K^0_S

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

K^0_S MEAN LIFE

For earlier measurements, beginning with BOLDT 58B, see our our 1986 edition, Physics Letters **170B** 130 (1986).

OUR FIT is described in the note on "Fits for K^0_L *CP*-Violation Parameters" in the K^0_L Particle Listings.

VALUE (10^{-10} s)	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
0.8934±0.0008 OUR FIT					
0.8940±0.0009 OUR AVERAGE					
0.8971±0.0021		BERTANZA	97	NA31	
0.8941±0.0014±0.0009		SCHWINGEN...	95	E773	Δm free, $\phi_{+-}=\phi_{SW}$
0.8929±0.0016		GIBBONS	93	E731	
0.8920±0.0044	214k	GROSSMAN	87	SPEC	
0.881 ±0.009	26k	ARONSON	76	SPEC	
0.8924±0.0032		[1] CARITHERS	75	SPEC	
0.8937±0.0048	6M	GEWENIGER	74B	ASPK	
0.8958±0.0045	50k	[2] SKJEGGEST...	72	HBC	
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.905 ±0.007		[3] ARONSON	82B	SPEC	
0.867 ±0.024	2173	[4] FACKLER	73	OSPK	
0.856 ±0.008	19994	[5] DONALD	68B	HBC	
0.872 ±0.009	20000	[5,6] HILL	68	DBC	
0.866 ±0.016		[5] ALFF-...	66B	OSPK	
0.843 ±0.013	5000	[5] KIRSCH	66	HBC	

[1] CARITHERS 75 value is for $m_{K^0_L} - m_{K^0_S}$ $\Delta m = 0.5301 \pm 0.0013$. The Δm dependence of the total decay rate (inverse mean life) is $\Gamma(K^0_S) = \left[(1.122 \pm 0.004) + 0.16(\Delta m - 0.5348)/\Delta m\right] 10^{10}$/s, or, in terms of meanlife $\tau_s = 0.8913 \pm 0.0032\ -0.238(\Delta m - 0.5348)$ where Δm and τ_s are in units of $10^{10}\hbar s^{-1}$ and 10^{-10}s respectively.

[2] HILL 68 has been changed by the authors from the published value (0.865 ± 0.009) because of a correction in the shift due to η_{+-}. SKJEGGESTAD 72 and HILL 68 give detailed discussions of systematics encountered in this type of experiment.

[3] ARONSON 82 find that K^0_S mean life may depend on the kaon energy.

[4] FACKLER 73 does not include systematic errors.

[5] Pre-1971 experiments are excluded from the average because of disagreement with later more precise experiments.

[6] HILL 68 has been changed by the authors from the published value (0.865 ± 0.009) because of a correction in the shift due to η_{+-}. SKJEGGESTAD 72 and HILL 68 give detailed discussions of systematics encountered in this type of experiment.

K^0_S DECAY MODES

	Mode		Fraction (Γ_i/Γ)	Scale factor/ Confidence level
Γ_1	$\pi^+\pi^-$		(68.61 ± 0.28) %	S=1.2
Γ_2	$\pi^0\pi^0$		(31.39 ± 0.28) %	S=1.2
Γ_3	$\pi^+\pi^-\gamma$	[a,b]	$(1.78\pm0.05)\times10^{-3}$	
Γ_4	$\gamma\gamma$		$(2.4\pm0.9)\times10^{-6}$	
Γ_5	$\pi^+\pi^-\pi^0$		$(3.2\ ^{+1.2}_{-1.0})\times10^{-7}$	
Γ_6	$3\pi^0$		$<3.7\times10^{-5}$	CL=90%
Γ_7	$\pi^\pm e^\mp\nu$	[c]	$(6.70\pm0.07)\times10^{-4}$	S=1.1
Γ_8	$\pi^\pm\mu^\mp\nu$	[c]	$(4.69\pm0.06)\times10^{-4}$	S=1.1
	$\Delta S = 1$ weak neutral current (*S1*) modes			
Γ_9	$\mu^+\mu^-$	*S1*	$<3.2\times10^{-7}$	CL=90%
Γ_{10}	e^+e^-	*S1*	$<1.4\times10^{-7}$	CL=90%
Γ_{11}	$\pi^0e^+e^-$	*S1*	$<1.1\times10^{-6}$	CL=90%

[*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*] Calculated from K^0_L semileptonic rates and the K^0_S lifetime assuming $\Delta S = \Delta Q$.

CONSTRAINED FIT INFORMATION

An overall fit to 3 branching ratios uses 17 measurements and one constraint to determine 2 parameters. The overall fit has a $\chi^2 =$ 16.5 for 16 degrees of freedom.

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

x_2	-100
	x_1

K^0_S DECAY RATES

$\Gamma(\pi^\pm e^\mp \nu)$ — Γ_7

VALUE (10^6 s^{-1})	DOCUMENT ID		TECN	COMMENT
7.50±0.08 OUR EVALUATION	Error includes scale factor of 1.1. From K^0_L measurements, assuming that $\Delta S = \Delta Q$ in K^0 decay so that $\Gamma(K^0_S \to \pi^\pm e^\mp \nu) = \Gamma(K^0_L \to \pi^\pm e^\mp \nu_e)$.			
• • • We do not use the following data for averages, fits, limits, etc. • • •				
seen	BURGUN	72	HBC	$K^+ p \to K^0 p \pi^+$
9.3 ±2.5	AUBERT	65	HLBC	ΔS=ΔQ, *CP* cons. not assumed

$\Gamma(\pi^\pm \mu^\mp \nu)$ — Γ_8

VALUE (10^6 s^{-1})	DOCUMENT ID
5.25±0.07 OUR EVALUATION	Error includes scale factor of 1.1. From K^0_L measurements, assuming that $\Delta S = \Delta Q$ in K^0 decay so that $\Gamma(K^0_S \to \pi^\pm \mu^\mp \nu) = \Gamma(K^0_L \to \pi^\pm \mu^\mp \nu)$.

K^0_S BRANCHING RATIOS

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

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.6861±0.0028 OUR FIT	Error includes scale factor of 1.2.				
0.671 ±0.010 OUR AVERAGE					
0.670 ±0.010	3447	[7] DOYLE	69	HBC	$\pi^- p \to \Lambda K^0$
0.70 ±0.08		COLUMBIA	60B	HBC	
0.68 ±0.04		CRAWFORD	59B	HBC	
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.740 ±0.024		[7] ANDERSON	62B	HBC	

[7] Anderson result not published, events added to Doyle sample.

$\Gamma(\pi^+\pi^-)/\Gamma(\pi^0\pi^0)$ — Γ_1/Γ_2

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
2.186±0.028 OUR FIT	Error includes scale factor of 1.2.				
2.197±0.026 OUR AVERAGE					
2.11 ±0.09	1315	EVERHART	76	WIRE	$\pi^- p \to \Lambda K^0$
2.169±0.094	16k	COWELL	74	OSPK	$\pi^- p \to \Lambda K^0$
2.16 ±0.08	4799	HILL	73	DBC	$K^+ d \to K^0 p p$
2.22 ±0.10	3068	[8] ALITTI	72	HBC	$K^+ p \to \pi^+ p K^0$
2.22 ±0.08	6380	MORSE	72B	DBC	$K^+ n \to K^0 p$
2.10 ±0.11	701	[9] NAGY	72	HLBC	$K^+ n \to K^0 p$
2.22 ±0.095	6150	[10] BALTAY	71	HBC	$K p \to K^0$ neutrals
2.282±0.043	7944	[11] MOFFETT	70	OSPK	$K^+ n \to K^0 p$
2.10 ±0.06	3700	MORFIN	69	HLBC	$K^+ n \to K^0 p$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
2.12 ±0.17	267	[9] BOZOKI	69	HLBC	
2.285±0.055	3016	[11] GOBBI	69	OSPK	$K^+ n \to K^0 p$

[8] The directly measured quantity is $K^0_S \to \pi^+\pi^-$/all K^0 = 0.345 ± 0.005.

[9] NAGY 72 is a final result which includes BOZOKI 69.

[10] The directly measured quantity is $K^0_S \to \pi^+\pi^-$/all $\overline{K}^0$ = 0.345 ± 0.005.

[11] MOFFETT 70 is a final result which includes GOBBI 69.

$\Gamma(\pi^0\pi^0)/\Gamma_{total}$ Γ_2/Γ

VALUE	*EVTS*	*DOCUMENT ID*		*TECN*
0.3139±0.0028 OUR FIT Error includes scale factor of 1.2.				
0.316 ±0.014 OUR AVERAGE Error includes scale factor of 1.3. See the ideogram below.				
0.335 ±0.014	1066	BROWN	63	HLBC
0.288 ±0.021	198	CHRETIEN	63	HLBC
0.30 ±0.035		BROWN	61	HLBC
0.26 ±0.06		BAGLIN	60	HLBC
0.27 ±0.11		CRAWFORD	59B	HBC

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

$\Gamma(\pi^+\pi^-\gamma)/\Gamma(\pi^+\pi^-)$ Γ_3/Γ_1

VALUE (units 10^{-3})	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
2.60±0.08 OUR AVERAGE					
2.56±0.09	1286	RAMBERG	93	E731	p_γ >50 MeV/c
2.68±0.15		[12] TAUREG	76	SPEC	p_γ >50 MeV/c
2.8 ±0.6		[13] BURGUN	73	HBC	p_γ >50 MeV/c
3.3 ±1.2	10	WEBBER	70	HBC	p_γ >50 MeV/c
no ratio given	27	BELLOTTI	66	HBC	p_γ >50 MeV/c

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

7.10±0.22	3723		RAMBERG	93	E731	p_γ >20 MeV/c
3.0 ±0.6	29	[14]	BOBISUT	74	HLBC	p_γ >40 MeV/c

[12] TAUREG 76 find direct emission contribution <0.06, CL = 90%.
[13] BURGUN 73 estimates that direct emission contribution is 0.3 ± 0.6.
[14] BOBISUT 74 not included in average because p_γ cut differs. Estimates direct emission contribution to be 0.5 or less, CL = 95%.

$\Gamma(\gamma\gamma)/\Gamma_{\text{total}}$ — Γ_4/Γ

VALUE (units 10^{-6})	*CL%*	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
2.4±0.9		35	[15] BARR	95B	NA31	
• • • We do not use the following data for averages, fits, limits, etc. • • •						
2.2±1.1		16	[16] BARR	95B	NA31	
< 13	90		BALATS	89	SPEC	
2.4±1.2		19	BURKHARDT	87	NA31	
< 133	90		BARMIN	86B	XEBC	
< 200	90		VASSERMAN	86	CALO	$\phi \to K^0_S K^0_L$
< 400	90	0	BARMIN	73B	HLBC	
< 710	90	0	[17] BANNER	72B	OSPK	
< 2000	90	0	MORSE	72B	DBC	
< 2200	90	0	[17] REPELLIN	71	OSPK	
<21000	90	0	[17] BANNER	69	OSPK	

[15] BARR 95B quotes this as the combined BARR 95B + BURKHARDT 87 result after rescaling BURKHARDT 87 to use same branching ratios and lifetimes as BARR 95B.
[16] BARR 95B result is calculated using B($K_L \to \gamma\gamma$) = (5.86 ± 0.17) × 10^{-4}.
[17] These limits are for maximum interference in K^0_S-K^0_L to 2γ's.

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

VALUE (units 10^{-7})	*CL%*	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
$\mathbf{3.2^{+1.2}_{-1.0}}$ **OUR AVERAGE**						
$2.5^{+1.3+0.5}_{-1.0-0.6}$		500k	[18] ADLER	97B	CPLR	
$4.8^{+2.2}_{-1.6}\pm1.1$			[19] ZOU	96	E621	
• • • We do not use the following data for averages, fits, limits, etc. • • •						
$4.1^{+2.5+0.5}_{-1.9-0.6}$			[20] ADLER	96E	CPLR	Sup. by ADLER 97B
$3.9^{+5.4+0.9}_{-1.8-0.7}$			[21] THOMSON	94	E621	Sup. by ZOU 96
<490	90		[22] BARMIN	85	HLBC	
<850	90		METCALF	72	ASPK	

[18] ADLER 97B find the *CP*-conserving parameters Re(λ) = (28 ± 7 ± 3) × 10^{-3}, Im(λ) = (−10 ± 8 ± 2) × 10^{-3}. They estimate B($K^0_S \to \pi^+\pi^-\pi^0$) from Re($\lambda$) and the K^0_L decay parameters.
[19] ZOU 96 is from the the measured quantities $|\rho_{+-0}| = 0.039^{+0.009}_{-0.006} \pm 0.005$ and ϕ_ρ = $(-9 \pm 18)^\circ$.
[20] ADLER 96E is from the measured quantities Re(λ) = $0.036 \pm 0.010^{+0.002}_{-0.003}$ and Im(λ) consistent with zero. Note that the quantity λ is the same as ρ_{+-0} used in other footnotes.

[21] THOMSON 94 calculates this branching ratio from their measurements $|\rho_{+-0}| = 0.035^{+0.019}_{-0.011} \pm 0.004$ and $\phi_\rho = (-59 \pm 48)^\circ$ where $|\rho_{+-0}| e^{i\phi_\rho} = A(K^0_S \to \pi^+\pi^-\pi^0, I=2)/A(K^0_L \to \pi^+\pi^-\pi^0)$.

[22] BARMIN 85 assumes that *CP*-allowed and *CP*-violating amplitudes are equally suppressed.

$\Gamma(3\pi^0)/\Gamma_{total}$ — Γ_6/Γ

VALUE (units 10^{-4})	*CL%*	*DOCUMENT ID*		*TECN*
<0.37	90	BARMIN	83	HLBC
• • • We do not use the following data for averages, fits, limits, etc. • • •				
<4.3	90	BARMIN	73	HLBC

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

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

VALUE (units 10^{-5})	*CL%*	*DOCUMENT ID*		*TECN*
< 0.032	90	GJESDAL	73	ASPK
• • • We do not use the following data for averages, fits, limits, etc. • • •				
<14	90	BOHM	69	OSPK
< 0.7	90	HYAMS	69B	OSPK
<22	90	[23] STUTZKE	69	OSPK
< 7	90	BOTT-...	67	OSPK

[23] Value calculated by us, using 2.3 instead of 1 event, 90% CL.

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

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

VALUE (units 10^{-7})	*CL%*	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
< 1.4	90		ANGELOPO...	97	CPLR	
• • • We do not use the following data for averages, fits, limits, etc. • • •						
< 28	90	0	BLICK	94	CNTR	Hyperon facility
< 100	90		BARMIN	86	XEBC	
<1100	90		BITSADZE	86	CALO	
<3400	90		BOHM	69	OSPK	

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

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

VALUE (units 10^{-6})	*CL%*	*EVTS*	*DOCUMENT ID*		*TECN*
< 1.1	90	0	BARR	93B	NA31
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<45	90		GIBBONS	88	E731

CP VIOLATION IN $K_S \to 3\pi$

Written 1996 by T. Nakada (Paul Scherrer Institute) and L. Wolfenstein (Carnegie-Mellon University).

The possible final states for the decay $K^0 \to \pi^+\pi^-\pi^0$ have isospin $I = 0$, 1, 2, and 3. The $I = 0$ and $I = 2$ states have $CP = +1$ and K_S can decay into them without violating CP symmetry, but they are expected to be strongly suppressed by centrifugal barrier effects. The $I = 1$ and $I = 3$ states, which have no centrifugal barrier, have $CP = -1$ so that the K_S decay to these requires CP violation.

In order to see CP violation in $K_S \to \pi^+\pi^-\pi^0$, it is necessary to observe the interference between K_S and K_L decay, which determines the amplitude ratio

$$\eta_{+-0} = \frac{A(K_S \to \pi^+\pi^-\pi^0)}{A(K_L \to \pi^+\pi^-\pi^0)} \ .$$

If η_{+-0} is obtained from an integration over the whole Dalitz plot, there is no contribution from the $I = 0$ and $I = 2$ final states and a nonzero value of η_{+-0} is entirely due to CP violation.

Only $I = 1$ and $I = 3$ states, which are $CP = -1$, are allowed for $K^0 \to \pi^0\pi^0\pi^0$ decays and the decay of K_S into $3\pi^0$ is an unambiguous sign of CP violation. Similarly to η_{+-0}, η_{000} is defined as

$$\eta_{000} = \frac{A(K_S \to \pi^0\pi^0\pi^0)}{A(K_L \to \pi^0\pi^0\pi^0)} \ .$$

If one assumes that CPT invariance holds and that there are no transitions to $I = 3$ (or to nonsymmetric $I = 1$ states), it can be shown that

$$\begin{aligned} \eta_{+-0} &= \eta_{000} \\ &= \epsilon + i\frac{\text{Im } a_1}{\text{Re } a_1} \ . \end{aligned}$$

With the Wu-Yang phase convention, a_1 is the weak decay amplitude for K^0 into $I = 1$ final states; ϵ is determined from

CP violation in $K_L \to 2\pi$ decays. The real parts of η_{+-0} and η_{000} are equal to $\mathrm{Re}(\epsilon)$. Since currently-known upper limits on $|\eta_{+-0}|$ and $|\eta_{000}|$ are much larger than $|\epsilon|$, they can be interpreted as upper limits on $\mathrm{Im}(\eta_{+-0})$ and $\mathrm{Im}(\eta_{000})$ and so as limits on the CP-violating phase of the decay amplitude a_1.

CP-VIOLATION PARAMETERS IN K^0_S DECAY

$\mathrm{Im}(\eta_{+-0})^2 = \Gamma(K^0_S \to \pi^+\pi^-\pi^0$, *CP*-violating) / $\Gamma(K^0_L \to \pi^+\pi^-\pi^0)$

CPT assumed valid (i.e. $\mathrm{Re}(\eta_{+-0}) \simeq 0$).

VALUE	*CL%*	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
• • • We do not use the following data for averages, fits, limits, etc. • • •						
<0.23	90	601	[24] BARMIN	85	HLBC	
<1.2	90	192	BALDO-...	75	HLBC	
<0.71	90	148	MALLARY	73	OSPK	Re(A)=−0.05 ± 0.17
<0.66	90	180	JAMES	72	HBC	
<1.2	90	99	JONES	72	OSPK	
<0.12	90	384	METCALF	72	ASPK	
<1.2	90	99	CHO	71	DBC	
<1.0	90	98	JAMES	71	HBC	Incl. in JAMES 72
<1.2	95	50	[25] MEISNER	71	HBC	CL=90% not avail.
<0.8	90	71	WEBBER	70	HBC	
<0.45	90		BEHR	66	HLBC	
<3.8	90	18	ANDERSON	65	HBC	Incl. in WEBBER 70

[24] BARMIN 85 find $\mathrm{Re}(\eta_{+-0}) = (0.05 \pm 0.17)$ and $\mathrm{Im}(\eta_{+-0}) = (0.15 \pm 0.33)$. Includes events of BALDO-CEOLIN 75.

[25] These authors find Re(A) = 2.75 ± 0.65, above value at Re(A) = 0.

$\mathrm{Im}(\eta_{+-0}) = \mathrm{Im}(\mathrm{A}(K^0_S \to \pi^+\pi^-\pi^0$, *CP*-violating) / $\mathrm{A}(K^0_L \to \pi^+\pi^-\pi^0))$

VALUE	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
$\mathbf{-0.002 \pm 0.009 ^{+0.002}_{-0.001}}$	500k	[26] ADLER	97B	CPLR	
• • • We do not use the following data for averages, fits, limits, etc. • • •					
−0.002±0.018±0.003	137k	[27] ADLER	96D	CPLR	Sup. by ADLER 97B
−0.015±0.017±0.025	272k	[28] ZOU	94	SPEC	

[26] ADLER 97B also find $\mathrm{Re}(\eta_{+-0}) = -0.002 \pm 0.007^{+0.004}_{-0.001}$.

[27] The ADLER 96D fit also yields $\mathrm{Re}(\eta_{+-0}) = 0.006 \pm 0.013 \pm 0.001$ with a correlation +0.66 between real and imaginary parts. Their results correspond to $|\eta_{+-0}| < 0.037$ with 90% CL.

[28] ZOU 94 use theoretical constraint $\mathrm{Re}(\eta_{+-0}) = \mathrm{Re}(\epsilon) = 0.0016$. Without this constraint they find $\mathrm{Im}(\eta_{+-0}) = 0.019 \pm 0.061$ and $\mathrm{Re}(\eta_{+-0}) = 0.019 \pm 0.027$.

$\mathrm{Im}(\eta_{000})^2 = \Gamma(K^0_S \to 3\pi^0)\ /\ \Gamma(K^0_L \to 3\pi^0)$

CPT assumed valid (i.e. $\mathrm{Re}(\eta_{000}) \simeq 0$). This limit determines branching ratio $\Gamma(3\pi^0)/\Gamma_{\mathrm{total}}$ above.

VALUE	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
<0.1	90	632	[29] BARMIN	83	HLBC	
• • • We do not use the following data for averages, fits, limits, etc. • • •						
<0.28	90		[30] GJESDAL	74B	SPEC	Indirect meas.
<1.2	90	22	BARMIN	73	HLBC	

[29] BARMIN 83 find $\mathrm{Re}(\eta_{000}) = (-0.08 \pm 0.18)$ and $\mathrm{Im}(\eta_{000}) = (-0.05 \pm 0.27)$. Assuming *CPT* invariance they obtain the limit quoted above.

[30] GJESDAL 74B uses $K2\pi$, $K_{\mu 3}$, and K_{e3} decay results, unitarity, and *CPT*. Calculates $|(\eta_{000})| = 0.26 \pm 0.20$. We convert to upper limit.

K^0_S REFERENCES

ADLER	97B	PL B407 193	R. Adler+	(CPLEAR Collab.)
ANGELOPO...	97	PL B413 232	A. Angelopoulos+	(CPLEAR Collab.)
BERTANZA	97	ZPHY C73 629	L. Bertanza	(PISA, CERN, EDIN, MANZ, ORSAY, SIEG)
ADLER	96D	PL B370 167	+Alhalel, Angelopoulos+	(CPLEAR Collab.)
ADLER	96E	PL B374 313	+Alhalel, Angelopoulos+	(CPLEAR Collab.)
ZOU	96	PL B369 362	+Beretvas, Caracappa+	(RUTG, MINN, MICH)
BARR	95B	PL B351 579	+Buchholz+	(CERN, EDIN, MANZ, LALO, PISA, SIEG)
SCHWINGEN...	95	PRL 74 4376	Schwingenheuer+	(EFI, CHIC, ELMT, FNAL, ILL, RUTG)
BLICK	94	PL B334 234	+Kolosov, Kutjin, Shelikov+	(SERP, JINR)
THOMSON	94	PL B337 411	+Zou, Beretvas, Caracappa, Devlin+	(RUTG, MINN, MICH)
ZOU	94	PL B329 519	+Beretvas, Caracappa, Devlin+	(RUTG, MINN, MICH)
BARR	93B	PL B304 381	+Buchholz+	(CERN, EDIN, MANZ, LALO, PISA, SIEG)
GIBBONS	93	PRL 70 1199	+Barker, Briere, Makoff+	(FNAL E731 Collab.)
Also	97	PR D55 6625	L.K. Gibbons+	(FNAL E731 Collab.)
RAMBERG	93	PRL 70 2525	+Bock, Coleman, Enagonio, Hsiung+	(FNAL E731 Collab.)
BALATS	89	SJNP 49 828	+Berezin, Bogdanov, Vishnevskii, Vishnyakov+	(ITEP)
		Translated from YAF 49 1332.		
GIBBONS	88	PRL 61 2661	+Papadimitriou+	(FNAL E731 Collab.)
BURKHARDT	87	PL B199 139	+	(CERN, EDIN, MANZ, LALO, PISA, SIEG)
GROSSMAN	87	PRL 59 18	+Heller, James, Shupe+	(MINN, MICH, RUTG)
BARMIN	86	SJNP 44 622	+Barylov, Davidenko, Demidov+	(ITEP)
		Translated from YAF 44 965.		
BARMIN	86B	NC 96A 159	+Barylov, Chistyakova, Chuvilo+	(ITEP, PADO)
BITSADZE	86	PL 167B 138	+Budagov	(CMNS, SOFI, SERP, TBIL, JINR, BAKU+)
PDG	86B	PL 170B 130	Aguilar-Benitez, Porter+	(CERN, CIT+)
VASSERMAN	86	JETPL 43 588	+Golubev, Gluskin, Druzhinin+	(NOVO)
		Translated from ZETFP 43 457.		
BARMIN	85	NC 85A 67	+Barylov, Chistyakova, Chuvilo+	(ITEP, PADO)
Also	85B	SJNP 41 759	Barmin, Barylov, Volkov+	(ITEP)
		Translated from YAF 41 1187.		
BARMIN	83	PL 128B 129	+Barylov, Chistyakova, Chuvilo+	(ITEP, PADO)
Also	84	SJNP 39 269	Barmin, Barylov, Golubchikov+	(ITEP, PADO)
		Translated from YAF 39 428.		
ARONSON	82	PRL 48 1078	+Bernstein+	(BNL, CHIC, STAN, WISC)
ARONSON	82B	PRL 48 1306	+Bock, Cheng, Fischbach	(BNL, CHIC, PURD)
Also	82B	PL 116B 73	Fischbach, Cheng+	(PURD, BNL, CHIC)
Also	83	PR D28 476	Aronson, Bock, Cheng+	(BNL, CHIC, PURD)
Also	83B	PR D28 495	Aronson, Bock, Cheng+	(BNL, CHIC, PURD)
ARONSON	76	NC 32A 236	+McIntyre, Roehrig+	(WISC, EFI, UCSD, ILLC)
EVERHART	76	PR D14 661	+Kraus, Lande, Long, Lowenstein+	(PENN)
TAUREG	76	PL 65B 92	+Zech, Dydak, Navarria+	(HEIDH, CERN, DORT)
BALDO-...	75	NC 25A 688	Baldo-Ceolin, Bobisut, Calimani+	(PADO, WISC)
CARITHERS	75	PRL 34 1244	+Modis, Nygren, Pun+	(COLU, NYU)
BOBISUT	74	LNC 11 646	+Huzita, Mattioli, Puglierin	(PADO)
COWELL	74	PR D10 2083	+Lee-Franzini, Orcutt, Franzini+	(STON, COLU)
GEWENIGER	74B	PL 48B 487	+Gjesdal, Presser+	(CERN, HEIDH)
GJESDAL	74B	PL 52B 119	+Presser, Steffen+	(CERN, HEIDH)
BARMIN	73	PL 46B 465	+Barylov, Davidenko, Demidov+	(ITEP)
BARMIN	73B	PL 47B 463	+Barylov, Davidenko, Demidov+	(ITEP)
BURGUN	73	PL 46B 481	+Bertranet, Lesquoy, Muller, Pauli+	(SACL, CERN)

FACKLER	73	PRL 31 847	+Frisch, Martin, Smoot, Sompayrac	(MIT)
GJESDAL	73	PL 44B 217	+Presser, Steffen, Steinberger+	(CERN, HEIDH)
HILL	73	PR D8 1290	+Sakitt, Samios, Burris, Engler+	(BNL, CMU)
MALLARY	73	PR D7 1953	+Binnie, Gallivan, Gomez, Peck, Sciulli+	(CIT)
ALITTI	72	PL 39B 568	+Lesquoy, Muller	(SACL)
BANNER	72B	PRL 29 237	+Cronin, Hoffman, Knapp, Shochet	(PRIN)
BURGUN	72	NP B50 194	+Lesquoy, Muller, Pauli+	(SACL, CERN, OSLO)
JAMES	72	NP B49 1	+Montanet, Paul, Saetre+	(CERN, SACL, OSLO)
JONES	72	NC 9A 151	+Abashian, Graham, Mantsch, Orr, Smith+	(ILL)
METCALF	72	PL 40B 703	+Neuhofer, Niebergall+	(CERN, IPN, WIEN)
MORSE	72B	PRL 28 388	+Nauenberg, Bierman, Sager+	(COLO, PRIN, UMD)
NAGY	72	NP B47 94	+Telbisz, Vestergombi	(BUDA)
Also	69	PL 30B 498	Bozoki, Fenyves, Gombosi, Nagy+	(BUDA)
SKJEGGEST...	72	NP B48 343	Skjeggestad, James+	(OSLO, CERN, SACL)
BALTAY	71	PRL 27 1678	+Bridgewater, Cooper, Gershwin, Habibi+	(COLU)
Also	71	Thesis Nevis 187	Cooper	(COLU)
CHO	71	PR D3 1557	+Dralle, Canter, Engler, Fisk+	(CMU, BNL, CASE)
JAMES	71	PL 35B 265	+Montanet, Paul, Pauli+	(CERN, SACL, OSLO)
MEISNER	71	PR D3 59	+Mann, Hertzbach, Kofler+	(MASA, BNL, YALE)
REPELLIN	71	PL 36B 603	+Wolff, Chollet, Gaillard, Jane+	(ORSAY, CERN)
MOFFETT	70	BAPS 15 512	+Gobbi, Green, Hakel, Rosen	(ROCH)
WEBBER	70	PR D1 1967	+Solmitz, Crawford, Alston-Garnjost	(LRL)
Also	69	Thesis UCRL 19226	Webber	(LRL)
BANNER	69	PR 188 2033	+Cronin, Liu, Pilcher	(PRIN)
BOHM	69	Thesis		(AACH)
BOZOKI	69	PL 30B 498	+Fenyves, Gombosi, Nagy+	(BUDA)
DOYLE	69	Thesis UCRL 18139		(LRL)
GOBBI	69	PRL 22 682	+Green, Hakel, Moffett, Rosen+	(ROCH)
HYAMS	69B	PL 29B 521	+Koch, Potter, VonLindern, Lorenz+	(CERN, MPIM)
MORFIN	69	PRL 23 660	+Sinclair	(MICH)
STUTZKE	69	PR 177 2009	+Abashian, Jones, Mantsch, Orr, Smith	(ILL)
DONALD	68B	PL 27B 58	+Edwards, Nisar+	(LIVP, CERN, IPNP, CDEF)
HILL	68	PR 171 1418	+Robinson, Sakitt+	(BNL, CMU)
BOTT-...	67	PL 24B 194	Bott-Bodenhausen, DeBouard, Cassel+	(CERN)
ALFF-...	66B	PL 21 595	Alff-Steinberger, Heuer, Kleinknecht+	(CERN)
BEHR	66	PL 22 540	+Brisson, Petiau+	(EPOL, MILA, PADO, ORSAY)
BELLOTTI	66	NC 45A 737	+Pullia, Baldo-Ceolin+	(MILA, PADO)
KIRSCH	66	PR 147 939	+Schmidt	(COLU)
ANDERSON	65	PRL 14 475	+Crawford, Golden, Stern, Binford+	(LRL, WISC)
AUBERT	65	PL 17 59	+Behr, Canavan, Chounet+	(EPOL, ORSAY)
BROWN	63	PR 130 769	+Kadyk, Trilling, Roe+	(LRL, MICH)
CHRETIEN	63	PR 131 2208	+	(BRAN, BROW, HARV, MIT)
ANDERSON	62B	CERN Conf. 836	+Crawford+	(LRL)
BROWN	61	NC 19 1155	+Bryant, Burnstein, Glaser, Kadyk+	(MICH)
BAGLIN	60	NC 18 1043	+Bloch, Brisson, Hennessy+	(EPOL)
COLUMBIA	60B	Rochester Conf. 727	Schwartz+	(COLU)
CRAWFORD	59B	PRL 2 266	+Cresti, Douglass, Good, Ticho+	(LRL)
BOLDT	58B	PRL 1 150	+Caldwell, Pal	(MIT)

OTHER RELATED PAPERS

LITTENBERG	93	ARNPS 43 729	+Valencia	(BNL, FNAL)
Rare and Radiative Kaon Decays				
BATTISTON	92	PRPL 214 293	+Cocolicchio, Fogli, Paver	(PGIA, CERN, TRSTT)
Status and Perspectives of K Decay Physics				
TRILLING	65B	UCRL 16473		(LRL)
Updated from 1965 Argonne Conference, page 115.				
CRAWFORD	62	CERN Conf. 827		(LRL)
FITCH	61	NC 22 1160	+Piroue, Perkins	(PRIN, LASL)
GOOD	61	PR 124 1223	+Matsen, Muller, Piccioni+	(LRL)
BIRGE	60	Rochester Conf. 601	+Ely+	(LRL, WISC)
MULLER	60	PRL 4 418	+Birge, Fowler, Good, Piccioni+	(LRL, BNL)