## LEPTONS

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 $J = \frac{1}{2}$ Mass  $m = (548.57990945 \pm 0.0000024) \times 10^{-6}$  u Mass  $m = 0.51099892 \pm 0.0000004$  MeV  $|m_{e^+} - m_{e^-}|/m < 8 \times 10^{-9}$ , CL = 90%  $|q_{e^+} + q_{e^-}|/e < 4 \times 10^{-8}$ Magnetic moment  $\mu = 1.001159652187 \pm 0.00000000004 \mu_B$   $(g_{e^+} - g_{e^-}) / g_{average} = (-0.5 \pm 2.1) \times 10^{-12}$ Electric dipole moment  $d = (0.07 \pm 0.07) \times 10^{-26}$  e cm Mean life  $\tau > 4.6 \times 10^{26}$  yr, CL = 90% <sup>[a]</sup>

# $\mu$

### $J = \frac{1}{2}$

Mass  $m = 0.1134289264 \pm 0.000000030$  u Mass  $m = 105.658369 \pm 0.00009$  MeV Mean life  $\tau = (2.19703 \pm 0.0004) \times 10^{-6}$  s  $\tau_{\mu^+}/\tau_{\mu^-} = 1.00002 \pm 0.00008$   $c\tau = 658.654$  m Magnetic moment  $\mu = 1.0011659203 \pm 0.000000007 \ e\hbar/2m_{\mu}$   $(g_{\mu^+} - g_{\mu^-}) / g_{average} = (-2.6 \pm 1.6) \times 10^{-8}$ Electric dipole moment  $d = (3.7 \pm 3.4) \times 10^{-19} \ e \,\mathrm{cm}$ 

### Decay parameters <sup>[b]</sup>

$$\begin{split} \rho &= 0.7518 \pm 0.0026 \\ \eta &= -0.007 \pm 0.013 \\ \delta &= 0.749 \pm 0.004 \\ \xi P_{\mu} &= 1.003 \pm 0.008 \ ^{[c]} \\ \xi P_{\mu} \delta / \rho &> 0.99682, \ CL &= 90\% \ ^{[c]} \\ \xi' &= 1.00 \pm 0.04 \\ \xi'' &= 0.7 \pm 0.4 \\ \alpha / A &= (0 \pm 4) \times 10^{-3} \\ \alpha' / A &= (0 \pm 4) \times 10^{-3} \\ \beta / A &= (4 \pm 6) \times 10^{-3} \\ \beta' / A &= (2 \pm 6) \times 10^{-3} \\ \overline{\eta} &= 0.02 \pm 0.08 \end{split}$$

 $\mu^+$  modes are charge conjugates of the modes below.

$\mu^-$ DECAY MODES	Fraction $(\Gamma_i/\Gamma)$	Confidence level	р (MeV/c)					
$e^-\overline{\nu}_e \nu_\mu$	pprox 100%		53					
$e^-\overline{\nu}_e \nu_\mu \gamma$	[d] (1.4±0.4) %		53					
$e^-\overline{ u}_e u_\mue^+e^-$	[e] (3.4±0.4) × 1	0-5	53					
Lepton Family number $(LF)$ violating modes								
$e^- \nu_e \overline{\nu}_\mu$ LF	[f] < 1.2 %	90%	53					
$e^-\gamma$ LF	< 1.2 × 1	0 <sup>-11</sup> 90%	53					
$e^-e^+e^-$ LF	< 1.0 × 1	0 <sup>-12</sup> 90%	53					
$e^- 2\gamma$ LF	< 7.2 × 1	0 <sup>-11</sup> 90%	53					

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$$J = \frac{1}{2}$$

 $\begin{array}{l} \text{Mass } m = 1776.99 \substack{+0.29 \\ -0.26} \text{ MeV} \\ (m_{\tau^+} - m_{\tau^-})/m_{\text{average}} < 3.0 \times 10^{-3} \text{, CL} = 90\% \\ \text{Mean life } \tau = (290.6 \pm 1.1) \times 10^{-15} \text{ s} \\ c\tau = 87.11 \ \mu\text{m} \\ \text{Magnetic moment anomaly} > -0.052 \text{ and } < 0.058 \text{, CL} = 95\% \\ \text{Re}(d_{\tau}) = -0.22 \text{ to } 0.45 \times 10^{-16} \ e\,\text{cm}, \text{ CL} = 95\% \\ \text{Im}(d_{\tau}) = -0.25 \text{ to } 0.008 \times 10^{-16} \ e\,\text{cm}, \text{ CL} = 95\% \end{array}$ 

#### Weak dipole moment

 $\begin{array}{l} {\sf Re}(d_{\tau}^w) < \ 0.50 \times 10^{-17} \ e\,{\sf cm}, \ {\sf CL} = 95\% \\ {\sf Im}(d_{\tau}^w) < \ 1.1 \times 10^{-17} \ e\,{\sf cm}, \ {\sf CL} = 95\% \end{array}$ 

### Weak anomalous magnetic dipole moment

 $\begin{array}{l} {\sf Re}(\alpha_{\tau}^{\it w}) < \ 1.1 \times 10^{-3} \text{, } {\sf CL} = 95\% \\ {\sf Im}(\alpha_{\tau}^{\it w}) < \ 2.7 \times 10^{-3} \text{, } {\sf CL} = 95\% \end{array}$ 

### **Decay parameters**

See the  $\tau$  Particle Listings for a note concerning  $\tau$ -decay parameters.

$$\begin{split} \rho^{\tau}(e \text{ or } \mu) &= 0.745 \pm 0.008 \\ \rho^{\tau}(e) &= 0.747 \pm 0.010 \\ \rho^{\tau}(\mu) &= 0.763 \pm 0.020 \\ \xi^{\tau}(e \text{ or } \mu) &= 0.985 \pm 0.030 \\ \xi^{\tau}(e) &= 0.994 \pm 0.040 \\ \xi^{\tau}(\mu) &= 1.030 \pm 0.059 \\ \eta^{\tau}(e \text{ or } \mu) &= 0.013 \pm 0.020 \\ \eta^{\tau}(\mu) &= 0.094 \pm 0.073 \\ (\delta\xi)^{\tau}(e \text{ or } \mu) &= 0.746 \pm 0.021 \\ (\delta\xi)^{\tau}(e) &= 0.734 \pm 0.028 \\ (\delta\xi)^{\tau}(\mu) &= 0.778 \pm 0.037 \\ \xi^{\tau}(\pi) &= 0.993 \pm 0.022 \\ \xi^{\tau}(\rho) &= 0.994 \pm 0.008 \\ \xi^{\tau}(a_1) &= 1.001 \pm 0.027 \\ \xi^{\tau}(\text{all hadronic modes}) &= 0.995 \pm 0.007 \end{split}$$

 $\tau^+$  modes are charge conjugates of the modes below. " $h^{\pm}$ " stands for  $\pi^{\pm}$  or  $K^{\pm}$ . " $\ell$ " stands for e or  $\mu$ . "Neutrals" stands for  $\gamma$ 's and/or  $\pi^0$ 's.

	-		Scale factor/	р	
$\tau^-$ Decay modes	ŀ	-raction(I <sub>i</sub> /I)	Confidence level	(MeV/ <i>c</i> )	
Modes with	n one	e charged particle	e		
particle <sup>-</sup> $\geq$ 0 neutrals $\geq$ 0 $K^0 \nu_{\tau}$ ("1-prong")		(85.35±0.07) %	S=1.1	_	
particle <sup>-</sup> $\geq$ 0 neutrals $\geq$ 0 $K_L^0 \nu_{\tau}$		(84.72±0.07) %	S=1.1	-	
$\mu^- \overline{ u}_\mu  u_ au$	[g]	$(17.36 \pm 0.06)$ %		885	
$\mu^- \overline{ u}_\mu  u_ au  \gamma$	[e]	( 3.6 $\pm$ 0.4 ) $ imes$ 1	0-3	885	
$e^-\overline{ u}_e \nu_{ au}$	[g]	$(17.84 \pm 0.06)$ %		888	
$e^-\overline{ u}_e  u_{ au} \gamma$	[e]	$(1.75\pm0.18)\%$		888	
$h^- \geq 0 {K}^0_L   u_ au$		$(12.30\pm0.11)$ %	S=1.4	883	
$h^-  u_{ au}$		$(11.75 \pm 0.11)$ %	S=1.4	883	
$\pi^-  u_{ au}$	[g]	$(11.06\pm0.11)$ %	S=1.4	883	
$K^-  u_{ au}$	[g]	( $6.86\pm0.23$ ) $ imes$ 1	0-3	820	
$h^- \geq 1$ neutrals $ u_ au$		$(36.92 \pm 0.14)$ %	S=1.1	-	
$h^- \pi^0 \nu_{\tau}$		(25.87±0.13) %	S=1.1	878	
$\pi^-\pi^0 u_ au$	[g]	(25.42±0.14) %	S=1.1	878	
$\pi^-\pi^0$ non- $ ho(770) u_ au$		( 3.0 $\pm$ 3.2 ) $ imes$ 1	0-3	878	
$K^{-}\pi^{0}\nu_{\tau}$	[g]	( $4.50\pm0.30 angle imes1$	0-3	814	
$h^- \geq 2\pi^0   u_ au$		$(10.77 \pm 0.15)$ %	S=1.1	-	

$$\begin{split} & h^{-} 2\pi^{0} \nu_{\tau} & (9.39 \pm 0.14) \% & S=1.1 & 862 \\ & h^{-} 2\pi^{0} \nu_{\tau} (ex.K^{0}) & (g).23 \pm 0.14) \% & S=1.1 & 862 \\ & \pi^{-} 2\pi^{0} \nu_{\tau} (ex.K^{0}) & (g) & (9.17 \pm 0.14) \% & S=1.1 & 862 \\ & \pi^{-} 2\pi^{0} \nu_{\tau} (ex.K^{0}) & < 9 & \times 10^{-3} & CL=95\% & 862 \\ & \pi^{-} 2\pi^{0} \nu_{\tau} (ex.K^{0}) & < 7 & \times 10^{-3} & CL=95\% & 862 \\ & vector & (1.37 \pm 0.11) \% & S=1.1 & - \\ & h^{-} 2\pi^{0} \nu_{\tau} (ex.K^{0}) & [g] & (5.8 \pm 2.3) \times 10^{-4} & 796 \\ & h^{-} \geq 3\pi^{0} \nu_{\tau} & (1.21 \pm 0.10) \% & 836 \\ & \pi^{-} 3\pi^{0} \nu_{\tau} (ex.K^{0}) & [g] & (1.08 \pm 0.10) \% & 836 \\ & \pi^{-} 3\pi^{0} \nu_{\tau} (ex.K^{0}) & [g] & (1.08 \pm 0.10) \% & 836 \\ & \pi^{-} 3\pi^{0} \nu_{\tau} (ex.K^{0}) & [g] & (1.08 \pm 0.10) \% & 836 \\ & K^{-} 3\pi^{0} \nu_{\tau} (ex.K^{0}) & [g] & (1.0 \pm 0.6) \times 10^{-3} & 800 \\ & h^{-} 4\pi^{0} \nu_{\tau} (ex.K^{0}) & [g] & (1.0 \pm 0.6) \times 10^{-3} & 800 \\ & h^{-} 4\pi^{0} \nu_{\tau} (ex.K^{0}) & [g] & (1.0 \pm 0.6) \times 10^{-3} & 800 \\ & K^{-} \geq 0\pi^{0} \geq 0K^{0} \geq 0\gamma \nu_{\tau} & (1.56 \pm 0.04) \% & 820 \\ & K^{-} \geq 1 (\pi^{0} \text{ or } K^{0} \text{ or } \gamma) \nu_{\tau} & (8.74 \pm 0.35) \times 10^{-3} & - \\ & h^{-} \overline{K}^{0} \nu_{\tau} & [g] & (1.54 \pm 0.16) \times 10^{-3} & S=1.1 & - \\ & h^{-} \overline{K}^{0} \nu_{\tau} & [g] & (1.54 \pm 0.16) \times 10^{-3} & S=1.1 & 812 \\ & \pi^{-} \overline{K}^{0} \sigma^{0} \nu_{\tau} & (5.2 \pm 0.4) \times 10^{-3} & S=1.1 & 812 \\ & \pi^{-} \overline{K}^{0} \sigma^{0} \nu_{\tau} & [g] & (1.54 \pm 0.16) \times 10^{-3} & 737 \\ & h^{-} \overline{K}^{0} \pi^{0} \nu_{\tau} & [g] & (3.7 \pm 0.4) \times 10^{-3} & 737 \\ & h^{-} \overline{K}^{0} \pi^{0} \nu_{\tau} & [g] & (3.7 \pm 0.4) \times 10^{-3} & 737 \\ & \pi^{-} \overline{K}^{0} \pi^{0} \nu_{\tau} & (2.2 \pm 0.5) \times 10^{-3} & 685 \\ & \pi^{-} \overline{K}^{0} \pi^{0} n^{0} \nu_{\tau} & (2.6 \pm 2.4) \times 10^{-3} & 5=1.1 & 682 \\ & \pi^{-} \overline{K}^{0} \pi^{0} n^{0} \nu_{\tau} & (2.6 \pm 2.4) \times 10^{-3} & 5=1.1 & 682 \\ & \pi^{-} \overline{K}^{0} \pi^{0} n^{0} \nu_{\tau} & (2.6 \pm 2.4) \times 10^{-3} & 5=1.1 & 682 \\ & \pi^{-} \overline{K}^{0} \pi^{0} n^{0} \nu_{\tau} & (2.6 \pm 2.4) \times 10^{-3} & 5=1.1 & 682 \\ & \pi^{-} \overline{K}^{0} \pi^{0} n^{0} \nu_{\tau} & (2.6 \pm 2.4) \times 10^{-3} & 5=1.1 & 682 \\ & \pi^{-} \overline{K}^{0} \pi^{0} n^{0} \nu_{\tau} & (2.6 \pm 2.4) \times 10^{-3} & 5=1.1 & 682 \\ & \pi^{-} \overline{K}^{0} \overline{K}^{0} n^{0} \nu_{\tau} & (2.6 \pm 2.4) \times 10^{-3} & 5=1.1 & 682 \\ & \pi^{$$

### Modes with three charged particles

$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	$h^- h^- h^+ \ge 0$ neutrals $\ge 0 \mathcal{K}_I^0 \nu_{\tau}$		$(15.19\pm0.07)$ %	S=1.1	861
$\begin{array}{lll} (\text{ex. } K_{5}^{0} \rightarrow \pi^{+} \pi^{-}) \\ ("3-\text{prong"}) \\ h^{-} h^{-} h^{+} \nu_{\tau} & (10.01 \pm 0.09) \% & \text{S=} 1.2 & 861 \\ h^{-} h^{-} h^{+} \nu_{\tau} (\text{ex. } K^{0}) & (9.65 \pm 0.09) \% & \text{S=} 1.2 & 861 \\ h^{-} h^{-} h^{+} \nu_{\tau} (\text{ex. } K^{0}, \omega) & (9.60 \pm 0.09) \% & \text{S=} 1.2 & 861 \\ \pi^{-} \pi^{+} \pi^{-} \nu_{\tau} & (9.47 \pm 0.10) \% & \text{S=} 1.2 & 861 \\ \pi^{-} \pi^{+} \pi^{-} \nu_{\tau} (\text{ex. } K^{0}) & (9.16 \pm 0.10) \% & \text{S=} 1.2 & 861 \\ \pi^{-} \pi^{+} \pi^{-} \nu_{\tau} (\text{ex. } K^{0}) & (9.16 \pm 0.10) \% & \text{S=} 1.2 & 861 \\ non-axial vector & \pi^{-} \pi^{+} \pi^{-} \nu_{\tau} (\text{ex. } K^{0}) & [g] & (9.12 \pm 0.10) \% & \text{S=} 1.3 & - \\ h^{-} h^{-} h^{+} \geq 1 \text{ neutrals } \nu_{\tau} & (5.19 \pm 0.10) \% & \text{S=} 1.3 & - \\ (\text{ex. } K_{5}^{0} \rightarrow \pi^{+} \pi^{-}) & (4.53 \pm 0.09) \% & \text{S=} 1.3 & - \\ (\text{ex. } K_{5}^{0} \rightarrow \pi^{+} \pi^{-}) & (4.53 \pm 0.09) \% & \text{S=} 1.3 & 834 \\ h^{-} h^{-} h^{+} \pi^{0} \nu_{\tau} (\text{ex. } K^{0}) & (4.35 \pm 0.09) \% & \text{S=} 1.3 & 834 \\ n^{-} n^{+} h^{-} \eta^{0} \nu_{\tau} (\text{ex. } K^{0}, \omega) & (2.62 \pm 0.09) \% & \text{S=} 1.3 & 834 \\ \pi^{-} \pi^{+} \pi^{-} \pi^{0} \nu_{\tau} (\text{ex. } K^{0}, \omega) & (2.62 \pm 0.09) \% & \text{S=} 1.3 & 834 \\ \pi^{-} \pi^{+} \pi^{-} \pi^{0} \nu_{\tau} (\text{ex. } K^{0}, \omega) & (2.5 \pm 0.4) \times 10^{-3} & 797 \\ h^{-} h^{-} h^{+} 2 \pi^{0} \nu_{\tau} (\text{ex. } K^{0}, \omega) & [g] & (2.51 \pm 0.09) \% & \text{S=} 1.3 & 834 \\ \pi^{-} \pi^{+} \pi^{-} \pi^{0} \nu_{\tau} (\text{ex. } K^{0}, \omega) & [g] & (2.3 \pm 0.8) \times 10^{-4} & \text{S=} 1.5 & 749 \\ K^{-} h^{+} h^{-} 2 0 \text{ neutrals } \nu_{\tau} & (5.9 \pm 0.4) \times 10^{-3} & \text{S=} 1.3 & 794 \\ K^{-} h^{+} \pi^{-} \nu_{\tau} (\text{ex. } K^{0}) & (1.07 \pm 0.22) \times 10^{-3} & \text{S=} 1.3 & 794 \\ K^{-} h^{+} \pi^{-} \nu_{\tau} (\text{ex. } K^{0}) & (1.07 \pm 0.22) \times 10^{-3} & \text{S=} 1.3 & 794 \\ K^{-} \pi^{+} \pi^{-} \nu_{\tau} (\text{ex. } K^{0}) & [g] & (3.3 \pm 0.4) \times 10^{-3} & \text{S=} 1.3 & 794 \\ K^{-} \pi^{+} \pi^{-} \nu_{\tau} (\text{ex. } K^{0}) & [g] & (3.3 \pm 0.4) \times 10^{-3} & \text{S=} 1.3 & 794 \\ K^{-} h^{+} \pi^{-} \pi^{0} \nu_{\tau} (\text{ex. } K^{0}) & [g] & (3.3 \pm 0.4) \times 10^{-3} & \text{S=} 1.3 & 794 \\ K^{-} \pi^{+} \pi^{-} \pi^{0} \nu_{\tau} (\text{ex. } K^{0}) & [g] & (3.3 \pm 0.4) \times 10^{-3} & \text{S=} 1.3 & 794 \\ K^{-} \pi^{+} \pi^{-} \pi^{0} \nu_{\tau} (\text{ex. } K^{0}) & [g] & (3.3 \pm$	$h^- h^- h^+ \geq 0$ neutrals $ u_{ au}$		$(14.57\pm0.07)$ %	S=1.1	861
	(ex. $K_S^0 \rightarrow \pi^+ \pi^-$ )		· · · ·		
$ \begin{array}{lll} h^{-}h^{-}h^{+}\nu_{\tau} & (10.01\pm 0.09)\% & \mathrm{S=1.2} & 861 \\ h^{-}h^{-}h^{+}\nu_{\tau}(\mathrm{ex}.K^{0}) & (9.65\pm 0.09)\% & \mathrm{S=1.2} & 861 \\ h^{-}h^{-}h^{+}\nu_{\tau}(\mathrm{ex}.K^{0},\omega) & (9.60\pm 0.09)\% & \mathrm{S=1.2} & 861 \\ \pi^{-}\pi^{+}\pi^{-}\nu_{\tau} & (9.47\pm 0.10)\% & \mathrm{S=1.2} & 861 \\ \pi^{-}\pi^{+}\pi^{-}\nu_{\tau}(\mathrm{ex}.K^{0}) & (9.16\pm 0.10)\% & \mathrm{S=1.2} & 861 \\ \pi^{-}\pi^{+}\pi^{-}\nu_{\tau}(\mathrm{ex}.K^{0}) & (9.12\pm 0.10)\% & \mathrm{S=1.2} & 861 \\ \pi^{-}\pi^{+}\pi^{-}\nu_{\tau}(\mathrm{ex}.K^{0},\omega) & [g] & (9.12\pm 0.10)\% & \mathrm{S=1.3} & - \\ h^{-}h^{-}h^{+} \geq 1 \ \mathrm{neutrals}\nu_{\tau} & (5.19\pm 0.10)\% & \mathrm{S=1.3} & - \\ h^{-}h^{-}h^{+} \geq 1 \ \mathrm{neutrals}\nu_{\tau} & (4.53\pm 0.09)\% & \mathrm{S=1.3} & - \\ (\mathrm{ex}.K_{S}^{0} \rightarrow \pi^{+}\pi^{-}) & & & \\ h^{-}h^{-}h^{+}\pi^{0}\nu_{\tau}(\mathrm{ex}.K^{0},\omega) & (2.62\pm 0.09)\% & \mathrm{S=1.3} & 834 \\ h^{-}h^{-}h^{+}\pi^{0}\nu_{\tau}(\mathrm{ex}.K^{0},\omega) & (2.62\pm 0.09)\% & \mathrm{S=1.3} & 834 \\ h^{-}h^{-}h^{+}\pi^{0}\nu_{\tau}(\mathrm{ex}.K^{0},\omega) & (2.62\pm 0.09)\% & \mathrm{S=1.3} & 834 \\ \pi^{-}\pi^{+}\pi^{-}\pi^{0}\nu_{\tau}(\mathrm{ex}.K^{0},\omega) & (2.62\pm 0.09)\% & \mathrm{S=1.3} & 834 \\ \pi^{-}\pi^{+}\pi^{-}\pi^{0}\nu_{\tau}(\mathrm{ex}.K^{0},\omega) & (2.5\pm 0.09)\% & \mathrm{S=1.3} & 834 \\ \pi^{-}\pi^{+}\pi^{-}\pi^{0}\nu_{\tau}(\mathrm{ex}.K^{0},\omega) & [g] & (2.5\pm 0.4)\times 10^{-3} & 797 \\ h^{-}h^{-}h^{+}2\pi^{0}\nu_{\tau}(\mathrm{ex}.K^{0},\omega) & [g] & (2.5\pm 0.4)\times 10^{-3} & 797 \\ h^{-}h^{-}h^{+}2\pi^{0}\nu_{\tau}(\mathrm{ex}.K^{0}) & (5.5\pm 0.4)\times 10^{-3} & \mathrm{S=1.5} & 749 \\ K^{-}h^{+}\pi^{-}\pi^{0}\nu_{\tau}(\mathrm{ex}.K^{0}) & (1.07\pm 0.2)\times 10^{-3} & \mathrm{S=1.3} & 794 \\ K^{-}h^{+}\pi^{-}\pi^{0}\nu_{\tau}(\mathrm{ex}.K^{0}) & (1.07\pm 0.2)\times 10^{-3} & \mathrm{S=1.3} & 794 \\ K^{-}\pi^{+}\pi^{-}\pi^{-}\nu_{\tau}(\mathrm{ex}.K^{0}) & (1.07\pm 0.2)\times 10^{-3} & \mathrm{S=1.3} & 794 \\ K^{-}\pi^{+}\pi^{-}\pi^{-}\nu_{\tau}(\mathrm{ex}.K^{0}) & (1.6\pm 0.6)\times 10^{-3} & \mathrm{S=1.3} & 794 \\ K^{-}\pi^{+}\pi^{-}\pi^{-}\nu_{\tau}(\mathrm{ex}.K^{0}) & (1.6\pm 0.6)\times 10^{-3} & \mathrm{S=1.3} & 794 \\ K^{-}\pi^{+}\pi^{-}\pi^{-}\nu_{\tau}(\mathrm{ex}.K^{0}) & (6.5\pm 2.4)\times 10^{-3} & \mathrm{S=1.6} & 794 \\ K^{-}\pi^{+}\pi^{-}\pi^{-}\nu_{\tau}(\mathrm{ex}.K^{0}) & (6.5\pm 2.4)\times 10^{-4} & 763 \\ K^{-}\pi^{+}\pi^{-}\pi^{-}0\nu_{\tau}(\mathrm{ex}.K^{0}) & (6.5\pm 2.4)\times 10^{-4} & 763 \\ K^{-}\pi^{+}\pi^{-}\pi^{-}0\nu_{\tau}(\mathrm{ex}.K^{0}) & (6.5\pm 2.4)\times 10^{-4} & 763 \\ K^{-}\pi^{+}\pi^{-}\pi^{-}0\nu_{\tau}(\mathrm{ex}.K^{0}) & (6.5\pm 2.4$	("3-prong")				
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	$h^- \dot{h}^- h^+ \nu_{\tau}$		$(10.01\pm0.09)$ %	S=1.2	861
$\begin{array}{lll} h^{-}h^{-}h^{+}\nu_{\tau}\left(\text{ex},K^{0},\omega\right) & (9.60\pm0.09)\% & \text{S=1.2} & 861\\ \pi^{-}\pi^{+}\pi^{-}\nu_{\tau} & (9.47\pm0.10)\% & \text{S=1.2} & 861\\ \pi^{-}\pi^{+}\pi^{-}\nu_{\tau}\left(\text{ex},K^{0}\right) & (9.16\pm0.10)\% & \text{S=1.2} & 861\\ \pi^{-}\pi^{+}\pi^{-}\nu_{\tau}\left(\text{ex},K^{0},\omega\right) & [g] & (9.12\pm0.10)\% & \text{S=1.2} & 861\\ n\text{ non-axial vector} & (5.19\pm0.10)\% & \text{S=1.3} & -\\ h^{-}h^{-}h^{+} \ge 1 \text{ neutrals } \nu_{\tau} & (4.92\pm0.09)\% & \text{S=1.3} & -\\ (ex. K_{S}^{0} \rightarrow \pi^{+}\pi^{-}) & (4.53\pm0.09)\% & \text{S=1.3} & 834\\ h^{-}h^{-}h^{+}\pi^{0}\nu_{\tau}\left(\text{ex},K^{0},\omega\right) & (2.62\pm0.09)\% & \text{S=1.3} & 834\\ h^{-}h^{-}h^{+}\pi^{0}\nu_{\tau}\left(\text{ex},K^{0},\omega\right) & (2.62\pm0.09)\% & \text{S=1.3} & 834\\ \pi^{-}\pi^{+}\pi^{-}\pi^{0}\nu_{\tau}\left(\text{ex},K^{0}\right) & (4.35\pm0.09)\% & \text{S=1.3} & 834\\ \pi^{-}\pi^{+}\pi^{-}\pi^{0}\nu_{\tau}\left(\text{ex},K^{0},\omega\right) & (2.62\pm0.09)\% & \text{S=1.3} & 834\\ \pi^{-}\pi^{+}\pi^{-}\pi^{0}\nu_{\tau}\left(\text{ex},K^{0}\right) & (4.25\pm0.09)\% & \text{S=1.3} & 834\\ \pi^{-}\pi^{+}\pi^{-}\pi^{0}\nu_{\tau}\left(\text{ex},K^{0},\omega\right) & [g] & (2.51\pm0.09)\% & \text{S=1.3} & 834\\ \pi^{-}\pi^{+}\pi^{-}\pi^{0}\nu_{\tau}\left(\text{ex},K^{0},\omega\right) & [g] & (2.51\pm0.09)\% & \text{S=1.3} & 834\\ \pi^{-}h^{-}h^{+}2\pi^{0}\nu_{\tau}\left(\text{ex},K^{0},\omega\right) & [g] & (2.51\pm0.09)\% & \text{S=1.3} & 834\\ \pi^{-}h^{-}h^{+}2\pi^{0}\nu_{\tau}\left(\text{ex},K^{0}\right) & [g] & (1.1\pm0.4)\times10^{-3} & 797\\ h^{-}h^{-}h^{+}2\pi^{0}\nu_{\tau}\left(\text{ex},K^{0}\right) & (5.4\pm0.4)\times10^{-3} & 797\\ h^{-}h^{-}h^{+}2\pi^{0}\nu_{\tau}\left(\text{ex},K^{0}\right) & (1.07\pm0.22)\times10^{-3} & 794\\ K^{-}h^{+}\pi^{-}\nu_{\tau}\left(\text{ex},K^{0}\right) & (1.07\pm0.22)\times10^{-3} & \text{S=1.3} & 794\\ K^{-}h^{+}\pi^{-}\nu_{\tau}\left(\text{ex},K^{0}\right) & (1.07\pm0.22)\times10^{-3} & \text{S=1.3} & 794\\ K^{-}\pi^{+}\pi^{-}\nu_{\tau}\left(\text{ex},K^{0}\right) & (1.07\pm0.22)\times10^{-3} & \text{S=1.3} & 794\\ K^{-}\pi^{+}\pi^{-}\nu_{\tau}\left(\text{ex},K^{0}\right) & (1.6\pm0.6)\times10^{-3} & \text{S=1.3} & 794\\ K^{-}\pi^{+}\pi^{-}\nu_{\tau}\left(\text{ex},K^{0}\right) & (1.6\pm0.6)\times10^{-3} & \text{S=1.3} & 794\\ K^{-}\pi^{+}\pi^{-}\nu_{\tau}\left(\text{ex},K^{0}\right) & [g] & (3.3\pm0.4)\times10^{-3} & \text{S=1.6} & 794\\ K^{-}\pi^{+}\pi^{-}\pi^{0}\nu_{\tau}\left(\text{ex},K^{0}\right) & [g] & (5.9\pm2.4)\times10^{-4} & 763\\ K^{-}\pi^{+}\pi^{-}\pi^{0}\nu_{\tau}\left(\text{ex},K^{0}\right) & [g] & (5.9\pm2.4)\times10^{-4} & 763\\ K^{-}\pi^{+}\pi^{-}\pi^{0}\nu_{\tau}\left(\text{ex},K^{0}\right) & [g] & (5.9\pm2.4)\times10^{-4} & 763\\ K^{-}\pi^{+}K^{-}\geq0 \text{ neut.} \nu_{\tau} & < 9 & \times10^{-4$	$h^{-} h^{-} h^{+} \nu_{\tau} (\text{ex.} K^{0})$		(9.65±0.09)%	S=1.2	861
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	$h^- h^- h^+ \nu_{\tau}$ (ex. $K^0$ , $\omega$ )		$(9.60\pm0.09)\%$	S=1.2	861
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	$\pi^-\pi^+\pi^-\nu_{\tau}$		( 9.47±0.10) %	S=1.2	861
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	$\pi^{-}\pi^{+}\pi^{-}\nu_{\tau}(\text{ex.}K^{0})$		$(9.16\pm0.10)\%$	S=1.2	861
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	$\pi^{-}\pi^{+}\pi^{-}\nu_{\tau}$ (ex. $K^{0}$ ),		< 2.4 %	CL=95%	861
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	non-axial vector				
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	$\pi^-\pi^+\pi^- u_ au$ (ex. $K^0$ , $\omega$ )	[g]	( 9.12±0.10) %	S=1.2	861
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	$h^-  h^-  h^+ \geq 1$ neutrals $ u_ au$		$(5.19\pm0.10)\%$	S=1.3	_
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	$h^- h^- h^+ \ge 1$ neutrals $\nu_{\tau}$		( 4.92±0.09) %	S=1.3	_
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	(ex. $K^0_{\underline{S}} \rightarrow \pi^+\pi^-$ )				
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	$h^- h^- h^+ \pi^0 \nu_{\tau}$		( 4.53±0.09) %	S=1.3	834
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	$h^{-}h^{-}h^{+}\pi^{0}\nu_{\tau}(\text{ex}.K^{0})$		( 4.35±0.09) %	S=1.3	834
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	$h^{-} h^{-} h^{+} \pi^{0} \nu_{\tau}$ (ex. $K^{0}$ , $\omega$ )		( 2.62±0.09) %	S=1.2	834
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	$\pi^{-}\pi^{+}\pi^{-}\pi^{0}\nu_{\tau}$		( 4.37±0.09) %	S=1.3	834
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	$\pi^{-}\pi^{+}\pi^{-}\pi^{0}\nu_{\tau}(\text{ex.}K^{0})$		( 4.25±0.09) %	S=1.3	834
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	$\pi^-\pi^+\pi^-\pi^0\nu_{\tau}(\text{ex.}K^0,\omega)$	[g]	( 2.51±0.09) %	S=1.2	834
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	$h^- h^- h^+ 2\pi^0 \nu_{\tau}$		$(5.5 \pm 0.4) \times 10^{-3}$		797
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	$h^{-}h^{-}h^{+}2\pi^{0}\nu_{\tau}(\text{ex}.K^{0})$		$(5.4 \pm 0.4) \times 10^{-3}$		797
$ \begin{split} h^{-}h^{-}h^{+}3\pi^{0}\nu_{\tau} & [g]  (2.3 \pm 0.8) \times 10^{-4} & S=1.5 & 749 \\ K^{-}h^{+}h^{-} \ge 0 \text{ neutrals } \nu_{\tau} & (6.9 \pm 0.4) \times 10^{-3} & S=1.3 & 794 \\ K^{-}h^{+}\pi^{-}\nu_{\tau}(\text{ex}.K^{0}) & (1.07\pm 0.2) \times 10^{-3} & S=1.5 & 794 \\ K^{-}h^{+}\pi^{-}\pi^{0}\nu_{\tau}(\text{ex}.K^{0}) & (1.07\pm 0.2) \times 10^{-3} & S=1.5 & 794 \\ K^{-}\pi^{+}\pi^{-} \ge 0 \text{ neutrals } \nu_{\tau} & (5.0 \pm 0.4) \times 10^{-3} & S=1.3 & 794 \\ K^{-}\pi^{+}\pi^{-} \ge 0 \text{ neutrals } \nu_{\tau} & (3.8 \pm 0.4) \times 10^{-3} & S=1.3 & 794 \\ 0\pi^{0}\nu_{\tau}(\text{ex}.K^{0}) & & \\ K^{-}\pi^{+}\pi^{-}\nu_{\tau} & (3.8 \pm 0.4) \times 10^{-3} & S=1.6 & 794 \\ K^{-}\pi^{+}\pi^{-}\nu_{\tau}(\text{ex}.K^{0}) & [g] & (3.3 \pm 0.4) \times 10^{-3} & S=1.6 & 794 \\ K^{-}\pi^{+}\pi^{-}\nu_{\tau} & (1.18\pm 0.25) \times 10^{-3} & - \\ K^{-}\pi^{+}\pi^{-}\pi^{0}\nu_{\tau} & (1.18\pm 0.25) \times 10^{-3} & - \\ K^{-}\pi^{+}\pi^{-}\pi^{0}\nu_{\tau}(\text{ex}.K^{0}) & (6.5 \pm 2.4) \times 10^{-4} & 763 \\ K^{-}\pi^{+}\pi^{-}\pi^{0}\nu_{\tau}(\text{ex}.K^{0},\eta) & [g] & (5.9 \pm 2.4) \times 10^{-4} & 763 \\ K^{-}\pi^{+}K^{-} \ge 0 \text{ neut. } \nu_{\tau} & < 9 & \times 10^{-4} & \text{CL}=95\% & 685 \\ \end{split}$	$h^- h^- h^+ 2\pi^0 \nu_\tau (\text{ex.} K^0, \omega, \eta)$	[g]	$(1.1 \pm 0.4) \times 10^{-3}$		797
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	$h^- h^- h^+ 3\pi^0 \nu_{\tau}$	[g]	$(2.3 \pm 0.8) \times 10^{-4}$	S=1.5	749
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	$K^- h^+ h^- \ge 0$ neutrals $\nu_{ au}$		$(6.9 \pm 0.4) \times 10^{-3}$	S=1.3	794
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	$K^{-}h^{+}\pi^{-}\nu_{\tau}(\text{ex}.K^{0})$		$(4.8 \pm 0.4) \times 10^{-3}$	S=1.5	794
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	$K^{-}h^{+}\pi^{-}\pi^{0}\nu_{\tau}(\text{ex}.K^{0})$		$(1.07\pm0.22)\times10^{-3}$		763
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	$K^-\pi^+\pi^- \ge 0$ neutrals $ u_{ au}$		$(5.0 \pm 0.4) \times 10^{-3}$	S=1.3	794
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	$K^-\pi^+\pi^- \geq 0$		$(3.9 \pm 0.4) \times 10^{-3}$	S=1.3	794
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	$0\pi^{\circ}\nu_{\tau}$ (ex. K°)		(		
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	$\kappa \pi \pi \nu_{\tau}$		$(3.8 \pm 0.4) \times 10^{-3}$	S=1.6	794
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	$\kappa \pi \pi \nu_{\tau} (\text{ex.}\kappa^{\circ})$	[g]	$(3.3 \pm 0.4) \times 10^{-3}$	S=1.6	794
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	$\kappa \rho^{\circ} \nu_{\tau} \rightarrow \nu_{\tau} + -$		$(1.6 \pm 0.6) \times 10^{-3}$		_
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	$\kappa \pi^+ \pi^- \nu_{\tau}$		( 1 10 + 0 25) + 10=3		760
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	$K^{-}\pi^{+}\pi^{-}\pi^{0}\mu (\infty K^{0})$		$(1.18\pm0.25)\times10^{-4}$		703
$K^{-}\pi^{+}K^{-} \ge 0$ neut. $\nu_{\tau} < 9 \times 10^{-4}$ CL=95% 685	$K^{-}\pi^{+}\pi^{-}\pi^{0}\mu$ (ex. K <sup>0</sup> m)	[~]	$(0.5 \pm 2.4) \times 10^{-4}$		705
$\nu_{\tau} \sim 0$ field: $\nu_{\tau} \sim 0$ $\times 10$ CL=95% 005	$K^{-}\pi^{+}K^{-} > 0$ point $\mu$	[8]	$(5.9 \pm 2.4) \times 10$	CI —05%	685
$K^- K^+ \pi^- > 0$ neut $\chi$ (107+018) $> 10^{-3}$ S-11 695	$K^- K^+ \pi^- > 0$ neut $V_\tau$		$(107+018) \times 10^{-3}$	CL = 95/0 S = 1.1	685
$K^- K^+ \pi^- \mu$ [ $\sigma$ ] (1.55±0.07) × 10 <sup>-2</sup> 3=1.1 003	$K^- K^+ \pi^- \nu$	[~]	$(1.51 \pm 0.10) \times 10^{-3}$	5-1.1	685
$K^{-}K^{+}\pi^{-}\pi^{0}\nu$ [g] (1.55±0.07)×10 005	$K - K + \pi - \pi^0 \mu$	ເຮ] [ກ]	$(42 + 16) \times 10^{-4}$	S-1 1	618
$K^- K^+ K^- > 0$ neut. $\nu_{\tau} < 2.1 \times 10^{-3}$ CL=95% 472	$K^-K^+K^- > 0$ neut. $\nu_{\tau}$	[Ð]	$< 2.1 \times 10^{-3}$	CL=95%	472

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$\begin{array}{cccccccccccccccccccccccccccccccccccc$	${\it K}^-{\it K}^+{\it K}^- u_ au$	< 3.7	imes 10 <sup>-5</sup>	CL=90%	472
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	$\pi^- {\it K}^+ \pi^- \geq$ 0 neut. $ u_ au$	< 2.5	imes 10 <sup>-3</sup>	CL=95%	794
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	$e^-e^-e^+\overline{ u}_e  u_{ au}$	$(2.8 \pm 1)$	L.5 ) $ imes$ 10 $^{-5}$		888
$ \begin{array}{c} \mbox{Modes with five charged particles} \\ 3h^{-}2h^{+} \geq 0 \mbox{ neutrals } \nu_{\tau} & (1.00\pm0.6)\times10^{-3} & 794 \\ (ex. K_{S}^{0} \rightarrow \pi^{-}\pi^{+}) & (1.00\pm0.6)\times10^{-4} & 794 \\ 3h^{-}2h^{+}\nu_{\tau}(ex.K^{0}) & [g] & (8.2\pm0.6)\times10^{-4} & 794 \\ 3h^{-}2h^{+}2\pi^{0}\nu_{\tau} & (ex.K^{0}) & [g] & (1.81\pm0.27)\times10^{-4} & 746 \\ 3h^{-}2h^{+}2\pi^{0}\nu_{\tau} & (8.0\pm0.7)\times10^{-3} & 800 \\ \hline \mbox{Miscellaneous other allowed modes} & (5\pi)^{-}\nu_{\tau} & (8.0\pm0.7)\times10^{-3} & 800 \\ 4h^{-}3h^{+} \geq 0 \mbox{neutrals } \nu_{\tau} & <2.4 & \times10^{-6} & CL=90\% & 683 \\ ("7-\text{prong"}) & (7-\text{prong"}) & (1.29\pm0.05)\% & 5=1.1 & -5 \\ K^{*}(892)^{-} \geq 0 \mbox{neutrals } \nu_{\tau} & (3.2\pm1.4)\times10^{-3} & 542 \\ K^{*}(892)^{0}\kappa^{-} \geq 0 \mbox{neutrals } \nu_{\tau} & (3.2\pm1.4)\times10^{-3} & 542 \\ K^{*}(892)^{0}\pi^{-}\nu_{\tau} & (2.2\pm0.5)\times10^{-3} & 666 \\ (\overline{K}^{*}(892)^{0}\pi^{-}\nu_{\tau} & (2.2\pm0.5)\times10^{-3} & 666 \\ (\overline{K}^{*}(892)^{0}\pi^{-}\nu_{\tau} & (1.2\pm0.18)\% & 5=1.7 & 335 \\ K^{*}(1400)^{-}\nu_{\tau} & (1.5\pm1.1)\times10^{-3} & 433 \\ K_{1}(1400)^{-}\nu_{\tau} & (1.5\pm1.4)\times10^{-3} & 5=1.7 & 335 \\ K^{*}(1430)^{-}\nu_{\tau} & (1.5\pm1.4)\times10^{-3} & 5=1.7 & 335 \\ K^{*}(1430)^{-}\nu_{\tau} & (1.5\pm1.4)\times10^{-3} & 5=1.7 & 335 \\ K^{*}(1430)^{-}\nu_{\tau} & (1.5\pm1.4)\times10^{-3} & 5=1.7 & 335 \\ K^{*}(1400)^{-}\nu_{\tau} & (1.5\pm1.4)\times10^{-3} & 5=1.7 & 335 \\ K^{*}(1400)^{-}\nu_{\tau} & (1.5\pm1.4)\times10^{-3} & 12.95\% & 317 \\ \eta\pi^{-}\pi^{0}n^{0}\nu_{\tau} & (1.5\pm0.5)\times10^{-4} & CL=95\% & 317 \\ \eta\pi^{-}\pi^{0}n^{0}\nu_{\tau} & (1.5\pm0.5)\times10^{-4} & CL=95\% & 317 \\ \eta\pi^{-}\pi^{0}n^{0}\nu_{\tau} & (2.2\pm0.7)\times10^{-4} & 661 \\ \eta K^{-}n^{0}\nu_{\tau} & (2.2\pm0.7)\times10^{-4} & 661 \\ \eta K^{-}n^{-}n^{-}\nu_{\tau} & (2.2\pm0.7)\times10^{-4} & 661 \\ \eta \pi^{-}\pi^{-}\pi^{-}\nu_{\tau} & (2.2\pm0.7)\times10^{-4} & 661 \\ \eta\pi^{-}\pi^{-}\pi^{-}\nu_{\tau} & (2.2\pm0.7)\times1$	$\mu^- e^- e^+ \overline{\nu}_\mu \nu_\tau$	< 3.6	imes 10 <sup>-5</sup>	CL=90%	885
$ \begin{array}{c} \text{Modes with twe charged particles} \\ 3h^-2h^+ \ge 0 \text{ neutrals } \nu_{\tau} & (1.00\pm0.06)\times10^{-3} & 794 \\ (ex. K_{S}^{0} \rightarrow \pi^-\pi^+) & (1.00\pm0.06)\times10^{-4} & 794 \\ 3h^-2h^+ \nu_{\tau}(ex. K^0) & [g] & (8.2\pm0.6)\times10^{-4} & 794 \\ 3h^-2h^+ \pi^0 \nu_{\tau}(ex. K^0) & [g] & (1.81\pm0.27)\times10^{-4} & 746 \\ 3h^-2h^+ 2\pi^0 \nu_{\tau} & < 1.1 & \times10^{-4} & \text{CL=90\%} & 687 \\ \hline \textbf{Miscellaneous other allowed modes} & (5\pi)^- \nu_{\tau} & (8.0\pm0.7)\times10^{-3} & 800 \\ 4h^-3h^+ \ge 0 \text{ neutrals } \nu_{\tau} & < 2.4 & \times10^{-6} & \text{CL=90\%} & 683 \\ ("7-\text{prong"}) & (2.91\pm0.08)\% & 5=1.1 & - \\ K^*(892)^- \nu_{\tau} & (1.29\pm0.05)\% & 665 \\ N^{K}(892)^- \nu_{\tau} & (1.29\pm0.05)\% & 665 \\ K^*(892)^0 K^- \ge 0 \text{ neutrals } \nu_{\tau} & (3.2\pm1.4)\times10^{-3} & 542 \\ K^*(892)^0 K^- \ge 0 \text{ neutrals } \nu_{\tau} & (2.2\pm0.5)\times10^{-3} & 656 \\ \overline{K}^*(892)^0 K^- \nu_{\tau} & (1.0\pm0.4)\times10^{-3} & - \\ \pi^-\overline{K}^0 \pi^0 \nu_{\tau} & (1.2\pm0.5)\times10^{-3} & 656 \\ \overline{K}^*(892)^0 \pi^- \nu_{\tau} & (1.0\pm0.4)\times10^{-3} & - \\ \pi^-\overline{K}^0 \pi^0 \nu_{\tau} & (1.5\pm1.4)\times10^{-3} & 433 \\ K_1(1400)^- \nu_{\tau} & (1.5\pm1.4)\times10^{-3} & 5=1.7 & 335 \\ K^*(1410)^- \nu_{\tau} & (1.5\pm1.4)\times10^{-3} & 5=1.7 & 335 \\ K^*(1410)^- \nu_{\tau} & (1.5\pm1.4)\times10^{-3} & 5=1.7 & 335 \\ K^*(1410)^- \nu_{\tau} & (1.5\pm1.4)\times10^{-3} & 326 \\ K^*_0(1430)^- \nu_{\tau} & (1.5\pm0.5)\times10^{-4} & \text{CL=95\%} & 317 \\ \eta \pi^- \pi^0 \nu_{\tau} & [g] & (1.74\pm0.24)\times10^{-3} & 788 \\ \eta \pi^- \pi^0 \nu_{\tau} & [g] & (1.74\pm0.24)\times10^{-3} & 788 \\ \eta \pi^- \pi^0 \nu_{\tau} & (1.5\pm0.5)\times10^{-4} & 716 \\ \eta K^- \kappa_{\tau} & (2.2\pm0.7)\times10^{-4} & 665 \\ \eta \overline{K}^0 \pi^- \nu_{\tau} & (2.2\pm0.7)\times10^{-4} & 665 \\ \eta \overline{K}^0 \pi^- \nu_{\tau} & (2.2\pm0.7)\times10^{-4} & 665 \\ \eta \overline{K}^0 \pi^- \nu_{\tau} & (2.2\pm0.7)\times10^{-4} & 665 \\ \eta \overline{K}^0 \pi^- \nu_{\tau} & (2.2\pm0.7)\times10^{-4} & 665 \\ \eta \overline{K}^0 \pi^- \nu_{\tau} & (2.2\pm0.7)\times10^{-4} & 665 \\ \eta \overline{K}^0 \pi^- \nu_{\tau} & (2.2\pm0.7)\times10^{-4} & 665 \\ \eta \overline{K}^0 \pi^- \nu_{\tau} & (2.2\pm0.7)\times10^{-4} & 665 \\ \eta \overline{K}^0 \pi^- \nu_{\tau} & (2.2\pm0.7)\times10^{-4} & 665 \\ \eta \overline{K}^0 \pi^- \nu_{\tau} & (2.2\pm0.7)\times10^{-4} & 665 \\ \eta \overline{K}^0 \pi^- \nu_{\tau} & (2.2\pm0.7)\times10^{-4} & 665 \\ \eta \overline{K}^0 \pi^- \nu_{\tau} & (2.2\pm0.7)\times10^{-4} & 665 \\ \eta \overline{K}^0 \pi^- \nu_{\tau} & (2.2\pm0.7)\times10^{-4} & 665 \\ \eta \overline{K}^0 \pi^- \nu_{\tau} & (2.2\pm0.7)\times10^{-4} & 665 \\ \eta \overline{K}^0 \pi^- \nu_{\tau} & (2.$		five charged			
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	Nodes with $2k^+ \ge 0$ neutrole as				704
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	$\begin{array}{ccc} 5n & 2n^+ \geq 0 \text{ neutrals } \nu_{\tau} \\ (\text{ex. } K_S^0 \rightarrow \pi^- \pi^+) \\ (\text{``5-prong''}) \end{array}$	( 1.00±0	).06) × 10 °		794
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	$3h^{-}2h^{+}\nu$ (ex $K^{0}$ )	$[\sigma]$ (82 +(	$(6) \times 10^{-4}$		704
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	$3h^{-}2h^{+}\pi^{0}\nu$ (ex $K^{0}$ )	$[g] (0.2 \pm 0.2)$	$(27) \times 10^{-4}$		746
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	$3h^{-}2h^{+}2\pi^{0}\nu$	[g] (1.01±0	$\times 10^{-4}$	CI 90%	687
$ \begin{array}{l c c c c c c c c c c c c c c c c c c c$	$\sin 2\pi 2\pi \nu_{\tau}$	< 1.1	~ 10	CL=9070	007
$\begin{array}{llllllllllllllllllllllllllllllllllll$	Miscellaneou	us other allow	ed modes		
$\begin{array}{llllllllllllllllllllllllllllllllllll$	$(5\pi)^- \nu_{\tau}$	( 8.0 ±0	$(0.7) \times 10^{-3}$		800
$ \begin{array}{llllllllllllllllllllllllllllllllllll$	$4h^-3h^+ \ge 0$ neutrals $\nu_{\tau}$	< 2.4	imes 10 <sup>-0</sup>	CL=90%	683
$\begin{array}{llllllllllllllllllllllllllllllllllll$	("7-prong")				
$\begin{array}{llllllllllllllllllllllllllllllllllll$	$X^{-}(S=-1)\nu_{\tau}$	$(2.91\pm 0)$	0.08) %	S=1.1	-
$\begin{array}{llllllllllllllllllllllllllllllllllll$	${\cal K}^*(892)^- \ge 0$ neutrals $\ge 0 {\cal K}^0_L  u_ au$	( 1.42±0	).18) %	S=1.4	665
$\begin{array}{llllllllllllllllllllllllllllllllllll$	$K^*(892)^-  u_ au$	$(1.29\pm 0)$	).05) %		665
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	$K^*(892)^0 K^- \ge 0$ neutrals $ u_{ au}$	$(3.2 \pm 1)$	L.4 ) $ imes$ 10 $^{-3}$		542
$ \begin{array}{llllllllllllllllllllllllllllllllllll$	$K^*(892)^0 K^- \nu_{ au}$	$(2.1 \pm 0)$	0.4 ) $ imes$ 10 <sup>-3</sup>		542
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	$\overline{K}^*(892)^0 \pi^- \geq 0$ neutrals $ u_ au$	( 3.8 ±1	L.7 ) $ imes$ 10 $^{-3}$		656
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	$\overline{K}^*(892)^0 \pi^-  u_ au$	( 2.2 ±0	0.5 ) $ imes$ 10 $^{-3}$		656
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	$ (\overline{K}^*(892)\pi)^- \nu_{\tau} \rightarrow \\ \pi^- \overline{K}^0 \pi^0 \nu_{\tau} $	( 1.0 ±0	0.4 ) $ imes 10^{-3}$		-
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	$K_1(1270)^- \nu_{\tau}$	( 4.7 ±1	L.1 ) $ imes$ 10 <sup>-3</sup>		433
$\begin{array}{llllllllllllllllllllllllllllllllllll$	$K_1(1400)^- \nu_{\tau}$	$(1.7 \pm 2)$	2.6 ) $\times 10^{-3}$	S=1.7	335
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	$K^*(1410)^-  u_ au$	( 1.5 $^+$	$^{1.4}_{1.0}$ ) $ imes$ 10 $^{-3}$		326
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	$K_{0}^{*}(1430)^{-} \nu_{\tau}$	< 5	imes 10 <sup>-4</sup>	CL=95%	328
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	$K_{2}^{*}(1430)^{-}\nu_{\tau}$	< 3	imes 10 <sup>-3</sup>	CL=95%	317
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	$\eta \pi^- \nu_{\tau}$	< 1.4	imes 10 <sup>-4</sup>	CL=95%	797
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	$\eta \pi^{-} \pi^{0} \nu_{\tau}$	[g] ( 1.74±0	$(0.24) \times 10^{-3}$		778
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	$\eta \pi^{-} \pi^{0} \pi^{0} \nu_{\tau}$	( 1.5 ±0	$(0.5) \times 10^{-4}$		746
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	$\eta K^- \nu_{\tau}$	[g] (2.7 ±0	$(0.6) \times 10^{-4}$		720
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	$\eta K^{*}(892)^{-} \nu_{\tau}$	( 2.9 ±0	$(0.9) \times 10^{-4}$		511
$\begin{array}{llllllllllllllllllllllllllllllllllll$	$\eta K^- \pi^0 \nu_{\tau}$	$(1.8 \pm 0)$	0.9 ) $ imes 10^{-4}$		665
$\begin{array}{llllllllllllllllllllllllllllllllllll$	$\eta \overline{K}{}^0 \pi^- \nu_{\tau}$	$(2.2 \pm 0)$	0.7 ) $ imes$ 10 $^{-4}$		661
$\begin{array}{rll} \eta \pi^{-} \pi^{+} \pi^{-} \nu_{\tau} & (2.3 \pm 0.5) \times 10^{-4} & 744 \\ \eta a_{1} (1260)^{-} \nu_{\tau} \rightarrow \eta \pi^{-} \rho^{0} \nu_{\tau} & < 3.9 & \times 10^{-4} & \text{CL} = 90\% & - \\ \eta \eta \pi^{-} \nu_{\tau} & & < 1.1 & \times 10^{-4} & \text{CL} = 95\% & 637 \\ \eta \eta \pi^{-} \pi^{0} \nu_{\tau} & & < 2.0 & \times 10^{-4} & \text{CL} = 95\% & 559 \end{array}$	$\eta \pi^+ \pi^- \pi^- \ge 0$ neutrals $ u_{ au}$	< 3	imes 10 <sup>-3</sup>	CL=90%	744
$ \begin{array}{cccccccccc} \eta  a_1(1260)^-  \nu_\tau & \to & \eta  \pi^-  \rho^0  \nu_\tau & < & 3.9 & \times 10^{-4} & \text{CL} = 90\% & - \\ \eta  \eta  \pi^-  \nu_\tau & & < & 1.1 & \times 10^{-4} & \text{CL} = 95\% & 637 \\ \eta  \eta  \pi^-  \pi^0  \nu_\tau & & < & 2.0 & \times 10^{-4} & \text{CL} = 95\% & 559 \end{array} $	$\eta \pi^- \pi^+ \pi^- \nu_\tau$	( 2.3 $\pm$ 0	0.5 ) $ imes$ 10 $^{-4}$		744
$\begin{array}{llllllllllllllllllllllllllllllllllll$	$\eta a_1(1260)^-  u_ au  o \eta \pi^-  ho^0  u_ au$	< 3.9	imes 10 <sup>-4</sup>	CL=90%	_
$\eta \eta \pi^{-} \pi^{0} \nu_{\tau} < 2.0 \times 10^{-4} \text{ CL}=95\% 559$	$\eta\eta\pi^-\nu_{\tau}$	< 1.1	imes 10 <sup>-4</sup>	CL=95%	637
	$\eta\eta\pi^{-}\pi^{0}\nu_{\tau}$	< 2.0	imes 10 <sup>-4</sup>	CL=95%	559

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$\eta'(958)\pi^- u_{ au}$	<	7.4	imes 10 <sup>-5</sup>	CL=90%	620
$\eta'(958) \pi^- \pi^0 \nu_{ au}$	<	8.0	imes 10 <sup>-5</sup>	CL=90%	591
$\phi \pi^- \nu_{ au}$	<	2.0	imes 10 <sup>-4</sup>	CL=90%	585
$\phi K^- \nu_{ au}$	<	6.7	imes 10 <sup>-5</sup>	CL=90%	445
$f_1(1285)\pi^- \nu_{ au}$		( 5.8 $\pm 2.3$	$)  imes 10^{-4}$		408
$f_1(1285)\pi^- u_ au ightarrow  au$		( 1.3 $\pm$ 0.4	$)  imes 10^{-4}$		-
$\eta \pi^- \pi^+ \pi^-  u_ au$					
$\pi(1300)^- \nu_{ au} \rightarrow (\rho \pi)^- \nu_{ au} \rightarrow$	<	1.0	imes 10 <sup>-4</sup>	CL=90%	-
$(3\pi)^-  u_{ au}$					
$\pi(1300)^-  u_ au  ightarrow$	<	1.9	imes 10 <sup>-4</sup>	CL=90%	-
$((\pi\pi)_{S-wave} \pi)^- \nu_{\tau} \rightarrow$					
$(3\pi)^-  u_{ au}$					
$h^-\omega\geq$ 0 neutrals $ u_ au$		$(2.38\pm0.02)$	8) %		708
$h^- \omega \nu_{ au}$	[g]	$(1.94\pm0.0)$	7) %		708
$h^- \omega \pi^0  u_ au$	[g]	( 4.4 $\pm 0.5$	$)  imes 10^{-3}$		684
$h^- \omega 2 \pi^0  u_{ au}$		( 1.4 $\pm 0.5$	$)  imes 10^{-4}$		644
$2h^- h^+ \omega \nu_{\tau}$		$(1.20\pm0.22)$	2) × 10 <sup>-4</sup>		641

### Lepton Family number (*LF*), Lepton number (*L*), or Baryon number (*B*) violating modes

*L* means lepton number violation (*e.g.*  $\tau^- \rightarrow e^+ \pi^- \pi^-$ ). Following common usage, *LF* means lepton family violation *and not* lepton number violation (*e.g.*  $\tau^- \rightarrow e^- \pi^+ \pi^-$ ). *B* means baryon number violation.

$e^-\gamma$	LF	< 2.7	imes 10 <sup>-6</sup>	CL=90%	888
$\mu^-\gamma$	LF	< 1.1	imes 10 <sup>-6</sup>	CL=90%	885
$e^{-}\pi^{0}$	LF	< 3.7	imes 10 <sup>-6</sup>	CL=90%	883
$\mu^- \pi^0$	LF	< 4.0	imes 10 <sup>-6</sup>	CL=90%	880
$e^{-}K_{S}^{0}$	LF	< 9.1	imes 10 <sup>-7</sup>	CL=90%	819
$\mu^- K_S^0$	LF	< 9.5	imes 10 <sup>-7</sup>	CL=90%	815
$e^-\eta$	LF	< 8.2	imes 10 <sup>-6</sup>	CL=90%	804
$\mu^-\eta$	LF	< 9.6	imes 10 <sup>-6</sup>	CL=90%	800
$e^-  ho^0$	LF	< 2.0	imes 10 <sup>-6</sup>	CL=90%	719
$\mu^-  ho^0$	LF	< 6.3	imes 10 <sup>-6</sup>	CL=90%	715
$e^{-}K^{*}(892)^{0}$	LF	< 5.1	imes 10 <sup>-6</sup>	CL=90%	665
$\mu^{-} K^{*}(892)^{0}$	LF	< 7.5	imes 10 <sup>-6</sup>	CL=90%	660
$e^{-}\overline{K}^{*}(892)^{0}$	LF	< 7.4	imes 10 <sup>-6</sup>	CL=90%	665
$\mu^{-}\overline{K}^{*}(892)^{0}$	LF	< 7.5	imes 10 <sup>-6</sup>	CL=90%	660
$e^-\phi$	LF	< 6.9	imes 10 <sup>-6</sup>	CL=90%	596
$\mu^-\phi$	LF	< 7.0	imes 10 <sup>-6</sup>	CL=90%	590
$e^-e^+e^-$	LF	< 2.9	imes 10 <sup>-6</sup>	CL=90%	888
$e^-\mu^+\mu^-$	LF	< 1.8	imes 10 <sup>-6</sup>	CL=90%	882
$e^+ \mu^- \mu^-$	LF	< 1.5	imes 10 <sup>-6</sup>	CL=90%	882
$\mu^- e^+ e^-$	LF	< 1.7	imes 10 <sup>-6</sup>	CL=90%	885
$\mu^+ e^- e^-$	LF	< 1.5	imes 10 <sup>-6</sup>	CL=90%	885

$\mu^- \mu^+ \mu^-$	LF	<	1.9	imes 10 <sup>-6</sup>	CL=90%	873
$e^{-\pi^{+}\pi^{-}}$	LF	<	2.2	imes 10 <sup>-6</sup>	CL=90%	877
$e^+\pi^-\pi^-$	L	<	1.9	imes 10 <sup>-6</sup>	CL=90%	877
$\mu^- \pi^+ \pi^-$	LF	<	8.2	imes 10 <sup>-6</sup>	CL=90%	866
$\mu^+\pi^-\pi^-$	L	<	3.4	imes 10 <sup>-6</sup>	CL=90%	866
$e^{-}\pi^{+}K^{-}$	LF	<	6.4	imes 10 <sup>-6</sup>	CL=90%	813
$e^{-}\pi^{-}K^{+}$	LF	<	3.8	imes 10 <sup>-6</sup>	CL=90%	813
$e^+\pi^-K^-$	L	<	2.1	imes 10 <sup>-6</sup>	CL=90%	813
$e^- K^0_{\varsigma} K^0_{\varsigma}$	LF	<	2.2	imes 10 <sup>-6</sup>	CL=90%	736
$e^{-}K^{+}K^{-}$	LF	<	6.0	imes 10 <sup>-6</sup>	CL=90%	739
$e^+ K^- K^-$	L	<	3.8	imes 10 <sup>-6</sup>	CL=90%	739
$\mu^- \pi^+ K^-$	LF	<	7.5	imes 10 <sup>-6</sup>	CL=90%	800
$\mu^-\pi^-K^+$	LF	<	7.4	imes 10 <sup>-6</sup>	CL=90%	800
$\mu^+\pi^-K^-$	L	<	7.0	imes 10 <sup>-6</sup>	CL=90%	800
$\mu^{-}K^{0}_{S}K^{0}_{S}$	LF	<	3.4	imes 10 <sup>-6</sup>	CL=90%	696
$\mu^- K^+ K^-$	LF	<	1.5	imes 10 <sup>-5</sup>	CL=90%	699
$\mu^+ K^- K^-$	L	<	6.0	imes 10 <sup>-6</sup>	CL=90%	699
$e^{-}\pi^{0}\pi^{0}$	LF	<	6.5	imes 10 <sup>-6</sup>	CL=90%	878
$\mu^- \pi^0 \pi^0$	LF	<	1.4	imes 10 <sup>-5</sup>	CL=90%	867
$e^-\eta\eta$	LF	<	3.5	imes 10 <sup>-5</sup>	CL=90%	699
$\mu^-\eta\eta$	LF	<	6.0	imes 10 <sup>-5</sup>	CL=90%	654
$e^{-\pi^{0}\eta}$	LF	<	2.4	imes 10 <sup>-5</sup>	CL=90%	798
$\mu^{-}\pi^{0}\eta$	LF	<	2.2	imes 10 <sup>-5</sup>	CL=90%	784
$\overline{P}\gamma_{-}$	L,B	<	3.5	imes 10 <sup>-6</sup>	CL=90%	641
$\overline{\rho}\pi^0$	L,B	<	1.5	imes 10 <sup>-5</sup>	CL=90%	632
$\overline{\rho}2\pi^0$	L,B	<	3.3	imes 10 <sup>-5</sup>	CL=90%	604
$\overline{p}\eta$	L,B	<	8.9	imes 10 <sup>-6</sup>	CL=90%	475
$\overline{p}\pi^0\eta$	L,B	<	2.7	imes 10 <sup>-5</sup>	CL=90%	360
$e^-$ light boson	LF	<	2.7	imes 10 <sup>-3</sup>	CL=95%	_
$\mu^-$ light boson	LF	<	5	imes 10 <sup>-3</sup>	CL=95%	-

# Heavy Charged Lepton Searches

 $L^{\pm}$  – charged lepton

Mass m>~100.8 GeV, CL = 95%  $^{[h]}$  Decay to u W.

### $L^{\pm}$ – stable charged heavy lepton

Mass m > 102.6 GeV, CL = 95%

## $\nu_{e}$

 $J = \frac{1}{2}$ 

The following results are obtained using neutrinos associated with  $e^+$  or  $e^-$ . See the Note on "Electron, muon, and tau neutrino listings" in the Particle Listings.

Mass m < 3 eV Interpretation of tritium beta decay experiments is complicated by anomalies near the endpoint, and the limits are not without ambiguity.

Mean life/mass,  $\tau/m_{\nu} > 7 \times 10^9 \text{ s/eV} {[i]}$  (solar) Mean life/mass,  $\tau/m_{\nu} > 300 \text{ s/eV}$ , CL = 90%  ${[i]}$  (reactor) Magnetic moment  $\mu < 1.0 \times 10^{-10} \mu_B$ , CL = 90%

# $u_{\mu}$

$$J = \frac{1}{2}$$

The following results are obtained using neutrinos associated with  $\mu^+$  or  $\mu^-$ . See the Note on "Electron, muon, and tau neutrino listings" in the Particle Listings.

Mass m < 0.19 MeV, CL = 90% Mean life/mass,  $\tau/m_{\nu} > 15.4$  s/eV, CL = 90% Magnetic moment  $\mu < 6.8 \times 10^{-10} \mu_B$ , CL = 90%

### $u_{ au}$

$$J=\frac{1}{2}$$

The following results are obtained using neutrinos associated with  $\tau^+$  or  $\tau^-$ . See the Note on "Electron, muon, and tau neutrino listings" in the Particle Listings.

Mass m < 18.2 MeV, CL = 95%Magnetic moment  $\mu < 3.9 \times 10^{-7} \mu_B$ , CL = 90%Electric dipole moment  $d < 5.2 \times 10^{-17} e$  cm, CL = 95%

### Number of Neutrino Types and Sum of Neutrino Masses

Number  $N = 2.994 \pm 0.012$  (Standard Model fits to LEP data) Number  $N = 2.92 \pm 0.07$  (Direct measurement of invisible Z width)

## Neutrino Mixing

There is now compelling evidence that neutrinos have nonzero mass from the observation of neutrino flavor change, both from the study of atmospheric neutrino fluxes by SuperKamiokande, and from the study of solar neutrino cross sections by SNO (charged and neutral currents) and SuperKamiokande (elastic scattering). The flavor change observed in solar neutrinos has been confirmed by the KamLAND experiment using reactor antineutrinos.

### Solar Neutrinos

Detectors using gallium ( $E_{\nu} \gtrsim 0.2 \text{ MeV}$ ), chlorine ( $E_{\nu} \gtrsim 0.8 \text{ MeV}$ ), and Cherenkov effect in water ( $E_{\nu} \gtrsim 5 \text{ MeV}$ ) measure significantly lower neutrino rates than are predicted from solar models. From the determination by SNO of the <sup>8</sup>B solar neutrino flux via elastic scattering, charged-current process interactions, and neutral-current interactions, one can determine the flux of non- $\nu_e$  active neutrinos to be  $\phi(\nu_{\mu\tau}) = (3.41^{+0.66}_{-0.64}) \times 10^6 \text{ cm}^{-2} \text{ s}^{-1}$ , providing a 5.3  $\sigma$  evidence for neutrino flavor change. A global analysis of the solar neutrino data, including the KamLAND results that confirm the effect using reactor antineutrinos, favors large mixing angles and  $\Delta(m^2) \simeq$  $(6-9) \times 10^{-5} \text{ eV}^2$ . See the Note "Solar Neutrinos" in the Listings and the review "Neutrino Mass, Mixing, and Flavor Change."

#### **Atmospheric Neutrinos**

Underground detectors observing neutrinos produced by cosmic rays in the atmosphere have measured a  $\nu_{\mu}/\nu_{e}$  ratio much less than expected, and also a deficiency of upward going  $\nu_{\mu}$  compared to downward. This can be explained by oscillations leading to the disappearance of  $\nu_{\mu}$  with  $\Delta m^{2} \approx (1\text{--}3) \times 10^{-3} \, \text{eV}^{2}$  and almost full mixing between  $\nu_{\mu}$  and  $\nu_{\tau}$ . The effect has been confirmed by the K2K experiment using accelerator neutrinos. See the review "Neutrino Mass, Mixing, and Flavor Change."

### Heavy Neutral Leptons, Searches for

For excited leptons, see Compositeness Limits below.

#### Stable Neutral Heavy Lepton Mass Limits

Mass m > 45.0 GeV, CL = 95% (Dirac) Mass m > 39.5 GeV, CL = 95% (Majorana)

#### Neutral Heavy Lepton Mass Limits

 $\begin{array}{ll} \text{Mass } m > & 90.3 \; \text{GeV, CL} = 95\% \\ & (\text{Dirac } \nu_L \; \text{coupling to } e, \; \mu, \; \tau; \; \text{conservative case}(\tau)) \\ \text{Mass } m > & 80.5 \; \text{GeV, CL} = 95\% \\ & (\text{Majorana } \nu_L \; \text{coupling to } e, \; \mu, \; \tau; \; \text{conservative case}(\tau)) \end{array}$ 

### NOTES

- [a] This is the best limit for the mode  $e^- \rightarrow \nu \gamma$ . The best limit for "electron disappearance" is  $6.4 \times 10^{24}$  yr.
- [b] See the "Note on Muon Decay Parameters" in the  $\mu$  Particle Listings for definitions and details.
- [c]  $P_{\mu}$  is the longitudinal polarization of the muon from pion decay. In standard V-A theory,  $P_{\mu} = 1$  and  $\rho = \delta = 3/4$ .
- [d] This only includes events with the  $\gamma$  energy > 10 MeV. Since the  $e^- \overline{\nu}_e \nu_\mu$ and  $e^- \overline{\nu}_e \nu_\mu \gamma$  modes cannot be clearly separated, we regard the latter mode as a subset of the former.
- [e] See the relevant Particle Listings for the energy limits used in this measurement.
- [f] A test of additive vs. multiplicative lepton family number conservation.
- [g] Basis mode for the  $\tau$ .
- [h]  $L^{\pm}$  mass limit depends on decay assumptions; see the Full Listings.
- [*i*] Limit assumes radiative decay of neutrino.