$\Delta B = 2$ VIA MIXING

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

χ_d	0.156 ± 0.024
$\Delta m_{B^0} = m_{B^0_H} - m_{B^0_L}$	$(0.51 \pm 0.06) \times 10^{12}\ \hbar\ \mathrm{s}^{-1}$
$x_d = \Delta m_{B^0}/\Gamma_{B^0}$	0.71 ± 0.06
χ_s	0.62 ± 0.13
$\Delta m_{B^0_s} = m_{B^0_{sH}} - m_{B^0_{sL}}$	$>1.8 \times 10^{12}\ \hbar\ \mathrm{s}^{-1}$, CL = 95%
$x_s = \Delta m_{B^0_s}/\Gamma_{B^0_s}$	>2.0, CL = 95%

$\Delta S = 1$ WEAK NEUTRAL CURRENT FORBIDDEN

Allowed by higher-order electroweak interactions.

$\Gamma(K^+ \to \pi^+ e^+ e^-)/\Gamma_{\text{total}}$		$(2.74 \pm 0.23) \times 10^{-7}$
$\Gamma(K^+ \to \pi^+ \mu^+ \mu^-)/\Gamma_{\text{total}}$		$<2.3 \times 10^{-7}$, CL = 90%
$\Gamma(K^+ \to \pi^+ \nu\overline{\nu})/\Gamma_{\text{total}}$		$<5.2 \times 10^{-9}$, CL = 90%
$\Gamma(K^0_S \to \mu^+ \mu^-)/\Gamma_{\text{total}}$		$<3.2 \times 10^{-7}$, CL = 90%
$\Gamma(K^0_S \to e^+ e^-)/\Gamma_{\text{total}}$		$<1.0 \times 10^{-5}$, CL = 90%
$\Gamma(K^0_S \to \pi^0 e^+ e^-)/\Gamma_{\text{total}}$		$<1.1 \times 10^{-6}$, CL = 90%
$\Gamma(K^0_L \to \mu^+ \mu^-)/\Gamma_{\text{total}}$		$(7.4 \pm 0.4) \times 10^{-9}$
$\Gamma(K^0_L \to \mu^+ \mu^- \gamma)/\Gamma_{\text{total}}$		$(2.8 \pm 2.8) \times 10^{-7}$
$\Gamma(K^0_L \to e^+ e^-)/\Gamma_{\text{total}}$		$<4.1 \times 10^{-11}$, CL = 90%
$\Gamma(K^0_L \to e^+ e^- \gamma)/\Gamma_{\text{total}}$		$(9.1 \pm 0.5) \times 10^{-6}$
$\Gamma(K^0_L \to e^+ e^- \gamma\gamma)/\Gamma_{\text{total}}$	[r]	$(6.6 \pm 3.2) \times 10^{-7}$
$\Gamma(K^0_L \to \pi^+ \pi^- e^+ e^-)/\Gamma_{\text{total}}$		$<2.5 \times 10^{-6}$, CL = 90%
$\Gamma(K^0_L \to \mu^+ \mu^- e^+ e^-)/\Gamma_{\text{total}}$		$<4.9 \times 10^{-6}$, CL = 90%
$\Gamma(K^0_L \to e^+ e^- e^+ e^-)/\Gamma_{\text{total}}$	[s]	$(3.9 \pm 0.7) \times 10^{-8}$
$\Gamma(K^0_L \to \pi^0 \mu^+ \mu^-)/\Gamma_{\text{total}}$		$<5.1 \times 10^{-9}$, CL = 90%
$\Gamma(K^0_L \to \pi^0 e^+ e^-)/\Gamma_{\text{total}}$		$<4.3 \times 10^{-9}$, CL = 90%
$\Gamma(K^0_L \to \pi^0 \nu\overline{\nu})/\Gamma_{\text{total}}$		$<2.2 \times 10^{-4}$, CL = 90%
$\Gamma(\Sigma^+ \to p e^+ e^-)/\Gamma_{\text{total}}$		$<7 \times 10^{-6}$

$\Delta C = 1$ WEAK NEUTRAL CURRENT FORBIDDEN

Allowed by higher-order electroweak interactions.

$\Gamma(D^+ \to \pi^+ e^+ e^-)/\Gamma_{\text{total}}$	$<2.5 \times 10^{-3}$, CL = 90%
$\Gamma(D^+ \to \pi^+ \mu^+ \mu^-)/\Gamma_{\text{total}}$	$<2.9 \times 10^{-3}$, CL = 90%
$\Gamma(D^0 \to e^+ e^-)/\Gamma_{\text{total}}$	$<1.3 \times 10^{-4}$, CL = 90%
$\Gamma(D^0 \to \mu^+ \mu^-)/\Gamma_{\text{total}}$	$<1.1 \times 10^{-5}$, CL = 90%
$\Gamma(D^0 \to \rho^0 e^+ e^-)/\Gamma_{\text{total}}$	$<4.5 \times 10^{-4}$, CL = 90%
$\Gamma(D^0 \to \rho^0 \mu^+ \mu^-)/\Gamma_{\text{total}}$	$<8.1 \times 10^{-4}$, CL = 90%

$\Delta B = 1$ WEAK NEUTRAL CURRENT FORBIDDEN

Allowed by higher-order electroweak interactions.

$\Gamma(B^+ \to \pi^+ e^+ e^-)/\Gamma_{\text{total}}$		$<3.9 \times 10^{-3}$, CL = 90%
$\Gamma(B^+ \to \pi^+ \mu^+ \mu^-)/\Gamma_{\text{total}}$		$<9.1 \times 10^{-3}$, CL = 90%
$\Gamma(B^+ \to K^+ e^+ e^-)/\Gamma_{\text{total}}$		$<6 \times 10^{-5}$, CL = 90%
$\Gamma(B^+ \to K^+ \mu^+ \mu^-)/\Gamma_{\text{total}}$		$<1.7 \times 10^{-4}$, CL = 90%
$\Gamma(B^+ \to K^*(892)^+ e^+ e^-)/\Gamma_{\text{total}}$		$<6.9 \times 10^{-4}$, CL = 90%
$\Gamma(B^+ \to K^*(892)^+ \mu^+ \mu^-)/\Gamma_{\text{total}}$		$<1.2 \times 10^{-3}$, CL = 90%
$\Gamma(\overline{b} \to e^+ e^-\ \text{anything})/\Gamma_{\text{total}}$	[t]	$<2.4 \times 10^{-3}$, CL = 90%
$\Gamma(\overline{b} \to \mu^+ \mu^-\ \text{anything})/\Gamma_{\text{total}}$	[t]	$<5.0 \times 10^{-5}$, CL = 90%
$\Gamma(B^0 \to e^+ e^-)/\Gamma_{\text{total}}$		$<5.9 \times 10^{-6}$, CL = 90%
$\Gamma(B^0 \to \mu^+ \mu^-)/\Gamma_{\text{total}}$		$<5.9 \times 10^{-6}$, CL = 90%
$\Gamma(B^0 \to K^0 e^+ e^-)/\Gamma_{\text{total}}$		$<3.0 \times 10^{-4}$, CL = 90%
$\Gamma(B^0 \to K^0 \mu^+ \mu^-)/\Gamma_{\text{total}}$		$<3.6 \times 10^{-4}$, CL = 90%
$\Gamma(B^0 \to K^*(892)^0 e^+ e^-)/\Gamma_{\text{total}}$		$<2.9 \times 10^{-4}$, CL = 90%
$\Gamma(B^0 \to K^*(892)^0 \mu^+ \mu^-)/\Gamma_{\text{total}}$		$<2.3 \times 10^{-5}$, CL = 90%

NOTES

In this Summary Table:

When a quantity has "(S = ...)" to its right, the error on the quantity has been enlarged by the "scale factor" S, defined as $S = \sqrt{\chi^2/(N-1)}$, where N is the number of measurements used in calculating the quantity. We do this when $S > 1$, which often indicates that the measurements are inconsistent. When $S > 1.25$, we also show in the Full Listings an ideogram of the measurements. For more about S, see the Introduction.

[a] Positronium data are from A.P. Mills and S. Berko, Physical Review Letters **18** 420 (1967); and K. Marko and A. Rich, Physical Review Letters **33** 980 (1974). Values for 90% confidence level, are from A.P. Mills, private communication.

[b] C parity forbids this to occur as a single-photon process.

[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] ϵ'/ϵ is derived from $|\eta_{00}/\eta_{+-}|$ measurements using theoretical input on phases.

[g] Neglecting photon channels. See, *e.g.*, A. Pais and S.B. Treiman, Phys. Rev. **D12**, 2744 (1975).

[h] Derived from measured values of ϕ_{+-}, ϕ_{00}, $|\eta|$, $\tau_{K^0_S}$, and $|m_{K^0_L} - m_{K^0_S}|$, as described in the introduction to this Table.

[i] The value is for the sum of the charge states indicated.

[j] A test of additive vs. multiplicative lepton family number conservation.

[k] ℓ means a sum over e and μ modes.

[l] $\Delta(m^2) = 100$ eV^2.

[m] 190 eV^2 $< \Delta(m^2) <$ 320 eV^2.

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

[o] There is some controversy about whether nuclear physics and model dependence complicate the analysis for bound neutrons (from which the best limit comes). For reactor experiments with free neutrons, the best limit is $> 10^7$ s.

[p] This is the best "electron disappearance" limit. The best limit for the mode $e^- \to \nu\gamma$ is $> 2.35 \times 10^{25}$ yr (CL=68%).

[q] The D^0_1-D^0_2 limits are inferred from the limit on $D^0 \to \overline{D}^0 \to K^+\pi^-$.

[r] See the K^0_L Full Listings for the energy limits used in this measurement.

[s] $m_{e^+e^-} > 470$ MeV.

[t] B^0, B^+, and B^0_s not separated.