*COMMENT*
0.54±0.04 OUR AVERAGE Error includes scale factor of 1.1.						
0.46 ± 0.08	82	[47] BARMIN	91	XEBC		$E(\gamma) > 10$ MeV, $0.6 < \cos\theta_{e\,\gamma} < 0.9$
0.56 ± 0.04	192	[48] BOLOTOV	86B	CALO	−	$E(\gamma) >10$ MeV
0.76 ± 0.28	13	[49] ROMANO	71	HLBC		$E(\gamma) >10$ MeV

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

1.51±0.25	82	[47] BARMIN	91	XEBC		E(γ) > 10 MeV, $\cos\theta_{e\ \gamma}$ < 0.98
0.48±0.20	16	[50] LJUNG	73	HLBC	+	$E(\gamma)$ >30 MeV
$0.22^{+0.15}_{-0.10}$		[50] LJUNG	73	HLBC	+	$E(\gamma)$ >30 MeV
0.53±0.22		[49] ROMANO	71	HLBC	+	$E(\gamma)$ >30 MeV
1.2 ±0.8		BELLOTTI	67	HLBC	+	$E(\gamma)$ >30 MeV

[47] BARMIN 91 quotes branching ratio $\Gamma(K \rightarrow e\pi^0\nu\gamma)/\Gamma_{\text{all}}$. The measured normalization is $[\Gamma(K \rightarrow e\pi^0\nu) + \Gamma(K \rightarrow \pi^+\pi^+\pi^-)]$. For comparison with other experiments we used $\Gamma(K \rightarrow e\pi^0\nu)/\Gamma_{\text{all}} = 0.0482$ to calculate the values quoted here.

[48] $\cos\theta(e\gamma)$ between 0.6 and 0.9.

[49] Both ROMANO 71 values are for $\cos\theta(e\gamma)$ between 0.6 and 0.9. Second value is for comparison with second LJUNG 73 value. We use lowest $E(\gamma)$ cut for Summary Table value. See ROMANO 71 for E_γ dependence.

[50] First LJUNG 73 value is for $\cos\theta(e\gamma)$ <0.9, second value is for $\cos\theta(e\gamma)$ between 0.6 and 0.9 for comparison with ROMANO 71.

$\Gamma(\pi^0 e^+ \nu_e \gamma(\text{SD}))/\Gamma_{\text{total}}$ — Γ_{27}/Γ

Structure-dependent part.

VALUE (units 10^{-5})	*CL%*	*DOCUMENT ID*		*TECN*	*CHG*
<5.3	90	BOLOTOV	86B	CALO	−

$\Gamma(\pi^0 \pi^0 e^+ \nu_e \gamma)/\Gamma_{\text{total}}$ — Γ_{28}/Γ

VALUE (units 10^{-6})	*CL%*	*EVTS*	*DOCUMENT ID*		*TECN*	*CHG*	*COMMENT*
<5	90	0	BARMIN	92	XEBC	+	E_γ > 10 MeV

$\Gamma(\pi^+ \pi^+ e^- \overline{\nu}_e)/\Gamma_{\text{total}}$ — Γ_{29}/Γ

Test of $\Delta S = \Delta Q$ rule.

VALUE (units 10^{-7})	*CL%*	*EVTS*	*DOCUMENT ID*		*TECN*	*CHG*
• • • We do not use the following data for averages, fits, limits, etc. • • •						
< 9.0	95	0	SCHWEINB...	71	HLBC	+
< 6.9	95	0	ELY	69	HLBC	+
<20.	95		BIRGE	65	FBC	+

$\Gamma(\pi^+ \pi^+ e^- \overline{\nu}_e)/\Gamma(\pi^+ \pi^- e^+ \nu_e)$ — Γ_{29}/Γ_9

Test of $\Delta S = \Delta Q$ rule.

VALUE (units 10^{-4})	*CL%*	*EVTS*	*DOCUMENT ID*		*TECN*
< 3	90	3	[51] BLOCH	76	SPEC
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<130.	95	0	BOURQUIN	71	ASPK

[51] BLOCH 76 quotes 3.6×10^{-4} at CL = 95%, we convert.

$\Gamma(\pi^+ \pi^+ \mu^- \overline{\nu}_\mu)/\Gamma_{\text{total}}$ — Γ_{30}/Γ

Test of $\Delta S = \Delta Q$ rule.

VALUE (units 10^{-6})	*CL%*	*EVTS*	*DOCUMENT ID*		*TECN*	*CHG*
<3.0	95	0	BIRGE	65	FBC	+

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

Test for $\Delta S = 1$ weak neutral current. Allowed by combined first-order weak and electromagnetic interactions.

VALUE (units 10^{-7})	CL%	EVTS	DOCUMENT ID		TECN	CHG	COMMENT
2.74±0.23 OUR AVERAGE							
2.75±0.23±0.13		500	[52] ALLIEGRO	92	SPEC	+	
2.7 ±0.5		41	[53] BLOCH	75	SPEC	+	
• • • We do not use the following data for averages, fits, limits, etc. • • •							
< 17	90		CENCE	74	ASPK	+	Three track evts
< 2.7	90		CENCE	74	ASPK	+	Two track events
<320	90		BEIER	72	OSPK	±	
< 44	90		BISI	67	DBC	+	
< 8.8	90		CLINE	67B	FBC	+	
< 24.5	90	1	CAMERINI	64	FBC	+	

[52] ALLIEGRO 92 assumes a vector interaction with a form factor given by $\lambda = 0.105 \pm 0.035 \pm 0.015$ and a correlation coefficient of -0.82.
[53] BLOCH 75 assumes a vector interaction.

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

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

VALUE (units 10^{-8})	CL%	DOCUMENT ID		TECN	CHG
5.0±0.4±0.9		[54] ADLER	97C	B787	
• • • We do not use the following data for averages, fits, limits, etc. • • •					
< 23	90	ATIYA	89	B787	+
<240	90	BISI	67	DBC	+
<300	90	CAMERINI	65	FBC	+

[54] ADLER 97C gives systematic error 0.7×10^{-8} and theoretical uncertainty 0.6×10^{-8}, which we combine in quadrature to obtain our second error.

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

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

VALUE (units 10^{-9})	CL%	EVTS	DOCUMENT ID		TECN	CHG	COMMENT
$0.42^{+0.97}_{-0.35}$		1	ADLER	97	B787		
• • • We do not use the following data for averages, fits, limits, etc. • • •							
< 2.4	90		ADLER	96	B787		
< 7.5	90		ATIYA	93	B787	+	$T(\pi)$ 115–127 MeV
< 5.2	90		[55] ATIYA	93	B787	+	
< 17	90	0	ATIYA	93B	B787	+	$T(\pi)$ 60–100 MeV
< 34	90		ATIYA	90	B787	+	
< 140	90		ASANO	81B	CNTR	+	$T(\pi)$ 116–127 MeV
< 940	90		[56] CABLE	73	CNTR	+	$T(\pi)$ 60–105 MeV
< 560	90		[56] CABLE	73	CNTR	+	$T(\pi)$ 60–127 MeV
<57000	90	0	[57] LJUNG	73	HLBC	+	
< 1400	90		[56] KLEMS	71	OSPK	+	$T(\pi)$ 117–127 MeV

[55] Combining ATIYA 93 and ATIYA 93B results. Superseded by ADLER 96.

[56] KLEMS 71 and CABLE 73 assume π spectrum same as K_{e3} decay. Second CABLE 73 limit combines CABLE 73 and KLEMS 71 data for vector interaction.
[57] LJUNG 73 assumes vector interaction.

$\Gamma(\mu^- \nu e^+ e^+)/\Gamma(\pi^+ \pi^- e^+ \nu_e)$ Γ_{34}/Γ_9

Test of lepton family number conservation.

VALUE (units 10^{-3})	CL%	EVTS	DOCUMENT ID		TECN	CHG
<0.5	90	0	[58] DIAMANT-...	76	SPEC	+

[58] DIAMANT-BERGER 76 quotes this result times our 1975 $\pi^+ \pi^- e \nu$ BR ratio.

$\Gamma(\mu^+ \nu_e)/\Gamma_{total}$ Γ_{35}/Γ

Forbidden by lepton family number conservation.

VALUE	CL%	EVTS	DOCUMENT ID		TECN	CHG	COMMENT
<0.004	90	0	[59] LYONS	81	HLBC	0	200 GeV K^+ narrow band ν beam
• • • We do not use the following data for averages, fits, limits, etc. • • •							
<0.012	90		[59] COOPER	82	HLBC		Wideband ν beam

[59] COOPER 82 and LYONS 81 limits on ν_e observation are here interpreted as limits on lepton family number violation in the absence of mixing.

$\Gamma(\pi^+ \mu^+ e^-)/\Gamma_{total}$ Γ_{36}/Γ

Test of lepton family number conservation.

VALUE (units 10^{-10})	CL%	EVTS	DOCUMENT ID		TECN	CHG	COMMENT
< 2.1	90	0	LEE	90	SPEC	+	
• • • We do not use the following data for averages, fits, limits, etc. • • •							
<11	90	0	CAMPAGNARI	88	SPEC	+	In LEE 90
<48	90	0	DIAMANT-...	76	SPEC	+	

$\Gamma(\pi^+ \mu^- e^+)/\Gamma_{total}$ Γ_{37}/Γ

Test of lepton family number conservation.

VALUE (units 10^{-9})	CL%	EVTS	DOCUMENT ID		TECN	CHG
< 7	90	0	[60] DIAMANT-...	76	SPEC	+
• • • We do not use the following data for averages, fits, limits, etc. • • •						
<28	90		[60] BEIER	72	OSPK	±

[60] Measurement actually applies to the sum of the $\pi^+ \mu^- e^+$ and $\pi^- \mu^+ e^+$ modes.

$\Gamma(\pi^- \mu^+ e^+)/\Gamma_{total}$ Γ_{38}/Γ

Test of total lepton number conservation.

VALUE (units 10^{-9})	CL%	EVTS	DOCUMENT ID		TECN	CHG
< 7	90	0	[61] DIAMANT-...	76	SPEC	+
• • • We do not use the following data for averages, fits, limits, etc. • • •						
<28	90		[61] BEIER	72	OSPK	±

[61] Measurement actually applies to the sum of the $\pi^+ \mu^- e^+$ and $\pi^- \mu^+ e^+$ modes.

$\Gamma(\pi^+ \mu^- e^+)/\Gamma_{total}$ Γ_{37}/Γ

VALUE (units 10^{-8})	CL%	DOCUMENT ID		TECN	CHG
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<1.4	90	BEIER	72	OSPK	±

$\Gamma(\pi^- e^+ e^+)/\Gamma_{total}$ — Γ_{39}/Γ

Test of total lepton number conservation.

VALUE (units 10^{-5})	DOCUMENT ID		TECN	CHG
• • • We do not use the following data for averages, fits, limits, etc. • • •				
<1.5	CHANG	68	HBC	−

$\Gamma(\pi^- e^+ e^+)/\Gamma(\pi^+ \pi^- e^+ \nu_e)$ — Γ_{39}/Γ_9

Test of total lepton number conservation.

VALUE (units 10^{-4})	CL%	EVTS	DOCUMENT ID		TECN	CHG
<2.5	90	0	[62] DIAMANT-...	76	SPEC	+

[62] DIAMANT-BERGER 76 quotes this result times our 1975 BR ratio.

$\Gamma(\pi^- \mu^+ \mu^+)/\Gamma_{total}$ — Γ_{40}/Γ

Forbidden by total lepton number conservation.

VALUE (units 10^{-4})	CL%	DOCUMENT ID		TECN
<1.5	90	[63] LITTENBERG	92	HBC

[63] LITTENBERG 92 is from retroactive data analysis of CHANG 68 bubble chamber data.

$\Gamma(\mu^+ \overline{\nu}_e)/\Gamma_{total}$ — Γ_{41}/Γ

Forbidden by total lepton number conservation.

VALUE (units 10^{-3})	CL%	DOCUMENT ID		TECN	COMMENT
<3.3	90	[64] COOPER	82	HLBC	Wideband ν beam

[64] COOPER 82 limit on $\overline{\nu}_e$ observation is here interpreted as a limit on lepton number violation in the absence of mixing.

$\Gamma(\pi^0 e^+ \overline{\nu}_e)/\Gamma_{total}$ — Γ_{42}/Γ

Forbidden by total lepton number conservation.

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.003	90	[65] COOPER	82	HLBC	Wideband ν beam

[65] COOPER 82 limit on $\overline{\nu}_e$ observation is here interpreted as a limit on lepton number violation in the absence of mixing.

$\Gamma(\pi^+ \gamma)/\Gamma_{total}$ — Γ_{43}/Γ

Violates angular momentum conservation. Not listed in Summary Table.

VALUE (units 10^{-6})	CL%	DOCUMENT ID		TECN	CHG
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<1.4	90	ASANO	82	CNTR	+
<4.0	90	[66] KLEMS	71	OSPK	+

[66] Test of model of Selleri, Nuovo Cimento **60A** 291 (1969).

K^+ LONGITUDINAL POLARIZATION OF EMITTED μ^+

VALUE	CL%	DOCUMENT ID		TECN	CHG	COMMENT
<−0.990	90	[67] AOKI	94	SPEC	+	
• • • We do not use the following data for averages, fits, limits, etc. • • •						
<−0.990	90	IMAZATO	92	SPEC	+	Repl. by AOKI 94
−0.970±0.047		[68] YAMANAKA	86	SPEC	+	
−1.0 ±0.1		[68] CUTTS	69	SPRK	+	
−0.96 ±0.12		[68] COOMBES	57	CNTR	+	

[67] AOKI 94 measures $\xi P_\mu = -0.9996 \pm 0.0030 \pm 0.0048$. The above limit is obtained by summing the statistical and systematic errors in quadrature, normalizing to the physically significant region ($|\xi P_\mu| < 1$) and assuming that ξ=1, its maximum value.

[68] Assumes ξ=1.

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ENERGY DEPENDENCE OF $K^\pm$ DALITZ PLOT

$|\text{matrix element}|^2 = 1 + gu + hu^2 + kv^2$

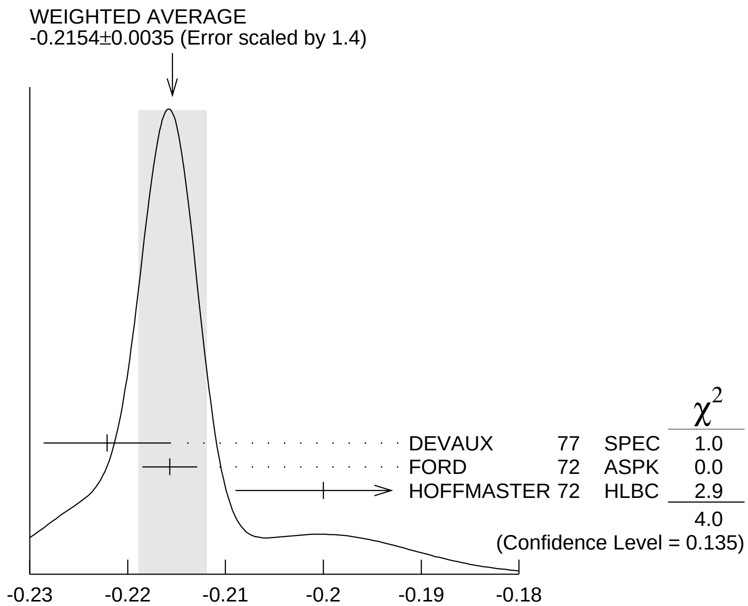
where $u = (s_3 - s_0) / m_\pi^2$ and $v = (s_1 - s_2) / m_\pi^2$

LINEAR COEFFICIENT g_{τ^+} FOR $K^+ \to \pi^+\pi^+\pi^-$

Some experiments use Dalitz variables x and y. In the comments we give a_y = coefficient of y term. See note above on "Dalitz Plot Parameters for $K \to 3\pi$ Decays." For discussion of the conversion of a_y to g, see the earlier version of the same note in the *Review* published in Physics Letters **111B** 70 (1982).

VALUE	EVTS	DOCUMENT ID		TECN	CHG	COMMENT
−0.2154±0.0035 OUR AVERAGE		Error includes scale factor of 1.4. See the ideogram below.				
−0.2221±0.0065	225k	DEVAUX	77	SPEC	+	a_y=.2814 ± .0082
−0.2157±0.0028	750k	FORD	72	ASPK	+	a_y=.2734 ± .0035
−0.200 ±0.009	39819	[69] HOFFMASTER	72	HLBC	+	
• • • We do not use the following data for averages, fits, limits, etc. • • •						
−0.196 ±0.012	17898	[70] GRAUMAN	70	HLBC	+	a_y=0.228 ± 0.030
−0.218 ±0.016	9994	[71] BUTLER	68	HBC	+	a_y=0.277 ± 0.020
−0.22 ±0.024	5428	[71,72] ZINCHENKO	67	HBC	+	a_y=0.28 ± 0.03

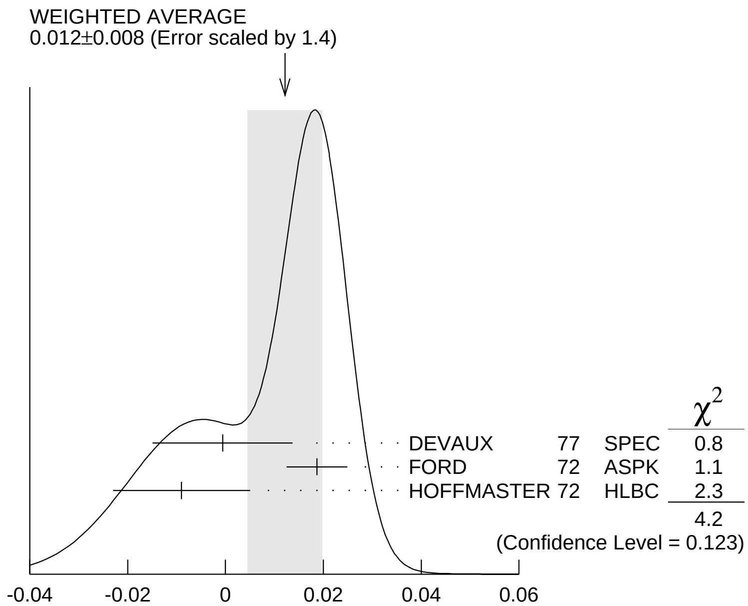
[69] HOFFMASTER 72 includes GRAUMAN 70 data.
[70] Emulsion data added — all events included by HOFFMASTER 72.
[71] Experiments with large errors not included in average.
[72] Also includes DBC events.



Linear energy dependence for $K^+ \rightarrow \pi^+\pi^+\pi^-$

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

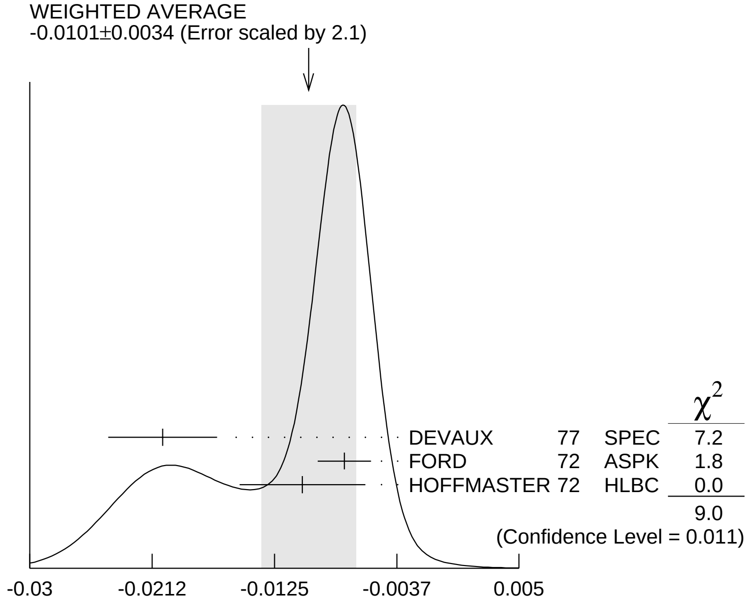
VALUE	EVTS	DOCUMENT ID		TECN	CHG	
0.012 ±0.008	**OUR AVERAGE**					Error includes scale factor of 1.4. See the ideogram below.
−0.0006±0.0143	225k	DEVAUX	77	SPEC	+	
0.0187±0.0062	750k	FORD	72	ASPK	+	
−0.009 ±0.014	39819	HOFFMASTER	72	HLBC	+	



Quadratic coefficient h for $K^+ \to \pi^+ \pi^+ \pi^-$

QUADRATIC COEFFICIENT k FOR $K^+ \to \pi^+ \pi^+ \pi^-$

VALUE	EVTS	DOCUMENT ID		TECN	CHG
−0.0101±0.0034 OUR AVERAGE		Error includes scale factor of 2.1. See the ideogram below.			
−0.0205±0.0039	225k	DEVAUX	77	SPEC	+
−0.0075±0.0019	750k	FORD	72	ASPK	+
−0.0105±0.0045	39819	HOFFMASTER	72	HLBC	+



Quadratic coefficient k for $K^+ \to \pi^+\pi^+\pi^-$

LINEAR COEFFICIENT g_{τ^-} FOR $K^- \to \pi^-\pi^-\pi^+$

Some experiments use Dalitz variables x and y. In the comments we give a_y = coefficient of y term. See note above on "Dalitz Plot Parameters for $K \to 3\pi$ Decays." For discussion of the conversion of a_y to g, see the earlier version of the same note in the *Review* published in Physics Letters **111B** 70 (1982).

VALUE	EVTS	DOCUMENT ID		TECN	CHG	COMMENT
−0.217 ±0.007	**OUR AVERAGE**	Error includes scale factor of 2.5.				
−0.2186±0.0028	750k	FORD	72	ASPK	−	a_y=.2770 ± .0035
−0.193 ±0.010	50919	MAST	69	HBC	−	a_y=0.244 ± 0.013
• • • We do not use the following data for averages, fits, limits, etc. • • •						
−0.199 ±0.008	81k	[73] LUCAS	73	HBC	−	a_y=0.252 ± 0.011
−0.190 ±0.023	5778	[74,75] MOSCOSO	68	HBC	−	a_y=0.242 ± 0.029
−0.220 ±0.035	1347	[76] FERRO-LUZZI	61	HBC	−	a_y=0.28 ± 0.045

[73] Quadratic dependence is required by K^0_L experiments. For comparison we average only those $K^\pm$ experiments which quote quadratic fit values.
[74] Experiments with large errors not included in average.
[75] Also includes DBC events.
[76] No radiative corrections included.

QUADRATIC COEFFICIENT h FOR $K^- \to \pi^-\pi^-\pi^+$

VALUE	EVTS	DOCUMENT ID		TECN	CHG
0.010 ±0.006	**OUR AVERAGE**				
0.0125±0.0062	750k	FORD	72	ASPK	−
−0.001 ±0.012	50919	MAST	69	HBC	−

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

VALUE	EVTS	DOCUMENT ID		TECN	CHG
−0.0084±0.0019 OUR AVERAGE					
−0.0083±0.0019	750k	FORD	72	ASPK	−
−0.014 ±0.012	50919	MAST	69	HBC	−

$(g_{\tau^+} - g_{\tau^-})$ / $(g_{\tau^+} + g_{\tau^-})$ FOR $K^\pm \rightarrow \pi^\pm\pi^+\pi^-$

A nonzero value for this quantity indicates *CP* violation.

VALUE (%)	EVTS	DOCUMENT ID		TECN
−0.70±0.53	3.2M	FORD	70	ASPK

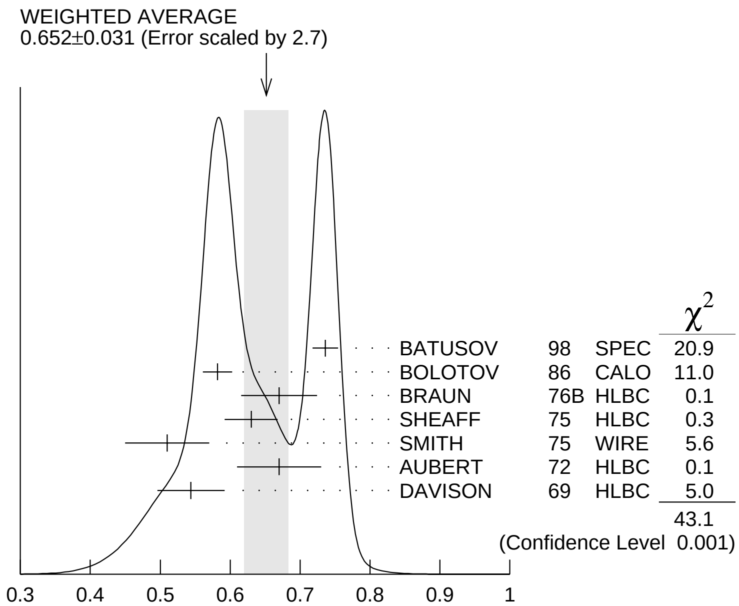
LINEAR COEFFICIENT g FOR $K^\pm \rightarrow \pi^\pm\pi^0\pi^0$

Unless otherwise stated, all experiments include terms quadratic in $(s_3 - s_0) / m^2_{\pi^+}$. See mini-review above.

VALUE	EVTS	DOCUMENT ID		TECN	CHG	COMMENT
0.652±0.031 OUR AVERAGE	Error includes scale factor of 2.7. See the ideogram below.					
0.736±0.014±0.012	33k	BATUSOV	98	SPEC	+	
0.582±0.021	43k	BOLOTOV	86	CALO	−	
0.670±0.054	3263	BRAUN	76B	HLBC	+	
0.630±0.038	5635	SHEAFF	75	HLBC	+	
0.510±0.060	27k	SMITH	75	WIRE	+	
0.67 ±0.06	1365	AUBERT	72	HLBC	+	
0.544±0.048	4048	DAVISON	69	HLBC	+	Also emulsion
• • • We do not use the following data for averages, fits, limits, etc. • • •						
0.806±0.220	4639	[77] BERTRAND	76	EMUL	+	
0.484±0.084	574	[78] LUCAS	73B	HBC	−	Dalitz pairs only
0.527±0.102	198	[77] PANDOULAS	70	EMUL	+	
0.586±0.098	1874	[78] BISI	65	HLBC	+	Also HBC
0.48 ±0.04	1792	[78] KALMUS	64	HLBC	+	

[77] Experiments with large errors not included in average.

[78] Authors give linear fit only.



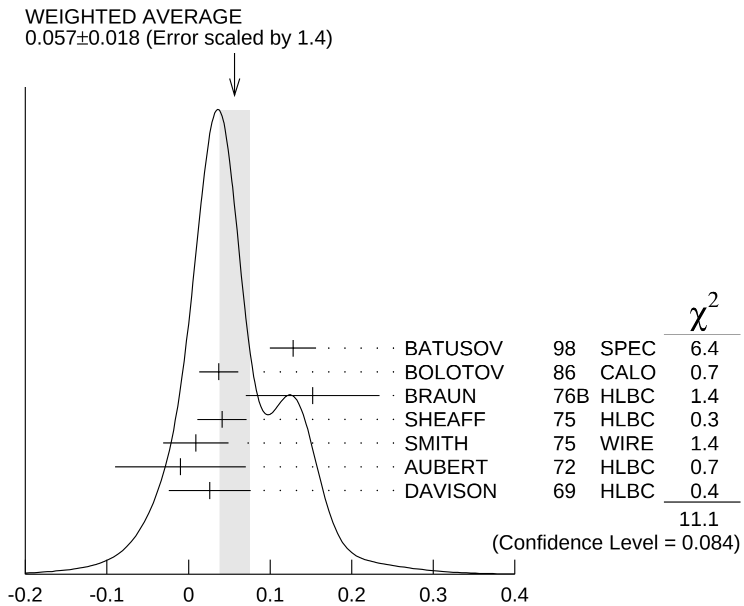
Linear energy dependence for $K^{\pm} \rightarrow \pi^{\pm}\pi^{0}\pi^{0}$

QUADRATIC COEFFICIENT *h* FOR $K^{\pm} \rightarrow \pi^{\pm}\pi^{0}\pi^{0}$

See mini-review above.

VALUE	*EVTS*	*DOCUMENT ID*		*TECN*	*CHG*	*COMMENT*
0.057±0.018 OUR AVERAGE		Error includes scale factor of 1.4. See the ideogram below.				
0.128±0.015±0.024	33k	BATUSOV	98	SPEC	+	
0.037±0.024	43k	BOLOTOV	86	CALO	−	
0.152±0.082	3263	BRAUN	76B	HLBC	+	
0.041±0.030	5635	SHEAFF	75	HLBC	+	
0.009±0.040	27k	SMITH	75	WIRE	+	
−0.01 ±0.08	1365	AUBERT	72	HLBC	+	
0.026±0.050	4048	DAVISON	69	HLBC	+	Also emulsion
• • • We do not use the following data for averages, fits, limits, etc. • • •						
0.164±0.121	4639	[79] BERTRAND	76	EMUL	+	
0.018±0.124	198	[79] PANDOULAS	70	EMUL	+	

[79] Experiments with large errors not included in average.



Quadratic coefficient h FOR $K^{\pm} \rightarrow \pi^{\pm}\pi^{0}\pi^{0}$

QUADRATIC COEFFICIENT k FOR $K^{\pm} \rightarrow \pi^{\pm}\pi^{0}\pi^{0}$

VALUE	*EVTS*	*DOCUMENT ID*		*TECN*	*CHG*
0.0197±0.0045±0.0029	33k	BATUSOV	98	SPEC	+

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$K^{\pm}_{\ell 3}$ FORM FACTORS

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.

$f_0 = f_+ + f_- t/(m^2_K - m^2_\pi)$.

λ_+, λ_-, and λ_0 are the linear expansion coefficients of f_+, f_-, and f_0.

λ_+ refers to the $K^{\pm}_{\mu 3}$ value except in the $K^{\pm}_{e3}$ sections.

$d\xi(0)/d\lambda_+$ is the correlation between $\xi(0)$ and λ_+ in $K^{\pm}_{\mu 3}$.

$d\lambda_0/d\lambda_+$ is the correlation between λ_0 and λ_+ in $K^{\pm}_{\mu 3}$.

t = momentum transfer to the π in units of m^2_π.

DP = Dalitz plot analysis.

PI = π spectrum analysis.

MU = μ spectrum analysis.

POL= μ polarization analysis.

BR = $K^{\pm}_{\mu 3}/K^{\pm}_{e3}$ branching ratio analysis.

E = positron or electron spectrum analysis.

RC = radiative corrections.

λ_+ (LINEAR ENERGY DEPENDENCE OF f_+ IN $K^\pm_{e3}$ DECAY)

For radiative correction of $K^\pm_{e3}$ Dalitz plot, see GINSBERG 67 and BECHERRAWY 70.

VALUE	EVTS	DOCUMENT ID		TECN	CHG	COMMENT
0.0276±0.0021 OUR AVERAGE						
0.018 ±0.007	3k	ARTEMOV	97B	SPEC	−	DP
0.0284±0.0027±0.0020	32k	[80] AKIMENKO	91	SPEC		PI, no RC
0.029 ±0.004	62k	[81] BOLOTOV	88	SPEC		PI, no RC
0.027 ±0.008		[82] BRAUN	73B	HLBC	+	DP, no RC
0.029 ±0.011	4017	CHIANG	72	OSPK	+	DP, RC negligible
0.027 ±0.010	2707	STEINER	71	HLBC	+	DP, uses RC
0.045 ±0.015	1458	BOTTERILL	70	OSPK		PI, uses RC
0.08 ±0.04	960	BOTTERILL	68C	ASPK	+	e^+, uses RC
$-0.02\ ^{+0.08}_{-0.12}$	90	EISLER	68	HLBC	+	PI, uses RC
$0.045\ ^{+0.017}_{-0.018}$	854	BELLOTTI	67B	FBC	+	DP, uses RC
+0.016 ±0.016	1393	IMLAY	67	OSPK	+	DP, no RC
$+0.028\ ^{+0.013}_{-0.014}$	515	KALMUS	67	FBC	+	e^+, PI, no RC
−0.04 ±0.05	230	BORREANI	64	HBC	+	e^+, no RC
−0.010 ±0.029	407	JENSEN	64	XEBC	+	PI, no RC
+0.036 ±0.045	217	BROWN	62B	XEBC	+	PI, no RC
• • • We do not use the following data for averages, fits, limits, etc. • • •						
0.025 ±0.007		[83] BRAUN	74	HLBC	+	$K_{\mu 3}/K_{e3}$ vs. t

[80] AKIMENKO 91 state that radiative corrections would raise λ_+ by 0.0013.

[81] BOLOTOV 88 state radiative corrections of GINSBERG 67 would raise λ_+ by 0.002.

[82] BRAUN 73B states that radiative corrections of GINSBERG 67 would lower λ^e_+ by 0.002 but that radiative corrections of BECHERRAWY 70 disagrees and would raise λ^e_+ by 0.005.

[83] BRAUN 74 is a combined $K_{\mu 3}$-K_{e3} result. It is not independent of BRAUN 73C ($K_{\mu 3}$) and BRAUN 73B (K_{e3}) form factor results.

$\xi_A = f_-/f_+$ (determined from $K^{\pm}_{\mu 3}$ spectra)

The parameter ξ is redundant with λ_0 below and is not put into the Meson Summary Table.

VALUE	$d\xi(0)/d\lambda_+$	EVTS	DOCUMENT ID		TECN	CHG	COMMENT
−0.33±0.14 OUR EVALUATION			Error includes scale factor of 1.6. Correlation is $d\xi(0)/d\lambda_+$=−14. From a fit discussed in note on $K_{\ell 3}$ form factors in 1982 edition, PL **111B** (April 1982).				
−0.27±0.25	−17	3973	WHITMAN	80	SPEC	+	DP
−0.8 ±0.8	−20	490	[84] ARNOLD	74	HLBC	+	DP
−0.57±0.24	−9	6527	[85] MERLAN	74	ASPK	+	DP
−0.36±0.40	−19	1897	[86] BRAUN	73C	HLBC	+	DP
−0.62±0.28	−12	4025	[87] ANKENBRA...	72	ASPK	+	PI
+0.45±0.28	−15	3480	[88] CHIANG	72	OSPK	+	DP
−1.1 ±0.56	−29	3240	[89] HAIDT	71	HLBC	+	DP
−0.5 ±0.8	−26	2041	[90] KIJEWSKI	69	OSPK	+	PI
+0.72±0.93	−17	444	CALLAHAN	66B	FBC	+	PI
• • • We do not use the following data for averages, fits, limits, etc. • • •							
−0.5 ±0.9	none	78	EISLER	68	HLBC	+	PI, λ_+=0
0.0 $^{+1.1}_{-0.9}$		2648	[91] CALLAHAN	66B	FBC	+	μ, λ_+=0
+0.7 ±0.5		87	GIACOMELLI	64	EMUL	+	MU+BR,λ_+=0
−0.08±0.7			[92] JENSEN	64	XEBC	+	DP+BR
+1.8 ±0.6		76	BROWN	62B	XEBC	+	DP+BR, λ_+=0

[84] ARNOLD 74 figure 4 was used to obtain ξ_A and $d\xi(0)/d\lambda_+$.

[85] MERLAN 74 figure 5 was used to obtain $d\xi(0)/d\lambda_+$.

[86] BRAUN 73C gives $\xi(t) = -0.34 \pm 0.20$, $d\xi(t)/d\lambda_+ = -14$ for $\lambda_+ = 0.027$, $t = 6.6$. We calculate above $\xi(0)$ and $d\xi(0)/d\lambda_+$ for their $\lambda_+ = 0.025 \pm 0.017$.

[87] ANKENBRANDT 72 figure 3 was used to obtain $d\xi(0)/d\lambda_+$.

[88] CHIANG 72 figure 10 was used to obtain $d\xi(0)/d\lambda_+$. Fit had $\lambda_- = \lambda_+$ but would not change for $\lambda_- = 0$. L.Pondrom, (private communication 74).

[89] HAIDT 71 table 8 (Dalitz plot analysis) gives $d\xi(0)/d\lambda_+ = (-1.1+0.5)/(0.050-0.029) = -29$, error raised from 0.50 to agree with $d\xi(0) = 0.20$ for fixed λ_+.

[90] KIJEWSKI 69 figure 17 was used to obtain $d\xi(0)/d\lambda_+$ and errors.

[91] CALLAHAN 66 table 1 (π analysis) gives $d\xi(0)/d\lambda_+ = (0.72–0.05)/(0–0.04) = -17$, error raised from 0.80 to agree with $d\xi(0) = 0.37$ for fixed λ_+. t unknown.

[92] JENSEN 64 gives $\lambda^{\mu}_{+} = \lambda^{e}_{+} = -0.020 \pm 0.027$. $d\xi(0)/d\lambda_+$ unknown. Includes SHAKLEE 64 $\xi_B(K_{\mu 3}/K_{e3})$.

$\xi_B = f_-/f_+$ (determined from $K^{\pm}_{\mu 3}/K^{\pm}_{e3}$)

The $K^{\pm}_{\mu 3}/K^{\pm}_{e3}$ branching ratio fixes a relationship between $\xi(0)$ and λ_+. We quote the author's $\xi(0)$ and associated λ_+ but do not average because the λ_+ values differ. The fit result and scale factor given below are not obtained from these ξ_B values. Instead they are obtained directly from the fitted $K^{\pm}_{\mu 3}/K^{\pm}_{e3}$ ratio $\Gamma(\pi^0 \mu^+ \nu_\mu)/\Gamma(\pi^0 e^+ \nu_e)$, with the exception of HEINTZE 77. The parameter ξ is redundant with λ_0 below and is not put into the Meson Summary Table.

VALUE	*EVTS*	*DOCUMENT ID*		*TECN*	*CHG*	*COMMENT*
−0.33±0.14 OUR EVALUATION		Error includes scale factor of 1.6. Correlation is $d\xi(0)/d\lambda_+ = -14$. From a fit discussed in note on $K_{\ell 3}$ form factors in 1982 edition, PL **111B** (April 1982).				
-0.12 ± 0.12	55k	[93] HEINTZE	77	CNTR	+	$\lambda_+=0.029$
• • • We do not use the following data for averages, fits, limits, etc. • • •						
$0.0\ \pm0.15$	5825	CHIANG	72	OSPK	+	$\lambda_+=0.03$, fig.10
-0.81 ± 0.27	1505	[94] HAIDT	71	HLBC	+	$\lambda_+=0.028$, fig.8
-0.35 ± 0.22		[95] BOTTERILL	70	OSPK	+	$\lambda_+=0.045\pm0.015$
$+0.91\pm0.82$		ZELLER	69	ASPK	+	$\lambda_+=0.023$
-0.08 ± 0.15	5601	[95] BOTTERILL	68B	ASPK	+	$\lambda_+=0.023\pm0.008$
-0.60 ± 0.20	1398	[94] EICHTEN	68	HLBC	+	See note
$+1.0\ \pm0.6$	986	GARLAND	68	OSPK	+	$\lambda_+=0$
$+0.75\pm0.50$	306	AUERBACH	67	OSPK	+	$\lambda_+=0$
$+0.4\ \pm0.4$	636	CALLAHAN	66B	FBC	+	$\lambda_+=0$
$+0.6\ \pm0.5$		BISI	65B	HBC	+	$\lambda_+=0$
$+0.8\ \pm0.6$	500	CUTTS	65	OSPK	+	$\lambda_+=0$
$-0.17^{+0.75}_{-0.99}$		SHAKLEE	64	XEBC	+	$\lambda_+=0$

[93] Calculated by us from λ_0 and λ_+ given below.

[94] EICHTEN 68 has $\lambda_+ = 0.023 \pm 0.008$, $t = 4$, independent of λ_-. Replaced by HAIDT 71.

[95] BOTTERILL 70 is re-evaluation of BOTTERILL 68B with different λ_+.

$\xi_C = f_-/f_+$ (determined from μ polarization in $K^\pm_{\mu 3}$)

The μ polarization is a measure of $\xi(t)$. No assumptions on λ_{+-} necessary, t (weighted by sensitivity to $\xi(t)$) should be specified. In λ_+, $\xi(0)$ parametrization this is $\xi(0)$ for $\lambda_+=0$. $d\xi/d\lambda = \xi t$. For radiative correction to muon polarization in $K^\pm_{\mu 3}$, see GINSBERG 71. The parameter ξ is redundant with λ_0 below and is not put into the Meson Summary Table.

VALUE	*EVTS*	*DOCUMENT ID*		*TECN*	*CHG*	*COMMENT*
−0.33±0.14 OUR EVALUATION		Error includes scale factor of 1.6. Correlation is $d\xi(0)/d\lambda_+ = -14$. From a fit discussed in note on $K_{\ell 3}$ form factors in 1982 edition, PL **111B** (April 1982).				
-0.25 ± 1.20	1585	[96] BRAUN	75	HLBC	+	POL, t=4.2
-0.95 ± 0.3	3133	[97] CUTTS	69	OSPK	+	Total pol. t=4.0
$-1.0\ \pm0.3$	6000	[98] BETTELS	68	HLBC	+	Total pol. t=4.9
• • • We do not use the following data for averages, fits, limits, etc. • • •						
-0.64 ± 0.27	40k	[99] MERLAN	74	ASPK	+	POL, $d\xi(0)/d\lambda_+ = +1.7$
$-1.4\ \pm1.8$	397	[100] CALLAHAN	66B	FBC	+	Total pol.
$-0.7\ ^{+0.9}_{-3.3}$	2950	[100] CALLAHAN	66B	FBC	+	Long. pol.
$+1.2\ ^{+2.4}_{-1.8}$	2100	[100] BORREANI	65	HLBC	+	Polarization
-4.0 to $+1.7$	500	[100] CUTTS	65	OSPK	+	Long. pol.

[96] BRAUN 75 $d\xi(0)/d\lambda_+ = \xi t = -0.25\times4.2 = -1.0$.

[97] CUTTS 69 $t = 4.0$ was calculated from figure 8. $d\xi(0)/d\lambda_+ = \xi t = -0.95\times4 = -3.8$.

[98] BETTELS 68 $d\xi(0)/d\lambda_+ = \xi t = -1.0\times4.9 = -4.9$.

[99] MERLAN 74 polarization result (figure 5) not possible. See discussion of polarization experiments in note on "$K_{\ell3}$ Form Factors" in the 1982 edition of this *Review* [Physics Letters **111B** (1982)].

[100] t value not given.

Im(ξ) in $K^{\pm}_{\mu3}$ DECAY (from transverse μ pol.)

Test of T reversal invariance.

VALUE	EVTS	DOCUMENT ID		TECN	CHG	COMMENT
-0.017 ± 0.025 OUR AVERAGE						
-0.016 ± 0.025	20M	CAMPBELL	81	CNTR	+	Pol.
$-0.3\ ^{+0.3}_{-0.4}$	3133	CUTTS	69	OSPK	+	Total pol. fig.7
$-0.1\ \pm0.3$	6000	BETTELS	68	HLBC	+	Total pol.
$0.0\ \pm1.0$	2648	CALLAHAN	66B	FBC	+	MU
$+1.6\ \pm1.3$	397	CALLAHAN	66B	FBC	+	Total pol.
$0.5\ ^{+1.4}_{-0.5}$	2950	CALLAHAN	66B	FBC	+	Long. pol.
• • • We do not use the following data for averages, fits, limits, etc. • • •						
-0.010 ± 0.019	32M	[101] BLATT	83	CNTR		Polarization

[101] Combined result of MORSE 80 ($K^0_{\mu3}$) and CAMPBELL 81 ($K^+_{\mu3}$).

λ_+ (LINEAR ENERGY DEPENDENCE OF f_+ IN $K^{\pm}_{\mu3}$ DECAY)

See also the corresponding entries and footnotes in sections ξ_A, ξ_C, and λ_0. For radiative correction of $K^{\pm}_{\mu3}$ Dalitz plot, see GINSBERG 70 and BECHERRAWY 70.

VALUE	EVTS	DOCUMENT ID		TECN	CHG	COMMENT
0.032 ± 0.008 OUR EVALUATION		Error includes scale factor of 1.6. From a fit discussed in note on $K_{\ell3}$ form factors in 1982 edition, PL **111B** (April 1982).				
0.014 ± 0.024	3k	ARTEMOV	97B	SPEC	−	DP
$+0.050\pm0.013$	3973	WHITMAN	80	SPEC	+	DP
0.025 ± 0.030	490	ARNOLD	74	HLBC	+	DP
0.027 ± 0.019	6527	MERLAN	74	ASPK	+	DP
0.025 ± 0.017	1897	BRAUN	73C	HLBC	+	DP
0.024 ± 0.019	4025	[102] ANKENBRA...	72	ASPK	+	PI
-0.006 ± 0.015	3480	CHIANG	72	OSPK	+	DP
0.050 ± 0.018	3240	HAIDT	71	HLBC	+	DP
0.009 ± 0.026	2041	KIJEWSKI	69	OSPK	+	PI
$0.0\ \pm0.05$	444	CALLAHAN	66B	FBC	+	PI
• • • We do not use the following data for averages, fits, limits, etc. • • •						
0.029 ± 0.024	3000	[103] ARTEMOV	97	SPEC	−	DP

[102] ANKENBRANDT 72 λ_+ from figure 3 to match $d\xi(0)/d\lambda_+$. Text gives 0.024 ± 0.022.

[103] Superseded by ARTEMOV 97B.

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

Wherever possible, we have converted the above values of $\xi(0)$ into values of λ_0 using the associated λ^μ_+ and $d\xi/d\lambda$.

VALUE	$d\lambda_0/d\lambda_+$	EVTS	DOCUMENT ID		TECN	CHG	COMMENT
0.006±0.007 OUR EVALUATION			Error includes scale factor of 1.6. Correlation is $d\lambda_0/d\lambda_+$=−0.16. From a fit discussed in note on $K_{\ell 3}$ form factors in 1982 edition, PL **111B** (April 1982).				
+0.058±0.020	0.0	3k	[104] ARTEMOV	97B	SPEC	−	DP
+0.029±0.011	−0.37	3973	WHITMAN	80	SPEC	+	DP
+0.019±0.010	+0.03	55k	[105] HEINTZE	77	SPEC	+	BR
+0.008±0.097	+0.92	1585	[106] BRAUN	75	HLBC	+	POL
−0.040±0.040	−0.62	490	ARNOLD	74	HLBC	+	DP
−0.019±0.015	+0.27	6527	[107] MERLAN	74	ASPK	+	DP
−0.008±0.020	−0.53	1897	[108] BRAUN	73C	HLBC	+	DP
−0.026±0.013	+0.03	4025	[109] ANKENBRA...	72	ASPK	+	PI
+0.030±0.014	−0.21	3480	[109] CHIANG	72	OSPK	+	DP
−0.039±0.029	−1.34	3240	[109] HAIDT	71	HLBC	+	DP
−0.056±0.024	+0.69	3133	[106] CUTTS	69	OSPK	+	POL
−0.031±0.045	−1.10	2041	[109] KIJEWSKI	69	OSPK	+	PI
−0.063±0.024	+0.60	6000	[106] BETTELS	68	HLBC	+	POL
+0.058±0.036	−0.37	444	[109] CALLAHAN	66B	FBC	+	PI
• • • We do not use the following data for averages, fits, limits, etc. • • •							
+0.062±0.024	0.0	3000	[110] ARTEMOV	97	SPEC	−	DP
−0.017±0.011			[111] BRAUN	74	HLBC	+	$K_{\mu 3}/K_{e3}$ vs. t

[104] ARTEMOV 97B does not give $d\lambda_0/d\lambda_+$ so we take it to be zero.

[105] HEINTZE 77 uses $\lambda_+ = 0.029 \pm 0.003$. $d\lambda_0/d\lambda_+$ estimated by us.

[106] λ_0 value is for $\lambda_+ = 0.03$ calculated by us from $\xi(0)$ and $d\xi(0)/d\lambda_+$.

[107] MERLAN 74 λ_0 and $d\lambda_0/d\lambda_+$ were calculated by us from ξ_A, λ^μ_+, and $d\xi(0)/d\lambda_+$. Their figure 6 gives $\lambda_0 = -0.025 \pm 0.012$ and no $d\lambda_0/d\lambda_+$.

[108] This value and error are taken from BRAUN 75 but correspond to the BRAUN 73C λ^μ_+ result. $d\lambda_0/d\lambda_+$ is from BRAUN 73C $d\xi(0)/d\lambda_+$ in ξ_A above.

[109] λ_0 calculated by us from $\xi(0)$, λ^μ_+, and $d\xi(0)/d\lambda_+$.

[110] ARTEMOV 97 does not give $d\lambda_0/d\lambda_+$ so we take it to be zero. Superseded by ARTEMOV 97B.

[111] BRAUN 74 is a combined $K_{\mu 3}$-K_{e3} result. It is not independent of BRAUN 73C ($K_{\mu 3}$) and BRAUN 73B (K_{e3}) form factor results.

$|f_S/f_+|$ FOR $K^\pm_{e3}$ DECAY

Ratio of scalar to f_+ couplings.

VALUE	CL%	EVTS	DOCUMENT ID		TECN	CHG	COMMENT
0.084±0.023 OUR AVERAGE			Error includes scale factor of 1.2.				
0.070±0.016±0.016		32k	AKIMENKO	91	SPEC		λ_+, f_S, f_T, ϕ fit
0.00 ±0.10		2827	BRAUN	75	HLBC	+	
0.14 $^{+0.03}_{-0.04}$		2707	STEINER	71	HLBC	+	λ_+, f_S, f_T, ϕ fit

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

<0.13	90	4017	CHIANG	72	OSPK	+
<0.23	90		BOTTERILL	68C	ASPK	
<0.18	90		BELLOTTI	67B	HLBC	
<0.30	95		KALMUS	67	HLBC	+

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

Ratio of tensor to f_+ couplings.

VALUE	CL%	EVTS	DOCUMENT ID		TECN	CHG	COMMENT
0.38±0.11 OUR AVERAGE			Error includes scale factor of 1.1.				
$0.53^{+0.09}_{-0.10}\pm0.10$		32k	AKIMENKO	91	SPEC		λ_+, f_S, f_T, ϕ fit
0.07±0.37		2827	BRAUN	75	HLBC	+	
$0.24^{+0.16}_{-0.14}$		2707	STEINER	71	HLBC	+	λ_+, f_S, f_T, ϕ fit

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

<0.75	90	4017	CHIANG	72	OSPK	+
<0.58	90		BOTTERILL	68C	ASPK	
<0.58	90		BELLOTTI	67B	HLBC	
<1.1	95		KALMUS	67	HLBC	+

f_T/f_+ FOR $K^{\pm}_{\mu 3}$ DECAY

Ratio of tensor to f_+ couplings.

VALUE	EVTS	DOCUMENT ID		TECN
0.02±0.12	1585	BRAUN	75	HLBC

DECAY FORM FACTORS FOR $K^{\pm} \rightarrow \pi^+\pi^- e^{\pm}\nu_e$

Given in ROSSELET 77, BEIER 73, and BASILE 71C.

DECAY FORM FACTOR FOR $K^{\pm} \rightarrow \pi^0\pi^0 e^{\pm}\nu$

Given in BOLOTOV 86B and BARMIN 88B.

$K^{\pm} \rightarrow \ell^{\pm}\nu\gamma$ FORM FACTORS

For definitions of the axial-vector F_A and vector F_V form factor, see the "Note on $\pi^{\pm} \rightarrow \ell^{\pm}\nu\gamma$ and $K^{\pm} \rightarrow \ell^{\pm}\nu\gamma$ Form Factors" in the $\pi^{\pm}$ section. In the kaon literature, often different definitions $a_K = F_A/m_K$ and $v_K = F_V/m_K$ are used.

$F_A + F_V$, SUM OF AXIAL-VECTOR AND VECTOR FORM FACTOR FOR $K \rightarrow e\nu_e\gamma$

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.148±0.010 OUR AVERAGE					
0.147±0.011	51	[112] HEINTZE	79	SPEC	$K \rightarrow e\nu\gamma$
$0.150^{+0.018}_{-0.023}$	56	[113] HEARD	75	SPEC	$K \rightarrow e\nu\gamma$

[112] HEINTZE 79 quotes absolute value of $|F_A + F_V| \sin\theta_c$. We use $\sin\theta_c = V_{us} = 0.2205$.
[113] HEARD 75 quotes absolute value of $|F_A + F_V| \sin\theta_c$. We use $\sin\theta_c = V_{us} = 0.2205$.

$F_A + F_V$, SUM OF AXIAL-VECTOR AND VECTOR FORM FACTOR FOR $K \rightarrow \mu\nu_\mu\gamma$

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
< 0.23	90	[114] AKIBA	85	SPEC	$K \rightarrow \mu\nu\gamma$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
−1.2 to 1.1	90	DEMIDOV	90	XEBC	$K \rightarrow \mu\nu\gamma$

[114] AKIBA 85 quotes absolute value.

$F_A - F_V$, DIFFERENCE OF AXIAL-VECTOR AND VECTOR FORM FACTOR FOR $K \rightarrow e\nu_e\gamma$

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
<0.49	90	[115] HEINTZE	79	SPEC	$K \rightarrow e\nu\gamma$

[115] HEINTZE 79 quotes $|F_A - F_V| < \sqrt{11}\,|F_A + F_V|$.

$F_A - F_V$, DIFFERENCE OF AXIAL-VECTOR AND VECTOR FORM FACTOR FOR $K \rightarrow \mu\nu_\mu\gamma$

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
−2.2 to 0.3 OUR EVALUATION					
−2.2 to 0.6	90	DEMIDOV	90	XEBC	$K \rightarrow \mu\nu\gamma$
−2.5 to 0.3	90	AKIBA	85	SPEC	$K \rightarrow \mu\nu\gamma$

$K^\pm$ REFERENCES

ADLER	98	PR D58 012003	S. Adler+	(BNL 787 Collab.)
BATUSOV	98	NP B516 3	V.Y. Batusov+	
ADLER	97	PRL 79 2204	S. Adler+	(BNL 787 Collab.)
ADLER	97C	PRL 79 4756	S. Adler+	(BNL 787 Collab.)
ARTEMOV	97	PAN 60 218	V.M. Artemov+	(JINR)
		Translated from YAF 60 277.		
ARTEMOV	97B	PAN 60 2023	V.M. Artemov+	
		Translated from YAF 60 2205.		
KITCHING	97	PRL 79 4079	P. Kitching+	(BNL 787 Collab.)
ADLER	96	PRL 76 1421	+Atiya, Chiang, Frank, Haggerty, Kycia+	(BNL 787 Collab.)
KOPTEV	95	JETPL 61 877	+Mikirtych'yants, Shcherbakov+	(PNPI)
		Translated from ZETFP 61 865.		
AOKI	94	PR D50 69	+Yamazaki, Imazato, Kawashima+	(INUS, KEK, TOKMS)
ATIYA	93	PRL 70 2521	+Chiang, Frank, Haggerty, Ito+	(BNL 787 Collab.)
Also	93C	PRL 71 305 (erratum)	Atiya, Chiang, Frank, Haggerty, Ito+	(BNL 787 Collab.)
ATIYA	93B	PR D48 R1	+Chiang, Frank, Haggerty, Ito+	(BNL 787 Collab.)
BIJNENS	93	NP B396 81	+Ecker, Gasser	(CERN, BERN)
ALLIEGRO	92	PRL 68 278	+Campagnari+	(BNL, FNAL, PSI, WASH, YALE)
BARMIN	92	SJNP 55 547	+Barylov, Chernukha, Davidenko+	(ITEP)
		Translated from YAF 55 976.		
IMAZATO	92	PRL 69 877	+Kawashima, Tanaka+	(KEK, INUS, TOKY, TOKMS)
IVANOV	92	THESIS		(PNPI)
LITTENBERG	92	PRL 68 443	+Shrock	(BNL, STON)
USHER	92	PR D45 3961	+Fero, Gee, Graf, Mandelkern, Schultz, Schultz	(UCI)
AKIMENKO	91	PL B259 225	+Beloussov+	(SERP, JINR, TBIL, CMNS, SOFU, KOSI)
BARMIN	91	SJNP 53 606	+Barylov, Davidenko, Demidov+	(ITEP)
		Translated from YAF 53 981.		
DENISOV	91	JETPL 54 558	+Zhelamkov, Ivanov, Lapina, Levchenko, Malakhov+	(PNPI)
		Translated from ZETFP 54 557.		
Also	92	THESIS	Ivanov	(PNPI)
ATIYA	90	PRL 64 21	+Chiang, Frank, Haggerty, Ito, Kycia+	(BNL 787 Collab.)
ATIYA	90B	PRL 65 1188	+Chiang, Frank, Haggerty, Ito, Kycia+	(BNL 787 Collab.)
DEMIDOV	90	SJNP 52 1006	+Dobrokhotov, Lyublev, Nikitenko+	(ITEP)
		Translated from YAF 52 1595.		
LEE	90	PRL 64 165	+Alliegro, Campagnari+	(BNL, FNAL, VILL, WASH, YALE)
ATIYA	89	PRL 63 2177	+Chiang, Frank, Haggerty, Ito, Kycia+	(BNL 787 Collab.)
BARMIN	89	SJNP 50 421	+Barylov, Davidenko, Demidov, Dolgolenko+	(ITEP)
		Translated from YAF 50 679.		
BARMIN	88	SJNP 47 643	+Barylov, Davidenko, Demidov, Dolgolenko+	(ITEP)
		Translated from YAF 47 1011.		

BARMIN	88B	SJNP 48 1032	+Barylov, Davidenko, Demidov, Dolgolenko+	(ITEP)
		Translated from YAF 48 1719.		
BOLOTOV	88	JETPL 47 7	+Gninenko, Dzhilkibaev, Isakov, Klubakov+	(ASCI)
		Translated from ZETFP 47 8.		
CAMPAGNARI	88	PRL 61 2062	+Alliegro, Chaloupka+	(BNL, FNAL, PSI, WASH, YALE)
GALL	88	PRL 60 186	+Austin+	(BOST, MIT, WILL, CIT, CMU, WYOM)
BARMIN	87	SJNP 45 62	+Barylov, Davidenko, Demidov+	(ITEP)
		Translated from YAF 45 97.		
BOLOTOV	87	SJNP 45 1023	+Gninenko, Dzhilkibaev, Isakov, Klubakov+	(INRM)
		Translated from YAF 45 1652.		
BOLOTOV	86	SJNP 44 73	+Gninenko, Dzhilkibaev, Isakov+	(INRM)
		Translated from YAF 44 117.		
BOLOTOV	86B	SJNP 44 68	+Gninenko, Dzhilkibaev, Isakov+	(INRM)
		Translated from YAF 44 108.		
YAMANAKA	86	PR D34 85	+Hayano, Taniguchi, Ishikawa+	(KEK, TOKY)
Also	84	PRL 52 329	Hayano, Yamanaka, Taniguchi+	(TOKY, KEK)
AKIBA	85	PR D32 2911	+Ishikawa, Iwasaki+	(TOKY, TINT, TSUK, KEK)
BOLOTOV	85	JETPL 42 481	+Gninenko, Dzhilkibaev, Isakov+	(INRM)
		Translated from ZETFP 42 390.		
BLATT	83	PR D27 1056	+Adair, Black, Campbell+	(YALE, BNL)
ASANO	82	PL 113B 195	+Kikutani, Kurokawa, Miyachi+	(KEK, TOKY, INUS, OSAK)
COOPER	82	PL 112B 97	+Guy, Michette, Tyndel, Venus	(RL)
PDG	82	PL 111B	Roos, Porter, Aguilar-Benitez+	(HELS, CIT, CERN)
PDG	82B	PL 111B 70	Roos, Porter, Aguilar-Benitez+	(HELS, CIT, CERN)
ASANO	81B	PL 107B 159	+Kikutani, Kurokawa, Miyachi+	(KEK, TOKY, INUS, OSAK)
CAMPBELL	81	PRL 47 1032	+Black, Blatt, Kasha, Schmidt+	(YALE, BNL)
Also	83	PR D27 1056	Blatt, Adair, Black, Campbell+	(YALE, BNL)
LUM	81	PR D23 2522	+Wiegand, Kessler, Deslattes, Seki+	(LBL, NBS+)
LYONS	81	ZPHY C10 215	+Albajar, Myatt	(OXF)
MORSE	80	PR D21 1750	+Leipuner, Larsen, Schmidt, Blatt+	(BNL, YALE)
WHITMAN	80	PR D21 652	+Abrams, Carroll, Kycia, Li+	(ILLC, BNL, ILL)
BARKOV	79	NP B148 53	+Vasserman, Zolotorev, Krupin+	(NOVO, KIAE)
HEINTZE	79	NP B149 365	+Heinzelmann, Igo-Kemenes+	(HEIDP, CERN)
ABRAMS	77	PR D15 22	+Carroll, Kycia, Li, Michael, Mockett+	(BNL)
DEVAUX	77	NP B126 11	+Bloch, Diamant-Berger, Maillard+	(SACL, GEVA)
HEINTZE	77	PL 70B 482	+Heinzelmann, Igo-Kemenes+	(HEIDP, CERN)
ROSSELET	77	PR D15 574	+Extermann, Fischer, Guisan+	(GEVA, SACL)
BERTRAND	76	NP B114 387	+Sacton+	(BRUX, KIDR, DUUC, LOUC, WARS)
BLOCH	76	PL 60B 393	+Bunce, Devaux, Diamant-Berger+	(GEVA, SACL)
BRAUN	76B	LNC 17 521	+Martyn, Erriquez+	(AACH3, BARI, BELG, CERN)
DIAMANT-...	76	PL 62B 485	Diamant-Berger, Bloch, Devaux+	(SACL, GEVA)
HEINTZE	76	PL 60B 302	+Heinzelmann, Igo-Kemenes, Mundhenke+	(HEIDP)
SMITH	76	NP B109 173	+Booth, Renshall, Jones+	(GLAS, LIVP, OXF, RHEL)
WEISSENBE...	76	NP B115 55	Weissenberg, Egorov, Minervina+	(ITEP, LEBD)
BLOCH	75	PL 56B 201	+Brehin, Bunce, Devaux+	(SACL, GEVA)
BRAUN	75	NP B89 210	+Cornelssen+	(AACH3, BARI, BRUX, CERN)
CHENG	75	NP A254 381	+Asano, Chen, Dugan, Hu, Wu+	(COLU, YALE)
HEARD	75	PL 55B 324	+Heintze, Heinzelmann+	(CERN, HEIDH)
HEARD	75B	PL 55B 327	+Heintze, Heinzelmann+	(CERN, HEIDH)
SHEAFF	75	PR D12 2570		(WISC)
SMITH	75	NP B91 45	+Booth, Renshall, Jones+	(GLAS, LIVP, OXF, RHEL)
ARNOLD	74	PR D9 1221	+Roe, Sinclair	(MICH)
BRAUN	74	PL 51B 393	+Cornelssen, Martyn+	(AACH3, BARI, BRUX, CERN)
CENCE	74	PR D10 776	+Harris, Jones, Morgado+	(HAWA, LBL, WISC)
Also	73	Thesis unpub.	Clarke	(WISC)
KUNSELMAN	74	PR C9 2469		(WYOM)
MERLAN	74	PR D9 107	+Kasha, Wanderer, Adair+	(YALE, BNL, LASL)
WEISSENBE...	74	PL 48B 474	Weissenberg, Egorov, Minervina+	(ITEP, LEBD)
ABRAMS	73B	PRL 30 500	+Carroll, Kycia, Li, Menes, Michael+	(BNL)
BACKENSTO...	73	PL 43B 431	Backenstoss+	(CERN, KARLK, KARLE, HEID, STOH)
BEIER	73	PRL 30 399	+Buchholz, Mann, Parker, Roberts	(PENN)
BRAUN	73B	PL 47B 185	+Cornelssen	(AACH3, BARI, BRUX, CERN)
Also	75	NP B89 210	Braun, Cornelssen+	(AACH3, BARI, BRUX, CERN)
BRAUN	73C	PL 47B 182	+Cornelssen	(AACH3, BARI, BRUX, CERN)
Also	75	NP B89 210	Braun, Cornelssen+	(AACH3, BARI, BRUX, CERN)
CABLE	73	PR D8 3807	+Hildebrand, Pang, Stiening	(EFI, LBL)
LJUNG	73	PR D8 1307	+Cline	(WISC)
Also	72	PRL 28 523	Ljung	(WISC)
Also	72	PRL 28 1287	Cline, Ljung	(WISC)
Also	69	PRL 23 326	Camerini, Ljung, Sheaff, Cline	(WISC)
LUCAS	73	PR D8 719	+Taft, Willis	(YALE)
LUCAS	73B	PR D8 727	+Taft, Willis	(YALE)

PANG	73	PR D8 1989	+Hildebrand, Cable, Stiening	(EFI, ARIZ, LBL)
Also	72	PL 40B 699	Cable, Hildebrand, Pang, Stiening	(EFI, LBL)
SMITH	73	NP B60 411	+Booth, Renshall, Jones+	(GLAS, LIVP, OXF, RHEL)
ABRAMS	72	PRL 29 1118	+Carroll, Kycia, Li, Menes, Michael+	(BNL)
ANKENBRA...	72	PRL 28 1472	Ankenbrandt, Larsen+	(BNL, LASL, FNAL, YALE)
AUBERT	72	NC 12A 509	+Heusse, Pascaud, Vialle+	(ORSAY, BRUX, EPOL)
BEIER	72	PRL 29 678	+Buchholz, Mann, Parker	(PENN)
CHIANG	72	PR D6 1254	+Rosen, Shapiro, Handler, Olsen+	(ROCH, WISC)
CLARK	72	PRL 29 1274	+Cork, Elioff, Kerth, McReynolds, Newton+	(LBL)
EDWARDS	72	PR D5 2720	+Beier, Bertram, Herzo, Koester+	(ILL)
FORD	72	PL 38B 335	+Piroue, Remmel, Smith, Souder	(PRIN)
HOFFMASTER	72	NP B36 1	+Koller, Taylor+	(STEV, SETO, LEHI)
BASILE	71C	PL 36B 619	+Brehin, Diamant-Berger, Kunz+	(SACL, GEVA)
BOURQUIN	71	PL 36B 615	+Boymond, Extermann, Marasco+	(GEVA, SACL)
GINSBERG	71	PR D4 2893		(MIT)
HAIDT	71	PR D3 10		(AACH, BARI, CERN, EPOL, NIJM+)
Also	69	PL 29B 691	Haidt+	(AACH, BARI, CERN, EPOL, NIJM, ORSAY+)
KLEMS	71	PR D4 66	+Hildebrand, Stiening	(CHIC, LRL)
Also	70	PRL 24 1086	Klems, Hildebrand, Stiening	(LRL, CHIC)
Also	70B	PRL 25 473	Klems, Hildebrand, Stiening	(LRL, CHIC)
OTT	71	PR D3 52	+Pritchard	(LOQM)
ROMANO	71	PL 36B 525	+Renton, Aubert, Burban-Lutz	(BARI, CERN, ORSAY)
SCHWEINB...	71	PL 36B 246	Schweinberger	(AACH, BELG, CERN, NIJM+)
STEINER	71	PL 36B 521		(AACH, BARI, CERN, EPOL, ORSAY, NIJM, PADO+)
BARDIN	70	PL 32B 121	+Bilenky, Pontecorvo	(JINR)
BECHERRAWY	70	PR D1 1452		(ROCH)
BOTTERILL	70	PL 31B 325	+Brown, Clegg, Corbett, Culligan+	(OXF)
FORD	70	PRL 25 1370	+Piroue, Remmel, Smith, Souder	(PRIN)
GAILLARD	70	CERN 70-14	+Chounet	(CERN, ORSAY)
GINSBERG	70	PR D1 229		(HAIF)
GRAUMAN	70	PR D1 1277	+Koller, Taylor, Pandoulas+	(STEV, SETO, LEHI)
Also	69	PRL 23 737	Grauman, Koller, Taylor+	(STEV, SETO, LEHI)
MALTSEV	70	SJNP 10 678	+Pestova, Solodovnikova, Fadeev+	(JINR)
		Translated from YAF 10 1195.		
PANDOULAS	70	PR D2 1205	+Taylor, Koller, Grauman+	(STEV, SETO)
CUTTS	69	PR 184 1380	+Stiening, Wiegand, Deutsch	(LRL, MIT)
Also	68	PRL 20 955	Cutts, Stiening, Wiegand, Deutsch	(LRL, MIT)
DAVISON	69	PR 180 1333	+Bacastow, Barkas, Evans, Fung, Porter+	(UCR)
ELY	69	PR 180 1319	+Gidal, Hagopian, Kalmus+	(LOUC, WISC, LRL)
EMMERSON	69	PRL 23 393	+Quirk	(OXF)
HERZO	69	PR 186 1403	+Banner, Beier, Bertram, Edwards+	(ILL)
KIJEWSKI	69	Thesis UCRL 18433		(LBL)
LOBKOWICZ	69	PR 185 1676	+Melissinos, Nagashima, Tewksbury+	(ROCH, BNL)
Also	66	PRL 17 548	Lobkowicz, Melissinos, Nagashima+	(ROCH, BNL)
MACEK	69	PRL 22 32	+Mann, McFarlane, Roberts+	(PENN, TEMP)
MAST	69	PR 183 1200	+Gershwin, Alston-Garnjost, Bangerter+	(LRL)
SELLERI	69	NC 60A 291		
ZELLER	69	PR 182 1420	+Haddock, Helland, Pahl+	(UCLA, LRL)
BETTELS	68	NC 56A 1106		(AACH, BARI, BERG, CERN, EPOL, NIJM, ORSAY+)
Also	71	PR D3 10	Haidt	(AACH, BARI, CERN, EPOL, NIJM+)
BOTTERILL	68B	PRL 21 766	+Brown, Clegg, Corbett+	(OXF)
BOTTERILL	68C	PR 174 1661	+Brown, Clegg, Corbett+	(OXF)
BUTLER	68	UCRL 18420	+Bland, Goldhaber, Goldhaber, Hirata+	(LRL)
CHANG	68	PRL 20 510	+Yodh, Ehrlich, Plano+	(UMD, RUTG)
CHEN	68	PRL 20 73	+Cutts, Kijewski, Stiening+	(LRL, MIT)
EICHTEN	68	PL 27B 586		(AACH, BARI, CERN, EPOL, ORSAY, PADO, VALE)
EISLER	68	PR 169 1090	+Fung, Marateck, Meyer, Plano	(RUTG)
ESCHSTRUTH	68	PR 165 1487	+Franklin, Hughes+	(PRIN, PENN)
GARLAND	68	PR 167 1225	+Tsipis, Devons, Rosen+	(COLU, RUTG, WISC)
MOSCOSO	68	Thesis		(ORSAY)
AUERBACH	67	PR 155 1505	+Dobbs, Mann+	(PENN, PRIN)
Also	74	PR D9 3216	Auerbach	
Erratum.				
BELLOTTI	67	Heidelberg Conf.	+Pullia	(MILA)
BELLOTTI	67B	NC 52A 1287	+Fiorini, Pullia	(MILA)
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BISI	67	PL 25B 572	+Cester, Chiesa, Vigone	(TORI)
BOTTERILL	67	PRL 19 982	+Brown, Corbett, Culligan+	(OXF)
Also	68	PR 171 1402	Botterill, Brown, Clegg, Corbett+	(OXF)

BOWEN 67B PR 154 1314 +Mann, McFarlane, Hughes+ (PPA)
CLINE 67B Herceg Novi Tbl. 4
Proc. International School on Elementary Particle Physics.
FLETCHER 67 PRL 19 98 +Beier, Edwards+ (ILL)
FORD 67 PRL 18 1214 +Lemonick, Nauenberg, Piroue (PRIN)
GINSBERG 67 PR 162 1570 (MASB)
IMLAY 67 PR 160 1203 +Eschstruth, Franklin+ (PRIN)
KALMUS 67 PR 159 1187 +Kernan (LRL)
ZINCHENKO 67 Thesis Rutgers (RUTG)
CALLAHAN 66 NC 44A 90 (WISC)
CALLAHAN 66B PR 150 1153 +Camerini+ (WISC, LRL, UCR, BARI)
CESTER 66 PL 21 343 +Eschstruth, Oneill+ (PPA)
See footnote 1 in AUERBACH 67.
Also 67 PR 155 1505 Auerbach, Dobbs, Mann+ (PENN, PRIN)
BIRGE 65 PR 139B 1600 +Ely, Gidal, Camerini, Cline+ (LRL, WISC)
BISI 65 NC 35 768 +Borreani, Cester, Ferraro+ (TORI)
BISI 65B PR 139B 1068 +Borreani, Marzari-Chiesa, Rinaudo+ (TORI)
BORREANI 65 PR 140B 1686 +Gidal, Rinaudo, Caforio+ (BARI, TORI)
CALLAHAN 65 PRL 15 129 +Cline (WISC)
CAMERINI 65 NC 37 1795 +Cline, Gidal, Kalmus, Kernan (WISC, LRL)
CLINE 65 PL 15 293 +Fry (WISC)
CUTTS 65 PR 138B 969 +Elioff, Stiening (LRL)
DEMARCO 65 PR 140B 1430 +Grosso, Rinaudo (TORI, CERN)
FITCH 65B PR 140B 1088 +Quarles, Wilkins (PRIN, MTHO)
GREINER 65 ARNS 15 67 (LRL)
STAMER 65 PR 138B 440 +Huetter, Koller, Taylor, Grauman (STEV)
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Updated from 1965 Argonne Conference, page 5.
YOUNG 65 Thesis UCRL 16362 (LRL)
Also 67 PR 156 1464 Young, Osborne, Barkas (LRL)
BORREANI 64 PL 12 123 +Rinaudo, Werbrouck (TORI)
CALLAHAN 64 PR 136B 1463 +March, Stark (WISC)
CAMERINI 64 PRL 13 318 +Cline, Fry, Powell (WISC, LRL)
CLINE 64 PRL 13 101 +Fry (WISC)
GIACOMELLI 64 NC 34 1134 +Monti, Quareni+ (BGNA, MUNI)
GREINER 64 PRL 13 284 +Osborne, Barkas (LRL)
JENSEN 64 PR 136B 1431 +Shaklee, Roe, Sinclair (MICH)
KALMUS 64 PRL 13 99 +Kernan, Pu, Powell, Dowd (LRL, WISC)
SHAKLEE 64 PR 136B 1423 +Jensen, Roe, Sinclair (MICH)
BARKAS 63 PRL 11 26 +Dyer, Heckman (LRL)
BOYARSKI 62 PR 128 2398 +Loh, Niemela, Ritson (MIT)
BROWN 62B PRL 8 450 +Kadyk, Trilling, Roe+ (LRL, MICH)
BARKAS 61 PR 124 1209 +Dyer, Mason, Norris, Nickols, Smit (LRL)
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COOMBES 57 PR 108 1348 +Cork, Galbraith, Lambertson, Wenzel (LBL)
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CRONIN	68B	Vienna Conf. 241		(PRIN)
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CABIBBO	64	PL 9 352	+Maksymowicz	(CERN)
Also	64B	PL 11 360	Cabibbo, Maksymowicz	(CERN)
Also	65	PL 14 72	Cabibbo, Maksymowicz	(CERN)
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BLOCK	62B	CERN Conf. 371	+Lendinara, Monari	(NWES, BGNA)
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