

CONSTITUÍNTES ELEMENTARES DA MATÉRIA

QUARKS

u (up)

d (down)

c (charm)

s (strange)

t (top)

b (beauty)

LEPTÕES

e (electrão)

ν_e (neutrino-e)

μ (muão)

ν_μ (neutrino- μ)

τ (tau)

ν_τ (neutrino- τ)

+ ANTIPARTÍCULAS

BOSÕES DE GAUGE (intermediários das interações)

γ (fotão)

-

interacção electromagnética

W^\pm, Z (bosões fracos)

interacção fraca

$g_i, i=1...8$ (gluões)

interacção forte

BOSÃO DE HIGGS

H

← não observado experimentalmente

HADRÕES

→ PARTÍCULAS COMPOSTAS DE QUARKS

MESÕES : estados $q\bar{q}$ $q \equiv$ quark

BARÍONES : estados qqq ou $\bar{q}\bar{q}\bar{q}$

NÃO SE OBSERVAM QUARKS LIVRES

○ PROTÃO E O NEUTRÃO SÃO BARÍONES

PROTÃO (p) : uud

NEUTRÃO (n) : ddu

Genericamente
designados por
NUCLÉONS

CARGA ELÉCTRICA dos QUARKS

$$Q_u = 2/3 = Q_c = Q_t$$

$$Q_d = -1/3 = Q_s = Q_b$$

TABLES OF PARTICLE PROPERTIES

April 1984

M. Aguilar-Benitez, R.N. Cahn, R.L. Crawford, R. Frosch, G.P. Gopal, R.E. Hendrick, J.J. Hernandez, G. Höhler, M.J. Losty, L. Montanet, F.C. Porter, A. Rittenberg, M. Roos, L.D. Roper, T. Shimada, R.E. Shrock, N.A. Törnqvist, T.G. Trippe, W.P. Trower, Ch. Walck, C.G. Wohl, G.P. Yost, and B. Armstrong (Technical Associate)

(Closing date for data: Jan. 1, 1984)

Stable Particle Table

*(decaiminto fraco
on electromagnético)*

For additional parameters, see Addendum to this table.

Quantities in italics are new or have changed by more than one (old) standard deviation since April 1982.

Particle	$I^G(J^PC)^a$	Mass ^b (MeV)	Mean life ^b (sec) $c\tau$ (cm)	Partial decay mode		p or P _{max} ^c (MeV/c)
				Mode	Fraction ^b	
GAUGE BOSONS						
γ	0,1(1 ⁻) ⁻	(< 3×10 ⁻³³)	—	stable		
W		<u>80800</u> ±2700	<u>81700</u> ±1500	$\Gamma < 7$ GeV	<u>ev</u> (seen)	40400
Z		<u>92900</u> ±1600	<u>4.6</u>	$\Gamma < 8.5$ GeV	e^+e^- (seen) $\mu^+\mu^-$ (seen)	46450 46450
→ weak gauge boson searches						
LEPTONS						
ν_e	$J = \frac{1}{2}$	(< 0.000046) ^d	stable (> 3×10 ⁸ m _e (MeV))	stable		
e	$J = \frac{1}{2}$	<u>0.5110034</u> ±0.0000014	stable (> 2×10 ²² y)	stable		
ν_μ	$J = \frac{1}{2}$	0 (< 0.50)	stable (> 1.1×10 ⁵ m _{ν_μ} (MeV))	stable		
μ	$J = \frac{1}{2}$	<u>105.65932</u> ±0.00029	<u>2.19709×10⁻⁶</u> ±0.00005 $c\tau = 6.5867 \times 10^4$	$\mu^- \rightarrow \mu^+ \rightarrow$ chg. conj.) $e^- \nu \nu$ $e^- \nu \nu \gamma$ $e^- \nu e \nu$ $e^- \nu \nu e^+ e^-$ $e^- \gamma$ $e^- e^+ e^-$ $e^- \gamma \gamma$	(100 %) { 1.4 ± 0.4 % (< 5 %) } { 2.2 ± 1.5 } × 10 ⁻⁵ (< 1.7) × 10 ⁻¹⁰ (< 1.9) × 10 ⁻⁹ (< 8.4) × 10 ⁻⁹	53 53 53 53 53 53
ν_τ	$J = \frac{1}{2}$	< 164				
τ	$J = \frac{1}{2}$	<u>1784.2</u> ±3.2	<u>(3.4 ± 0.5) × 10⁻¹³</u> $c\tau = 0.010$	$\tau^- \rightarrow \tau^+ \rightarrow$ chg. conj.) $\mu^- \nu \nu$ $e^- \nu \nu$ hadron ⁻ neutrals 3(hadron [±]) neutrals 5(hadron [±]) neutrals † 3(hadron [±]) ν 3(hadron [±]) ν (> 1 γ) † $\pi^- \nu$ $\rho^- \nu$ $K^- \nu$ K ⁻ neutrals	(18.5 ± 1.1) % (16.5 ± 0.9) % (48.1 ± 2.0) % S=1.1* (17.0 ± 1.3) % S=1.2* (< 1.4) % (5 ± 4) % (12 ± 4) % (10.3 ± 1.2) % (22.1 ± 2.4) % (1.3 ± 0.5) % (small) %	889 892 887 726 824

(continued next page)

Stable Particle Table (cont'd)

Particle	$\Gamma^G(J^P)C^a$	Mass ^b (MeV)	Mean life ^b (sec) $c\tau$ (cm)	Partial decay mode		p or p_{max}^c (MeV/c)
				Mode	Fraction ^b	
τ^- (or $\tau^+ \rightarrow$ chg. conj.)						
τ (continued)				$\dagger[K^{*0}(892)\nu$	(1.7 ± 0.7)%	669
				$K^{*0}(1430)\nu$	(<0.9)%	323
				$\pi^- \rho^0 \nu$	(5.4 ± 1.7)%	718
				e^- chgd.parts.		
				+ μ^- chgd.parts.	(<4)%	
				$\mu^- \gamma$	(<5.5) $\times 10^{-4}$	889
				$e^- \gamma$	(<6.4) $\times 10^{-4}$	892
				$\mu^- \mu^+ \mu^-$	(<4.9) $\times 10^{-4}$	876
				$e^- \mu^+ \mu^-$	(<3.3) $\times 10^{-4}$	886
				$\mu^- e^+ e^-$	(<4.4) $\times 10^{-4}$	889
				$e^- e^+ e^-$	(<4.0) $\times 10^{-4}$	892
				$\mu^- \pi^0$	(<8.2) $\times 10^{-4}$	884
				$e^- \pi^0$	(<2.1) $\times 10^{-3}$	887
				$\mu^- K^0$	(<1.0) $\times 10^{-3}$	819
				$e^- K^0$	(<1.3) $\times 10^{-3}$	823
			$\mu^- \rho^0$	(<4.4) $\times 10^{-4}$	722	
			$e^- \rho^0$	(<3.7) $\times 10^{-4}$	726	

- searches for massive neutrinos and lepton mixing
- ν bounds from astrophysics and cosmology
- heavy lepton searches

NONSTRANGE MESONS^a

Particle	$\Gamma^G(J^P)C^a$	Mass ^b (MeV)	Mean life ^b (sec) $c\tau$ (cm)	Partial decay mode		p or p_{max}^c (MeV/c)				
				Mode	Fraction ^b					
π^\pm (or $\pi^\pm \rightarrow$ chg. conj.)										
π^\pm	$1^-(0^-)$	139.5673 ±0.0007	2.6030 $\times 10^{-8}$ ±0.0023 $c\tau=780.4$	$\mu^\pm \nu$	100%	30				
				$e^\pm \nu$	(1.232 ± 0.024) $\times 10^{-4}$	70				
				$\dagger[\mu^\pm \nu \gamma$	(1.24 ± 0.25) $\times 10^{-4}$	30				
				$e^\pm \nu \gamma$	(5.6 ± 0.7) $\times 10^{-8}$	70				
				$e^\pm \nu \pi^0$	(1.033 ± 0.034) $\times 10^{-8}$	5				
				$e^\pm \nu e^+ e^-$	(<5) $\times 10^{-9}$	70				
				$\mu^\pm \nu e$	(<1.5) $\times 10^{-3}$	30				
			$\mu^\pm \nu e$	(<8) $\times 10^{-3}$	30					
π^0	$1^-(0^-)+$	134.9630 ±0.0038	0.83 $\times 10^{-16}$ ±0.06 S=1.8* $c\tau=2.5 \times 10^{-6}$	$\gamma\gamma$	(98.802 ± 0.030)%	67				
				$\gamma e^+ e^-$	(1.198)%	67				
				$\gamma\gamma\gamma$	(<3.8) $\times 10^{-7}$	67				
				$e^+ e^- e^+ e^-$	(3.24) $\times 10^{-5}$	67				
				$\gamma\gamma\gamma\gamma$	(<4) $\times 10^{-6}$	67				
				$e^+ e^-$	(1.8 ± 0.7) $\times 10^{-7}$	67				
				$\nu\nu$	(<2.4) $\times 10^{-5}$	67				
				$\mu^+ e^- + \mu^- e^+$	(<7) $\times 10^{-8}$	26				
				η	$0^+(0^-)+$	548.8 ±0.6 S=1.4*	$\Gamma=(0.88 \pm 0.12)\text{keV}$ Neutral decays (70.9 ± 0.7)%	$\gamma\gamma$	(39.0 ± 0.8)%	274
								$3\pi^0$	(31.8 ± 0.8)%	180
$\pi^0 \gamma\gamma$	(0.10 ± 0.02)%	258								
$\pi^+ \pi^- \pi^0$	(23.7 ± 0.5)%	175								
$\pi^+ \pi^- \gamma$	(4.91 ± 0.13)%	236								
$e^+ e^- \gamma$	(0.50 ± 0.12)%	274								
$\mu^+ \mu^- \gamma$	(3.1 ± 0.4) $\times 10^{-4}$	253								
$e^+ e^-$	(<3) $\times 10^{-4}$	274								
$\mu^+ \mu^-$	(6.5 ± 2.1) $\times 10^{-6}$	253								
$\pi^+ \pi^- e^+ e^-$	(0.13 ± 0.13)%	236								
$\pi^+ \pi^- \gamma\gamma$	(<0.21)%	236								
$\pi^+ \pi^- \pi^0 \gamma$	(<6) $\times 10^{-4}$	175								
$\pi^+ \pi^-$	(<0.15)%	236								
$\pi^0 e^+ e^-$	(<5) $\times 10^{-5}$	258								
$\pi^0 \mu^+ \mu^-$	(<5) $\times 10^{-6}$	211								
	$\pi^0 \mu^+ \mu^- \gamma$	(<3) $\times 10^{-6}$	211							

$\mu\bar{d}$
 $\bar{d}\mu$

$\mu\bar{u}, d\bar{d}$

$\mu\bar{u}, d\bar{d}$