

TESTS OF DISCRETE SPACE-TIME SYMMETRIES

CHARGE CONJUGATION (C) INVARIANCE

$\Gamma(\pi^0 \rightarrow 3\gamma)/\Gamma_{\text{total}}$	$<3.1 \times 10^{-8}$, CL = 90%
η C-nonconserving decay parameters	
$\pi^+ \pi^- \pi^0$ left-right asymmetry parameter	$(0.09^{+0.11}_{-0.12}) \times 10^{-2}$
$\pi^+ \pi^- \pi^0$ sextant asymmetry parameter	$(0.12^{+0.10}_{-0.11}) \times 10^{-2}$
$\pi^+ \pi^- \pi^0$ quadrant asymmetry parameter	$(-0.09 \pm 0.09) \times 10^{-2}$
$\pi^+ \pi^- \gamma$ left-right asymmetry parameter	$(0.9 \pm 0.4) \times 10^{-2}$
$\pi^+ \pi^- \gamma$ parameter β (<i>D</i> -wave)	-0.02 ± 0.07 ($S = 1.3$)
$\Gamma(\eta \rightarrow \pi^0 \gamma)/\Gamma_{\text{total}}$	$<9 \times 10^{-5}$, CL = 90%
$\Gamma(\eta \rightarrow \pi^0 \pi^0 \gamma)/\Gamma_{\text{total}}$	$<5 \times 10^{-4}$, CL = 90%
$\Gamma(\eta \rightarrow \pi^0 \pi^0 \pi^0 \gamma)/\Gamma_{\text{total}}$	$<6 \times 10^{-5}$, CL = 90%
$\Gamma(\eta \rightarrow 3\gamma)/\Gamma_{\text{total}}$	$<1.6 \times 10^{-5}$, CL = 90%
$\Gamma(\eta \rightarrow \pi^0 e^+ e^-)/\Gamma_{\text{total}}$	[a] $<4 \times 10^{-5}$, CL = 90%
$\Gamma(\eta \rightarrow \pi^0 \mu^+ \mu^-)/\Gamma_{\text{total}}$	[a] $<5 \times 10^{-6}$, CL = 90%
$\Gamma(\omega(782) \rightarrow \eta \pi^0)/\Gamma_{\text{total}}$	$<1 \times 10^{-3}$, CL = 90%
$\Gamma(\omega(782) \rightarrow 3\pi^0)/\Gamma_{\text{total}}$	$<3 \times 10^{-4}$, CL = 90%
<i>c</i> decay parameter of $\eta'(958)$	0.015 ± 0.018
asymmetry parameter for $\eta'(958) \rightarrow \pi^+ \pi^- \gamma$ decay	-0.01 ± 0.04
$\Gamma(\eta'(958) \rightarrow \pi^0 e^+ e^-)/\Gamma_{\text{total}}$	[a] $<1.4 \times 10^{-3}$, CL = 90%
$\Gamma(\eta'(958) \rightarrow \eta e^+ e^-)/\Gamma_{\text{total}}$	[a] $<2.4 \times 10^{-3}$, CL = 90%
$\Gamma(\eta'(958) \rightarrow 3\gamma)/\Gamma_{\text{total}}$	$<1.0 \times 10^{-4}$, CL = 90%
$\Gamma(\eta'(958) \rightarrow \mu^+ \mu^- \pi^0)/\Gamma_{\text{total}}$	[a] $<6.0 \times 10^{-5}$, CL = 90%
$\Gamma(\eta'(958) \rightarrow \mu^+ \mu^- \eta)/\Gamma_{\text{total}}$	[a] $<1.5 \times 10^{-5}$, CL = 90%
$\Gamma(J/\psi(1S) \rightarrow \gamma\gamma)/\Gamma_{\text{total}}$	$<5 \times 10^{-6}$, CL = 90%

PARITY (P) INVARIANCE

e electric dipole moment	$(0.07 \pm 0.07) \times 10^{-26}$ e cm
μ electric dipole moment	$(3.7 \pm 3.4) \times 10^{-19}$ e cm
$\text{Re}(d_\tau = \tau$ electric dipole moment)	-0.22 to 0.45×10^{-16} e cm, CL = 95%
$\Gamma(\eta \rightarrow \pi^+ \pi^-)/\Gamma_{\text{total}}$	$<1.3 \times 10^{-5}$, CL = 90%
$\Gamma(\eta \rightarrow \pi^0 \pi^0)/\Gamma_{\text{total}}$	$<3.5 \times 10^{-4}$, CL = 90%
$\Gamma(\eta \rightarrow 4\pi^0)/\Gamma_{\text{total}}$	$<6.9 \times 10^{-7}$, CL = 90%
$\Gamma(\eta'(958) \rightarrow \pi^+ \pi^-)/\Gamma_{\text{total}}$	$<2.9 \times 10^{-3}$, CL = 90%
$\Gamma(\eta'(958) \rightarrow \pi^0 \pi^0)/\Gamma_{\text{total}}$	$<9 \times 10^{-4}$, CL = 90%
$\Gamma(\eta_c(1S) \rightarrow \pi^+ \pi^-)/\Gamma_{\text{total}}$	$<6 \times 10^{-4}$, CL = 90%
$\Gamma(\eta_c(1S) \rightarrow \pi^0 \pi^0)/\Gamma_{\text{total}}$	$<4 \times 10^{-4}$, CL = 90%
$\Gamma(\eta_c(1S) \rightarrow K^+ K^-)/\Gamma_{\text{total}}$	$<6 \times 10^{-4}$, CL = 90%
$\Gamma(\eta_c(1S) \rightarrow K_S^0 K_S^0)/\Gamma_{\text{total}}$	$<3.1 \times 10^{-4}$, CL = 90%
p electric dipole moment	$<0.54 \times 10^{-23}$ e cm
n electric dipole moment	$<0.29 \times 10^{-25}$ e cm, CL = 90%
Λ electric dipole moment	$<1.5 \times 10^{-16}$ e cm, CL = 95%

TIME REVERSAL (T) INVARIANCE

e electric dipole moment	$(0.07 \pm 0.07) \times 10^{-26}$ e cm
μ electric dipole moment	$(3.7 \pm 3.4) \times 10^{-19}$ e cm
μ decay parameters	
transverse e^+ polarization normal to plane of μ spin, e^+ momentum	$(-2 \pm 8) \times 10^{-3}$
α'/A	$(0 \pm 4) \times 10^{-3}$
β'/A	$(1 \pm 5) \times 10^{-3}$
$\text{Re}(d_\tau = \tau$ electric dipole moment)	-0.22 to 0.45×10^{-16} e cm, CL = 95%
P_T in $K^+ \rightarrow \pi^0 \mu^+ \nu_\mu$	$(-1.7 \pm 2.5) \times 10^{-3}$
P_T in $K^+ \rightarrow \mu^+ \nu_\mu \gamma$	$(-0.6 \pm 1.9) \times 10^{-2}$
$\text{Im}(\xi)$ in $K^+ \rightarrow \pi^0 \mu^+ \nu_\mu$ decay (from transverse μ pol.)	-0.006 ± 0.008
asymmetry A_T in K^0 - \bar{K}^0 mixing	$(6.6 \pm 1.6) \times 10^{-3}$
$\text{Im}(\xi)$ in $K_{\mu 3}^0$ decay (from transverse μ pol.)	-0.007 ± 0.026
$A_T(K_S^0 K^\pm \pi^+ \pi^-)$ in D^\pm	0.02 ± 0.07
$A_T(K^+ K^- \pi^+ \pi^-)$ in D^0, \bar{D}^0	0.01 ± 0.07
$A_T(K_S^0 K^\pm \pi^+ \pi^-)$ in D_S^\pm	[b] -0.04 ± 0.07
p electric dipole moment	$<0.54 \times 10^{-23}$ e cm
n electric dipole moment	$<0.29 \times 10^{-25}$ e cm, CL = 90%
$n \rightarrow p e^- \bar{\nu}_e$ decay parameters	
ϕ_{AV} , phase of g_A relative to g_V	[c] $(180.06 \pm 0.07)^\circ$

triple correlation coefficient D	$(-4 \pm 6) \times 10^{-4}$
Λ electric dipole moment	$<1.5 \times 10^{-16}$ ecm, CL = 95%
triple correlation coefficient D for $\Sigma^- \rightarrow ne^- \bar{\nu}_e$	0.11 ± 0.10

CP INVARIANCE

$\text{Re}(d_\tau^W)$	$<0.50 \times 10^{-17}$ ecm, CL = 95%
$\text{Im}(d_\tau^W)$	$<1.1 \times 10^{-17}$ ecm, CL = 95%
$\Gamma(\eta \rightarrow \pi^+ \pi^-) / \Gamma_{\text{total}}$	$<1.3 \times 10^{-5}$, CL = 90%
$\Gamma(\eta \rightarrow \pi^0 \pi^0) / \Gamma_{\text{total}}$	$<3.5 \times 10^{-4}$, CL = 90%
$\Gamma(\eta \rightarrow 4\pi^0) / \Gamma_{\text{total}}$	$<6.9 \times 10^{-7}$, CL = 90%
$\Gamma(\eta'(958) \rightarrow \pi^+ \pi^-) / \Gamma_{\text{total}}$	$<2.9 \times 10^{-3}$, CL = 90%
$\Gamma(\eta'(958) \rightarrow \pi^0 \pi^0) / \Gamma_{\text{total}}$	$<9 \times 10^{-4}$, CL = 90%
$K^\pm \rightarrow \pi^\pm \pi^+ \pi^-$ rate difference/average	$(0.08 \pm 0.12)\%$
$K^\pm \rightarrow \pi^\pm \pi^0 \pi^0$ rate difference/average	$(0.0 \pm 0.6)\%$
$K^\pm \rightarrow \pi^\pm \pi^0 \gamma$ rate difference/average	$(0.9 \pm 3.3)\%$
$K^\pm \rightarrow \pi^\pm \pi^+ \pi^- (g_+ - g_-) / (g_+ + g_-)$	$(-1.5 \pm 2.2) \times 10^{-4}$
$K^\pm \rightarrow \pi^\pm \pi^0 \pi^0 (g_+ - g_-) / (g_+ + g_-)$	$(1.8 \pm 1.8) \times 10^{-4}$
$\Delta(K_{\pi\mu\mu}^\pm) = \frac{\Gamma(K_{\pi\mu\mu}^+) - \Gamma(K_{\pi\mu\mu}^-)}{\Gamma(K_{\pi\mu\mu}^+) + \Gamma(K_{\pi\mu\mu}^-)}$	-0.02 ± 0.12
$A_S = [\Gamma(K_S^0 \rightarrow \pi^- e^+ \nu_e) - \Gamma(K_S^0 \rightarrow \pi^+ e^- \bar{\nu}_e)] / \text{SUM}$	$(2 \pm 10) \times 10^{-3}$
$\text{Im}(\eta_{+-0}) = \text{Im}(A(K_S^0 \rightarrow \pi^+ \pi^- \pi^0, \text{CP-violating}) / A(K_L^0 \rightarrow \pi^+ \pi^- \pi^0))$	-0.002 ± 0.009
$\text{Im}(\eta_{000}) = \text{Im}(A(K_S^0 \rightarrow \pi^0 \pi^0 \pi^0) / A(K_L^0 \rightarrow \pi^0 \pi^0 \pi^0))$	$(-0.1 \pm 1.6) \times 10^{-2}$
$ \eta_{000} = A(K_S^0 \rightarrow 3\pi^0) / A(K_L^0 \rightarrow 3\pi^0) $	<0.018 , CL = 90%
CP asymmetry A in $K_S^0 \rightarrow \pi^+ \pi^- e^+ e^-$	$(-1 \pm 4)\%$
$\Gamma(K_S^0 \rightarrow 3\pi^0) / \Gamma_{\text{total}}$	$<1.2 \times 10^{-7}$, CL = 90%
linear coefficient j for $K_L^0 \rightarrow \pi^+ \pi^- \pi^0$	0.0012 ± 0.0008
quadratic coefficient f for $K_L^0 \rightarrow \pi^+ \pi^- \pi^0$	0.004 ± 0.006
$ \epsilon'_{+-\gamma} / \epsilon$ for $K_L^0 \rightarrow \pi^+ \pi^- \gamma$	<0.3 , CL = 90%
$ g_{E1} $ for $K_L^0 \rightarrow \pi^+ \pi^- \gamma$	<0.21 , CL = 90%
$\Gamma(K_L^0 \rightarrow \pi^0 \mu^+ \mu^-) / \Gamma_{\text{total}}$	[d] $<3.8 \times 10^{-10}$, CL = 90%
$\Gamma(K_L^0 \rightarrow \pi^0 e^+ e^-) / \Gamma_{\text{total}}$	[d] $<2.8 \times 10^{-10}$, CL = 90%
$\Gamma(K_L^0 \rightarrow \pi^0 \nu \bar{\nu}) / \Gamma_{\text{total}}$	[e] $<6.7 \times 10^{-8}$, CL = 90%
$A_{CP}(K_S^0 \pi^\pm)$ in D^\pm	-0.009 ± 0.009
$A_{CP}(K^\mp 2\pi^\pm)$ in D^\pm	-0.005 ± 0.010
$A_{CP}(K^\mp \pi^\pm \pi^\pm \pi^0)$ in D^\pm	0.010 ± 0.013
$A_{CP}(K_S^0 \pi^\pm \pi^0)$ in D^\pm	0.003 ± 0.009

$A_{CP}(K_S^0 \pi^\pm \pi^+ \pi^-)$ in D^\pm	0.001 ± 0.013
$A_{CP}(K_S^0 K^\pm)$ in D^\pm	0.07 ± 0.06
$A_{CP}(K^+ K^- \pi^\pm)$ in D^\pm	$(0.3 \pm 0.6)\%$
$A_{CP}(K^\pm K^{*0})$ in D^\pm	$(0.1 \pm 1.3)\%$
$A_{CP}(\phi \pi^\pm)$ in D^\pm	$(-0.9 \pm 1.1)\%$
$A_{CP}(\pi^+ \pi^- \pi^\pm)$ in D^\pm	-0.02 ± 0.04
$A_{CP}(K_S^0 K^\pm \pi^+ \pi^-)$ in D^\pm	-0.04 ± 0.07
$A_{CP}(K^+ K^-)$ in D^0, \bar{D}^0	$(-0.17 \pm 0.31) \times 10^{-2}$ ($S = 1.3$)
$A_{CP}(K_S^0 K_S^0)$ in D^0, \bar{D}^0	-0.23 ± 0.19
$A_{CP}(\pi^+ \pi^-)$ in D^0, \bar{D}^0	$(0.2 \pm 0.4) \times 10^{-2}$
$A_{CP}(\pi^0 \pi^0)$ in D^0, \bar{D}^0	0.00 ± 0.05
$A_{CP}(\pi^+ \pi^- \pi^0)$ in D^0, \bar{D}^0	$(0.3 \pm 0.4)\%$
$A_{CP}(K_S^0 \phi)$ in D^0, \bar{D}^0	-0.03 ± 0.09
$A_{CP}(K_S^0 \pi^0)$ in D^0, \bar{D}^0	0.001 ± 0.013
$A_{CP}(K^\pm \pi^\mp)$ in D^0, \bar{D}^0	0.022 ± 0.032
$A_{CP}(K^\mp \pi^\pm \pi^0)$ in D^0, \bar{D}^0	0.002 ± 0.009
$A_{CP}(K^\pm \pi^\mp \pi^0)$ in D^0, \bar{D}^0	0.00 ± 0.05
$A_{CP}(K_S^0 \pi^+ \pi^-)$ in D^0, \bar{D}^0	$-0.009^{+0.026}_{-0.060}$
$A_{CP}(K^*(892)^\mp \pi^\pm \rightarrow K_S^0 \pi^+ \pi^-)$ in $D^0 \rightarrow$ $K^{*-} \pi^+, \bar{D}^0 \rightarrow K^{*+} \pi^-$	$<3.5 \times 10^{-4}$, CL = 95%
$A_{CP}(K^*(892)^\pm \pi^\mp \rightarrow K_S^0 \pi^+ \pi^-)$ in $D^0 \rightarrow$ $K^{*+} \pi^-, \bar{D}^0 \rightarrow K^{*-} \pi^+$	$<7.8 \times 10^{-4}$, CL = 95%
$A_{CP}(K_S^0 \rho^0 \rightarrow K_S^0 \pi^+ \pi^-)$ in D^0, \bar{D}^0	$<4.8 \times 10^{-4}$, CL = 95%
$A_{CP}(K_S^0 \omega \rightarrow K_S^0 \pi^+ \pi^-)$ in D^0, \bar{D}^0	$<9.2 \times 10^{-4}$, CL = 95%
$A_{CP}(K_S^0 f_0(980) \rightarrow K_S^0 \pi^+ \pi^-)$ in D^0, \bar{D}^0	$<6.8 \times 10^{-4}$, CL = 95%
$A_{CP}(K_S^0 f_2(1270) \rightarrow K_S^0 \pi^+ \pi^-)$ in D^0, \bar{D}^0	$<13.5 \times 10^{-4}$, CL = 95%
$A_{CP}(K_S^0 f_0(1370) \rightarrow K_S^0 \pi^+ \pi^-)$ in D^0, \bar{D}^0	$<25.5 \times 10^{-4}$, CL = 95%
$A_{CP}(K_0^*(1430)^\mp \pi^\pm \rightarrow K_S^0 \pi^+ \pi^-)$ in D^0, \bar{D}^0	$<9.0 \times 10^{-4}$, CL = 95%
$A_{CP}(K_2^*(1430)^\mp \pi^\pm \rightarrow K_S^0 \pi^+ \pi^-)$ in D^0, \bar{D}^0	$<6.5 \times 10^{-4}$, CL = 95%
$A_{CP}(K^*(1680)^\mp \pi^\pm \rightarrow K_S^0 \pi^+ \pi^-)$ in D^0, \bar{D}^0	$<28.4 \times 10^{-4}$, CL = 95%
$A_{CP}(K^\pm \pi^\mp \pi^+ \pi^-)$ in D^0, \bar{D}^0	-0.02 ± 0.04
$A_{CP}(K^+ K^- \pi^+ \pi^-)$ in D^0, \bar{D}^0	-0.08 ± 0.07
$A_{CP}(K^\pm K_S^0)$ in $D_s^\pm \rightarrow K^\pm K_S^0$	0.049 ± 0.023
$A_{CP}(K^+ K^- \pi^\pm)$ in $D_s^\pm \rightarrow K^+ K^- \pi^\pm$	0.003 ± 0.014
$A_{CP}(K^+ K^- \pi^\pm \pi^0)$ in $D_s^\pm \rightarrow K^+ K^- \pi^\pm \pi^0$	-0.06 ± 0.04
$A_{CP}(K_S^0 K^\mp 2\pi^\pm)$ in $D_s^+ \rightarrow K_S^0 K^- 2\pi^+, D_s^- \rightarrow$ $K_S^0 K^+ 2\pi^-$	-0.01 ± 0.04
$A_{CP}(\pi^+ \pi^- \pi^\pm)$ in $D_s^\pm \rightarrow \pi^+ \pi^- \pi^\pm$	0.02 ± 0.05
$A_{CP}(\pi^\pm \eta)$ in $D_s^\pm \rightarrow \pi^\pm \eta$	-0.08 ± 0.05
$A_{CP}(\pi^\pm \eta')$ in $D_s^\pm \rightarrow \pi^\pm \eta'$	-0.06 ± 0.04

$A_{CP}(K^\pm \pi^0)$ in $D_S^\pm \rightarrow K^\pm \pi^0$	0.02 ± 0.29
$A_{CP}(K_S^0 \pi^\pm)$ in $D_S^\pm \rightarrow K_S^0 \pi^\pm$	0.27 ± 0.11
$A_{CP}(K^\pm \eta)$ in $D_S^\pm \rightarrow K^\pm \eta$	-0.20 ± 0.18
$A_{CP}(K^\pm \eta'(958))$ in $D_S^\pm \rightarrow K^\pm \eta'(958)$	-0.2 ± 0.4
$A_{CP}(B^+ \rightarrow J/\psi(1S) K^+)$	0.009 ± 0.008 (S = 1.3)
$A_{CP}(B^+ \rightarrow J/\psi(1S) \pi^+)$	0.01 ± 0.07 (S = 1.3)
$A_{CP}(B^+ \rightarrow J/\psi K^*(892)^+)$	-0.048 ± 0.033
$A_{CP}(B^+ \rightarrow \psi(2S) K^+)$	-0.025 ± 0.024
$A_{CP}(B^+ \rightarrow \psi(2S) K^*(892)^+)$	0.08 ± 0.21
$A_{CP}(B^+ \rightarrow \chi_{c1} K^+)$	-0.009 ± 0.033
$A_{CP}(B^+ \rightarrow \chi_{c1} K^*(892)^+)$	0.5 ± 0.5
$A_{CP}(B^+ \rightarrow \bar{D}^0 \pi^+)$	-0.008 ± 0.008
$A_{CP}(B^+ \rightarrow D_{CP(+1)} \pi^+)$	0.035 ± 0.024
$A_{CP}(B^+ \rightarrow D_{CP(-1)} \pi^+)$	0.017 ± 0.026
$A_{CP}(B^+ \rightarrow \bar{D}^0 K^+)$	0.07 ± 0.04
$A_{CP}(B^+ \rightarrow [K^- \pi^+]_D K^+)$	$-0.1^{+0.9}_{-1.1}$
$A_{CP}(B^+ \rightarrow [K^- \pi^+]_{\bar{D}} K^*(892)^+)$	-0.2 ± 0.6
$A_{CP}(B^+ \rightarrow [K^- \pi^+]_D \pi^+)$	-0.02 ± 0.16
$A_{CP}(B^+ \rightarrow [\pi^+ \pi^- \pi^0]_D K^+)$	-0.02 ± 0.15
$A_{CP}(B^+ \rightarrow D_{CP(+1)} K^+)$	0.21 ± 0.10 (S = 1.2)
$A_{CP}(B^+ \rightarrow D_{CP(-1)} K^+)$	-0.10 ± 0.08
$A_{CP}(B^+ \rightarrow \bar{D}^{*0} \pi^+)$	-0.014 ± 0.015
$A_{CP}(B^+ \rightarrow (D_{CP(+1)}^*)^0 \pi^+)$	-0.02 ± 0.05
$A_{CP}(B^+ \rightarrow (D_{CP(-1)}^*)^0 \pi^+)$	-0.09 ± 0.05
$A_{CP}(B^+ \rightarrow D^{*0} K^+)$	-0.07 ± 0.04
$A_{CP}(B^+ \rightarrow D_{CP(+1)}^{*0} K^+)$	-0.12 ± 0.08
$A_{CP}(B^+ \rightarrow D_{CP(-1)}^* K^+)$	0.07 ± 0.10
$A_{CP}(B^+ \rightarrow D_{CP(+1)} K^*(892)^+)$	-0.08 ± 0.21
$A_{CP}(B^+ \rightarrow D_{CP(-1)} K^*(892)^+)$	-0.3 ± 0.4
$A_{CP}(B^+ \rightarrow K_S^0 \pi^+)$	0.009 ± 0.029 (S = 1.2)
$A_{CP}(B^+ \rightarrow K^+ \pi^0)$	0.051 ± 0.025
$A_{CP}(B^+ \rightarrow \eta' K^+)$	0.016 ± 0.019
$A_{CP}(B^+ \rightarrow \eta K^+)$	-0.27 ± 0.09
$A_{CP}(B^+ \rightarrow \eta K^*(892)^+)$	0.02 ± 0.06
$A_{CP}(B^+ \rightarrow \omega K^+)$	0.02 ± 0.05
$A_{CP}(B^+ \rightarrow K^*(892)^+ \pi^0)$	0.04 ± 0.29
$A_{CP}(B^+ \rightarrow K^{*0} \pi^+)$	-0.04 ± 0.09 (S = 2.1)
$A_{CP}(B^+ \rightarrow K^+ \pi^- \pi^+)$	0.038 ± 0.022

$A_{CP}(B^+ \rightarrow f_0(980)K^+)$	$-0.10^{+0.05}_{-0.04}$
$A_{CP}(B^+ \rightarrow \rho^0 K^+)$	0.37 ± 0.10
$A_{CP}(B^+ \rightarrow K_0^*(1430)^0 \pi^+)$	0.055 ± 0.033
$A_{CP}(B^+ \rightarrow p \bar{\Lambda} \gamma)$	0.17 ± 0.17
$A_{CP}(B^+ \rightarrow p \bar{\Lambda} \pi^0)$	0.01 ± 0.17
$A_{CP}(B^+ \rightarrow \rho^0 K^*(892)^+)$	—
$A_{CP}(B^+ \rightarrow K^0 K^+)$	0.12 ± 0.18
$A_{CP}(B^+ \rightarrow K^+ K_S^0 K_S^0)$	-0.04 ± 0.11
$A_{CP}(B^+ \rightarrow K^+ K^- K^+)$	-0.017 ± 0.030
$A_{CP}(B^+ \rightarrow \phi K^+)$	-0.01 ± 0.06
$A_{CP}(B^+ \rightarrow \phi K^*(892)^+)$	-0.01 ± 0.08
$A_{CP}(B^+ \rightarrow \eta K^+ \gamma)$	-0.12 ± 0.07
$A_{CP}(B^+ \rightarrow \pi^+ \pi^0)$	0.06 ± 0.05
$A_{CP}(B^+ \rightarrow \pi^+ \pi^- \pi^+)$	-0.01 ± 0.08
$A_{CP}(B^+ \rightarrow \rho^0 \pi^+)$	-0.07 ± 0.13
$A_{CP}(B^+ \rightarrow f_2(1270) \pi^+)$	0.00 ± 0.25
$A_{CP}(B^+ \rightarrow \rho^+ \pi^0)$	0.02 ± 0.11
$A_{CP}(B^+ \rightarrow \rho^+ \rho^0)$	-0.05 ± 0.05
$A_{CP}(B^+ \rightarrow \omega \pi^+)$	-0.04 ± 0.06
$A_{CP}(B^+ \rightarrow \omega \rho^+)$	-0.20 ± 0.09
$A_{CP}(B^+ \rightarrow \eta \pi^+)$	-0.16 ± 0.07 (S = 1.1)
$A_{CP}(B^+ \rightarrow \eta' \pi^+)$	0.21 ± 0.15
$A_{CP}(B^+ \rightarrow \eta \rho^+)$	0.11 ± 0.11
$A_{CP}(B^+ \rightarrow p \bar{p} \pi^+)$	0.00 ± 0.04
$A_{CP}(B^+ \rightarrow p \bar{p} K^+)$	-0.16 ± 0.07
$A_{CP}(B^+ \rightarrow p \bar{p} K^*(892)^+)$	0.21 ± 0.16 (S = 1.4)
$\text{Re}(\epsilon_{B^0})/(1+ \epsilon_{B^0} ^2)$	$(-0.1 \pm 1.4) \times 10^{-3}$
$A_{T/CP}$	0.005 ± 0.018
$A_{CP}(B^0 \rightarrow D^*(2010)^+ D^-)$	0.02 ± 0.04
$A_{CP}(B^0 \rightarrow K^+ \pi^- \pi^0)$	$(0 \pm 6) \times 10^{-2}$
$A_{CP}(B^0 \rightarrow \rho^- K^+)$	0.15 ± 0.13
$A_{CP}(B^0 \rightarrow K^*(892)^+ \pi^-)$	$-0.10^{+0.11}_{-0.10}$
$A_{CP}(B^0 \rightarrow K^*(892)^0 \pi^+ \pi^-)$	0.07 ± 0.05
$A_{CP}(B^0 \rightarrow K^*(892)^0 K^+ K^-)$	0.01 ± 0.05
$A_{CP}(B^0 \rightarrow K^*(892)^0 \phi)$	0.01 ± 0.05
$A_{CP}(B^0 \rightarrow K^*(892)^0 K^- \pi^+)$	0.2 ± 0.4
$A_{CP}(B^0 \rightarrow \phi(K\pi)_0^*{}^0)$	0.20 ± 0.15
$A_{CP}(B^0 \rightarrow \rho^+ \pi^-)$	0.08 ± 0.12 (S = 2.0)
$A_{CP}(B^0 \rightarrow \rho^- \pi^+)$	-0.16 ± 0.23 (S = 1.7)
$A_{CP}(B^0 \rightarrow K^*(1430) \gamma)$	-0.08 ± 0.15
$A_{CP}(B^0 \rightarrow p \bar{p} K^*(892)^0)$	0.05 ± 0.12

$A_{CP}(B^0 \rightarrow p\bar{\Lambda}\pi^-)$	-0.02 ± 0.10
$C_{D^*(2010)^-D^+}(B^0 \rightarrow D^*(2010)^-D^+)$	0.07 ± 0.14
$C_{D^*(2010)^+D^-}(B^0 \rightarrow D^*(2010)^+D^-)$	-0.09 ± 0.22 (S = 1.6)
$C_+(B^0 \rightarrow D^{*+}D^{*-})$	0.00 ± 0.12
$C_-(B^0 \rightarrow D^{*+}D^{*-})$	0.4 ± 0.5
$S_-(B^0 \rightarrow D^{*+}D^{*-})$	-1.8 ± 0.7
$C_{D^+D^-}(B^0 \rightarrow D^+D^-)$	-0.5 ± 0.4 (S = 2.5)
$C_{J/\psi(1S)\pi^0}(B^0 \rightarrow J/\psi(1S)\pi^0)$	-0.13 ± 0.13
$C_{K_S^0\pi^0}(B^0 \rightarrow K_S^0\pi^0)$	0.09 ± 0.10
$S_{K_S^0\pi^0}(B^0 \rightarrow K_S^0\pi^0)$	0.50 ± 0.18
$C_{\eta'(958)K}(B^0 \rightarrow \eta'(958)K_S^0)$	-0.04 ± 0.20 (S = 2.5)
$S_{\eta'(958)K}(B^0 \rightarrow \eta'(958)K_S^0)$	0.43 ± 0.17 (S = 1.5)
$C_{\omega K_S^0}(B^0 \rightarrow \omega K_S^0)$	-0.30 ± 0.28 (S = 1.6)
$S_{\omega K_S^0}(B^0 \rightarrow \omega K_S^0)$	0.43 ± 0.24
$C_{f_0(980)K_S^0}(B^0 \rightarrow f_0(980)K_S^0)$	-0.03 ± 0.26 (S = 1.9)
$S_{f_0(980)K_S^0}(B^0 \rightarrow f_0(980)K_S^0)$	-0.02 ± 0.21 (S = 1.1)
$C_{K^+K^-K_S^0}(B^0 \rightarrow K^+K^-K_S^0)$	0.07 ± 0.08
$C_{\phi K_S^0}(B^0 \rightarrow \phi K_S^0)$	-0.01 ± 0.12
$S_{\phi K_S^0}(B^0 \rightarrow \phi K_S^0)$	0.39 ± 0.17
$C_{K_S K_S K_S}(B^0 \rightarrow K_S K_S K_S)$	-0.15 ± 0.16 (S = 1.1)
$S_{K_S K_S K_S}(B^0 \rightarrow K_S K_S K_S)$	-0.4 ± 0.5 (S = 2.5)
$C_{K_S^0\pi^0\gamma}(B^0 \rightarrow K_S^0\pi^0\gamma)$	0.36 ± 0.33
$S_{K_S^0\pi^0\gamma}(B^0 \rightarrow K_S^0\pi^0\gamma)$	-0.8 ± 0.6
$C_{K^*(892)^0\gamma}(B^0 \rightarrow K^*(892)^0\gamma)$	-0.04 ± 0.16 (S = 1.2)
$S_{K^*(892)^0\gamma}(B^0 \rightarrow K^*(892)^0\gamma)$	-0.15 ± 0.22
$C_{\pi\pi}(B^0 \rightarrow \pi^+\pi^-)$	-0.38 ± 0.17 (S = 2.6)
$C_{\pi^0\pi^0}(B^0 \rightarrow \pi^0\pi^0)$	-0.48 ± 0.30
$C_{\rho\pi}(B^0 \rightarrow \rho^+\pi^-)$	0.01 ± 0.14 (S = 1.9)
$S_{\rho\pi}(B^0 \rightarrow \rho^+\pi^-)$	0.01 ± 0.09
$\Delta S_{\rho\pi}(B^0 \rightarrow \rho^+\pi^-)$	-0.05 ± 0.10
$C_{\rho^0\pi^0}(B^0 \rightarrow \rho^0\pi^0)$	0.3 ± 0.4
$S_{\rho^0\pi^0}(B^0 \rightarrow \rho^0\pi^0)$	0.1 ± 0.4
$C_{\rho\rho}(B^0 \rightarrow \rho^+\rho^-)$	-0.05 ± 0.13

$S_{\rho\rho}(B^0 \rightarrow \rho^+\rho^-)$	-0.06 ± 0.17
$ \lambda (B^0 \rightarrow J/\psi K^*(892)^0)$	$<0.25, \text{CL} = 95\%$
$(S_+ + S_-)/2(B^0 \rightarrow D^{*-}\pi^+)$	-0.037 ± 0.012
$(S_- - S_+)/2(B^0 \rightarrow D^{*-}\pi^+)$	-0.006 ± 0.016
$(S_+ + S_-)/2(B^0 \rightarrow D^-\pi^+)$	-0.046 ± 0.023
$(S_- - S_+)/2(B^0 \rightarrow D^-\pi^+)$	-0.022 ± 0.021
$A_{CP}(B \rightarrow K^*(892)\gamma)$	-0.010 ± 0.028
$A_{CP}(B \rightarrow s\gamma)$	-0.014 ± 0.028
$A_{CP}(b \rightarrow X_s \ell^+ \ell^-)$	-0.22 ± 0.26
$\Gamma(\eta_c(1S) \rightarrow \pi^+\pi^-)/\Gamma_{\text{total}}$	$<6 \times 10^{-4}, \text{CL} = 90\%$
$\Gamma(\eta_c(1S) \rightarrow \pi^0\pi^0)/\Gamma_{\text{total}}$	$<4 \times 10^{-4}, \text{CL} = 90\%$
$\Gamma(\eta_c(1S) \rightarrow K^+K^-)/\Gamma_{\text{total}}$	$<6 \times 10^{-4}, \text{CL} = 90\%$
$\Gamma(\eta_c(1S) \rightarrow K_S^0 K_S^0)/\Gamma_{\text{total}}$	$<3.1 \times 10^{-4}, \text{CL} = 90\%$
$[\alpha_-(\Lambda) + \alpha_+(\bar{\Lambda})] / [\alpha_-(\Lambda) - \alpha_+(\bar{\Lambda})]$	0.012 ± 0.021
$\frac{[\alpha(\Xi^-)\alpha_-(\Lambda) - \alpha(\Xi^+)\alpha_+(\bar{\Lambda})]}{[\alpha(\Xi^-)\alpha_-(\Lambda) + \alpha(\Xi^+)\alpha_+(\bar{\Lambda})]}$	$(0 \pm 7) \times 10^{-4}$
$(\alpha + \bar{\alpha})/(\alpha - \bar{\alpha})$ in $\Omega^- \rightarrow \Lambda K^-, \bar{\Omega}^+ \rightarrow \bar{\Lambda} K^+$	-0.02 ± 0.13
$(\alpha + \bar{\alpha})/(\alpha - \bar{\alpha})$ in $\Lambda_c^+ \rightarrow \Lambda \pi^+, \bar{\Lambda}_c^- \rightarrow \bar{\Lambda} \pi^-$	-0.07 ± 0.31
$(\alpha + \bar{\alpha})/(\alpha - \bar{\alpha})$ in $\Lambda_c^+ \rightarrow \Lambda e^+ \nu_e, \bar{\Lambda}_c^- \rightarrow \bar{\Lambda} e^- \bar{\nu}_e$	0.00 ± 0.04

CP VIOLATION OBSERVED

$\text{Re}(\epsilon)$	$(1.596 \pm 0.013) \times 10^{-3}$
charge asymmetry in $K_{\ell 3}^0$ decays	
$A_L =$ weighted average of $A_L(\mu)$ and $A_L(e)$	$(0.332 \pm 0.006)\%$
$A_L(\mu) = [\Gamma(\pi^- \mu^+ \nu_\mu) - \Gamma(\pi^+ \mu^- \bar{\nu}_\mu)]/\text{sum}$	$(0.304 \pm 0.025)\%$
$A_L(e) = [\Gamma(\pi^- e^+ \nu_e) - \Gamma(\pi^+ e^- \bar{\nu}_e)]/\text{sum}$	$(0.334 \pm 0.007)\%$
parameters for $K_L^0 \rightarrow 2\pi$ decay	
$ \eta_{00} = A(K_L^0 \rightarrow 2\pi^0) / A(K_S^0 \rightarrow 2\pi^0) $	$(2.221 \pm 0.011) \times 10^{-3} (S = 1.8)$
$ \eta_{+-} = A(K_L^0 \rightarrow \pi^+\pi^-) / A(K_S^0 \rightarrow \pi^+\pi^-) $	$(2.232 \pm 0.011) \times 10^{-3} (S = 1.8)$
$ \epsilon = (2 \eta_{+-} + \eta_{00})/3$	$(2.228 \pm 0.011) \times 10^{-3} (S = 1.8)$
$ \eta_{00}/\eta_{+-} $	[f] $0.9951 \pm 0.0008 (S = 1.6)$
$\text{Re}(\epsilon'/\epsilon) = (1 - \eta_{00}/\eta_{+-})/3$	[f] $(1.65 \pm 0.26) \times 10^{-3} (S = 1.6)$
Assuming <i>CPT</i>	
ϕ_{+-} , phase of η_{+-}	$(43.51 \pm 0.05)^\circ (S = 1.1)$
ϕ_{00} , phase of η_{00}	$(43.52 \pm 0.05)^\circ (S = 1.1)$
$\phi_\epsilon = (2\phi_{+-} + \phi_{00})/3$	$(43.51 \pm 0.05)^\circ (S = 1.1)$
Not assuming <i>CPT</i>	
ϕ_{+-} , phase of η_{+-}	$(43.4 \pm 0.7)^\circ (S = 1.3)$

ϕ_{00} , phase of η_{00}	$(43.7 \pm 0.8)^\circ$ ($S = 1.2$)
$\phi_\epsilon = (2\phi_{+-} + \phi_{00})/3$	$(43.5 \pm 0.7)^\circ$ ($S = 1.3$)
CP asymmetry A in $K_L^0 \rightarrow \pi^+ \pi^- e^+ e^-$	$(13.7 \pm 1.5)\%$
β_{CP} from $K_L^0 \rightarrow e^+ e^- e^+ e^-$	-0.19 ± 0.07
γ_{CP} from $K_L^0 \rightarrow e^+ e^- e^+ e^-$	0.01 ± 0.11 ($S = 1.6$)
parameters for $K_L^0 \rightarrow \pi^+ \pi^- \gamma$ decay	
$ \eta_{+-\gamma} = A(K_L^0 \rightarrow \pi^+ \pi^- \gamma, CP \text{ violating})/A(K_S^0 \rightarrow \pi^+ \pi^- \gamma) $	$(2.35 \pm 0.07) \times 10^{-3}$
$\phi_{+-\gamma}$ = phase of $\eta_{+-\gamma}$	$(44 \pm 4)^\circ$
$\Gamma(K_L^0 \rightarrow \pi^+ \pi^-)/\Gamma_{\text{total}}$	[g] $(1.966 \pm 0.010) \times 10^{-3}$ ($S = 1.6$)
$\Gamma(K_L^0 \rightarrow \pi^0 \pi^0)/\Gamma_{\text{total}}$	$(8.65 \pm 0.06) \times 10^{-4}$ ($S = 1.8$)
$A_{CP}(B^0 \rightarrow K^+ \pi^-)$	-0.098 ± 0.013
$A_{CP}(B^0 \rightarrow \eta K^*(892)^0)$	0.19 ± 0.05
$S_{D^*(2010)^- D^+}(B^0 \rightarrow D^*(2010)^- D^+)$	-0.78 ± 0.21
$S_{D^*(2010)^+ D^-}(B^0 \rightarrow D^*(2010)^+ D^-)$	-0.61 ± 0.19
$C_{D^{*+} D^{*-}}(B^0 \rightarrow D^{*+} D^{*-})$	0.07 ± 0.09
$S_{D^{*+} D^{*-}}(B^0 \rightarrow D^{*+} D^{*-})$	-0.70 ± 0.16
$S_+(B^0 \rightarrow D^{*+} D^{*-})$	-0.76 ± 0.16
$S_{D^+ D^-}(B^0 \rightarrow D^+ D^-)$	-0.87 ± 0.26
$S_{J/\psi(1S)\pi^0}(B^0 \rightarrow J/\psi(1S)\pi^0)$	-0.94 ± 0.29 ($S = 1.9$)
$S_{\eta' K^0}(B^0 \rightarrow \eta' K^0)$	0.60 ± 0.07
$S_{K^+ K^- K_S^0}(B^0 \rightarrow K^+ K^- K_S^0)$	$-0.74^{+0.12}_{-0.10}$
$S_{K^+ K^- K_S^0}(B^0 \rightarrow K^+ K^- K_S^0 \text{ inclusive})$	-0.65 ± 0.12
$S_{\pi\pi}(B^0 \rightarrow \pi^+ \pi^-)$	-0.61 ± 0.08
$\Delta C_{\rho\pi}(B^0 \rightarrow \rho^+ \pi^-)$	0.37 ± 0.08
$S_{\eta_c K_S^0}(B^0 \rightarrow \eta_c K_S^0)$	0.93 ± 0.17
$\sin(2\beta)(B^0 \rightarrow J/\psi K_S^0)$	0.671 ± 0.023
$S_{J/\psi(nS)K^0}(B^0 \rightarrow J/\psi(nS)K^0)$	0.658 ± 0.024
$S_{\chi_{c1} K_S^0}(B^0 \rightarrow \chi_{c1} K_S^0)$	0.61 ± 0.16
$\sin(2\beta_{\text{eff}})(B^0 \rightarrow K^+ K^- K_S^0)$	$0.77^{+0.13}_{-0.12}$

CPT INVARIANCE

$(m_{W^+} - m_{W^-}) / m_{\text{average}}$	-0.002 ± 0.007
$(m_{e^+} - m_{e^-}) / m_{\text{average}}$	$< 8 \times 10^{-9}$, CL = 90%
$ q_{e^+} + q_{e^-} /e$	$< 4 \times 10^{-8}$
$(g_{e^+} - g_{e^-}) / g_{\text{average}}$	$(-0.5 \pm 2.1) \times 10^{-12}$
$(\tau_{\mu^+} - \tau_{\mu^-}) / \tau_{\text{average}}$	$(2 \pm 8) \times 10^{-5}$
$(g_{\mu^+} - g_{\mu^-}) / g_{\text{average}}$	$(-0.11 \pm 0.12) \times 10^{-8}$
$(m_{\tau^+} - m_{\tau^-}) / m_{\text{average}}$	$< 2.8 \times 10^{-4}$, CL = 90%
$(m_{\pi^+} - m_{\pi^-}) / m_{\text{average}}$	$(2 \pm 5) \times 10^{-4}$
$(\tau_{\pi^+} - \tau_{\pi^-}) / \tau_{\text{average}}$	$(6 \pm 7) \times 10^{-4}$
$(m_{K^+} - m_{K^-}) / m_{\text{average}}$	$(-0.6 \pm 1.8) \times 10^{-4}$
$(\tau_{K^+} - \tau_{K^-}) / \tau_{\text{average}}$	$(0.10 \pm 0.09)\%$ (S = 1.2)
$K^\pm \rightarrow \mu^\pm \nu_\mu$ rate difference/average	$(-0.5 \pm 0.4)\%$
$K^\pm \rightarrow \pi^\pm \pi^0$ rate difference/average	[h] $(0.8 \pm 1.2)\%$
δ in $K^0 - \bar{K}^0$ mixing	
real part of δ	$(2.3 \pm 2.7) \times 10^{-4}$
imaginary part of δ	$(0.4 \pm 2.1) \times 10^{-5}$
Re(γ), K_{e3} parameter	$(0.4 \pm 2.5) \times 10^{-3}$
Re(x_-), K_{e3} parameter	$(-2.9 \pm 2.0) \times 10^{-3}$
$ m_{K^0} - m_{\bar{K}^0} / m_{\text{average}}$	[i] $< 8 \times 10^{-19}$, CL = 90%
$(\Gamma_{K^0} - \Gamma_{\bar{K}^0}) / m_{\text{average}}$	$(8 \pm 8) \times 10^{-18}$
phase difference $\phi_{00} - \phi_{+-}$	$(0.2 \pm 0.4)^\circ$
$\text{Re}(\frac{2}{3}\eta_{+-} + \frac{1}{3}\eta_{00}) - \frac{A_{\bar{K}^0}}{2}$	$(-3 \pm 35) \times 10^{-6}$
$A_{CPT}(K^\mp \pi^\pm)$ in D^0, \bar{D}^0	0.008 ± 0.008
$ m_p - m_{\bar{p}} / m_p$	[j] $< 2 \times 10^{-9}$, CL = 90%
$(\frac{q_{\bar{p}}}{m_{\bar{p}}} - \frac{q_p}{m_p}) / \frac{q_p}{m_p}$	$(-9 \pm 9) \times 10^{-11}$
$ q_p + q_{\bar{p}} /e$	[j] $< 2 \times 10^{-9}$, CL = 90%
$(\mu_p + \mu_{\bar{p}}) / \mu_p$	$(-2.6 \pm 2.9) \times 10^{-3}$
$(m_n - m_{\bar{n}}) / m_n$	$(9 \pm 5) \times 10^{-5}$
$(m_\Lambda - m_{\bar{\Lambda}}) / m_\Lambda$	$(-0.1 \pm 1.1) \times 10^{-5}$ (S = 1.6)
$(\tau_\Lambda - \tau_{\bar{\Lambda}}) / \tau_\Lambda$	-0.001 ± 0.009
$(\tau_{\Sigma^+} - \tau_{\bar{\Sigma}^-}) / \tau_{\Sigma^+}$	$(-0.6 \pm 1.2) \times 10^{-3}$
$(\mu_{\Sigma^+} + \mu_{\bar{\Sigma}^-}) / \mu_{\Sigma^+}$	0.014 ± 0.015
$(m_{\Xi^-} - m_{\bar{\Xi}^+}) / m_{\Xi^-}$	$(-3 \pm 9) \times 10^{-5}$
$(\tau_{\Xi^-} - \tau_{\bar{\Xi}^+}) / \tau_{\Xi^-}$	-0.01 ± 0.07
$(\mu_{\Xi^-} + \mu_{\bar{\Xi}^+}) / \mu_{\Xi^-} $	$+0.01 \pm 0.05$
$(m_{\Omega^-} - m_{\bar{\Omega}^+}) / m_{\Omega^-}$	$(-1 \pm 8) \times 10^{-5}$

$$(\tau_{\Omega^-} - \tau_{\bar{\Omega}^+}) / \tau_{\Omega^-} \quad -0.002 \pm 0.040$$

TESTS OF NUMBER CONSERVATION LAWS

LEPTON FAMILY NUMBER

Lepton family number conservation means separate conservation of each of L_e , L_μ , L_τ .

$\Gamma(Z \rightarrow e^\pm \mu^\mp) / \Gamma_{\text{total}}$	[k] $< 1.7 \times 10^{-6}$, CL = 95%
$\Gamma(Z \rightarrow e^\pm \tau^\mp) / \Gamma_{\text{total}}$	[k] $< 9.8 \times 10^{-6}$, CL = 95%
$\Gamma(Z \rightarrow \mu^\pm \tau^\mp) / \Gamma_{\text{total}}$	[k] $< 1.2 \times 10^{-5}$, CL = 95%
$\sigma(e^+ e^- \rightarrow e^\pm \tau^\mp) / \sigma(e^+ e^- \rightarrow \mu^+ \mu^-)$	$< 8.9 \times 10^{-6}$, CL = 95%
$\sigma(e^+ e^- \rightarrow \mu^\pm \tau^\mp) / \sigma(e^+ e^- \rightarrow \mu^+ \mu^-)$	$< 4.0 \times 10^{-6}$, CL = 95%
limit on $\mu^- \rightarrow e^-$ conversion	
$\sigma(\mu^- {}^{32}\text{S} \rightarrow e^- {}^{32}\text{S}) /$	$< 7 \times 10^{-11}$, CL = 90%
$\sigma(\mu^- {}^{32}\text{S} \rightarrow \nu_\mu {}^{32}\text{P}^*)$	
$\sigma(\mu^- \text{Ti} \rightarrow e^- \text{Ti}) /$	$< 4.3 \times 10^{-12}$, CL = 90%
$\sigma(\mu^- \text{Ti} \rightarrow \text{capture})$	
$\sigma(\mu^- \text{Pb} \rightarrow e^- \text{Pb}) /$	$< 4.6 \times 10^{-11}$, CL = 90%
$\sigma(\mu^- \text{Pb} \rightarrow \text{capture})$	
limit on muonium \rightarrow antimuonium conversion $R_g =$	< 0.0030 , CL = 90%
G_C / G_F	
$\Gamma(\mu^- \rightarrow e^- \nu_e \bar{\nu}_\mu) / \Gamma_{\text{total}}$	[f] $< 1.2 \times 10^{-2}$, CL = 90%
$\Gamma(\mu^- \rightarrow e^- \gamma) / \Gamma_{\text{total}}$	$< 1.2 \times 10^{-11}$, CL = 90%
$\Gamma(\mu^- \rightarrow e^- e^+ e^-) / \Gamma_{\text{total}}$	$< 1.0 \times 10^{-12}$, CL = 90%
$\Gamma(\mu^- \rightarrow e^- 2\gamma) / \Gamma_{\text{total}}$	$< 7.2 \times 10^{-11}$, CL = 90%
$\Gamma(\tau^- \rightarrow e^- \gamma) / \Gamma_{\text{total}}$	$< 1.1 \times 10^{-7}$, CL = 90%
$\Gamma(\tau^- \rightarrow \mu^- \gamma) / \Gamma_{\text{total}}$	$< 4.5 \times 10^{-8}$, CL = 90%
$\Gamma(\tau^- \rightarrow e^- \pi^0) / \Gamma_{\text{total}}$	$< 8.0 \times 10^{-8}$, CL = 90%
$\Gamma(\tau^- \rightarrow \mu^- \pi^0) / \Gamma_{\text{total}}$	$< 1.1 \times 10^{-7}$, CL = 90%
$\Gamma(\tau^- \rightarrow e^- K_S^0) / \Gamma_{\text{total}}$	$< 3.3 \times 10^{-8}$, CL = 90%
$\Gamma(\tau^- \rightarrow \mu^- K_S^0) / \Gamma_{\text{total}}$	$< 4.0 \times 10^{-8}$, CL = 90%
$\Gamma(\tau^- \rightarrow e^- \eta) / \Gamma_{\text{total}}$	$< 9.2 \times 10^{-8}$, CL = 90%
$\Gamma(\tau^- \rightarrow \mu^- \eta) / \Gamma_{\text{total}}$	$< 6.5 \times 10^{-8}$, CL = 90%
$\Gamma(\tau^- \rightarrow e^- \rho^0) / \Gamma_{\text{total}}$	$< 6.3 \times 10^{-8}$, CL = 90%
$\Gamma(\tau^- \rightarrow \mu^- \rho^0) / \Gamma_{\text{total}}$	$< 6.8 \times 10^{-8}$, CL = 90%
$\Gamma(\tau^- \rightarrow e^- \omega) / \Gamma_{\text{total}}$	$< 1.1 \times 10^{-7}$, CL = 90%
$\Gamma(\tau^- \rightarrow \mu^- \omega) / \Gamma_{\text{total}}$	$< 8.9 \times 10^{-8}$, CL = 90%

$\Gamma(\tau^- \rightarrow e^- K^*(892)^0)/\Gamma_{\text{total}}$	$<7.8 \times 10^{-8}$, CL = 90%
$\Gamma(\tau^- \rightarrow \mu^- K^*(892)^0)/\Gamma_{\text{total}}$	$<5.9 \times 10^{-8}$, CL = 90%
$\Gamma(\tau^- \rightarrow e^- \bar{K}^*(892)^0)/\Gamma_{\text{total}}$	$<7.7 \times 10^{-8}$, CL = 90%
$\Gamma(\tau^- \rightarrow \mu^- \bar{K}^*(892)^0)/\Gamma_{\text{total}}$	$<1.0 \times 10^{-7}$, CL = 90%
$\Gamma(\tau^- \rightarrow e^- \eta'(958))/\Gamma_{\text{total}}$	$<1.6 \times 10^{-7}$, CL = 90%
$\Gamma(\tau^- \rightarrow \mu^- \eta'(958))/\Gamma_{\text{total}}$	$<1.3 \times 10^{-7}$, CL = 90%
$\Gamma(\tau^- \rightarrow e^- f_0(980) \rightarrow e^- \pi^+ \pi^-)/\Gamma_{\text{total}}$	$<3.2 \times 10^{-8}$, CL = 90%
$\Gamma(\tau^- \rightarrow \mu^- f_0(980) \rightarrow \mu^- \pi^+ \pi^-)/\Gamma_{\text{total}}$	$<3.4 \times 10^{-8}$, CL = 90%
$\Gamma(\tau^- \rightarrow e^- \phi)/\Gamma_{\text{total}}$	$<7.3 \times 10^{-8}$, CL = 90%
$\Gamma(\tau^- \rightarrow \mu^- \phi)/\Gamma_{\text{total}}$	$<1.3 \times 10^{-7}$, CL = 90%
$\Gamma(\tau^- \rightarrow e^- e^+ e^-)/\Gamma_{\text{total}}$	$<3.6 \times 10^{-8}$, CL = 90%
$\Gamma(\tau^- \rightarrow e^- \mu^+ \mu^-)/\Gamma_{\text{total}}$	$<3.7 \times 10^{-8}$, CL = 90%
$\Gamma(\tau^- \rightarrow e^+ \mu^- \mu^-)/\Gamma_{\text{total}}$	$<2.3 \times 10^{-8}$, CL = 90%
$\Gamma(\tau^- \rightarrow \mu^- e^+ e^-)/\Gamma_{\text{total}}$	$<2.7 \times 10^{-8}$, CL = 90%
$\Gamma(\tau^- \rightarrow \mu^+ e^- e^-)/\Gamma_{\text{total}}$	$<2.0 \times 10^{-8}$, CL = 90%
$\Gamma(\tau^- \rightarrow \mu^- \mu^+ \mu^-)/\Gamma_{\text{total}}$	$<3.2 \times 10^{-8}$, CL = 90%
$\Gamma(\tau^- \rightarrow e^- \pi^+ \pi^-)/\Gamma_{\text{total}}$	$<1.2 \times 10^{-7}$, CL = 90%
$\Gamma(\tau^- \rightarrow \mu^- \pi^+ \pi^-)/\Gamma_{\text{total}}$	$<2.9 \times 10^{-7}$, CL = 90%
$\Gamma(\tau^- \rightarrow e^- \pi^+ K^-)/\Gamma_{\text{total}}$	$<3.2 \times 10^{-7}$, CL = 90%
$\Gamma(\tau^- \rightarrow e^- \pi^- K^+)/\Gamma_{\text{total}}$	$<1.6 \times 10^{-7}$, CL = 90%
$\Gamma(\tau^- \rightarrow e^- K_S^0 K_S^0)/\Gamma_{\text{total}}$	$<2.2 \times 10^{-6}$, CL = 90%
$\Gamma(\tau^- \rightarrow e^- K^+ K^-)/\Gamma_{\text{total}}$	$<1.4 \times 10^{-7}$, CL = 90%
$\Gamma(\tau^- \rightarrow \mu^- \pi^+ K^-)/\Gamma_{\text{total}}$	$<2.6 \times 10^{-7}$, CL = 90%
$\Gamma(\tau^- \rightarrow \mu^- \pi^- K^+)/\Gamma_{\text{total}}$	$<3.2 \times 10^{-7}$, CL = 90%
$\Gamma(\tau^- \rightarrow \mu^- K_S^0 K_S^0)/\Gamma_{\text{total}}$	$<3.4 \times 10^{-6}$, CL = 90%
$\Gamma(\tau^- \rightarrow \mu^- K^+ K^-)/\Gamma_{\text{total}}$	$<2.5 \times 10^{-7}$, CL = 90%
$\Gamma(\tau^- \rightarrow e^- \pi^0 \pi^0)/\Gamma_{\text{total}}$	$<6.5 \times 10^{-6}$, CL = 90%
$\Gamma(\tau^- \rightarrow \mu^- \pi^0 \pi^0)/\Gamma_{\text{total}}$	$<1.4 \times 10^{-5}$, CL = 90%
$\Gamma(\tau^- \rightarrow e^- \eta \eta)/\Gamma_{\text{total}}$	$<3.5 \times 10^{-5}$, CL = 90%
$\Gamma(\tau^- \rightarrow \mu^- \eta \eta)/\Gamma_{\text{total}}$	$<6.0 \times 10^{-5}$, CL = 90%
$\Gamma(\tau^- \rightarrow e^- \pi^0 \eta)/\Gamma_{\text{total}}$	$<2.4 \times 10^{-5}$, CL = 90%
$\Gamma(\tau^- \rightarrow \mu^- \pi^0 \eta)/\Gamma_{\text{total}}$	$<2.2 \times 10^{-5}$, CL = 90%
$\Gamma(\tau^- \rightarrow e^- \text{light boson})/\Gamma_{\text{total}}$	$<2.7 \times 10^{-3}$, CL = 95%
$\Gamma(\tau^- \rightarrow \mu^- \text{light boson})/\Gamma_{\text{total}}$	$<5 \times 10^{-3}$, CL = 95%

LEPTON FAMILY NUMBER VIOLATION IN NEUTRINOS

Solar Neutrinos	
$\sin^2(2\theta_{12})$	0.87 ± 0.03
Δm_{21}^2	$(7.59 \pm 0.20) \times 10^{-5} \text{ eV}^2$
Atmospheric Neutrinos	
$\sin^2(2\theta_{23})$	[<i>m</i>] >0.92
Δm_{32}^2	[<i>n</i>] $(2.43 \pm 0.13) \times 10^{-3} \text{ eV}^2$
$\Gamma(\pi^+ \rightarrow \mu^+ \nu_e)/\Gamma_{\text{total}}$	[<i>o</i>] $<8.0 \times 10^{-3}$, CL = 90%

$\Gamma(\pi^+ \rightarrow \mu^- e^+ e^+ \nu)/\Gamma_{\text{total}}$	$<1.6 \times 10^{-6}$, CL = 90%
$\Gamma(\pi^0 \rightarrow \mu^+ e^-)/\Gamma_{\text{total}}$	$<3.8 \times 10^{-10}$, CL = 90%
$\Gamma(\pi^0 \rightarrow \mu^- e^+)/\Gamma_{\text{total}}$	$<3.4 \times 10^{-9}$, CL = 90%
$\Gamma(\pi^0 \rightarrow \mu^+ e^- + \mu^- e^+)/\Gamma_{\text{total}}$	$<3.6 \times 10^{-10}$, CL = 90%
$\Gamma(\eta \rightarrow \mu^+ e^- + \mu^- e^+)/\Gamma_{\text{total}}$	$<6 \times 10^{-6}$, CL = 90%
$\Gamma(\eta'(958) \rightarrow e\mu)/\Gamma_{\text{total}}$	$<4.7 \times 10^{-4}$, CL = 90%
$\Gamma(K^+ \rightarrow \mu^- \nu e^+ e^+)/\Gamma_{\text{total}}$	$<2.0 \times 10^{-8}$, CL = 90%
$\Gamma(K^+ \rightarrow \mu^+ \nu_e)/\Gamma_{\text{total}}$	[o] $<4 \times 10^{-3}$, CL = 90%
$\Gamma(K^+ \rightarrow \pi^+ \mu^+ e^-)/\Gamma_{\text{total}}$	$<1.3 \times 10^{-11}$, CL = 90%
$\Gamma(K^+ \rightarrow \pi^+ \mu^- e^+)/\Gamma_{\text{total}}$	$<5.2 \times 10^{-10}$, CL = 90%
$\Gamma(K_L^0 \rightarrow e^\pm \mu^\mp)/\Gamma_{\text{total}}$	[k] $<4.7 \times 10^{-12}$, CL = 90%
$\Gamma(K_L^0 \rightarrow e^\pm e^\pm \mu^\mp \mu^\mp)/\Gamma_{\text{total}}$	[k] $<4.12 \times 10^{-11}$, CL = 90%
$\Gamma(K_L^0 \rightarrow \pi^0 \mu^\pm e^\mp)/\Gamma_{\text{total}}$	[k] $<7.6 \times 10^{-11}$, CL = 90%
$\Gamma(K_L^0 \rightarrow \pi^0 \pi^0 \mu^\pm e^\mp)/\Gamma_{\text{total}}$	$<1.7 \times 10^{-10}$, CL = 90%
$\Gamma(D^+ \rightarrow \pi^+ e^\pm \mu^\mp)/\Gamma_{\text{total}}$	[k] $<3.4 \times 10^{-5}$, CL = 90%
$\Gamma(D^+ \rightarrow K^+ e^\pm \mu^\mp)/\Gamma_{\text{total}}$	[k] $<6.8 \times 10^{-5}$, CL = 90%
$\Gamma(D^0 \rightarrow \mu^\pm e^\mp)/\Gamma_{\text{total}}$	[k] $<8.1 \times 10^{-7}$, CL = 90%
$\Gamma(D^0 \rightarrow \pi^0 e^\pm \mu^\mp)/\Gamma_{\text{total}}$	[k] $<8.6 \times 10^{-5}$, CL = 90%
$\Gamma(D^0 \rightarrow \eta e^\pm \mu^\mp)/\Gamma_{\text{total}}$	[k] $<1.0 \times 10^{-4}$, CL = 90%
$\Gamma(D^0 \rightarrow \pi^+ \pi^- e^\pm \mu^\mp)/\Gamma_{\text{total}}$	[k] $<1.5 \times 10^{-5}$, CL = 90%
$\Gamma(D^0 \rightarrow \rho^0 e^\pm \mu^\mp)/\Gamma_{\text{total}}$	[k] $<4.9 \times 10^{-5}$, CL = 90%
$\Gamma(D^0 \rightarrow \omega e^\pm \mu^\mp)/\Gamma_{\text{total}}$	[k] $<1.2 \times 10^{-4}$, CL = 90%
$\Gamma(D^0 \rightarrow K^- K^+ e^\pm \mu^\mp)/\Gamma_{\text{total}}$	[k] $<1.8 \times 10^{-4}$, CL = 90%
$\Gamma(D^0 \rightarrow \phi e^\pm \mu^\mp)/\Gamma_{\text{total}}$	[k] $<3.4 \times 10^{-5}$, CL = 90%
$\Gamma(D^0 \rightarrow \bar{K}^0 e^\pm \mu^\mp)/\Gamma_{\text{total}}$	[k] $<1.0 \times 10^{-4}$, CL = 90%
$\Gamma(D^0 \rightarrow K^- \pi^+ e^\pm \mu^\mp)/\Gamma_{\text{total}}$	[k] $<5.53 \times 10^{-4}$, CL = 90%
$\Gamma(D^0 \rightarrow \bar{K}^*(892)^0 e^\pm \mu^\mp)/\Gamma_{\text{total}}$	[k] $<8.3 \times 10^{-5}$, CL = 90%
$\Gamma(D_s^+ \rightarrow \pi^+ e^\pm \mu^\mp)/\Gamma_{\text{total}}$	[k] $<6.1 \times 10^{-4}$, CL = 90%
$\Gamma(D_s^+ \rightarrow K^+ e^\pm \mu^\mp)/\Gamma_{\text{total}}$	[k] $<6.3 \times 10^{-4}$, CL = 90%
$\Gamma(K^+ \mu^\pm \tau^\mp)/\Gamma_{\text{total}}$	$<77 \times 10^{-6}$, CL = 90%
$\Gamma(B^+ \rightarrow \pi^+ e^+ \mu^-)/\Gamma_{\text{total}}$	$<6.4 \times 10^{-3}$, CL = 90%
$\Gamma(B^+ \rightarrow \pi^+ e^- \mu^+)/\Gamma_{\text{total}}$	$<6.4 \times 10^{-3}$, CL = 90%
$\Gamma(B^+ \rightarrow \pi^+ e^\pm \mu^\mp)/\Gamma_{\text{total}}$	$<1.7 \times 10^{-7}$, CL = 90%
$\Gamma(B^+ \rightarrow K^+ e^+ \mu^-)/\Gamma_{\text{total}}$	$<9.1 \times 10^{-8}$, CL = 90%
$\Gamma(B^+ \rightarrow K^+ e^- \mu^+)/\Gamma_{\text{total}}$	$<1.3 \times 10^{-7}$, CL = 90%
$\Gamma(B^+ \rightarrow K^+ e^\pm \mu^\mp)/\Gamma_{\text{total}}$	$<9.1 \times 10^{-8}$, CL = 90%
$\Gamma(B^+ \rightarrow K^+ \mu^\pm \tau^\mp)/\Gamma_{\text{total}}$	$<7.7 \times 10^{-5}$, CL = 90%
$\Gamma(B^+ \rightarrow K^*(892)^+ e^+ \mu^-)/\Gamma_{\text{total}}$	$<1.3 \times 10^{-6}$, CL = 90%
$\Gamma(B^+ \rightarrow K^*(892)^+ e^- \mu^+)/\Gamma_{\text{total}}$	$<9.9 \times 10^{-7}$, CL = 90%
$\Gamma(B^+ \rightarrow K^*(892)^+ e^\pm \mu^\mp)/\Gamma_{\text{total}}$	$<1.4 \times 10^{-7}$, CL = 90%
$\Gamma(B^0 \rightarrow e^\pm \mu^\mp)/\Gamma_{\text{total}}$	[k] $<9.2 \times 10^{-8}$, CL = 90%

$\Gamma(B^0 \rightarrow \pi^0 e^\pm \mu^\mp)/\Gamma_{\text{total}}$	$<1.4 \times 10^{-7}$, CL = 90%
$\Gamma(B^0 \rightarrow K^0 e^\pm \mu^\mp)/\Gamma_{\text{total}}$	$<2.7 \times 10^{-7}$, CL = 90%
$\Gamma(B^0 \rightarrow K^*(892)^0 e^+ \mu^-)/\Gamma_{\text{total}}$	$<5.3 \times 10^{-7}$, CL = 90%
$\Gamma(B^0 \rightarrow K^*(892)^0 e^- \mu^+)/\Gamma_{\text{total}}$	$<3.4 \times 10^{-7}$, CL = 90%
$\Gamma(B^0 \rightarrow K^*(892)^0 e^\pm \mu^\mp)/\Gamma_{\text{total}}$	$<5.8 \times 10^{-7}$, CL = 90%
$\Gamma(B^0 \rightarrow e^\pm \tau^\mp)/\Gamma_{\text{total}}$	[k] $<2.8 \times 10^{-5}$, CL = 90%
$\Gamma(B^0 \rightarrow \mu^\pm \tau^\mp)/\Gamma_{\text{total}}$	[k] $<2.2 \times 10^{-5}$, CL = 90%
$\Gamma(B \rightarrow s e^\pm \mu^\mp)/\Gamma_{\text{total}}$	[k] $<2.2 \times 10^{-5}$, CL = 90%
$\Gamma(B \rightarrow \pi e^\pm \mu^\mp)/\Gamma_{\text{total}}$	$<9.2 \times 10^{-8}$, CL = 90%
$\Gamma(B \rightarrow \rho e^\pm \mu^\mp)/\Gamma_{\text{total}}$	$<3.2 \times 10^{-6}$, CL = 90%
$\Gamma(B \rightarrow K e^\pm \mu^\mp)/\Gamma_{\text{total}}$	$<3.8 \times 10^{-8}$, CL = 90%
$\Gamma(B \rightarrow K^*(892) e^\pm \mu^\mp)/\Gamma_{\text{total}}$	$<5.1 \times 10^{-7}$, CL = 90%
$\Gamma(B_s^0 \rightarrow e^\pm \mu^\mp)/\Gamma_{\text{total}}$	[k] $<6.1 \times 10^{-6}$, CL = 90%
$\Gamma(e^\pm \tau^\mp)/\Gamma_{\text{total}}$	$<8.3 \times 10^{-6}$, CL = 90%
$\Gamma(\mu^\pm \tau^\mp)/\Gamma_{\text{total}}$	$<2.0 \times 10^{-6}$, CL = 90%
$\Gamma(J/\psi(1S) \rightarrow e^\pm \mu^\mp)/\Gamma_{\text{total}}$	$<1.1 \times 10^{-6}$, CL = 90%
$\Gamma(J/\psi(1S) \rightarrow e^\pm \tau^\mp)/\Gamma_{\text{total}}$	$<8.3 \times 10^{-6}$, CL = 90%
$\Gamma(J/\psi(1S) \rightarrow \mu^\pm \tau^\mp)/\Gamma_{\text{total}}$	$<2.0 \times 10^{-6}$, CL = 90%
$\Gamma(\Upsilon(1S) \rightarrow \mu^\pm \tau^\mp)/\Gamma_{\text{total}}$	$<6.0 \times 10^{-6}$, CL = 95%
$\Gamma(\Upsilon(2S) \rightarrow \mu^\pm \tau^\mp)/\Gamma_{\text{total}}$	$<1.44 \times 10^{-5}$, CL = 95%
$\Gamma(\Upsilon(3S) \rightarrow \mu^\pm \tau^\mp)/\Gamma_{\text{total}}$	$<2.03 \times 10^{-5}$, CL = 95%

TOTAL LEPTON NUMBER

Violation of total lepton number conservation also implies violation of lepton family number conservation.

$\Gamma(Z \rightarrow \nu e)/\Gamma_{\text{total}}$	$<1.8 \times 10^{-6}$, CL = 95%
$\Gamma(Z \rightarrow \nu \mu)/\Gamma_{\text{total}}$	$<1.8 \times 10^{-6}$, CL = 95%
limit on $\mu^- \rightarrow e^+$ conversion	
$\sigma(\mu^- 32S \rightarrow e^+ 32Si^*) /$	$<9 \times 10^{-10}$, CL = 90%
$\sigma(\mu^- 32S \rightarrow \nu_\mu 32P^*)$	
$\sigma(\mu^- 127I \rightarrow e^+ 127Sb^*) /$	$<3 \times 10^{-10}$, CL = 90%
$\sigma(\mu^- 127I \rightarrow \text{anything})$	
$\sigma(\mu^- Ti \rightarrow e^+ Ca) /$	$<3.6 \times 10^{-11}$, CL = 90%
$\sigma(\mu^- Ti \rightarrow \text{capture})$	
$\Gamma(\tau^- \rightarrow e^+ \pi^- \pi^-)/\Gamma_{\text{total}}$	$<2.0 \times 10^{-7}$, CL = 90%
$\Gamma(\tau^- \rightarrow \mu^+ \pi^- \pi^-)/\Gamma_{\text{total}}$	$<7 \times 10^{-8}$, CL = 90%
$\Gamma(\tau^- \rightarrow e^+ \pi^- K^-)/\Gamma_{\text{total}}$	$<1.8 \times 10^{-7}$, CL = 90%
$\Gamma(\tau^- \rightarrow e^+ K^- K^-)/\Gamma_{\text{total}}$	$<1.5 \times 10^{-7}$, CL = 90%
$\Gamma(\tau^- \rightarrow \mu^+ \pi^- K^-)/\Gamma_{\text{total}}$	$<2.2 \times 10^{-7}$, CL = 90%
$\Gamma(\tau^- \rightarrow \mu^+ K^- K^-)/\Gamma_{\text{total}}$	$<4.4 \times 10^{-7}$, CL = 90%

$\Gamma(\tau^- \rightarrow \bar{p}\gamma)/\Gamma_{\text{total}}$	$<3.5 \times 10^{-6}$, CL = 90%
$\Gamma(\tau^- \rightarrow \bar{p}\pi^0)/\Gamma_{\text{total}}$	$<1.5 \times 10^{-5}$, CL = 90%
$\Gamma(\tau^- \rightarrow \bar{p}2\pi^0)/\Gamma_{\text{total}}$	$<3.3 \times 10^{-5}$, CL = 90%
$\Gamma(\tau^- \rightarrow \bar{p}\eta)/\Gamma_{\text{total}}$	$<8.9 \times 10^{-6}$, CL = 90%
$\Gamma(\tau^- \rightarrow \bar{p}\pi^0\eta)/\Gamma_{\text{total}}$	$<2.7 \times 10^{-5}$, CL = 90%
$\Gamma(\tau^- \rightarrow \Lambda\pi^-)/\Gamma_{\text{total}}$	$<7.2 \times 10^{-8}$, CL = 90%
$\Gamma(\tau^- \rightarrow \bar{\Lambda}\pi^-)/\Gamma_{\text{total}}$	$<1.4 \times 10^{-7}$, CL = 90%
$t_{1/2}(^76\text{Ge} \rightarrow ^76\text{Se} + 2 e^-)$	$>1.9 \times 10^{25}$ yr, CL = 90%
$\Gamma(\pi^+ \rightarrow \mu^+\bar{\nu}_e)/\Gamma_{\text{total}}$	[o] $<1.5 \times 10^{-3}$, CL = 90%
$\Gamma(K^+ \rightarrow \pi^-\mu^+e^+)/\Gamma_{\text{total}}$	$<5.0 \times 10^{-10}$, CL = 90%
$\Gamma(K^+ \rightarrow \pi^-e^+e^+)/\Gamma_{\text{total}}$	$<6.4 \times 10^{-10}$, CL = 90%
$\Gamma(K^+ \rightarrow \pi^-\mu^+\mu^+)/\Gamma_{\text{total}}$	[o] $<3.0 \times 10^{-9}$, CL = 90%
$\Gamma(K^+ \rightarrow \mu^+\bar{\nu}_e)/\Gamma_{\text{total}}$	[o] $<3.3 \times 10^{-3}$, CL = 90%
$\Gamma(K^+ \rightarrow \pi^0e^+\bar{\nu}_e)/\Gamma_{\text{total}}$	$<3 \times 10^{-3}$, CL = 90%
$\Gamma(D^+ \rightarrow \pi^-e^+e^+)/\Gamma_{\text{total}}$	$<3.6 \times 10^{-6}$, CL = 90%
$\Gamma(D^+ \rightarrow \pi^-\mu^+\mu^+)/\Gamma_{\text{total}}$	$<4.8 \times 10^{-6}$, CL = 90%
$\Gamma(D^+ \rightarrow \pi^-e^+\mu^+)/\Gamma_{\text{total}}$	$<5.0 \times 10^{-5}$, CL = 90%
$\Gamma(D^+ \rightarrow \rho^-\mu^+\mu^+)/\Gamma_{\text{total}}$	$<5.6 \times 10^{-4}$, CL = 90%
$\Gamma(D^+ \rightarrow K^-e^+e^+)/\Gamma_{\text{total}}$	$<4.5 \times 10^{-6}$, CL = 90%
$\Gamma(D^+ \rightarrow K^-\mu^+\mu^+)/\Gamma_{\text{total}}$	$<1.3 \times 10^{-5}$, CL = 90%
$\Gamma(D^+ \rightarrow K^-e^+\mu^+)/\Gamma_{\text{total}}$	$<1.3 \times 10^{-4}$, CL = 90%
$\Gamma(D^+ \rightarrow K^*(892)^-\mu^+\mu^+)/\Gamma_{\text{total}}$	$<8.5 \times 10^{-4}$, CL = 90%
$\Gamma(D^0 \rightarrow \pi^-\pi^-e^+e^+ + \text{c.c.})/\Gamma_{\text{total}}$	$<1.12 \times 10^{-4}$, CL = 90%
$\Gamma(D^0 \rightarrow \pi^-\pi^-\mu^+\mu^+ + \text{c.c.})/\Gamma_{\text{total}}$	$<2.9 \times 10^{-5}$, CL = 90%
$\Gamma(D^0 \rightarrow K^-\pi^-e^+e^+ + \text{c.c.})/\Gamma_{\text{total}}$	$<2.06 \times 10^{-4}$, CL = 90%
$\Gamma(D^0 \rightarrow K^-\pi^-\mu^+\mu^+ + \text{c.c.})/\Gamma_{\text{total}}$	$<3.9 \times 10^{-4}$, CL = 90%
$\Gamma(D^0 \rightarrow K^-K^-e^+e^+ + \text{c.c.})/\Gamma_{\text{total}}$	$<1.52 \times 10^{-4}$, CL = 90%
$\Gamma(D^0 \rightarrow K^-K^-\mu^+\mu^+ + \text{c.c.})/\Gamma_{\text{total}}$	$<9.4 \times 10^{-5}$, CL = 90%
$\Gamma(D^0 \rightarrow \pi^-\pi^-e^+\mu^+ + \text{c.c.})/\Gamma_{\text{total}}$	$<7.9 \times 10^{-5}$, CL = 90%
$\Gamma(D^0 \rightarrow K^-\pi^-e^+\mu^+ + \text{c.c.})/\Gamma_{\text{total}}$	$<2.18 \times 10^{-4}$, CL = 90%
$\Gamma(D^0 \rightarrow K^-K^-e^+\mu^+ + \text{c.c.})/\Gamma_{\text{total}}$	$<5.7 \times 10^{-5}$, CL = 90%
$\Gamma(D_s^+ \rightarrow \pi^-e^+e^+)/\Gamma_{\text{total}}$	$<6.9 \times 10^{-4}$, CL = 90%
$\Gamma(D_s^+ \rightarrow \pi^-\mu^+\mu^+)/\Gamma_{\text{total}}$	$<2.9 \times 10^{-5}$, CL = 90%
$\Gamma(D_s^+ \rightarrow \pi^-e^+\mu^+)/\Gamma_{\text{total}}$	$<7.3 \times 10^{-4}$, CL = 90%
$\Gamma(D_s^+ \rightarrow K^-e^+e^+)/\Gamma_{\text{total}}$	$<6.3 \times 10^{-4}$, CL = 90%
$\Gamma(D_s^+ \rightarrow K^-\mu^+\mu^+)/\Gamma_{\text{total}}$	$<1.3 \times 10^{-5}$, CL = 90%
$\Gamma(D_s^+ \rightarrow K^-e^+\mu^+)/\Gamma_{\text{total}}$	$<6.8 \times 10^{-4}$, CL = 90%
$\Gamma(D_s^+ \rightarrow K^*(892)^-\mu^+\mu^+)/\Gamma_{\text{total}}$	$<1.4 \times 10^{-3}$, CL = 90%
$\Gamma(B^+ \rightarrow \pi^-e^+e^+)/\Gamma_{\text{total}}$	$<1.6 \times 10^{-6}$, CL = 90%
$\Gamma(B^+ \rightarrow \pi^-\mu^+\mu^+)/\Gamma_{\text{total}}$	$<1.4 \times 10^{-6}$, CL = 90%
$\Gamma(B^+ \rightarrow \pi^-e^+\mu^+)/\Gamma_{\text{total}}$	$<1.3 \times 10^{-6}$, CL = 90%

$\Gamma(B^+ \rightarrow \rho^- e^+ e^+)/\Gamma_{\text{total}}$	$<2.6 \times 10^{-6}$, CL = 90%
$\Gamma(B^+ \rightarrow \rho^- \mu^+ \mu^+)/\Gamma_{\text{total}}$	$<5.0 \times 10^{-6}$, CL = 90%
$\Gamma(B^+ \rightarrow \rho^- e^+ \mu^+)/\Gamma_{\text{total}}$	$<3.3 \times 10^{-6}$, CL = 90%
$\Gamma(B^+ \rightarrow K^- e^+ e^+)/\Gamma_{\text{total}}$	$<1.0 \times 10^{-6}$, CL = 90%
$\Gamma(B^+ \rightarrow K^- \mu^+ \mu^+)/\Gamma_{\text{total}}$	$<1.8 \times 10^{-6}$, CL = 90%
$\Gamma(B^+ \rightarrow K^- e^+ \mu^+)/\Gamma_{\text{total}}$	$<2.0 \times 10^{-6}$, CL = 90%
$\Gamma(B^+ \rightarrow K^*(892)^- e^+ e^+)/\Gamma_{\text{total}}$	$<2.8 \times 10^{-6}$, CL = 90%
$\Gamma(B^+ \rightarrow K^*(892)^- \mu^+ \mu^+)/\Gamma_{\text{total}}$	$<8.3 \times 10^{-6}$, CL = 90%
$\Gamma(B^+ \rightarrow K^*(892)^- e^+ \mu^+)/\Gamma_{\text{total}}$	$<4.4 \times 10^{-6}$, CL = 90%
$\Gamma(\Xi^- \rightarrow p \mu^- \mu^-)/\Gamma_{\text{total}}$	$<4 \times 10^{-8}$, CL = 90%
$\Gamma(\Lambda_c^+ \rightarrow \Sigma^- \mu^+ \mu^+)/\Gamma_{\text{total}}$	$<7.0 \times 10^{-4}$, CL = 90%

BARYON NUMBER

$\Gamma(Z \rightarrow p e)/\Gamma_{\text{total}}$	$<1.8 \times 10^{-6}$, CL = 95%
$\Gamma(Z \rightarrow p \mu)/\Gamma_{\text{total}}$	$<1.8 \times 10^{-6}$, CL = 95%
$\Gamma(\tau^- \rightarrow \bar{p} \gamma)/\Gamma_{\text{total}}$	$<3.5 \times 10^{-6}$, CL = 90%
$\Gamma(\tau^- \rightarrow \bar{p} \pi^0)/\Gamma_{\text{total}}$	$<1.5 \times 10^{-5}$, CL = 90%
$\Gamma(\tau^- \rightarrow \bar{p} 2\pi^0)/\Gamma_{\text{total}}$	$<3.3 \times 10^{-5}$, CL = 90%
$\Gamma(\tau^- \rightarrow \bar{p} \eta)/\Gamma_{\text{total}}$	$<8.9 \times 10^{-6}$, CL = 90%
$\Gamma(\tau^- \rightarrow \bar{p} \pi^0 \eta)/\Gamma_{\text{total}}$	$<2.7 \times 10^{-5}$, CL = 90%
$\Gamma(\tau^- \rightarrow \Lambda \pi^-)/\Gamma_{\text{total}}$	$<7.2 \times 10^{-8}$, CL = 90%
$\Gamma(\tau^- \rightarrow \bar{\Lambda} \pi^-)/\Gamma_{\text{total}}$	$<1.4 \times 10^{-7}$, CL = 90%
p mean life	$>2.1 \times 10^{29}$ years, CL = 90%

A few examples of proton or bound neutron decay follow. For limits on many other nucleon decay channels, see the Baryon Summary Table.

$\tau(N \rightarrow e^+ \pi)$	$> 158 (n), > 1600 (p) \times 10^{30}$ years, CL = 90%
$\tau(N \rightarrow \mu^+ \pi)$	$> 100 (n), > 473 (p) \times 10^{30}$ years, CL = 90%
$\tau(N \rightarrow e^+ K)$	$> 17 (n), > 150 (p) \times 10^{30}$ years, CL = 90%
$\tau(N \rightarrow \mu^+ K)$	$> 26 (n), > 120 (p) \times 10^{30}$ years, CL = 90%
limit on $n\bar{n}$ oscillations (free n)	$>0.86 \times 10^8$ s, CL = 90%
limit on $n\bar{n}$ oscillations (bound n)	[p] $>1.2 \times 10^8$ s, CL = 90%

ELECTRIC CHARGE (Q)

$$e \rightarrow \nu_e \gamma \text{ and astrophysical limits} \quad [q] > 4.6 \times 10^{26} \text{ yr, CL} = 90\%$$

$$\Gamma(n \rightarrow p \nu_e \bar{\nu}_e) / \Gamma_{\text{total}} < 8 \times 10^{-27}, \text{ CL} = 68\%$$

$\Delta S = \Delta Q$ RULE

Violations allowed in second-order weak interactions.

$$\Gamma(K^+ \rightarrow \pi^+ \pi^+ e^- \bar{\nu}_e) / \Gamma_{\text{total}} < 1.2 \times 10^{-8}, \text{ CL} = 90\%$$

$$\Gamma(K^+ \rightarrow \pi^+ \pi^+ \mu^- \bar{\nu}_\mu) / \Gamma_{\text{total}} < 3.0 \times 10^{-6}, \text{ CL} = 95\%$$

$$\text{Re}(x_+), K_{e3} \text{ parameter} \quad (-0.9 \pm 3.0) \times 10^{-3}$$

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

$$\text{real part of } x \quad -0.002 \pm 0.006$$

$$\text{imaginary part of } x \quad 0.0012 \pm 0.0021$$

$$\Gamma(\Sigma^+ \rightarrow n \ell^+ \nu) / \Gamma(\Sigma^- \rightarrow n \ell^- \bar{\nu}) < 0.043$$

$$\Gamma(\Sigma^+ \rightarrow n e^+ \nu_e) / \Gamma_{\text{total}} < 5 \times 10^{-6}, \text{ CL} = 90\%$$

$$\Gamma(\Sigma^+ \rightarrow n \mu^+ \nu_\mu) / \Gamma_{\text{total}} < 3.0 \times 10^{-5}, \text{ CL} = 90\%$$

$$\Gamma(\Xi^0 \rightarrow \Sigma^- e^+ \nu_e) / \Gamma_{\text{total}} < 9 \times 10^{-4}, \text{ CL} = 90\%$$

$$\Gamma(\Xi^0 \rightarrow \Sigma^- \mu^+ \nu_\mu) / \Gamma_{\text{total}} < 9 \times 10^{-4}, \text{ CL} = 90\%$$

$\Delta S = 2$ FORBIDDEN

Allowed in second-order weak interactions.

$$\Gamma(\Xi^0 \rightarrow p \pi^-) / \Gamma_{\text{total}} < 8 \times 10^{-6}, \text{ CL} = 90\%$$

$$\Gamma(\Xi^0 \rightarrow p e^- \bar{\nu}_e) / \Gamma_{\text{total}} < 1.3 \times 10^{-3}$$

$$\Gamma(\Xi^0 \rightarrow p \mu^- \bar{\nu}_\mu) / \Gamma_{\text{total}} < 1.3 \times 10^{-3}$$

$$\Gamma(\Xi^- \rightarrow n \pi^-) / \Gamma_{\text{total}} < 1.9 \times 10^{-5}, \text{ CL} = 90\%$$

$$\Gamma(\Xi^- \rightarrow n e^- \bar{\nu}_e) / \Gamma_{\text{total}} < 3.2 \times 10^{-3}, \text{ CL} = 90\%$$

$$\Gamma(\Xi^- \rightarrow n \mu^- \bar{\nu}_\mu) / \Gamma_{\text{total}} < 1.5 \times 10^{-2}, \text{ CL} = 90\%$$

$$\Gamma(\Xi^- \rightarrow p \pi^- \pi^-) / \Gamma_{\text{total}} < 4 \times 10^{-4}, \text{ CL} = 90\%$$

$$\Gamma(\Xi^- \rightarrow p \pi^- e^- \bar{\nu}_e) / \Gamma_{\text{total}} < 4 \times 10^{-4}, \text{ CL} = 90\%$$

$$\Gamma(\Xi^- \rightarrow p \pi^- \mu^- \bar{\nu}_\mu) / \Gamma_{\text{total}} < 4 \times 10^{-4}, \text{ CL} = 90\%$$

$$\Gamma(\Omega^- \rightarrow \Lambda \pi^-) / \Gamma_{\text{total}} < 2.9 \times 10^{-6}, \text{ CL} = 90\%$$

$\Delta S = 2$ VIA MIXING

Allowed in second-order weak interactions, e.g. mixing.

$$m_{K_L^0} - m_{K_S^0} \quad (0.5292 \pm 0.0009) \times 10^{10} \hbar \text{ s}^{-1} \quad (S = 1.2)$$

$$m_{K_L^0} - m_{K_S^0} \quad (3.483 \pm 0.006) \times 10^{-12} \text{ MeV}$$

$\Delta C = 2$ VIA MIXING

Allowed in second-order weak interactions, e.g. mixing.

$$|m_{D_1^0} - m_{D_2^0}| = x\Gamma \quad (2.37^{+0.66}_{-0.71}) \times 10^{10} \hbar \text{ s}^{-1}$$

$$(\Gamma_{D_1^0} - \Gamma_{D_2^0})/\Gamma = 2y \quad (1.56^{+0.36}_{-0.38}) \times 10^{-2}$$

$\Delta B = 2$ VIA MIXING

Allowed in second-order weak interactions, e.g. mixing.

$$\chi_d \quad 0.1873 \pm 0.0024$$

$$\Delta m_{B^0} = m_{B_H^0} - m_{B_L^0} \quad (0.507 \pm 0.005) \times 10^{12} \hbar \text{ s}^{-1}$$

$$x_d = \Delta m_{B^0}/\Gamma_{B^0} \quad 0.774 \pm 0.008$$

$$\Delta m_{B_s^0} = m_{B_{sH}^0} - m_{B_{sL}^0} \quad (17.77 \pm 0.12) \times 10^{12} \hbar \text{ s}^{-1}$$

$$x_s = \Delta m_{B_s^0}/\Gamma_{B_s^0} \quad 26.2 \pm 0.5$$

$$\chi_s \quad 0.49927 \pm 0.00003$$

$\Delta S = 1$ WEAK NEUTRAL CURRENT FORBIDDEN

Allowed by higher-order electroweak interactions.

$\Gamma(K^+ \rightarrow \pi^+ e^+ e^-)/\Gamma_{\text{total}}$	$(2.88 \pm 0.13) \times 10^{-7}$
$\Gamma(K^+ \rightarrow \pi^+ \mu^+ \mu^-)/\Gamma_{\text{total}}$	$(8.1 \pm 1.4) \times 10^{-8}$ ($S = 2.7$)
$\Gamma(K^+ \rightarrow \pi^+ \nu \bar{\nu})/\Gamma_{\text{total}}$	$(1.7 \pm 1.1) \times 10^{-10}$
$\Gamma(K^+ \rightarrow \pi^+ \pi^0 \nu \bar{\nu})/\Gamma_{\text{total}}$	$< 4.3 \times 10^{-5}$, CL = 90%
$\Gamma(K_S^0 \rightarrow \mu^+ \mu^-)/\Gamma_{\text{total}}$	$< 3.2 \times 10^{-7}$, CL = 90%
$\Gamma(K_S^0 \rightarrow e^+ e^-)/\Gamma_{\text{total}}$	$< 1.4 \times 10^{-7}$, CL = 90%
$\Gamma(K_S^0 \rightarrow \pi^0 e^+ e^-)/\Gamma_{\text{total}}$	[r] $(3.0^{+1.5}_{-1.2}) \times 10^{-9}$
$\Gamma(K_S^0 \rightarrow \pi^0 \mu^+ \mu^-)/\Gamma_{\text{total}}$	$(2.9^{+1.5}_{-1.2}) \times 10^{-9}$
$\Gamma(K_L^0 \rightarrow \mu^+ \mu^-)/\Gamma_{\text{total}}$	$(6.84 \pm 0.11) \times 10^{-9}$
$\Gamma(K_L^0 \rightarrow e^+ e^-)/\Gamma_{\text{total}}$	$(9^{+6}_{-4}) \times 10^{-12}$
$\Gamma(K_L^0 \rightarrow \pi^+ \pi^- e^+ e^-)/\Gamma_{\text{total}}$	[s] $(3.11 \pm 0.19) \times 10^{-7}$
$\Gamma(K_L^0 \rightarrow \pi^0 \pi^0 e^+ e^-)/\Gamma_{\text{total}}$	$< 6.6 \times 10^{-9}$, CL = 90%
$\Gamma(K_L^0 \rightarrow \mu^+ \mu^- e^+ e^-)/\Gamma_{\text{total}}$	$(2.69 \pm 0.27) \times 10^{-9}$
$\Gamma(K_L^0 \rightarrow e^+ e^- e^+ e^-)/\Gamma_{\text{total}}$	$(3.56 \pm 0.21) \times 10^{-8}$
$\Gamma(K_L^0 \rightarrow \pi^0 \mu^+ \mu^-)/\Gamma_{\text{total}}$	$< 3.8 \times 10^{-10}$, CL = 90%
$\Gamma(K_L^0 \rightarrow \pi^0 e^+ e^-)/\Gamma_{\text{total}}$	$< 2.8 \times 10^{-10}$, CL = 90%
$\Gamma(K_L^0 \rightarrow \pi^0 \nu \bar{\nu})/\Gamma_{\text{total}}$	$< 6.7 \times 10^{-8}$, CL = 90%
$\Gamma(K_L^0 \rightarrow \pi^0 \pi^0 \nu \bar{\nu})/\Gamma_{\text{total}}$	$< 4.7 \times 10^{-5}$, CL = 90%
$\Gamma(\Sigma^+ \rightarrow p e^+ e^-)/\Gamma_{\text{total}}$	$< 7 \times 10^{-6}$
$\Gamma(\Sigma^+ \rightarrow p \mu^+ \mu^-)/\Gamma_{\text{total}}$	$(9^{+9}_{-8}) \times 10^{-8}$

$\Delta C = 1$ WEAK NEUTRAL CURRENT FORBIDDEN

Allowed by higher-order electroweak interactions.

$\Gamma(D^+ \rightarrow \pi^+ e^+ e^-)/\Gamma_{\text{total}}$	$< 7.4 \times 10^{-6}$, CL = 90%
$\Gamma(D^+ \rightarrow \pi^+ \mu^+ \mu^-)/\Gamma_{\text{total}}$	$< 3.9 \times 10^{-6}$, CL = 90%
$\Gamma(D^+ \rightarrow \rho^+ \mu^+ \mu^-)/\Gamma_{\text{total}}$	$< 5.6 \times 10^{-4}$, CL = 90%
$\Gamma(D^0 \rightarrow \gamma \gamma)/\Gamma_{\text{total}}$	$< 2.7 \times 10^{-5}$, CL = 90%
$\Gamma(D^0 \rightarrow e^+ e^-)/\Gamma_{\text{total}}$	$< 1.2 \times 10^{-6}$, CL = 90%
$\Gamma(D^0 \rightarrow \mu^+ \mu^-)/\Gamma_{\text{total}}$	$< 1.3 \times 10^{-6}$, CL = 90%
$\Gamma(D^0 \rightarrow \pi^0 e^+ e^-)/\Gamma_{\text{total}}$	$< 4.5 \times 10^{-5}$, CL = 90%
$\Gamma(D^0 \rightarrow \pi^0 \mu^+ \mu^-)/\Gamma_{\text{total}}$	$< 1.8 \times 10^{-4}$, CL = 90%
$\Gamma(D^0 \rightarrow \eta e^+ e^-)/\Gamma_{\text{total}}$	$< 1.1 \times 10^{-4}$, CL = 90%
$\Gamma(D^0 \rightarrow \eta \mu^+ \mu^-)/\Gamma_{\text{total}}$	$< 5.3 \times 10^{-4}$, CL = 90%
$\Gamma(D^0 \rightarrow \pi^+ \pi^- e^+ e^-)/\Gamma_{\text{total}}$	$< 3.73 \times 10^{-4}$, CL = 90%

$\Gamma(D^0 \rightarrow \rho^0 e^+ e^-)/\Gamma_{\text{total}}$	$<1.0 \times 10^{-4}$, CL = 90%
$\Gamma(D^0 \rightarrow \pi^+ \pi^- \mu^+ \mu^-)/\Gamma_{\text{total}}$	$<3.0 \times 10^{-5}$, CL = 90%
$\Gamma(D^0 \rightarrow \rho^0 \mu^+ \mu^-)/\Gamma_{\text{total}}$	$<2.2 \times 10^{-5}$, CL = 90%
$\Gamma(D^0 \rightarrow \omega e^+ e^-)/\Gamma_{\text{total}}$	$<1.8 \times 10^{-4}$, CL = 90%
$\Gamma(D^0 \rightarrow \omega \mu^+ \mu^-)/\Gamma_{\text{total}}$	$<8.3 \times 10^{-4}$, CL = 90%
$\Gamma(D^0 \rightarrow K^- K^+ e^+ e^-)/\Gamma_{\text{total}}$	$<3.15 \times 10^{-4}$, CL = 90%
$\Gamma(D^0 \rightarrow \phi e^+ e^-)/\Gamma_{\text{total}}$	$<5.2 \times 10^{-5}$, CL = 90%
$\Gamma(D^0 \rightarrow K^- K^+ \mu^+ \mu^-)/\Gamma_{\text{total}}$	$<3.3 \times 10^{-5}$, CL = 90%
$\Gamma(D^0 \rightarrow \phi \mu^+ \mu^-)/\Gamma_{\text{total}}$	$<3.1 \times 10^{-5}$, CL = 90%
$\Gamma(D^0 \rightarrow K^- \pi^+ e^+ e^-)/\Gamma_{\text{total}}$	$<3.85 \times 10^{-4}$, CL = 90%
$\Gamma(D^0 \rightarrow K^- \pi^+ \mu^+ \mu^-)/\Gamma_{\text{total}}$	$<3.59 \times 10^{-4}$, CL = 90%
$\Gamma(D^0 \rightarrow \pi^+ \pi^- \pi^0 \mu^+ \mu^-)/\Gamma_{\text{total}}$	$<8.1 \times 10^{-4}$, CL = 90%
$\Gamma(D_s^+ \rightarrow K^+ e^+ e^-)/\Gamma_{\text{total}}$	$<1.6 \times 10^{-3}$, CL = 90%
$\Gamma(D_s^+ \rightarrow K^+ \mu^+ \mu^-)/\Gamma_{\text{total}}$	$<3.6 \times 10^{-5}$, CL = 90%
$\Gamma(D_s^+ \rightarrow K^*(892)^+ \mu^+ \mu^-)/\Gamma_{\text{total}}$	$<1.4 \times 10^{-3}$, CL = 90%
$\Gamma(\Lambda_c^+ \rightarrow p \mu^+ \mu^-)/\Gamma_{\text{total}}$	$<3.4 \times 10^{-4}$, CL = 90%

$\Delta B = 1$ WEAK NEUTRAL CURRENT FORBIDDEN

Allowed by higher-order electroweak interactions.

$\Gamma(B^+ \rightarrow \pi^+ \ell^+ \ell^-)/\Gamma_{\text{total}}$	$<4.9 \times 10^{-8}$, CL = 90%
$\Gamma(B^+ \rightarrow \pi^+ e^+ e^-)/\Gamma_{\text{total}}$	$<8.0 \times 10^{-8}$, CL = 90%
$\Gamma(B^+ \rightarrow \pi^+ \mu^+ \mu^-)/\Gamma_{\text{total}}$	$<6.9 \times 10^{-8}$, CL = 90%
$\Gamma(B^+ \rightarrow \pi^+ \nu \bar{\nu})/\Gamma_{\text{total}}$	$<1.0 \times 10^{-4}$, CL = 90%
$\Gamma(B^+ \rightarrow K^+ \ell^+ \ell^-)/\Gamma_{\text{total}}$	[t] $(4.4^{+0.8}_{-0.7}) \times 10^{-7}$ (S = 1.1)
$\Gamma(B^+ \rightarrow K^+ e^+ e^-)/\Gamma_{\text{total}}$	$(4.9 \pm 1.0) \times 10^{-7}$
$\Gamma(B^+ \rightarrow K^+ \mu^+ \mu^-)/\Gamma_{\text{total}}$	$(4.5^{+0.9}_{-0.8}) \times 10^{-7}$
$\Gamma(B^+ \rightarrow K^+ \bar{\nu} \nu)/\Gamma_{\text{total}}$	$<1.4 \times 10^{-5}$, CL = 90%
$\Gamma(B^+ \rightarrow \rho^+ \nu \bar{\nu})/\Gamma_{\text{total}}$	$<1.5 \times 10^{-4}$, CL = 90%
$\Gamma(B^+ \rightarrow K^*(892)^+ \ell^+ \ell^-)/\Gamma_{\text{total}}$	[t] $(7 \pm 5) \times 10^{-7}$
$\Gamma(B^+ \rightarrow K^*(892)^+ \nu \bar{\nu})/\Gamma_{\text{total}}$	$<8 \times 10^{-5}$, CL = 90%
$\Gamma(B^+ \rightarrow K^*(892)^+ e^+ e^-)/\Gamma_{\text{total}}$	$(8 \pm 8) \times 10^{-7}$
$\Gamma(B^+ \rightarrow K^*(892)^+ \mu^+ \mu^-)/\Gamma_{\text{total}}$	$(8^{+6}_{-4}) \times 10^{-7}$
$\Gamma(B^0 \rightarrow \gamma \gamma)/\Gamma_{\text{total}}$	$<6.2 \times 10^{-7}$, CL = 90%
$\Gamma(B^0 \rightarrow e^+ e^-)/\Gamma_{\text{total}}$	$<1.13 \times 10^{-7}$, CL = 90%
$\Gamma(B^0 \rightarrow e^+ e^- \gamma)/\Gamma_{\text{total}}$	$<1.2 \times 10^{-7}$, CL = 90%
$\Gamma(B^0 \rightarrow \mu^+ \mu^-)/\Gamma_{\text{total}}$	$<1.5 \times 10^{-8}$, CL = 90%
$\Gamma(B^0 \rightarrow \mu^+ \mu^- \gamma)/\Gamma_{\text{total}}$	$<1.6 \times 10^{-7}$, CL = 90%
$\Gamma(B^0 \rightarrow \tau^+ \tau^-)/\Gamma_{\text{total}}$	$<4.1 \times 10^{-3}$, CL = 90%
$\Gamma(B^0 \rightarrow \pi^0 \ell^+ \ell^-)/\Gamma_{\text{total}}$	$<1.2 \times 10^{-7}$, CL = 90%

$\Gamma(B^0 \rightarrow \pi^0 e^+ e^-)/\Gamma_{\text{total}}$	$<1.4 \times 10^{-7}$, CL = 90%
$\Gamma(B^0 \rightarrow \pi^0 \mu^+ \mu^-)/\Gamma_{\text{total}}$	$<1.8 \times 10^{-7}$, CL = 90%
$\Gamma(B^0 \rightarrow \pi^0 \nu \bar{\nu})/\Gamma_{\text{total}}$	$<2.2 \times 10^{-4}$, CL = 90%
$\Gamma(B^0 \rightarrow K^0 \ell^+ \ell^-)/\Gamma_{\text{total}}$	[t] $(2.9^{+1.6}_{-1.3}) \times 10^{-7}$
$\Gamma(B^0 \rightarrow K^0 \nu \bar{\nu})/\Gamma_{\text{total}}$	$<1.6 \times 10^{-4}$, CL = 90%
$\Gamma(B^0 \rightarrow \rho^0 \nu \bar{\nu})/\Gamma_{\text{total}}$	$<4.4 \times 10^{-4}$, CL = 90%
$\Gamma(B^0 \rightarrow K^0 e^+ e^-)/\Gamma_{\text{total}}$	$(1.3^{+1.6}_{-1.1}) \times 10^{-7}$
$\Gamma(B^0 \rightarrow K^0 \mu^+ \mu^-)/\Gamma_{\text{total}}$	$(5.7^{+2.2}_{-1.8}) \times 10^{-7}$
$\Gamma(B^0 \rightarrow K^*(892)^0 \ell^+ \ell^-)/\Gamma_{\text{total}}$	[t] $(9.5 \pm 1.8) \times 10^{-7}$
$\Gamma(B^0 \rightarrow K^*(892)^0 e^+ e^-)/\Gamma_{\text{total}}$	$(1.04^{+0.35}_{-0.31}) \times 10^{-6}$
$\Gamma(B^0 \rightarrow K^*(892)^0 \mu^+ \mu^-)/\Gamma_{\text{total}}$	$(9.8 \pm 2.1) \times 10^{-7}$
$\Gamma(B^0 \rightarrow K^*(892)^0 \nu \bar{\nu})/\Gamma_{\text{total}}$	$<1.2 \times 10^{-4}$, CL = 90%
$\Gamma(B^0 \rightarrow \phi \nu \bar{\nu})/\Gamma_{\text{total}}$	$<5.8 \times 10^{-5}$, CL = 90%
$\Gamma(B^0 \rightarrow \text{invisible})/\Gamma_{\text{total}}$	$<2.2 \times 10^{-4}$, CL = 90%
$\Gamma(B^0 \rightarrow \nu \bar{\nu} \gamma)/\Gamma_{\text{total}}$	$<4.7 \times 10^{-5}$, CL = 90%
$\Gamma(B \rightarrow s e^+ e^-)/\Gamma_{\text{total}}$	$(4.7 \pm 1.3) \times 10^{-6}$
$\Gamma(B \rightarrow s \mu^+ \mu^-)/\Gamma_{\text{total}}$	$(4.3 \pm 1.2) \times 10^{-6}$
$\Gamma(B \rightarrow s \ell^+ \ell^-)/\Gamma_{\text{total}}$	[t] $(4.5 \pm 1.0) \times 10^{-6}$
$\Gamma(B \rightarrow K e^+ e^-)/\Gamma_{\text{total}}$	$(3.8^{+0.8}_{-0.7}) \times 10^{-7}$
$\Gamma(B \rightarrow K^*(892) e^+ e^-)/\Gamma_{\text{total}}$	$(1.13 \pm 0.27) \times 10^{-6}$
$\Gamma(B \rightarrow K \mu^+ \mu^-)/\Gamma_{\text{total}}$	$(4.2^{+0.9}_{-0.8}) \times 10^{-7}$
$\Gamma(B \rightarrow K^*(892) \mu^+ \mu^-)/\Gamma_{\text{total}}$	$(1.03^{+0.26}_{-0.23}) \times 10^{-6}$
$\Gamma(B \rightarrow K \ell^+ \ell^-)/\Gamma_{\text{total}}$	$(3.9 \pm 0.7) \times 10^{-7}$ (S = 1.2)
$\Gamma(B \rightarrow K^*(892) \ell^+ \ell^-)/\Gamma_{\text{total}}$	$(9.4 \pm 1.8) \times 10^{-7}$ (S = 1.1)
$\Gamma(\bar{b} \rightarrow \mu^+ \mu^- \text{ anything})/\Gamma_{\text{total}}$	$<3.2 \times 10^{-4}$, CL = 90%
$\Gamma(B_S^0 \rightarrow \gamma \gamma)/\Gamma_{\text{total}}$	$<8.7 \times 10^{-6}$, CL = 90%
$\Gamma(B_S^0 \rightarrow \mu^+ \mu^-)/\Gamma_{\text{total}}$	$<4.7 \times 10^{-8}$, CL = 90%
$\Gamma(B_S^0 \rightarrow e^+ e^-)/\Gamma_{\text{total}}$	$<5.4 \times 10^{-5}$, CL = 90%
$\Gamma(B_S^0 \rightarrow \phi(1020) \mu^+ \mu^-)/\Gamma_{\text{total}}$	$<3.2 \times 10^{-6}$, CL = 90%
$\Gamma(B_S^0 \rightarrow \phi \nu \bar{\nu})/\Gamma_{\text{total}}$	$<5.4 \times 10^{-3}$, CL = 90%

$\Delta T = 1$ WEAK NEUTRAL CURRENT FORBIDDEN

Allowed by higher-order electroweak interactions.

$$\Gamma(t \rightarrow Z q (q=u,c))/\Gamma_{\text{total}} \quad [u] \quad <3.7 \times 10^{-2}, \text{ CL} = 95\%$$

NOTES

- [a] C parity forbids this to occur as a single-photon process.
- [b] See the Particle Listings for the (complicated) definition of this quantity.
- [c] Time-reversal invariance requires this to be 0° or 180° .
- [d] Allowed by higher-order electroweak interactions.
- [e] Violates *CP* in leading order. Test of direct *CP* violation since the indirect *CP*-violating and *CP*-conserving contributions are expected to be suppressed.
- [f] $\text{Re}(\epsilon'/\epsilon) = \epsilon'/\epsilon$ to a very good approximation provided the phases satisfy *CPT* invariance.
- [g] This mode includes gammas from inner bremsstrahlung but not the direct emission mode $K_L^0 \rightarrow \pi^+ \pi^- \gamma$ (DE).
- [h] Neglecting photon channels. See, *e.g.*, A. Pais and S.B. Treiman, Phys. Rev. **D12**, 2744 (1975).
- [i] Derived from measured values of ϕ_{+-} , ϕ_{00} , $|\eta|$, $|m_{K_L^0} - m_{K_S^0}|$, and $\tau_{K_S^0}$, as described in the introduction to “Tests of Conservation Laws.”
- [j] These two results are not independent, and both use the more precise measurement of $|q_{\bar{p}}/m_{\bar{p}}|/(q_p/m_p)$.
- [k] The value is for the sum of the charge states or particle/antiparticle states indicated.
- [l] A test of additive vs. multiplicative lepton family number conservation.
- [m] The limit quoted corresponds to the projection onto the $\sin^2(2\theta_{23})$ axis of the 90% CL contour in the $\sin^2(2\theta_{23})-\Delta m_{32}^2$ plane.
- [n] The sign of Δm_{32}^2 is not known at this time. The range quoted is for the absolute value.
- [o] Derived from an analysis of neutrino-oscillation experiments.
- [p] There is some controversy about whether nuclear physics and model dependence complicate the analysis for bound neutrons (from which the best limit comes). The first limit here is from reactor experiments with free neutrons.
- [q] This is the best limit for the mode $e^- \rightarrow \nu \gamma$. The best limit for “electron disappearance” is 6.4×10^{24} yr.
- [r] See the K_S^0 Particle Listings for the energy limits used in this measurement.
- [s] See the K_L^0 Particle Listings for the energy limits used in this measurement.
- [t] An ℓ indicates an e or a μ mode, not a sum over these modes.
- [u] This limit is for $\Gamma(t \rightarrow Z q)/\Gamma(t \rightarrow W b)$.