STRANGE MESONS ($S = \pm 1$, $C = B = 0$)

$K^+ = u\overline{s}$, $K^0 = d\overline{s}$, $\overline{K}^0 = \overline{d}\,s$, $K^- = \overline{u}\,s$, similarly for K^*'s

$K^\pm$

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

Mass $m = 493.677 \pm 0.016$ MeV [a] (S = 2.8)
Mean life $\tau = (1.2384 \pm 0.0024) \times 10^{-8}$ s (S = 2.0)
$c\tau = 3.713$ m

Slope parameter g [b]

(See Particle Listings for quadratic coefficients)

$K^+ \to \pi^+\pi^+\pi^- = -0.2154 \pm 0.0035$ (S = 1.4)
$K^- \to \pi^-\pi^-\pi^+ = -0.217 \pm 0.007$ (S = 2.5)
$K^\pm \to \pi^\pm\pi^0\pi^0 = 0.638 \pm 0.020$ (S = 2.5)

$K^\pm$ decay form factors [c,d]

Assuming μ-e universality

$\lambda_+(K^+_{\mu 3}) = \lambda_+(K^+_{e3}) = (2.78 \pm 0.07) \times 10^{-2}$ (S = 1.5)
$\lambda_0(K^+_{\mu 3}) = (1.77 \pm 0.16) \times 10^{-2}$ (S = 1.5)

Not assuming μ-e universality

$\lambda_+(K^+_{e3}) = (2.77 \pm 0.05) \times 10^{-2}$
$\lambda_+(K^+_{\mu 3}) = (2.84 \pm 0.27) \times 10^{-2}$ (S = 1.8)
$\lambda_0(K^+_{\mu 3}) = (1.74 \pm 0.22) \times 10^{-2}$ (S = 1.8)

K^+_{e3} $\left|f_S/f_+\right| = (-0.3^{+0.8}_{-0.7}) \times 10^{-2}$
K^+_{e3} $\left|f_T/f_+\right| = (-1.2 \pm 2.3) \times 10^{-2}$
$K^+_{\mu 3}$ $\left|f_S/f_+\right| = (0.2 \pm 0.6) \times 10^{-2}$
$K^+_{\mu 3}$ $\left|f_T/f_+\right| = (-0.1 \pm 0.7) \times 10^{-2}$
$K^+ \to e^+\nu_e\gamma$ $\left|F_A + F_V\right| = 0.148 \pm 0.010$
$K^+ \to \mu^+\nu_\mu\gamma$ $\left|F_A + F_V\right| = 0.165 \pm 0.013$
$K^+ \to e^+\nu_e\gamma$ $\left|F_A - F_V\right| < 0.49$
$K^+ \to \mu^+\nu_\mu\gamma$ $\left|F_A - F_V\right| = -0.24$ to 0.04, CL = 90%

Charge Radius

$\langle r \rangle = 0.560 \pm 0.031$ fm

CP violation parameters

$\Delta(K^{\pm}_{\pi\mu\mu}) = -0.02 \pm 0.12$

T violation parameters

$K^+ \to \pi^0 \mu^+ \nu_\mu \quad P_T = (-4 \pm 5) \times 10^{-3}$

$K^+ \to \mu^+ \nu_\mu \gamma \quad P_T = (-0.6 \pm 1.9) \times 10^{-2}$

$K^+ \to \pi^0 \mu^+ \nu_\mu \quad \mathrm{Im}(\xi) = -0.014 \pm 0.014$

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

K^+ DECAY MODES		Fraction (Γ_i/Γ)	Scale factor/ Confidence level	p (MeV/c)
Leptonic and semileptonic modes				
$e^+ \nu_e$		$(1.55 \pm 0.07) \times 10^{-5}$		247
$\mu^+ \nu_\mu$		(63.43 ± 0.17) %	S=1.2	236
$\pi^0 e^+ \nu_e$		(4.87 ± 0.06) %	S=1.2	228
Called K^+_{e3}.				
$\pi^0 \mu^+ \nu_\mu$		(3.27 ± 0.06) %	S=1.2	215
Called $K^+_{\mu 3}$.				
$\pi^0 \pi^0 e^+ \nu_e$		$(2.1 \pm 0.4) \times 10^{-5}$		206
$\pi^+ \pi^- e^+ \nu_e$		$(4.08 \pm 0.09) \times 10^{-5}$		203
$\pi^+ \pi^- \mu^+ \nu_\mu$		$(1.4 \pm 0.9) \times 10^{-5}$		151
$\pi^0 \pi^0 \pi^0 e^+ \nu_e$		$< 3.5 \times 10^{-6}$	CL=90%	135
Hadronic modes				
$\pi^+ \pi^0$		(21.13 ± 0.14) %	S=1.1	205
$\pi^+ \pi^0 \pi^0$		(1.73 ± 0.04) %	S=1.2	133
$\pi^+ \pi^+ \pi^-$		(5.576 ± 0.031) %	S=1.1	125
Leptonic and semileptonic modes with photons				
$\mu^+ \nu_\mu \gamma$	[e,f]	$(5.50 \pm 0.28) \times 10^{-3}$		236
$\pi^0 e^+ \nu_e \gamma$	[e,f]	$(2.65 \pm 0.20) \times 10^{-4}$		228
$\pi^0 e^+ \nu_e \gamma$(SD)	[g]	$< 5.3 \times 10^{-5}$	CL=90%	228
$\pi^0 \mu^+ \nu_\mu \gamma$	[e,f]	$< 6.1 \times 10^{-5}$	CL=90%	215
$\pi^0 \pi^0 e^+ \nu_e \gamma$		$< 5 \times 10^{-6}$	CL=90%	206
Hadronic modes with photons				
$\pi^+ \pi^0 \gamma$	[e,f]	$(2.75 \pm 0.15) \times 10^{-4}$		205
$\pi^+ \pi^0 \gamma$(DE)	[f,h]	$(4.4 \pm 0.8) \times 10^{-6}$		205
$\pi^+ \pi^0 \pi^0 \gamma$	[e,f]	$(7.4 {}^{+5.5}_{-2.9}) \times 10^{-6}$		133
$\pi^+ \pi^+ \pi^- \gamma$	[e,f]	$(1.04 \pm 0.31) \times 10^{-4}$		125
$\pi^+ \gamma \gamma$	[f]	$(1.10 \pm 0.32) \times 10^{-6}$		227
$\pi^+ 3\gamma$	[f]	$< 1.0 \times 10^{-4}$	CL=90%	227

Leptonic modes with $\ell\overline{\ell}$ pairs

$e^+\nu_e\nu\overline{\nu}$			$<$ 6	$\times 10^{-5}$	CL=90%	247
$\mu^+\nu_\mu\nu\overline{\nu}$			$<$ 6.0	$\times 10^{-6}$	CL=90%	236
$e^+\nu_e e^+ e^-$			(2.48 $\pm$0.20)	$\times 10^{-8}$		247
$\mu^+\nu_\mu e^+ e^-$			(7.06 $\pm$0.31)	$\times 10^{-8}$		236
$e^+\nu_e\mu^+\mu^-$			$<$ 5	$\times 10^{-7}$	CL=90%	223
$\mu^+\nu_\mu\mu^+\mu^-$			$<$ 4.1	$\times 10^{-7}$	CL=90%	185

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

$\pi^+\pi^+e^-\overline{\nu}_e$	SQ		$<$ 1.2	$\times 10^{-8}$	CL=90%	203
$\pi^+\pi^+\mu^-\overline{\nu}_\mu$	SQ		$<$ 3.0	$\times 10^{-6}$	CL=95%	151
$\pi^+e^+e^-$	$S1$		(2.88 $\pm$0.13)	$\times 10^{-7}$		227
$\pi^+\mu^+\mu^-$	$S1$		(8.1 $\pm$1.4)	$\times 10^{-8}$	S=2.7	172
$\pi^+\nu\overline{\nu}$	$S1$		(1.6 $^{+1.8}_{-0.8}$)	$\times 10^{-10}$		227
$\pi^+\pi^0\nu\overline{\nu}$	$S1$		$<$ 4.3	$\times 10^{-5}$	CL=90%	205
$\mu^-\nu e^+e^+$	LF		$<$ 2.0	$\times 10^{-8}$	CL=90%	236
$\mu^+\nu_e$	LF	[i]	$<$ 4	$\times 10^{-3}$	CL=90%	236
$\pi^+\mu^+e^-$	LF		$<$ 2.8	$\times 10^{-11}$	CL=90%	214
$\pi^+\mu^-e^+$	LF		$<$ 5.2	$\times 10^{-10}$	CL=90%	214
$\pi^-\mu^+e^+$	L		$<$ 5.0	$\times 10^{-10}$	CL=90%	214
$\pi^-e^+e^+$	L		$<$ 6.4	$\times 10^{-10}$	CL=90%	227
$\pi^-\mu^+\mu^+$	L	[i]	$<$ 3.0	$\times 10^{-9}$	CL=90%	172
$\mu^+\overline{\nu}_e$	L	[i]	$<$ 3.3	$\times 10^{-3}$	CL=90%	236
$\pi^0e^+\overline{\nu}_e$	L		$<$ 3	$\times 10^{-3}$	CL=90%	228
$\pi^+\gamma$		[j]	$<$ 3.6	$\times 10^{-7}$	CL=90%	227

K^0

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

50% K_S, 50% K_L

Mass $m = 497.648 \pm 0.022$ MeV

$m_{K^0} - m_{K^\pm} = 3.972 \pm 0.027$ MeV (S = 1.2)

Mean Square Charge Radius

$\langle r^2 \rangle = -0.076 \pm 0.018$ fm^2 (S = 1.1)

T-violation parameters in K^0-$\overline{K}^0$ mixing [c]

Asymmetry A_T in K^0-$\overline{K}^0$ mixing $= (6.6 \pm 1.6) \times 10^{-3}$

CPT-violation parameters [c]

Re $\delta = (2.9 \pm 2.7) \times 10^{-4}$
Im $\delta = (0.02 \pm 0.05) \times 10^{-3}$
$\left|m_{K^0} - m_{\overline{K}^0}\right| \,/\, m_{\text{average}} \;<\; 10^{-18}$, CL = 90% [k]
$(\Gamma_{K^0} - \Gamma_{\overline{K}^0})/m_{\text{average}} = (8 \pm 8) \times 10^{-18}$

K^0_S

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

Mean life $\tau = (0.8953 \pm 0.0006) \times 10^{-10}$ s (S = 1.4) Assuming *CPT*
Mean life $\tau = (0.8958 \pm 0.0006) \times 10^{-10}$ s (S = 1.2) Not assuming *CPT*
$c\tau = 2.6842$ cm Assuming *CPT*

CP-violation parameters [l]

$\text{Im}(\eta_{+-0}) = -0.002 \pm 0.009$
$\text{Im}(\eta_{000}) = -0.05 \pm 0.13$
CP asymmetry *A* in $\pi^+\pi^-e^+e^- = (-1 \pm 4)\%$

K^0_S DECAY MODES		Fraction (Γ_i/Γ)	Scale factor/ Confidence level	p (MeV/c)
Hadronic modes				
$\pi^0\pi^0$		(31.05 ± 0.14) %	S=1.1	209
$\pi^+\pi^-$		(68.95 ± 0.14) %	S=1.1	206
$\pi^+\pi^-\pi^0$		$(3.2 \;^{+1.2}_{-1.0}) \times 10^{-7}$		133
Modes with photons or $\ell\overline{\ell}$ pairs				
$\pi^+\pi^-\gamma$	[e,m]	$(1.79 \pm 0.05) \times 10^{-3}$		206
$\pi^+\pi^-e^+e^-$		$(4.69 \pm 0.30) \times 10^{-5}$		206
$\pi^0\gamma\gamma$	[m]	$(4.9 \pm 1.8) \times 10^{-8}$		231
$\gamma\gamma$		$(2.80 \pm 0.07) \times 10^{-6}$		249
Semileptonic modes				
$\pi^{\pm}e^{\mp}\nu_e$	[n]	$(6.9 \pm 0.4) \times 10^{-4}$		229
***CP* violating (*CP*) and $\Delta S = 1$ weak neutral current (*S1*) modes**				
$3\pi^0$	*CP*	$< 1.4 \times 10^{-5}$	CL=90%	139
$\mu^+\mu^-$	*S1*	$< 3.2 \times 10^{-7}$	CL=90%	225
e^+e^-	*S1*	$< 1.4 \times 10^{-7}$	CL=90%	249
$\pi^0e^+e^-$	*S1* [m]	$(3.0 \;^{+1.5}_{-1.2}) \times 10^{-9}$		231

K^0_L

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

$m_{K_L} - m_{K_S}$
$= (0.5292 \pm 0.0010) \times 10^{10}\ \hbar\ s^{-1}$ (S = 1.2) Assuming CPT
$= (3.483 \pm 0.006) \times 10^{-12}$ MeV Assuming CPT
$= (0.5290 \pm 0.0016) \times 10^{10}\ \hbar\ s^{-1}$ (S = 1.2) Not assuming CPT

Mean life $\tau = (5.18 \pm 0.04) \times 10^{-8}$ s (S = 1.1)
$c\tau = 15.51$ m

Slope parameter g [b]

(See Particle Listings for quadratic coefficients)

$K^0_L \to \pi^+\pi^-\pi^0 = 0.678 \pm 0.008$ (S = 1.5)

K_L decay form factors [c]

Assuming μ-e universality

$\lambda_+(K^0_{\mu 3}) = \lambda_+(K^0_{e3}) = 0.0300 \pm 0.0020$ (S = 2.0)

$\lambda_0(K^0_{\mu 3}) = 0.030 \pm 0.005$ (S = 2.0)

Not assuming μ-e universality

$\lambda_+(K^0_{e3}) = 0.0291 \pm 0.0018$ (S = 1.5)

$\lambda_+(K^0_{\mu 3}) = 0.033 \pm 0.005$ (S = 2.3)

$\lambda_0(K^0_{\mu 3}) = 0.027 \pm 0.006$ (S = 2.3)

K^0_{e3} $|f_S/f_+| < 0.04$, CL = 68%

K^0_{e3} $|f_T/f_+| < 0.23$, CL = 68%

$K^0_{\mu 3}$ $|f_T/f_+| = 0.12 \pm 0.12$

$K_L \to e^+e^-\gamma$: $\alpha_{K^*} = -0.33 \pm 0.05$

$K_L \to \mu^+\mu^-\gamma$: $\alpha_{K^*} = -0.158 \pm 0.027$

$K_L \to e^+e^-e^+e^-$: $\alpha^{\text{eff}}_{K^*} = -0.14 \pm 0.22$

$K_L \to \pi^+\pi^-e^+e^-$: $a_1/a_2 = -0.734 \pm 0.022$ GeV^2

$K_L \to \pi^0 2\gamma$: $a_V = -0.54 \pm 0.12$ (S = 2.8)

CP-violation parameters [l]

$\delta_L = (0.327 \pm 0.012)\%$

$|\eta_{00}| = (2.276 \pm 0.014) \times 10^{-3}$

$|\eta_{+-}| = (2.288 \pm 0.014) \times 10^{-3}$

$|\epsilon| = (2.284 \pm 0.014) \times 10^{-3}$

$|\eta_{00}/\eta_{+-}| = 0.9950 \pm 0.0008$ [o] (S = 1.6)

$\mathrm{Re}(\epsilon'/\epsilon) = (1.67 \pm 0.26) \times 10^{-3}$ [o] (S = 1.6)

Assuming *CPT*

$\phi_{+-} = (43.52 \pm 0.06)^\circ$ (S = 1.3)

$\phi_{00} = (43.50 \pm 0.06)^\circ$ (S = 1.3)

$\phi_\epsilon = \phi_{\mathrm{SW}} = (43.51 \pm 0.05)^\circ$ (S = 1.2)

Not assuming *CPT*

$\phi_{+-} = (43.4 \pm 0.7)^\circ$ (S = 1.3)

$\phi_{00} = (43.7 \pm 0.8)^\circ$ (S = 1.2)

$\phi_\epsilon = (43.5 \pm 0.7)^\circ$ (S = 1.3)

CP asymmetry *A* in $K^0_L \to \pi^+\pi^- e^+ e^- = (13.8 \pm 2.2)\%$

β_{CP} from $K^0_L \to e^+ e^- e^+ e^- = -0.23 \pm 0.09$

γ_{CP} from $K^0_L \to e^+ e^- e^+ e^- = -0.09 \pm 0.09$

j for $K^0_L \to \pi^+\pi^-\pi^0 = 0.0012 \pm 0.0008$

f for $K^0_L \to \pi^+\pi^-\pi^0 = 0.004 \pm 0.006$

$|\eta_{+-\gamma}| = (2.35 \pm 0.07) \times 10^{-3}$

$\phi_{+-\gamma} = (44 \pm 4)^\circ$

$|\epsilon'_{+-\gamma}|/\epsilon < 0.3$, CL = 90%

T-violation parameters

$\mathrm{Im}(\xi)$ in $K^0_{\mu 3} = -0.007 \pm 0.026$

CPT invariance tests

$\phi_{00} - \phi_{+-} = (0.2 \pm 0.4)^\circ$

$\mathrm{Re}(\frac{2}{3}\eta_{+-} + \frac{1}{3}\eta_{00}) - \frac{\delta_L}{2} = (-3 \pm 35) \times 10^{-6}$

$\Delta S = -\Delta Q$ in $K^0_{\ell 3}$ decay

Re $x = -0.002 \pm 0.006$

Im $x = 0.0012 \pm 0.0021$

K^0_L DECAY MODES		Fraction (Γ_i/Γ)	Scale factor/ Confidence level	p (MeV/c)
Semileptonic modes				
$\pi^{\pm} e^{\mp} \nu_e$	[n]	(38.81 ± 0.27) %	S=1.1	229
Called K^0_{e3}.				
$\pi^{\pm} \mu^{\mp} \nu_\mu$	[n]	(27.19 ± 0.25) %	S=1.1	216
Called $K^0_{\mu 3}$.				
$(\pi \mu \text{atom}) \nu$		$(1.06 \pm 0.11) \times 10^{-7}$		188
$\pi^0 \pi^{\pm} e^{\mp} \nu$	[n]	$(5.18 \pm 0.29) \times 10^{-5}$		207
Hadronic modes, including Charge conjugation×Parity Violating (*CPV*) modes				
$3\pi^0$		(21.05 ± 0.23) %	S=1.1	139
$\pi^+ \pi^- \pi^0$		(12.59 ± 0.19) %	S=1.6	133
$\pi^+ \pi^-$	*CPV*	$(2.090 \pm 0.025) \times 10^{-3}$	S=1.1	206
$\pi^0 \pi^0$	*CPV*	$(9.32 \pm 0.12) \times 10^{-4}$	S=1.1	209
Semileptonic modes with photons				
$\pi^{\pm} e^{\mp} \nu_e \gamma$	[e,n,p]	$(3.53 \pm 0.06) \times 10^{-3}$		229
$\pi^{\pm} \mu^{\mp} \nu_\mu \gamma$		$(5.7 {}^{+0.6}_{-0.7}) \times 10^{-4}$		216
Hadronic modes with photons or $\ell\overline{\ell}$ pairs				
$\pi^0 \pi^0 \gamma$		$< 5.6 \times 10^{-6}$		209
$\pi^+ \pi^- \gamma$	[e,p]	$(4.39 \pm 0.12) \times 10^{-5}$	S=1.8	206
$\pi^0 2\gamma$	[p]	$(1.41 \pm 0.12) \times 10^{-6}$	S=2.8	231
$\pi^0 \gamma e^+ e^-$		$(2.3 \pm 0.4) \times 10^{-8}$		231
Other modes with photons or $\ell\overline{\ell}$ pairs				
2γ		$(5.90 \pm 0.07) \times 10^{-4}$	S=1.1	249
3γ		$< 2.4 \times 10^{-7}$	CL=90%	249
$e^+ e^- \gamma$		$(10.0 \pm 0.5) \times 10^{-6}$	S=1.5	249
$\mu^+ \mu^- \gamma$		$(3.59 \pm 0.11) \times 10^{-7}$	S=1.3	225
$e^+ e^- \gamma \gamma$	[p]	$(5.95 \pm 0.33) \times 10^{-7}$		249
$\mu^+ \mu^- \gamma \gamma$	[p]	$(1.0 {}^{+0.8}_{-0.6}) \times 10^{-8}$		225

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

$\mu^+\mu^-$	$S1$		$(7.27 \pm 0.14) \times 10^{-9}$		225
e^+e^-	$S1$		$(9\ {}^{+6}_{-4}) \times 10^{-12}$		249
$\pi^+\pi^-e^+e^-$	$S1$	[p]	$(3.11 \pm 0.19) \times 10^{-7}$		206
$\pi^0\pi^0e^+e^-$	$S1$		$< 6.6 \times 10^{-9}$	CL=90%	209
$\mu^+\mu^-e^+e^-$	$S1$		$(2.69 \pm 0.27) \times 10^{-9}$		225
$e^+e^-e^+e^-$	$S1$		$(3.75 \pm 0.27) \times 10^{-8}$		249
$\pi^0\mu^+\mu^-$	CP,$S1$	[q]	$< 3.8 \times 10^{-10}$	CL=90%	177
$\pi^0e^+e^-$	CP,$S1$	[q]	$< 5.1 \times 10^{-10}$	CL=90%	231
$\pi^0\nu\overline{\nu}$	CP,$S1$	[r]	$< 5.9 \times 10^{-7}$	CL=90%	231
$e^\pm\mu^\mp$	LF	[n]	$< 4.7 \times 10^{-12}$	CL=90%	238
$e^\pm e^\pm\mu^\mp\mu^\mp$	LF	[n]	$< 4.12 \times 10^{-11}$	CL=90%	225
$\pi^0\mu^\pm e^\mp$	LF	[n]	$< 6.2 \times 10^{-9}$	CL=90%	217

$K^*(892)$

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

$K^*(892)^\pm$ mass $m = 891.66 \pm 0.26$ MeV
$K^*(892)^0$ mass $m = 896.10 \pm 0.27$ MeV (S = 1.4)
$K^*(892)^\pm$ full width $\Gamma = 50.8 \pm 0.9$ MeV
$K^*(892)^0$ full width $\Gamma = 50.7 \pm 0.6$ MeV (S = 1.1)

$K^*(892)$ DECAY MODES	Fraction (Γ_i/Γ)	Confidence level	p (MeV/c)
$K\pi$	~ 100 %		289
$K^0\gamma$	$(2.30 \pm 0.20) \times 10^{-3}$		307
$K^\pm\gamma$	$(9.9 \pm 0.9) \times 10^{-4}$		309
$K\pi\pi$	$< 7 \times 10^{-4}$	95%	223

$K_1(1270)$

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

Mass $m = 1273 \pm 7$ MeV [s]
Full width $\Gamma = 90 \pm 20$ MeV [s]

$K_1(1270)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$K\rho$	(42 ± 6) %	43
$K_0^*(1430)\pi$	(28 ± 4) %	†
$K^*(892)\pi$	(16 ± 5) %	302
$K\omega$	(11.0 ± 2.0) %	†
$K f_0(1370)$	(3.0 ± 2.0) %	–
γK^0	seen	539

$K_1(1400)$

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

Mass $m = 1402 \pm 7$ MeV
Full width $\Gamma = 174 \pm 13$ MeV (S = 1.6)

$K_1(1400)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$K^*(892)\pi$	(94 ± 6) %	402
$K\rho$	(3.0 ± 3.0) %	292
$K f_0(1370)$	(2.0 ± 2.0) %	–
$K\omega$	(1.0 ± 1.0) %	284
$K_0^*(1430)\pi$	not seen	†
γK^0	seen	613

$K^*(1410)$

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

Mass $m = 1414 \pm 15$ MeV (S = 1.3)
Full width $\Gamma = 232 \pm 21$ MeV (S = 1.1)

$K^*(1410)$ DECAY MODES	Fraction (Γ_i/Γ)	Confidence level	p (MeV/c)
$K^*(892)\pi$	> 40 %	95%	410
$K\pi$	(6.6 ± 1.3) %		612
$K\rho$	< 7 %	95%	305
γK^0	seen		619

$K_0^*(1430)$ [t]

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

Mass $m = 1412 \pm 6$ MeV
Full width $\Gamma = 294 \pm 23$ MeV

$K_0^*(1430)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$K\pi$	(93 ± 10) %	611

$K_2^*(1430)$

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

$K_2^*(1430)^\pm$ mass $m = 1425.6 \pm 1.5$ MeV (S = 1.1)
$K_2^*(1430)^0$ mass $m = 1432.4 \pm 1.3$ MeV
$K_2^*(1430)^\pm$ full width $\Gamma = 98.5 \pm 2.7$ MeV (S = 1.1)
$K_2^*(1430)^0$ full width $\Gamma = 109 \pm 5$ MeV (S = 1.9)

$K_2^*(1430)$ DECAY MODES	Fraction (Γ_i/Γ)	Scale factor/ Confidence level	p (MeV/c)
$K\pi$	(49.9 ± 1.2) %		619
$K^*(892)\pi$	(24.7 ± 1.5) %		419
$K^*(892)\pi\pi$	(13.4 ± 2.2) %		372
$K\rho$	(8.7 ± 0.8) %	S=1.2	318
$K\omega$	(2.9 ± 0.8) %		311
$K^+\gamma$	$(2.4\pm0.5)\times10^{-3}$	S=1.1	627
$K\eta$	$(1.5^{+3.4}_{-1.0})\times10^{-3}$	S=1.3	486
$K\omega\pi$	$< 7.2 \times10^{-4}$	CL=95%	100
$K^0\gamma$	$< 9 \times10^{-4}$	CL=90%	626

$K^*(1680)$

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

Mass $m = 1717 \pm 27$ MeV (S = 1.4)
Full width $\Gamma = 322 \pm 110$ MeV (S = 4.2)

$K^*(1680)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$K\pi$	(38.7 ± 2.5) %	781
$K\rho$	$(31.4^{+4.7}_{-2.1})$ %	570
$K^*(892)\pi$	$(29.9^{+2.2}_{-4.7})$ %	618

$K_2(1770)$ [u]

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

Mass $m = 1773 \pm 8$ MeV
Full width $\Gamma = 186 \pm 14$ MeV

$K_2(1770)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$K\pi\pi$		794
$K_2^*(1430)\pi$	dominant	288
$K^*(892)\pi$	seen	654

$K f_2(1270)$	seen	53
$K \phi$	seen	441
$K \omega$	seen	607

$K_3^*(1780)$

$I(J^P) = \frac{1}{2}(3^-)$

Mass $m = 1776 \pm 7$ MeV (S = 1.1)
Full width $\Gamma = 159 \pm 21$ MeV (S = 1.3)

$K_3^*(1780)$ DECAY MODES	Fraction (Γ_i/Γ)	Confidence level	p (MeV/c)
$K \rho$	(31 ± 9) %		613
$K^*(892)\pi$	(20 ± 5) %		656
$K \pi$	(18.8 ± 1.0) %		813
$K \eta$	(30 ± 13) %		719
$K_2^*(1430)\pi$	< 16 %	95%	291

$K_2(1820)$ [v]

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

Mass $m = 1816 \pm 13$ MeV
Full width $\Gamma = 276 \pm 35$ MeV

$K_2(1820)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$K_2^*(1430)\pi$	seen	327
$K^*(892)\pi$	seen	681
$K f_2(1270)$	seen	185
$K \omega$	seen	638

$K_4^*(2045)$

$I(J^P) = \frac{1}{2}(4^+)$

Mass $m = 2045 \pm 9$ MeV (S = 1.1)
Full width $\Gamma = 198 \pm 30$ MeV

$K_4^*(2045)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$K \pi$	(9.9 ± 1.2) %	958
$K^*(892)\pi\pi$	(9 ± 5) %	802
$K^*(892)\pi\pi\pi$	(7 ± 5) %	768
$\rho K \pi$	(5.7 ± 3.2) %	741
$\omega K \pi$	(5.0 ± 3.0) %	738
$\phi K \pi$	(2.8 ± 1.4) %	594
$\phi K^*(892)$	(1.4 ± 0.7) %	363

NOTES

[*a*] See the note in the $K^{\pm}$ Particle Listings.

[*b*] The definition of the slope parameter g of the $K \rightarrow 3\pi$ Dalitz plot is as follows (see also "Note on Dalitz Plot Parameters for $K \rightarrow 3\pi$ Decays" in the $K^{\pm}$ Particle Listings):

$$\left|M\right|^2 = 1 + g(s_3 - s_0)/m^2_{\pi^+} + \cdots .$$

[*c*] For more details and definitions of parameters see the Particle Listings.

[*d*] See the "Note on $\pi^{\pm} \rightarrow \ell^{\pm}\nu\gamma$ and $K^{\pm} \rightarrow \ell^{\pm}\nu\gamma$ Form Factors" in the $\pi^{\pm}$ Particle Listings for definitions and details.

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

[*f*] See the $K^{\pm}$ Particle Listings for the energy limits used in this measurement.

[*g*] Structure-dependent part.

[*h*] Direct-emission branching fraction.

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

[*j*] Violates angular-momentum conservation.

[*k*] Derived from measured values of ϕ_{+-}, ϕ_{00}, $\left|\eta\right|$, $\left|m_{K^0_L} - m_{K^0_S}\right|$, and $\tau_{K^0_S}$, as described in the introduction to "Tests of Conservation Laws."

[*l*] The *CP*-violation parameters are defined as follows (see also "Note on *CP* Violation in $K_S \rightarrow 3\pi$" and "Note on *CP* Violation in K^0_L Decay" in the Particle Listings):

$$\eta_{+-} = \left|\eta_{+-}\right| e^{i\phi_{+-}} = \frac{A(K^0_L \rightarrow \pi^+\pi^-)}{A(K^0_S \rightarrow \pi^+\pi^-)} = \epsilon + \epsilon'$$

$$\eta_{00} = \left|\eta_{00}\right| e^{i\phi_{00}} = \frac{A(K^0_L \rightarrow \pi^0\pi^0)}{A(K^0_S \rightarrow \pi^0\pi^0)} = \epsilon - 2\epsilon'$$

$$\delta = \frac{\Gamma(K^0_L \rightarrow \pi^-\ell^+\nu) - \Gamma(K^0_L \rightarrow \pi^+\ell^-\nu)}{\Gamma(K^0_L \rightarrow \pi^-\ell^+\nu) + \Gamma(K^0_L \rightarrow \pi^+\ell^-\nu)} ,$$

$$\mathrm{Im}(\eta_{+-0})^2 = \frac{\Gamma(K^0_S \rightarrow \pi^+\pi^-\pi^0)^{CP\ \mathrm{viol.}}}{\Gamma(K^0_L \rightarrow \pi^+\pi^-\pi^0)} ,$$

$$\mathrm{Im}(\eta_{000})^2 = \frac{\Gamma(K^0_S \rightarrow \pi^0\pi^0\pi^0)}{\Gamma(K^0_L \rightarrow \pi^0\pi^0\pi^0)} .$$

where for the last two relations *CPT* is assumed valid, *i.e.*, $\mathrm{Re}(\eta_{+-0}) \simeq 0$ and $\mathrm{Re}(\eta_{000}) \simeq 0$.

[*m*] See the K^0_S Particle Listings for the energy limits used in this measurement.

[*n*] The value is for the sum of the charge states or particle/antiparticle states indicated.

[*o*] $\mathrm{Re}(\epsilon'/\epsilon) = \epsilon'/\epsilon$ to a very good approximation provided the phases satisfy *CPT* invariance.

[*p*] See the K^0_L Particle Listings for the energy limits used in this measurement.

[*q*] Allowed by higher-order electroweak interactions.

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

[*s*] This is only an educated guess; the error given is larger than the error on the average of the published values. See the Particle Listings for details.

[*t*] See the "Note on $f_0(1370)$" in the $f_0(1370)$ Particle Listings and in the 1994 edition.

[*u*] See the note in the $L(1770)$ Particle Listings in Reviews of Modern Physics **56** No. 2 Pt. II (1984), p. S200. See also the "Note on $K_2(1770)$ and the $K_2(1820)$" in the $K_2(1770)$ Particle Listings .

[*v*] See the "Note on $K_2(1770)$ and the $K_2(1820)$" in the $K_2(1770)$ Particle Listings .