

## 1. Lepton Flavor Violation

Table 1: HFAG Winter 2012 upper limit for the lepton flavor violating  $\tau$  decay modes. L means lepton number violation as well as the lepton flavor violation.

Decay mode	Category	Upper limit at 90%		Exp.	Ref.
$\Gamma_{156} = e^- \gamma$	$l\gamma$	$< 12.$	$\cdot 10^{-8}$	Belle	[1]
		$< 3.3$	$\cdot 10^{-8}$	Babar	[2]
$\Gamma_{157} = \mu^- \gamma$		$< 4.5$	$\cdot 10^{-8}$	Belle	[1]
		$< 4.4$	$\cdot 10^{-8}$	Babar	[2]
$\Gamma_{158} = e^- \pi^0$	$lP^0$	$< 2.2$	$\cdot 10^{-8}$	Belle	[3]
		$< 13.$	$\cdot 10^{-8}$	Babar	[4]
$\Gamma_{159} = \mu^- \pi^0$		$< 2.7$	$\cdot 10^{-8}$	Belle	[3]
		$< 11.$	$\cdot 10^{-8}$	Babar	[4]
$\Gamma_{162} = e^- \eta$		$< 4.4$	$\cdot 10^{-8}$	Belle	[3]
		$< 16.$	$\cdot 10^{-8}$	Babar	[4]
$\Gamma_{163} = \mu^- \eta$		$< 2.3$	$\cdot 10^{-8}$	Belle	[3]
		$< 15.$	$\cdot 10^{-8}$	Babar	[4]
$\Gamma_{172} = e^- \eta'(958)$		$< 3.6$	$\cdot 10^{-8}$	Belle	[3]
		$< 24.$	$\cdot 10^{-8}$	Babar	[4]
$\Gamma_{173} = \mu^- \eta'(958)$		$< 3.8$	$\cdot 10^{-8}$	Belle	[3]
		$< 14.$	$\cdot 10^{-8}$	Babar	[4]
$\Gamma_{160} = e^- K_S^0$		$< 2.6$	$\cdot 10^{-8}$	Belle	[5]
		$< 3.3$	$\cdot 10^{-8}$	Babar	[6]
$\Gamma_{161} = \mu^- K_S^0$		$< 2.3$	$\cdot 10^{-8}$	Belle	[5]
		$< 4.0$	$\cdot 10^{-8}$	Babar	[6]
$\Gamma_{174} = e^- f_0(958)$	$lS^0$	$< 3.2$	$\cdot 10^{-8}$	Belle	[7]
$\Gamma_{175} = \mu^- f_0(958)$		$< 3.4$	$\cdot 10^{-8}$	Belle	[7]
$\Gamma_{164} = e^- \rho^0$	$lV^0$	$< 1.8$	$\cdot 10^{-8}$	Belle	[8]
		$< 4.6$	$\cdot 10^{-8}$	Babar	[9]
$\Gamma_{165} = \mu^- \rho^0$		$< 1.2$	$\cdot 10^{-8}$	Belle	[8]
		$< 2.6$	$\cdot 10^{-8}$	Babar	[9]
$\Gamma_{168} = e^- K^*(892)^0$		$< 3.2$	$\cdot 10^{-8}$	Belle	[8]
		$< 5.9$	$\cdot 10^{-8}$	Babar	[9]
$\Gamma_{169} = \mu^- K^*(892)^0$		$< 7.2$	$\cdot 10^{-8}$	Belle	[8]
		$< 17.$	$\cdot 10^{-8}$	Babar	[9]
$\Gamma_{170} = e^- \bar{K}^*(892)^0$		$< 3.4$	$\cdot 10^{-8}$	Belle	[8]
		$< 4.6$	$\cdot 10^{-8}$	Babar	[9]
$\Gamma_{171} = \mu^- \bar{K}^*(892)^0$		$< 7.0$	$\cdot 10^{-8}$	Belle	[8]
		$< 7.3$	$\cdot 10^{-8}$	Babar	[9]
$\Gamma_{176} = e^- \phi$		$< 3.1$	$\cdot 10^{-8}$	Belle	[8]
		$< 3.1$	$\cdot 10^{-8}$	Babar	[9]

$\Gamma_{177} = \mu^- \phi$		$< 8.4$	$\cdot$	$10^{-8}$	Belle	[8]
		$< 19.$	$\cdot$	$10^{-8}$	Babar	[9]
$\Gamma_{166} = e^- \omega$		$< 4.8$	$\cdot$	$10^{-8}$	Belle	[8]
		$< 11.$	$\cdot$	$10^{-8}$	Babar	[10]
$\Gamma_{167} = \mu^- \omega$		$< 4.7$	$\cdot$	$10^{-8}$	Belle	[8]
		$< 10.$	$\cdot$	$10^{-8}$	Babar	[10]
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$\Gamma_{178} = e^- e^+ e^-$	$lll$	$< 2.7$	$\cdot$	$10^{-8}$	Belle	[11]
		$< 2.9$	$\cdot$	$10^{-8}$	Babar	[12]
$\Gamma_{181} = \mu^- e^+ e^-$		$< 1.8$	$\cdot$	$10^{-8}$	Belle	[11]
		$< 2.2$	$\cdot$	$10^{-8}$	Babar	[12]
$\Gamma_{179} = e^- \mu + \mu^-$		$< 2.7$	$\cdot$	$10^{-8}$	Belle	[11]
		$< 3.2$	$\cdot$	$10^{-8}$	Babar	[12]
$\Gamma_{183} = \mu^- \mu + \mu^-$		$< 2.1$	$\cdot$	$10^{-8}$	Belle	[11]
		$< 3.3$	$\cdot$	$10^{-8}$	Babar	[12]
$\Gamma_{182} = e^- \mu + e^-$		$< 1.5$	$\cdot$	$10^{-8}$	Belle	[11]
		$< 1.8$	$\cdot$	$10^{-8}$	Babar	[12]
$\Gamma_{180} = \mu^- e^+ \mu^-$		$< 1.7$	$\cdot$	$10^{-8}$	Belle	[11]
		$< 2.6$	$\cdot$	$10^{-8}$	Babar	[12]
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$\Gamma_{184} = e^- \pi^+ \pi^-$	$lhh$	$< 2.3$	$\cdot$	$10^{-8}$	Belle	[13]
		$< 12.$	$\cdot$	$10^{-8}$	Babar	[14]
$\Gamma_{186} = \mu^- \pi^+ \pi^-$		$< 2.1$	$\cdot$	$10^{-8}$	Belle	[13]
		$< 29.$	$\cdot$	$10^{-8}$	Babar	[14]
$\Gamma_{188} = e^- \pi^+ K^-$		$< 3.7$	$\cdot$	$10^{-8}$	Belle	[13]
		$< 32.$	$\cdot$	$10^{-8}$	Babar	[14]
$\Gamma_{194} = \mu^- \pi^+ K^-$		$< 8.6$	$\cdot$	$10^{-8}$	Belle	[13]
		$< 26.$	$\cdot$	$10^{-8}$	Babar	[14]
$\Gamma_{189} = e^- K^+ \pi^-$		$< 3.1$	$\cdot$	$10^{-8}$	Belle	[13]
		$< 17.$	$\cdot$	$10^{-8}$	Babar	[14]
$\Gamma_{195} = \mu^- K^+ \pi^-$		$< 4.5$	$\cdot$	$10^{-8}$	Belle	[13]
		$< 32.$	$\cdot$	$10^{-8}$	Babar	[14]
$\Gamma_{192} = e^- K^+ K^-$		$< 3.4$	$\cdot$	$10^{-8}$	Belle	[13]
		$< 14.$	$\cdot$	$10^{-8}$	Babar	[14]
$\Gamma_{198} = \mu^- K^+ K^-$		$< 4.4$	$\cdot$	$10^{-8}$	Belle	[13]
		$< 25.$	$\cdot$	$10^{-8}$	Babar	[14]
$\Gamma_{191} = e^- K_S^0 K_S^0$		$< 7.1$	$\cdot$	$10^{-8}$	Belle	[5]
$\Gamma_{197} = \mu^- K_S^0 K_S^0$		$< 8.0$	$\cdot$	$10^{-8}$	Belle	[5]
$\Gamma_{185} = e^+ \pi^- \pi^-$	(L)	$< 2.0$	$\cdot$	$10^{-8}$	Belle	[13]
	(L)	$< 27.$	$\cdot$	$10^{-8}$	Babar	[14]
$\Gamma_{187} = \mu^+ \pi^- \pi^-$	(L)	$< 3.9$	$\cdot$	$10^{-8}$	Belle	[13]
	(L)	$< 7.0$	$\cdot$	$10^{-8}$	Babar	[14]
$\Gamma_{190} = e^+ \pi^- K^-$	(L)	$< 3.2$	$\cdot$	$10^{-8}$	Belle	[13]
	(L)	$< 18.$	$\cdot$	$10^{-8}$	Babar	[14]
$\Gamma_{196} = \mu^+ \pi^- K^-$	(L)	$< 4.8$	$\cdot$	$10^{-8}$	Belle	[13]

$\Gamma_{193} = e^+ K^- K^-$	(L)	$< 22.$	$\cdot$	$10^{-8}$	Babar	[14]
	(L)	$< 3.3$	$\cdot$	$10^{-8}$	Belle	[13]
$\Gamma_{199} = \mu^+ K^- K^-$	(L)	$< 15.$	$\cdot$	$10^{-8}$	Babar	[14]
	(L)	$< 4.7$	$\cdot$	$10^{-8}$	Belle	[13]
	(L)	$< 48.$	$\cdot$	$10^{-8}$	Babar	[14]
$\Gamma_{211} = \pi^- \Lambda$	$\Lambda h$	$< 3.0$	$\cdot$	$10^{-8}$	Belle	[15]
		$< 5.8$	$\cdot$	$10^{-8}$	Babar	[16]
$\Gamma_{212} = \pi^- \bar{\Lambda}$		$< 2.8$	$\cdot$	$10^{-8}$	Belle	[15]
		$< 5.9$	$\cdot$	$10^{-8}$	Babar	[16]
$\Gamma_{xx} = K^- \Lambda$		$< 4.2$	$\cdot$	$10^{-8}$	Belle	[15]
		$< 15.$	$\cdot$	$10^{-8}$	Babar	[16]
$\Gamma_{xx} = K^- \bar{\Lambda}$		$< 3.1$	$\cdot$	$10^{-8}$	Belle	[15]
		$< 7.2$	$\cdot$	$10^{-8}$	Babar	[16]

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