

LEPTONS

e

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

$$\text{Mass } m = (548.579909044 \pm 0.000000010) \times 10^{-6} \text{ u}$$

$$\text{Mass } m = 0.51099895069 \pm 0.00000000016 \text{ MeV}$$

$$|m_{e^+} - m_{e^-}|/m < 8 \times 10^{-9}, \text{ CL} = 90\%$$

$$|q_{e^+} + q_{e^-}|/e < 4 \times 10^{-8}$$

Magnetic moment anomaly

$$(g-2)/2 = (1159.65218062 \pm 0.00000012) \times 10^{-6}$$

$$(g_{e^+} - g_{e^-}) / g_{\text{average}} = (-0.5 \pm 2.1) \times 10^{-12}$$

$$\text{Electric dipole moment } d < 0.041 \times 10^{-28} \text{ e cm, CL} = 90\%$$

$$\text{Mean life } \tau > 6.6 \times 10^{28} \text{ yr, CL} = 90\% \text{ [a]}$$

NODE=LXXX005

NODE=S003

NODE=S003AMU;DTYPE=M

NODE=S003M;DTYPE=M

NODE=S003DM;DTYPE=k

NODE=S003DQ;DTYPE=q

NODE=S003MM;DTYPE=m

NODE=S003MMR;DTYPE=k

NODE=S003EDM;DTYPE=e

NODE=S003T;DTYPE=T

μ

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

$$\text{Mass } m = 0.1134289257 \pm 0.0000000025 \text{ u}$$

$$\text{Mass } m = 105.6583755 \pm 0.0000023 \text{ MeV}$$

$$\text{Mean life } \tau = (2.1969811 \pm 0.0000022) \times 10^{-6} \text{ s}$$

$$\tau_{\mu^+}/\tau_{\mu^-} = 1.00002 \pm 0.00008$$

$$c\tau = 658.6384 \text{ m}$$

$$\text{Magnetic moment anomaly } (g-2)/2 = (11659205.9 \pm 2.2) \times 10^{-10}$$

$$(g_{\mu^+} - g_{\mu^-}) / g_{\text{average}} = (-0.11 \pm 0.12) \times 10^{-8}$$

$$\text{Electric dipole moment } |d| < 1.8 \times 10^{-19} \text{ e cm, CL} = 95\%$$

Decay parameters [b]

$$\rho = 0.74979 \pm 0.00026$$

$$\eta = 0.057 \pm 0.034$$

$$\delta = 0.75047 \pm 0.00034$$

$$\xi P_{\mu} = 1.0009^{+0.0016}_{-0.0007} \text{ [c]}$$

$$\xi P_{\mu} \delta / \rho = 1.0018^{+0.0016}_{-0.0007} \text{ [c]}$$

$$\xi' = 1.00 \pm 0.04$$

$$\xi'' = 0.98 \pm 0.04$$

$$\alpha/A = (0 \pm 4) \times 10^{-3}$$

$$\alpha'/A = (-10 \pm 20) \times 10^{-3}$$

$$\beta/A = (4 \pm 6) \times 10^{-3}$$

$$\beta'/A = (2 \pm 7) \times 10^{-3}$$

$$\bar{\eta} = 0.02 \pm 0.08$$

NODE=S004

NODE=S004AMU;DTYPE=M

NODE=S004M;DTYPE=M

NODE=S004T;DTYPE=T

NODE=S004DT;DTYPE=z

NODE=S004CTA;DTYPE=C;OUR EVAL

NODE=S004MM;DTYPE=m

NODE=S004MMR;DTYPE=m

NODE=S004EDM;DTYPE=e

CLUMP=D

NODE=S004RHO;DTYPE=d;CLUMP=D

NODE=S004ETA;DTYPE=d;CLUMP=D

NODE=S004DEL;DTYPE=d;CLUMP=D

NODE=S004XI;DTYPE=d;CLUMP=D

NODE=S004XID;DTYPE=d;CLUMP=D

NODE=S004PL;DTYPE=d;CLUMP=D

NODE=S004XPP;DTYPE=d;CLUMP=D

NODE=S004AL;DTYPE=d;CLUMP=D

NODE=S004ALP;DTYPE=d;CLUMP=D

NODE=S004BT;DTYPE=d;CLUMP=D

NODE=S004BTP;DTYPE=d;CLUMP=D

NODE=S004ETB;DTYPE=d;CLUMP=D

μ^+ modes are charge conjugates of the modes below.

μ^- DECAY MODES	Fraction (Γ_i/Γ)	Confidence level	p (MeV/c)
$e^- \bar{\nu}_e \nu_\mu$	$\approx 100\%$		53
$e^- \bar{\nu}_e \nu_\mu \gamma$	[d] $(6.0 \pm 0.5) \times 10^{-8}$		53
$e^- \bar{\nu}_e \nu_\mu e^+ e^-$	[e] $(3.4 \pm 0.4) \times 10^{-5}$		53
Lepton Family number (LF) violating modes			
$e^- \nu_e \bar{\nu}_\mu$	LF [f] < 1.2	%	90% 53
$e^- \gamma$	LF < 3.1	$\times 10^{-13}$	90% 53
$e^- e^+ e^-$	LF < 1.0	$\times 10^{-12}$	90% 53
$e^- 2\gamma$	LF < 7.2	$\times 10^{-11}$	90% 53

τ

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

Mass $m = 1776.93 \pm 0.09$ MeV

$(m_{\tau^+} - m_{\tau^-})/m_{\text{average}} < 2.8 \times 10^{-4}$, CL = 90%

Mean life $\tau = (290.3 \pm 0.5) \times 10^{-15}$ s

$c\tau = 87.03$ μm

Magnetic moment anomaly = -0.057 to 0.024 , CL = 95%

$\text{Re}(d_\tau) = -0.185$ to 0.061×10^{-16} e cm, CL = 95%

$\text{Im}(d_\tau) = -0.103$ to 0.023×10^{-16} e cm, CL = 95%

Weak dipole moment

$\text{Re}(d_\tau^W) < 0.50 \times 10^{-17}$ e cm, CL = 95%

$\text{Im}(d_\tau^W) < 1.1 \times 10^{-17}$ e cm, CL = 95%

Weak anomalous magnetic dipole moment

$\text{Re}(\alpha_\tau^W) < 1.1 \times 10^{-3}$, CL = 95%

$\text{Im}(\alpha_\tau^W) < 2.7 \times 10^{-3}$, CL = 95%

$\tau^\pm \rightarrow \pi^\pm K_S^0 \nu_\tau$ (RATE DIFFERENCE) / (RATE SUM) =
(-0.36 ± 0.25)%

Decay parameters

See the τ Particle Listings for a note concerning τ -decay parameters.

$\rho(e \text{ or } \mu) = 0.745 \pm 0.008$

$\rho(e) = 0.747 \pm 0.010$

$\rho(\mu) = 0.763 \pm 0.020$

$\xi(e \text{ or } \mu) = 0.985 \pm 0.030$

$\xi(e) = 0.994 \pm 0.040$

$\xi(\mu) = 1.030 \pm 0.059$

$\eta(e \text{ or } \mu) = 0.013 \pm 0.020$

$\eta(\mu) = 0.094 \pm 0.073$

$(\delta\xi)(e \text{ or } \mu) = 0.746 \pm 0.021$

$(\delta\xi)(e) = 0.734 \pm 0.028$

$(\delta\xi)(\mu) = 0.778 \pm 0.037$

$\xi(\pi) = 0.993 \pm 0.022$

$\xi(\rho) = 0.994 \pm 0.008$

$\xi(a_1) = 1.001 \pm 0.027$

$\xi(\text{all hadronic modes}) = 0.995 \pm 0.007$

$\xi'(\mu) = 0.2 \pm 1.0$

$\bar{\eta}(\mu) = -1.3 \pm 1.7$

$(\xi\kappa)(e \text{ or } \mu) = 0.5 \pm 0.4$

$(\xi\kappa)(e) = -0.4 \pm 1.2$

$(\xi\kappa)(\mu) = 0.8 \pm 0.6$

NODE=S004235;NODE=S004

DESIG=1;OUR EVAL;→ UNCHECKED ←

DESIG=2

DESIG=7

NODE=S004;CLUMP=A

DESIG=3

DESIG=4

DESIG=5

DESIG=6

NODE=S035

NODE=S035M;DTYPE=M

NODE=S035MDF;DTYPE=D

NODE=S035T;DTYPE=T

NODE=S035CTA;DTYPE=C;OUR EVAL

NODE=S035MM;DTYPE=m

NODE=S035EDM;DTYPE=e

NODE=S035EDI;DTYPE=e

CLUMP=K

NODE=S035WDM;DTYPE=e;CLUMP=K

NODE=S035WDI;DTYPE=e;CLUMP=K

CLUMP=Q

NODE=S035WMM;DTYPE=e;CLUMP=Q

NODE=S035WMI;DTYPE=e;CLUMP=Q

NODE=S035DR1;DTYPE=v

CLUMP=D

NODE=S035RHO;DTYPE=d;CLUMP=D

NODE=S035RHE;DTYPE=d;CLUMP=D

NODE=S035RHM;DTYPE=d;CLUMP=D

NODE=S035XI;DTYPE=d;CLUMP=D

NODE=S035XE;DTYPE=d;CLUMP=D

NODE=S035XM;DTYPE=d;CLUMP=D

NODE=S035ETA;DTYPE=d;CLUMP=D

NODE=S035ETM;DTYPE=d;CLUMP=D

NODE=S035DXI;DTYPE=d;CLUMP=D

NODE=S035DXE;DTYPE=d;CLUMP=D

NODE=S035DXM;DTYPE=d;CLUMP=D

NODE=S035XPI;DTYPE=d;CLUMP=D

NODE=S035XRH;DTYPE=d;CLUMP=D

NODE=S035XA1;DTYPE=d;CLUMP=D

NODE=S035XAL;DTYPE=d;CLUMP=D

NODE=S035A00;DTYPE=d;CLUMP=D

NODE=S035BEM;DTYPE=d;CLUMP=D

NODE=S035XIK;DTYPE=d;CLUMP=D

NODE=S035XKE;DTYPE=d;CLUMP=D

NODE=S035XKM;DTYPE=d;CLUMP=D

τ^+ modes are charge conjugates of the modes below. " $h^\pm$ " stands for $\pi^\pm$ or $K^\pm$. " ℓ " stands for e or μ . "Neutrals" stands for γ 's and/or π^0 's.

NODE=S035215;NODE=S035

τ^- DECAY MODES	Fraction (Γ_i/Γ)	Scale factor/ Confidence level	p (MeV/c)	
Modes with one charged particle				
particle $^- \geq 0$ neutrals $\geq 0 K^0 \nu_\tau$ (“1-prong”)	(85.24 $\pm$ 0.06) %	—	—	NODE=S035;CLUMP=B DESIG=219
particle $^- \geq 0$ neutrals $\geq 0 K_L^0 \nu_\tau$	(84.58 $\pm$ 0.06) %	—	—	DESIG=191
$\mu^- \bar{\nu}_\mu \nu_\tau$	[g] (17.37 $\pm$ 0.04) %	885	885	DESIG=1
$\mu^- \bar{\nu}_\mu \nu_\tau \gamma$	[e] (3.67 $\pm$ 0.08) $\times 10^{-3}$	885	885	DESIG=76
$e^- \bar{\nu}_e \nu_\tau$	[g] (17.85 $\pm$ 0.04) %	888	888	DESIG=2
$e^- \bar{\nu}_e \nu_\tau \gamma$	[e] (1.83 $\pm$ 0.05) %	888	888	DESIG=274
$h^- \geq 0 K_L^0 \nu_\tau$	(12.03 $\pm$ 0.05) %	883	883	DESIG=181
$h^- \nu_\tau$	(11.51 $\pm$ 0.05) %	883	883	DESIG=217
$\pi^- \nu_\tau$	[g] (10.82 $\pm$ 0.05) %	883	883	DESIG=12
$K^- \nu_\tau$	[g] (6.97 $\pm$ 0.10) $\times 10^{-3}$	820	820	DESIG=7
$h^- \geq 1$ neutrals ν_τ	(37.00 $\pm$ 0.09) %	—	—	DESIG=192
$h^- \geq 1 \pi^0 \nu_\tau$ (ex. K^0)	(36.50 $\pm$ 0.09) %	—	—	DESIG=299
$h^- \pi^0 \nu_\tau$	(25.93 $\pm$ 0.09) %	878	878	DESIG=171
$\pi^- \pi^0 \nu_\tau$	[g] (25.49 $\pm$ 0.09) %	878	878	DESIG=16
$\pi^- \pi^0$ non- $\rho(770) \nu_\tau$	(3.0 $\pm$ 3.2) $\times 10^{-3}$	878	878	DESIG=24
$K^- \pi^0 \nu_\tau$	[g] (4.33 $\pm$ 0.15) $\times 10^{-3}$	814	814	DESIG=182
$h^- \geq 2 \pi^0 \nu_\tau$	(10.81 $\pm$ 0.09) %	—	—	DESIG=19
$h^- 2 \pi^0 \nu_\tau$	(9.48 $\pm$ 0.10) %	862	862	DESIG=218
$h^- 2 \pi^0 \nu_\tau$ (ex. K^0)	(9.32 $\pm$ 0.10) %	862	862	DESIG=27
$\pi^- 2 \pi^0 \nu_\tau$ (ex. K^0)	[g] (9.26 $\pm$ 0.10) %	862	862	DESIG=201
$\pi^- 2 \pi^0 \nu_\tau$ (ex. K^0), scalar	< 9 $\times 10^{-3}$ CL=95%	862	862	DESIG=282
$\pi^- 2 \pi^0 \nu_\tau$ (ex. K^0), vector	< 7 $\times 10^{-3}$ CL=95%	862	862	DESIG=283
$K^- 2 \pi^0 \nu_\tau$ (ex. K^0)	[g] (6.5 $\pm$ 2.2) $\times 10^{-4}$	796	796	DESIG=115
$h^- \geq 3 \pi^0 \nu_\tau$	(1.34 $\pm$ 0.07) %	—	—	DESIG=79
$h^- \geq 3 \pi^0 \nu_\tau$ (ex. K^0)	(1.26 $\pm$ 0.07) %	—	—	DESIG=300
$h^- 3 \pi^0 \nu_\tau$	(1.18 $\pm$ 0.07) %	836	836	DESIG=26
$\pi^- 3 \pi^0 \nu_\tau$ (ex. K^0)	[g] (1.04 $\pm$ 0.07) %	836	836	DESIG=203
$K^- 3 \pi^0 \nu_\tau$ (ex. K^0 , η)	[g] (4.8 $\pm$ 2.1) $\times 10^{-4}$	766	766	DESIG=116
$h^- 4 \pi^0 \nu_\tau$ (ex. K^0)	(1.6 $\pm$ 0.4) $\times 10^{-3}$	800	800	DESIG=220
$h^- 4 \pi^0 \nu_\tau$ (ex. K^0, η)	[g] (1.1 $\pm$ 0.4) $\times 10^{-3}$	800	800	DESIG=110
$a_1(1260) \nu_\tau \rightarrow \pi^- \gamma \nu_\tau$	(4.0 $\pm$ 1.5) $\times 10^{-4}$	—	—	DESIG=344
$K^- \geq 0 \pi^0 \geq 0 K^0 \geq 0 \gamma \nu_\tau$	(1.552 $\pm$ 0.029) %	820	820	DESIG=198
$K^- \geq 1 (\pi^0 \text{ or } K^0 \text{ or } \gamma) \nu_\tau$	(8.59 $\pm$ 0.28) $\times 10^{-3}$	—	—	DESIG=11
Modes with K^0's				
K_S^0 (particles) $^- \nu_\tau$	(9.43 $\pm$ 0.28) $\times 10^{-3}$	—	—	NODE=S035;CLUMP=F DESIG=127
$h^- \bar{K}^0 \nu_\tau$	(9.87 $\pm$ 0.14) $\times 10^{-3}$	812	812	DESIG=212
$\pi^- \bar{K}^0 \nu_\tau$	[g] (8.38 $\pm$ 0.14) $\times 10^{-3}$	812	812	DESIG=117
$\pi^- \bar{K}^0$	(5.4 $\pm$ 2.1) $\times 10^{-4}$	812	812	DESIG=142
(non- $K^*(892)^- \nu_\tau$)				
$K^- K^0 \nu_\tau$	[g] (1.486 $\pm$ 0.034) $\times 10^{-3}$	737	737	DESIG=62
$K^- K^0 \geq 0 \pi^0 \nu_\tau$	(2.99 $\pm$ 0.07) $\times 10^{-3}$	737	737	DESIG=273
$h^- \bar{K}^0 \pi^0 \nu_\tau$	(5.32 $\pm$ 0.13) $\times 10^{-3}$	794	794	DESIG=213
$\pi^- \bar{K}^0 \pi^0 \nu_\tau$	[g] (3.82 $\pm$ 0.13) $\times 10^{-3}$	794	794	DESIG=118
$\bar{K}^0 \rho^- \nu_\tau$	(2.2 $\pm$ 0.5) $\times 10^{-3}$	612	612	DESIG=249
$K^- K^0 \pi^0 \nu_\tau$	[g] (1.50 $\pm$ 0.07) $\times 10^{-3}$	685	685	DESIG=119
$\pi^- \bar{K}^0 \geq 1 \pi^0 \nu_\tau$	(4.08 $\pm$ 0.25) $\times 10^{-3}$	—	—	DESIG=272
$\pi^- \bar{K}^0 \pi^0 \pi^0 \nu_\tau$ (ex. K^0)	[g] (2.6 $\pm$ 2.3) $\times 10^{-4}$	763	763	DESIG=238
$K^- K^0 \pi^0 \pi^0 \nu_\tau$	< 1.6 $\times 10^{-4}$ CL=95%	619	619	DESIG=239
$\pi^- K^0 \bar{K}^0 \nu_\tau$	(1.55 $\pm$ 0.24) $\times 10^{-3}$	682	682	DESIG=141

$\pi^- K_S^0 K_S^0 \nu_\tau$	[g] (2.35 ± 0.06) × 10 ⁻⁴	682	DESIG=214
$\pi^- K_S^0 K_L^0 \nu_\tau$	[g] (1.08 ± 0.24) × 10 ⁻³	682	DESIG=240
$\pi^- K_L^0 K_L^0 \nu_\tau$	(2.35 ± 0.06) × 10 ⁻⁴	682	DESIG=342
$\pi^- K^0 \bar{K}^0 \pi^0 \nu_\tau$	(3.6 ± 1.2) × 10 ⁻⁴	614	DESIG=278
$\pi^- K_S^0 K_S^0 \pi^0 \nu_\tau$	[g] (1.82 ± 0.21) × 10 ⁻⁵	614	DESIG=241
$K^{*-} K^0 \pi^0 \nu_\tau \rightarrow$ $\pi^- K_S^0 K_S^0 \pi^0 \nu_\tau$	(1.08 ± 0.21) × 10 ⁻⁵	—	DESIG=336
$f_1(1285) \pi^- \nu_\tau \rightarrow$ $\pi^- K_S^0 K_S^0 \pi^0 \nu_\tau$	(6.8 ± 1.5) × 10 ⁻⁶	—	DESIG=337
$f_1(1420) \pi^- \nu_\tau \rightarrow$ $\pi^- K_S^0 K_S^0 \pi^0 \nu_\tau$	(2.4 ± 0.8) × 10 ⁻⁶	—	DESIG=338
$\pi^- K_S^0 K_L^0 \pi^0 \nu_\tau$	[g] (3.2 ± 1.2) × 10 ⁻⁴	614	DESIG=242
$\pi^- K_L^0 K_L^0 \pi^0 \nu_\tau$	(1.82 ± 0.21) × 10 ⁻⁵	614	DESIG=343
$K^- K_S^0 K_S^0 \nu_\tau$	< 6.3 × 10 ⁻⁷ CL=90%	466	DESIG=332
$K^- K_S^0 K_S^0 \pi^0 \nu_\tau$	< 4.0 × 10 ⁻⁷ CL=90%	337	DESIG=333
$K^0 h^+ h^- h^- \geq 0$ neutrals ν_τ	< 1.7 × 10 ⁻³ CL=95%	760	DESIG=29
$K^0 h^+ h^- h^- \nu_\tau$	[g] (2.5 ± 2.0) × 10 ⁻⁴	760	DESIG=244
Modes with three charged particles			
$h^- h^- h^+ \geq 0$ neutrals $\geq 0 K_L^0 \nu_\tau$	(15.20 ± 0.06) %	861	NODE=S035;CLUMP=C DESIG=194
$h^- h^- h^+ \geq 0$ neutrals ν_τ	(14.55 ± 0.06) %	861	DESIG=209
(ex. $K_S^0 \rightarrow \pi^+ \pi^-$) ("3-prong")			
$h^- h^- h^+ \nu_\tau$	(9.80 ± 0.05) %	861	DESIG=17
$h^- h^- h^+ \nu_\tau$ (ex. K^0)	(9.45 ± 0.05) %	861	DESIG=208
$h^- h^- h^+ \nu_\tau$ (ex. K^0, ω)	(9.42 ± 0.05) %	861	DESIG=215
$\pi^- \pi^+ \pi^- \nu_\tau$	(9.31 ± 0.05) %	861	DESIG=257
$\pi^- \pi^+ \pi^- \nu_\tau$ (ex. K^0)	(9.02 ± 0.05) %	861	DESIG=258
$\pi^- \pi^+ \pi^- \nu_\tau$ (ex. K^0),	< 2.4 % CL=95%	861	DESIG=284
non-axial vector $\pi^- \pi^+ \pi^- \nu_\tau$ (ex. K^0, ω)	[g] (8.99 ± 0.05) %	861	DESIG=259
$h^- h^- h^+ \geq 1$ neutrals ν_τ	(5.29 ± 0.05) %	—	DESIG=18
$h^- h^- h^+ \geq 1 \pi^0 \nu_\tau$ (ex. K^0)	(5.09 ± 0.05) %	—	DESIG=222
$h^- h^- h^+ \pi^0 \nu_\tau$	(4.76 ± 0.05) %	834	DESIG=25
$h^- h^- h^+ \pi^0 \nu_\tau$ (ex. K^0)	(4.57 ± 0.05) %	834	DESIG=143
$h^- h^- h^+ \pi^0 \nu_\tau$ (ex. K^0, ω)	(2.79 ± 0.07) %	834	DESIG=202
$\pi^- \pi^+ \pi^- \pi^0 \nu_\tau$	(4.62 ± 0.05) %	834	DESIG=261
$\pi^- \pi^+ \pi^- \pi^0 \nu_\tau$ (ex. K^0)	(4.49 ± 0.05) %	834	DESIG=262
$\pi^- \pi^+ \pi^- \pi^0 \nu_\tau$ (ex. K^0, ω)	[g] (2.74 ± 0.07) %	834	DESIG=263
$h^- h^- h^+ \geq 2 \pi^0 \nu_\tau$ (ex. K^0)	(5.17 ± 0.31) × 10 ⁻³	—	DESIG=301
$h^- h^- h^+ 2 \pi^0 \nu_\tau$	(5.05 ± 0.31) × 10 ⁻³	797	DESIG=221
$h^- h^- h^+ 2 \pi^0 \nu_\tau$ (ex. K^0)	(4.95 ± 0.31) × 10 ⁻³	797	DESIG=112
$h^- h^- h^+ 2 \pi^0 \nu_\tau$ (ex. K^0, ω, η)	[g] (10 ± 4) × 10 ⁻⁴	797	DESIG=216
$h^- h^- h^+ 3 \pi^0 \nu_\tau$	(2.13 ± 0.30) × 10 ⁻⁴	749	DESIG=204
$2 \pi^- \pi^+ 3 \pi^0 \nu_\tau$ (ex. K^0)	(1.94 ± 0.30) × 10 ⁻⁴	749	DESIG=318
$2 \pi^- \pi^+ 3 \pi^0 \nu_\tau$ (ex. K^0, η ,	(1.7 ± 0.4) × 10 ⁻⁴	—	DESIG=319
$f_1(1285))$			
$2 \pi^- \pi^+ 3 \pi^0 \nu_\tau$ (ex. K^0, η ,	[g] (1.4 ± 2.7) × 10 ⁻⁵	—	DESIG=320
$\omega, f_1(1285))$			
$K^- h^+ h^- \geq 0$ neutrals ν_τ	(6.29 ± 0.14) × 10 ⁻³	794	DESIG=28
$K^- h^+ \pi^- \nu_\tau$ (ex. K^0)	(4.37 ± 0.07) × 10 ⁻³	794	DESIG=270
$K^- h^+ \pi^- \pi^0 \nu_\tau$ (ex. K^0)	(8.6 ± 1.2) × 10 ⁻⁴	763	DESIG=271
$K^- \pi^+ \pi^- \geq 0$ neutrals ν_τ	(4.77 ± 0.14) × 10 ⁻³	794	DESIG=6
$K^- \pi^+ \pi^- \geq$ $0 \pi^0 \nu_\tau$ (ex. K^0)	(3.73 ± 0.13) × 10 ⁻³	794	DESIG=275
$K^- \pi^+ \pi^- \nu_\tau$	(3.45 ± 0.07) × 10 ⁻³	794	DESIG=245

$K^- \pi^+ \pi^- \nu_\tau$ (ex. K^0)	(2.93 $\pm$ 0.07) $\times 10^{-3}$	794	DESIG=260
$K^- \pi^+ \pi^- \nu_\tau$ (ex. K^0, ω) [g]	(2.93 $\pm$ 0.07) $\times 10^{-3}$	794	DESIG=340
$K^- \rho^0 \nu_\tau \rightarrow$ $K^- \pi^+ \pi^- \nu_\tau$	(1.4 $\pm$ 0.5) $\times 10^{-3}$	—	DESIG=286
$K^- \pi^+ \pi^- \pi^0 \nu_\tau$	(1.31 $\pm$ 0.12) $\times 10^{-3}$	763	DESIG=246
$K^- \pi^+ \pi^- \pi^0 \nu_\tau$ (ex. K^0)	(8.0 $\pm$ 1.2) $\times 10^{-4}$	763	DESIG=264
$K^- \pi^+ \pi^- \pi^0 \nu_\tau$ (ex. K^0, η)	(7.6 $\pm$ 1.2) $\times 10^{-4}$	763	DESIG=285
$K^- \pi^+ \pi^- \pi^0 \nu_\tau$ (ex. K^0, ω)	(3.7 $\pm$ 0.9) $\times 10^{-4}$	763	DESIG=294
$K^- \pi^+ \pi^- \pi^0 \nu_\tau$ (ex. K^0, ω, η) [g]	(3.9 $\pm$ 1.4) $\times 10^{-4}$	763	DESIG=341
$K^- \pi^+ K^- \geq 0$ neut. ν_τ	< 9 $\times 10^{-4}$ CL=95%	685	DESIG=123
$K^- K^+ \pi^- \geq 0$ neut. ν_τ	(1.496 $\pm$ 0.033) $\times 10^{-3}$	685	DESIG=122
$K^- K^+ \pi^- \nu_\tau$ [g]	(1.435 $\pm$ 0.027) $\times 10^{-3}$	685	DESIG=5
$K^- K^+ \pi^- \pi^0 \nu_\tau$ [g]	(6.1 $\pm$ 1.8) $\times 10^{-5}$	618	DESIG=247
$K^- K^+ K^- \nu_\tau$	(2.2 $\pm$ 0.8) $\times 10^{-5}$ S=5.4	472	DESIG=248
$K^- K^+ K^- \nu_\tau$ (ex. ϕ)	< 2.5 $\times 10^{-6}$ CL=90%	—	DESIG=303
$K^- K^+ K^- \pi^0 \nu_\tau$	< 4.8 $\times 10^{-6}$ CL=90%	346	DESIG=296
$\pi^- K^+ \pi^- \geq 0$ neut. ν_τ	< 2.5 $\times 10^{-3}$ CL=95%	794	DESIG=121
$e^- e^- e^+ \bar{\nu}_e \nu_\tau$	(2.8 $\pm$ 1.5) $\times 10^{-5}$	888	DESIG=210
$\mu^- e^- e^+ \bar{\nu}_\mu \nu_\tau$	< 3.2 $\times 10^{-5}$ CL=90%	885	DESIG=211
$\pi^- e^- e^+ \nu_\tau$	seen	883	DESIG=350
$\pi^- \mu^- \mu^+ \nu_\tau$	< 1.14 $\times 10^{-5}$ CL=90%	870	DESIG=349

Modes with five charged particles

$3h^- 2h^+ \geq 0$ neutrals ν_τ	(9.9 $\pm$ 0.4) $\times 10^{-4}$	794	NODE=S035;CLUMP=D DESIG=20
(ex. $K_S^0 \rightarrow \pi^- \pi^+$) ("5-prong")			
$3h^- 2h^+ \nu_\tau$ (ex. K^0)	(8.29 $\pm$ 0.31) $\times 10^{-4}$	794	DESIG=3
$3\pi^- 2\pi^+ \nu_\tau$ (ex. K^0, ω)	(8.27 $\pm$ 0.31) $\times 10^{-4}$	794	DESIG=321
$3\pi^- 2\pi^+ \nu_\tau$ (ex. K^0, ω , $f_1(1285)$) [g]	(7.75 $\pm$ 0.30) $\times 10^{-4}$	—	DESIG=322
$K^- 2\pi^- 2\pi^+ \nu_\tau$ (ex. K^0) [g]	(6 $\pm$ 12) $\times 10^{-7}$	716	DESIG=327
$K^+ 3\pi^- \pi^+ \nu_\tau$	< 5.0 $\times 10^{-6}$ CL=90%	716	DESIG=328
$K^+ K^- 2\pi^- \pi^+ \nu_\tau$	< 4.5 $\times 10^{-7}$ CL=90%	528	DESIG=329
$3h^- 2h^+ \pi^0 \nu_\tau$ (ex. K^0)	(1.65 $\pm$ 0.11) $\times 10^{-4}$	746	DESIG=4
$3\pi^- 2\pi^+ \pi^0 \nu_\tau$ (ex. K^0)	(1.64 $\pm$ 0.11) $\times 10^{-4}$	746	DESIG=323
$3\pi^- 2\pi^+ \pi^0 \nu_\tau$ (ex. K^0, η , $f_1(1285)$)	(1.11 $\pm$ 0.10) $\times 10^{-4}$	—	DESIG=324
$3\pi^- 2\pi^+ \pi^0 \nu_\tau$ (ex. K^0, η , $\omega, f_1(1285)$) [g]	(3.8 $\pm$ 0.9) $\times 10^{-5}$	—	DESIG=325
$K^- 2\pi^- 2\pi^+ \pi^0 \nu_\tau$ (ex. K^0) [g]	(1.1 $\pm$ 0.6) $\times 10^{-6}$	657	DESIG=330
$K^+ 3\pi^- \pi^+ \pi^0 \nu_\tau$	< 8 $\times 10^{-7}$ CL=90%	657	DESIG=331
$3h^- 2h^+ 2\pi^0 \nu_\tau$	< 3.4 $\times 10^{-6}$ CL=90%	687	DESIG=128

Miscellaneous other allowed modes

$(5\pi)^- \nu_\tau$	(7.8 $\pm$ 0.5) $\times 10^{-3}$	800	NODE=S035;CLUMP=E DESIG=129
$4h^- 3h^+ \geq 0$ neutrals ν_τ	< 3.0 $\times 10^{-7}$ CL=90%	682	DESIG=61
("7-prong")			
$4h^- 3h^+ \nu_\tau$	< 4.3 $\times 10^{-7}$ CL=90%	682	DESIG=290
$4h^- 3h^+ \pi^0 \nu_\tau$	< 2.5 $\times 10^{-7}$ CL=90%	612	DESIG=291
$X^-(S=-1) \nu_\tau$	(2.92 $\pm$ 0.04) %	—	DESIG=281
$K^*(892)^- \geq 0$ neutrals $\geq$	(1.42 $\pm$ 0.18) % S=1.4	665	DESIG=23
$0K_L^0 \nu_\tau$			
$K^*(892)^- \nu_\tau$	(1.20 $\pm$ 0.07) % S=1.8	665	DESIG=21
$K^*(892)^- \nu_\tau \rightarrow \pi^- \bar{K}^0 \nu_\tau$	(7.82 $\pm$ 0.26) $\times 10^{-3}$	—	DESIG=304
$K^*(892)^0 K^- \geq 0$ neutrals ν_τ	(3.2 $\pm$ 1.4) $\times 10^{-3}$	542	DESIG=97
$K^*(892)^0 K^- \nu_\tau$	(2.1 $\pm$ 0.4) $\times 10^{-3}$	542	DESIG=206
$\bar{K}^*(892)^0 \pi^- \geq 0$ neutrals ν_τ	(3.8 $\pm$ 1.7) $\times 10^{-3}$	656	DESIG=98
$\bar{K}^*(892)^0 \pi^- \nu_\tau$	(2.2 $\pm$ 0.5) $\times 10^{-3}$	656	DESIG=205
$(\bar{K}^*(892)\pi)^- \nu_\tau \rightarrow$ $\pi^- \bar{K}^0 \pi^0 \nu_\tau$	(1.0 $\pm$ 0.4) $\times 10^{-3}$	—	DESIG=250
$K_1(1270)^- \nu_\tau$	(4.7 $\pm$ 1.1) $\times 10^{-3}$	445	DESIG=125

$K_1(1400)^- \nu_\tau$	$(1.7 \pm 2.6) \times 10^{-3}$	$S=1.7$	335	DESIG=126
$K^*(1410)^- \nu_\tau$	$(1.5 \pm 1.4 \pm 1.0) \times 10^{-3}$		326	DESIG=279
$K_0^*(1430)^- \nu_\tau$	$< 5 \times 10^{-4}$	CL=95%	317	DESIG=280
$K_2^*(1430)^- \nu_\tau$	$< 3 \times 10^{-3}$	CL=95%	315	DESIG=22
$\eta \pi^- \nu_\tau$	$< 9.9 \times 10^{-5}$	CL=95%	797	DESIG=14
$\eta \pi^- \pi^0 \nu_\tau$	$[g] (1.39 \pm 0.07) \times 10^{-3}$		778	DESIG=58
$\eta \pi^- \pi^0 \pi^0 \nu_\tau$	$[g] (1.9 \pm 0.4) \times 10^{-4}$		746	DESIG=68
$\eta K^- \nu_\tau$	$[g] (1.55 \pm 0.08) \times 10^{-4}$		720	DESIG=109
$\eta K^*(892)^- \nu_\tau$	$(1.38 \pm 0.15) \times 10^{-4}$		511	DESIG=265
$\eta K^- \pi^0 \nu_\tau$	$[g] (4.8 \pm 1.2) \times 10^{-5}$		665	DESIG=266
$\eta K^- \pi^0 (\text{non-}K^*(892)) \nu_\tau$	$< 3.5 \times 10^{-5}$	CL=90%	—	DESIG=309
$\eta \bar{K}^0 \pi^- \nu_\tau$	$[g] (9.4 \pm 1.5) \times 10^{-5}$		661	DESIG=267
$\eta \bar{K}^0 \pi^- \pi^0 \nu_\tau$	$< 5.0 \times 10^{-5}$	CL=90%	590	DESIG=310
$\eta K^- K^0 \nu_\tau$	$< 9.0 \times 10^{-6}$	CL=90%	430	DESIG=311
$\eta \pi^+ \pi^- \pi^- \geq 0$ neutrals ν_τ	$< 3 \times 10^{-3}$	CL=90%	744	DESIG=66
$\eta \pi^- \pi^+ \pi^- \nu_\tau (\text{ex. } K^0)$	$[g] (2.20 \pm 0.13) \times 10^{-4}$		744	DESIG=230
$\eta \pi^- \pi^+ \pi^- \nu_\tau (\text{ex. } K^0, f_1(1285))$	$(9.9 \pm 1.6) \times 10^{-5}$		—	DESIG=314
$\eta a_1(1260)^- \nu_\tau \rightarrow \eta \pi^- \rho^0 \nu_\tau$	$< 3.9 \times 10^{-4}$	CL=90%	—	DESIG=231
$\eta \eta \pi^- \nu_\tau$	$< 7.4 \times 10^{-6}$	CL=90%	637	DESIG=69
$\eta \eta \pi^- \pi^0 \nu_\tau$	$< 2.0 \times 10^{-4}$	CL=95%	559	DESIG=70
$\eta \eta K^- \nu_\tau$	$< 3.0 \times 10^{-6}$	CL=90%	382	DESIG=312
$\eta'(958) \pi^- \nu_\tau$	$< 4.0 \times 10^{-6}$	CL=90%	620	DESIG=232
$\eta'(958) \pi^- \pi^0 \nu_\tau$	$< 1.2 \times 10^{-5}$	CL=90%	591	DESIG=233
$\eta'(958) K^- \nu_\tau$	$< 2.4 \times 10^{-6}$	CL=90%	495	DESIG=326
$\phi \pi^- \nu_\tau$	$(3.4 \pm 0.6) \times 10^{-5}$		585	DESIG=207
$\phi K^- \nu_\tau$	$[g] (4.4 \pm 1.6) \times 10^{-5}$		445	DESIG=223
$f_1(1285) \pi^- \nu_\tau$	$(3.9 \pm 0.5) \times 10^{-4}$	$S=1.9$	408	DESIG=234
$f_1(1285) \pi^- \nu_\tau \rightarrow \eta \pi^- \pi^+ \pi^- \nu_\tau$	$(1.18 \pm 0.07) \times 10^{-4}$	$S=1.3$	—	DESIG=235
$f_1(1285) \pi^- \nu_\tau \rightarrow 3\pi^- 2\pi^+ \nu_\tau$	$[g] (5.2 \pm 0.4) \times 10^{-5}$		—	DESIG=315
$\pi(1300)^- \nu_\tau \rightarrow (\rho \pi)^- \nu_\tau \rightarrow (3\pi)^- \nu_\tau$	$< 1.0 \times 10^{-4}$	CL=90%	—	DESIG=276
$\pi(1300)^- \nu_\tau \rightarrow ((\pi \pi)_{S\text{-wave}} \pi)^- \nu_\tau \rightarrow (3\pi)^- \nu_\tau$	$< 1.9 \times 10^{-4}$	CL=90%	—	DESIG=277
$h^- \omega \geq 0$ neutrals ν_τ	$(2.40 \pm 0.08) \%$		708	DESIG=71
$h^- \omega \nu_\tau$	$(1.99 \pm 0.06) \%$		708	DESIG=8
$\pi^- \omega \nu_\tau$	$[g] (1.95 \pm 0.06) \%$		708	DESIG=339
$K^- \omega \nu_\tau$	$[g] (4.1 \pm 0.9) \times 10^{-4}$		610	DESIG=295
$h^- \omega \pi^0 \nu_\tau$	$[g] (4.1 \pm 0.4) \times 10^{-3}$		684	DESIG=113
$h^- \omega 2\pi^0 \nu_\tau$	$(1.4 \pm 0.5) \times 10^{-4}$		644	DESIG=237
$\pi^- \omega 2\pi^0 \nu_\tau$	$[g] (7.2 \pm 1.6) \times 10^{-5}$		644	DESIG=317
$h^- 2\omega \nu_\tau$	$< 5.4 \times 10^{-7}$	CL=90%	250	DESIG=302
$2h^- h^+ \omega \nu_\tau$	$(1.20 \pm 0.22) \times 10^{-4}$		641	DESIG=287
$2\pi^- \pi^+ \omega \nu_\tau (\text{ex. } K^0)$	$[g] (8.4 \pm 0.6) \times 10^{-5}$		641	DESIG=316

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

NODE=S035;CLUMP=A

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.

NODE=S035

$e^- \gamma$	LF	$< 3.3 \times 10^{-8}$	CL=90%	888	DESIG=32
$e^- \gamma \gamma$	LF	$< 2.5 \times 10^{-4}$	CL=90%	888	DESIG=355
$\mu^- \gamma$	LF	$< 4.2 \times 10^{-8}$	CL=90%	885	DESIG=31
$\mu^- \gamma \gamma$	LF	$< 5.8 \times 10^{-4}$	CL=90%	885	DESIG=356
$e^- \pi^0$	LF	$< 8.0 \times 10^{-8}$	CL=90%	883	DESIG=40
$\mu^- \pi^0$	LF	$< 1.1 \times 10^{-7}$	CL=90%	880	DESIG=39
$e^- K_S^0$	LF	$< 8 \times 10^{-9}$	CL=90%	819	DESIG=42
$\mu^- K_S^0$	LF	$< 1.2 \times 10^{-8}$	CL=90%	815	DESIG=41

$e^- \eta$	LF	< 9.2	$\times 10^{-8}$ CL=90%	804	DESIG=67
$\mu^- \eta$	LF	< 6.5	$\times 10^{-8}$ CL=90%	800	DESIG=114
$e^- \rho^0$	LF	< 2.2	$\times 10^{-8}$ CL=90%	719	DESIG=44
$\mu^- \rho^0$	LF	< 1.7	$\times 10^{-8}$ CL=90%	715	DESIG=43
$e^- \omega$	LF	< 2.4	$\times 10^{-8}$ CL=90%	716	DESIG=305
$\mu^- \omega$	LF	< 3.9	$\times 10^{-8}$ CL=90%	711	DESIG=306
$e^- K^{*}(892)^0$	LF	< 1.9	$\times 10^{-8}$ CL=90%	665	DESIG=53
$\mu^- K^{*}(892)^0$	LF	< 2.9	$\times 10^{-8}$ CL=90%	659	DESIG=54
$e^- \bar{K}^{*}(892)^0$	LF	< 1.7	$\times 10^{-8}$ CL=90%	665	DESIG=131
$\mu^- \bar{K}^{*}(892)^0$	LF	< 4.3	$\times 10^{-8}$ CL=90%	659	DESIG=132
$e^- \eta'(958)$	LF	< 1.6	$\times 10^{-7}$ CL=90%	630	DESIG=292
$\mu^- \eta'(958)$	LF	< 1.3	$\times 10^{-7}$ CL=90%	625	DESIG=293
$e^- f_0(980) \rightarrow e^- \pi^+ \pi^-$	LF	< 3.2	$\times 10^{-8}$ CL=90%	—	DESIG=307
$\mu^- f_0(980) \rightarrow \mu^- \pi^+ \pi^-$	LF	< 3.4	$\times 10^{-8}$ CL=90%	—	DESIG=308
$e^- \phi$	LF	< 2.0	$\times 10^{-8}$ CL=90%	596	DESIG=255
$\mu^- \phi$	LF	< 2.3	$\times 10^{-8}$ CL=90%	590	DESIG=256
$e^- e^+ e^-$	LF	< 2.7	$\times 10^{-8}$ CL=90%	888	DESIG=38
$e^- \mu^+ \mu^-$	LF	< 2.7	$\times 10^{-8}$ CL=90%	882	DESIG=36
$e^+ \mu^- \mu^-$	LF	< 1.7	$\times 10^{-8}$ CL=90%	882	DESIG=55
$\mu^- e^+ e^-$	LF	< 1.8	$\times 10^{-8}$ CL=90%	885	DESIG=37
$\mu^+ e^- e^-$	LF	< 1.5	$\times 10^{-8}$ CL=90%	885	DESIG=56
$\mu^- \mu^+ \mu^-$	LF	< 1.9	$\times 10^{-8}$ CL=90%	873	DESIG=35
$e^- \pi^+ \pi^-$	LF	< 2.3	$\times 10^{-8}$ CL=90%	877	DESIG=45
$e^+ \pi^- \pi^-$	L	< 2.0	$\times 10^{-8}$ CL=90%	877	DESIG=46
$\mu^- \pi^+ \pi^-$	LF	< 2.1	$\times 10^{-8}$ CL=90%	866	DESIG=47
$\mu^+ \pi^- \pi^-$	L	< 3.9	$\times 10^{-8}$ CL=90%	866	DESIG=48
$e^- \pi^+ K^-$	LF	< 3.7	$\times 10^{-8}$ CL=90%	813	DESIG=49
$e^- \pi^- K^+$	LF	< 3.1	$\times 10^{-8}$ CL=90%	813	DESIG=77
$e^+ \pi^- K^-$	L	< 3.2	$\times 10^{-8}$ CL=90%	813	DESIG=50
$e^- K_S^0 K_S^0$	LF	< 7.1	$\times 10^{-8}$ CL=90%	736	DESIG=288
$e^- K^+ K^-$	LF	< 3.4	$\times 10^{-8}$ CL=90%	739	DESIG=251
$e^+ K^- K^-$	L	< 3.3	$\times 10^{-8}$ CL=90%	739	DESIG=252
$\mu^- \pi^+ K^-$	LF	< 8.6	$\times 10^{-8}$ CL=90%	800	DESIG=51
$\mu^- \pi^- K^+$	LF	< 4.5	$\times 10^{-8}$ CL=90%	800	DESIG=78
$\mu^+ \pi^- K^-$	L	< 4.8	$\times 10^{-8}$ CL=90%	800	DESIG=52
$\mu^- K_S^0 K_S^0$	LF	< 8.0	$\times 10^{-8}$ CL=90%	696	DESIG=289
$\mu^- K^+ K^-$	LF	< 4.4	$\times 10^{-8}$ CL=90%	699	DESIG=253
$\mu^+ K^- K^-$	L	< 4.7	$\times 10^{-8}$ CL=90%	699	DESIG=254
$e^- \pi^0 \pi^0$	LF	< 6.5	$\times 10^{-6}$ CL=90%	878	DESIG=224
$\mu^- \pi^0 \pi^0$	LF	< 1.4	$\times 10^{-5}$ CL=90%	867	DESIG=225
$e^- \eta \eta$	LF	< 3.5	$\times 10^{-5}$ CL=90%	699	DESIG=226
$\mu^- \eta \eta$	LF	< 6.0	$\times 10^{-5}$ CL=90%	653	DESIG=227
$e^- \pi^0 \eta$	LF	< 2.4	$\times 10^{-5}$ CL=90%	798	DESIG=228
$\mu^- \pi^0 \eta$	LF	< 2.2	$\times 10^{-5}$ CL=90%	784	DESIG=229
$p e^- e^-$	L,B	< 3.0	$\times 10^{-8}$ CL=90%	641	DESIG=351
$\bar{p} e^+ e^-$	L,B	< 3.0	$\times 10^{-8}$ CL=90%	641	DESIG=352
$\bar{p} e^+ \mu^-$	L,B	< 2.0	$\times 10^{-8}$ CL=90%	635	DESIG=353
$\bar{p} e^- \mu^+$	L,B	< 1.8	$\times 10^{-8}$ CL=90%	635	DESIG=354
$p \mu^- \mu^-$	L,B	< 4.0	$\times 10^{-8}$ CL=90%	618	DESIG=334
$\bar{p} \mu^+ \mu^-$	L,B	< 1.8	$\times 10^{-8}$ CL=90%	618	DESIG=335
$\bar{p} \gamma$	L,B	< 3.5	$\times 10^{-6}$ CL=90%	641	DESIG=104
$\bar{p} \pi^0$	L,B	< 1.5	$\times 10^{-5}$ CL=90%	632	DESIG=105
$\bar{p} 2\pi^0$	L,B	< 3.3	$\times 10^{-5}$ CL=90%	604	DESIG=268
$\bar{p} \eta$	L,B	< 8.9	$\times 10^{-6}$ CL=90%	475	DESIG=106
$\bar{p} \pi^0 \eta$	L,B	< 2.7	$\times 10^{-5}$ CL=90%	360	DESIG=269
$\Lambda \pi^-$	L,B	< 4.7	$\times 10^{-8}$ CL=90%	525	DESIG=297
$\bar{\Lambda} \pi^-$	L,B	< 4.3	$\times 10^{-8}$ CL=90%	525	DESIG=298
$e^- \text{light boson}$	LF	< 4.5	$\times 10^{-4}$ CL=90%	—	DESIG=102
$\mu^- \text{light boson}$	LF	< 2.8	$\times 10^{-4}$ CL=90%	—	DESIG=103

Heavy Charged Lepton Searches

$L^\pm$ – charged lepton

Mass $m > 100.8$ GeV, CL = 95% ^[h] Decay to νW .

NODE=S025

CLUMP=A

NODE=S025MS;DTYPE=M;CLUMP=A

$L^\pm$ – stable charged heavy leptonMass $m > 102.6$ GeV, CL = 95%

CLUMP=Y

NODE=S025MSS;DTYPE=M;CLUMP=Y

Neutrino Properties

See the note on “Neutrino properties listings” in the Particle Listings.

Mass $m < 0.45$ eV, CL = 90% (tritium decay)Mean life/mass, $\tau/m > 300$ s/eV, CL = 90% (reactor)Mean life/mass, $\tau/m > 7 \times 10^9$ s/eV (solar)Mean life/mass, $\tau/m > 15.4$ s/eV, CL = 90% (accelerator)Magnetic moment $\mu < 0.064 \times 10^{-10} \mu_B$, CL = 90% (solar + radiochemical)

NODE=S066

NODE=S066MAE;DTYPE=M

NODE=S066TM1;DTYPE=A;OUR LIM;

→ UNCHECKED ←

NODE=S066TM2;DTYPE=A;OUR LIM;

→ UNCHECKED ←

NODE=S066TM3;DTYPE=A;OUR LIM;

→ UNCHECKED ←

NODE=S066MGM;DTYPE=m

Number of Neutrino TypesNumber $N = 2.996 \pm 0.007$ (Standard Model fits to LEP-SLC data)Number $N = 2.92 \pm 0.05$ ($S = 1.2$) (Direct measurement of invisible Z width)

NODE=S007

NODE=S007NE;DTYPE=N;CLUMP=N

NODE=S007NI;DTYPE=N;CLUMP=N

Neutrino Mixing

The following values are obtained through data analyses based on the 3-neutrino mixing scheme described in the review “Neutrino Masses, Mixing, and Oscillations.”

$$\sin^2(\theta_{12}) = 0.307 \pm 0.012$$

$$\Delta m_{21}^2 = (7.53 \pm 0.18) \times 10^{-5} \text{ eV}^2$$

$$\sin^2(\theta_{23}) = 0.537 \pm 0.020 \quad (S = 1.2) \quad (\text{Inverted order})$$

$$\sin^2(\theta_{23}) = 0.534^{+0.015}_{-0.019} \quad (\text{Normal order})$$

$$\Delta m_{32}^2 = (-2.524 \pm 0.031) \times 10^{-3} \text{ eV}^2 \quad (S = 1.2) \quad (\text{Inverted order})$$

$$\Delta m_{32}^2 = (2.451 \pm 0.026) \times 10^{-3} \text{ eV}^2 \quad (\text{Normal order})$$

$$\sin^2(\theta_{13}) = (2.17 \pm 0.07) \times 10^{-2} \quad (S = 1.4)$$

$$\delta, CP \text{ violating phase} = 1.21^{+0.19}_{-0.22} \pi \text{ rad} \quad (S = 1.2)$$

$$\langle \Delta m_{21}^2 - \Delta \bar{m}_{21}^2 \rangle < 1.1 \times 10^{-4} \text{ eV}^2, \text{ CL} = 99.7\%$$

$$\langle \Delta m_{32}^2 - \Delta \bar{m}_{32}^2 \rangle = (-0.12 \pm 0.25) \times 10^{-3} \text{ eV}^2$$

NODE=S067

NODE=S067P12;DTYPE=A;CLUMP=A

NODE=S067DM3;DTYPE=A;CLUMP=A

NODE=S067P23;DTYPE=A;CLUMP=B

NODE=S067SM3;DTYPE=A;CLUMP=B;

OUR EVAL; → UNCHECKED ←

NODE=S067DM1;DTYPE=A;CLUMP=B

NODE=S067Q23;DTYPE=A;CLUMP=B;

OUR EVAL; → UNCHECKED ←

NODE=S067P13;DTYPE=A;CLUMP=C

NODE=S067DEL;DTYPE=A

NODE=S067CPT;DTYPE=A

NODE=S067CP2;DTYPE=A

NOTES[a] This is the best limit for the mode $e^- \rightarrow \nu \gamma$.

[b] See the review on “Muon Decay Parameters” for definitions and details.

[c] P_μ is the longitudinal polarization of the muon from pion decay. For $V-A$ coupling, $P_\mu = 1$ and $\rho = \delta = 3/4$.[d] This only includes events with energy of $e > 45$ MeV and energy of $\gamma > 40$ MeV. Since the $e^- \bar{\nu}_e \nu_\mu$ and $e^- \bar{\nu}_e \nu_\mu \gamma$ 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 τ .[h] $L^\pm$ mass limit depends on decay assumptions; see the Full Listings.

LINKAGE=EML

LINKAGE=SWL

LINKAGE=SX

LINKAGE=XMD

LINKAGE=KDM

LINKAGE=CK

LINKAGE=BB

LINKAGE=LPM