$K^{\pm}$ – THIS IS PART 2 OF 3

To reduce the size of this section's PostScript file, we have divided it into three PostScript files. We present the following index:

PART 1

PART 2

PART 3

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

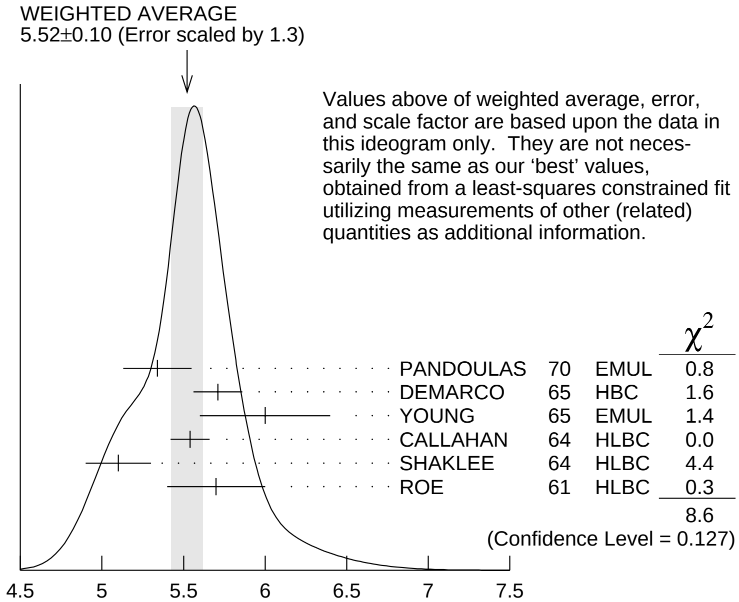
$\Gamma(\pi^+\pi^0)/\Gamma(\pi^+\pi^+\pi^-)$ Γ_3/Γ_4

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.

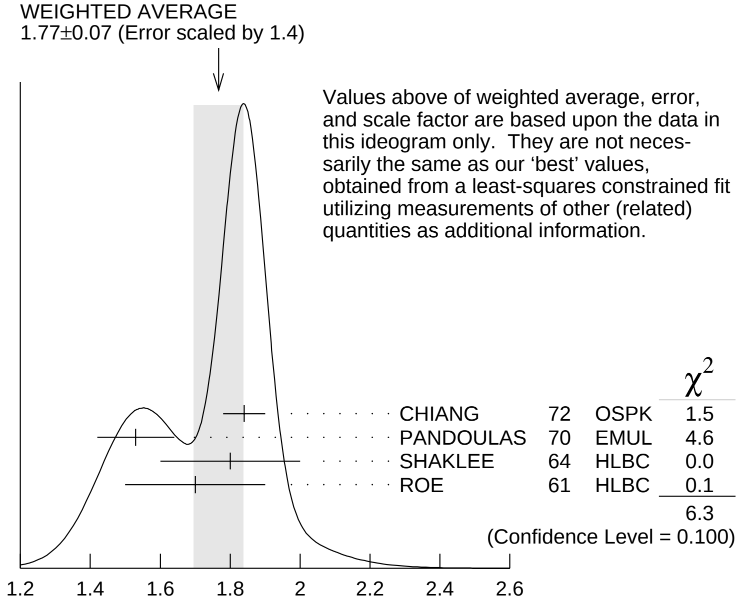


$\Gamma\left(\pi^+\pi^+\pi^-\right)/\Gamma_{total}$ (units 10^{-2})

$\Gamma\left(\pi^+\pi^0\pi^0\right)/\Gamma_{total}$ 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).

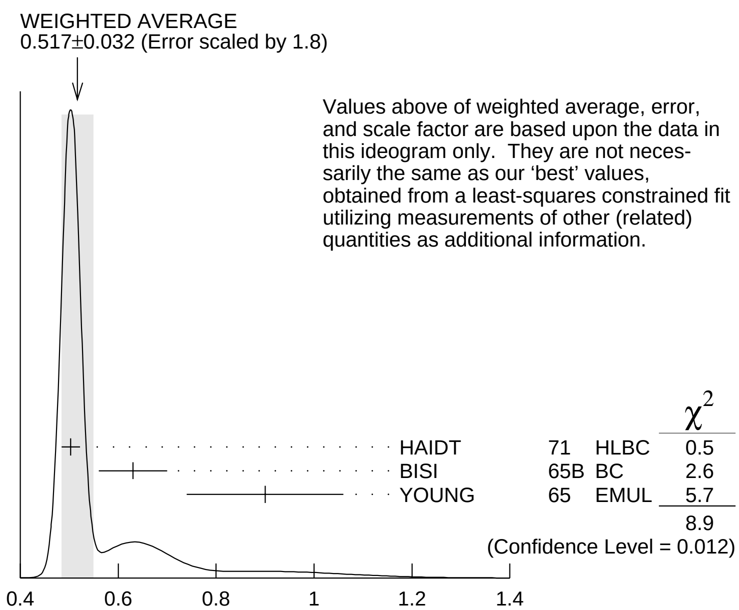
[22] AUERBACH 67 changed from 0.0602 ± 0.0046 by erratum which brings the μ-spectrum calculation into agreement with GAILLARD 70 appendix B.

$\Gamma(\pi^0\mu^+\nu_\mu)/\Gamma(\pi^+\pi^+\pi^-)$ — 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.



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

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

[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 $\Gamma(\pi^0e^+\nu_e)/\Gamma(\pi^+\pi^+\pi^-)$).

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

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	+

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

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

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

$\Gamma(\mu^+\nu_\mu\gamma)/\Gamma_{total}$ — Γ_{19}/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 $K \to e\nu\gamma$.

[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_{20}/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_{21}/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_{22}/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_{23}/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_{24}/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_{25}/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 $\Gamma(K \to e\pi^0\nu\gamma)/\Gamma_{\text{all}}$. The measured normalization is $[\Gamma(K \to e\pi^0\nu) + \Gamma(K \to \pi^+\pi^+\pi^-)]$. For comparison with other experiments we used $\Gamma(K \to e\pi^0\nu)/\Gamma_{\text{all}} = 0.0482$ 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_{26}/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_{27}/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_{28}/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_{28}/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_{29}/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_{30}/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_{31}/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_{32}/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
$\mathbf{0.42^{+0.97}_{-0.35}}$		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_{33}/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_{34}/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_{35}/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_{36}/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_{37}/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_{36}/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_{38}/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_{38}/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_{39}/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_{40}/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_{41}/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_{42}/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.