

ELEMENTARY PARTICLE CARDS

- This document contains 61 elementary particle cards. 24 matter and antimatter particles, 12 exchange particles, and the Higgs boson.
- ▶ They should be printed out in color on thick paper, cut out, and laminated.
- Use the cards to stimulate ideas as well as questions and answers for learning about elementary particles.

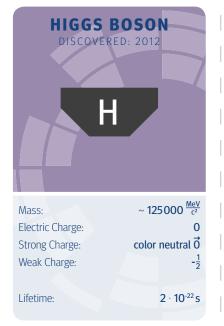
EXCHANGE PARTICLES AND HIGGS-BOSON













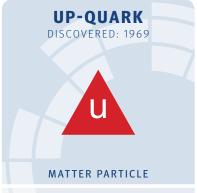
MATERIAL

MATTER PARTICLES: QUARKS

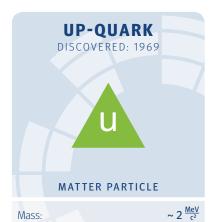




Mass:	~ 2 MeV/c²
Electric Charge:	+ \frac{2}{3}
Strong Charge:	blue
Weak Charge:	+\frac{1}{2}
Lifetime:	unlimited



MATTERI	711110EE
Mass: Electric Charge:	$\sim 2 \frac{\text{MeV}}{\text{c}^2} + \frac{2}{3}$
Strong Charge: Weak Charge:	red + 1/2
Lifetime:	unlimited
2.104.1101	u







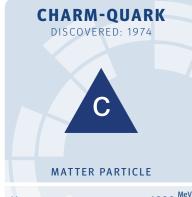




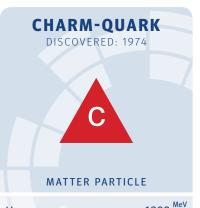
Mass:	~ 5 MeV/c²
Electric Charge:	-1/3
Strong Charge:	red_
Weak Charge:	-1/2
Lifetime:	880 s



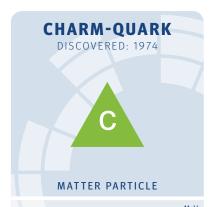




Mass:	~ 1300 MeV c²
Electric Charge:	+ $\frac{2}{3}$
Strong Charge:	blue
Weak Charge:	+\frac{1}{2}
Lifetime:	10 ⁻¹² s



Mass:	~ 1300 MeV c2
Electric Charge:	$+\frac{2}{3}$
Strong Charge:	red
Weak Charge:	+1/2
Lifetime:	10 ⁻¹² s



Mass:	~ 1300 MeV c ²
Electric Charge:	$+\frac{2}{3}$
Strong Charge:	green
Weak Charge:	+1/2
Lifetime:	10 ⁻¹² s

MATTER PARTICLES: QUARKS





Mass:	~ 100 MeV c2
Electric Charge:	- <u>1</u>
Strong Charge:	blue
Weak Charge:	$-\frac{1}{2}$
Lifetime:	5 · 10 ⁻⁸ s



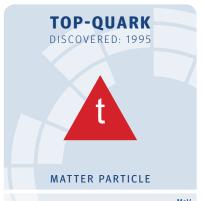
Mass:	$\sim 100 \frac{\text{MeV}}{\text{c}^2}$
Electric Charge:	$-\frac{1}{3}$
Strong Charge:	red
Weak Charge:	$-\frac{1}{2}$
Lifetime:	5 · 10 ⁻⁸ s



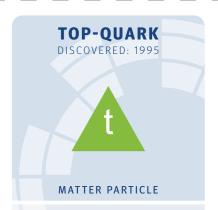




Mass:	$\sim 173000\frac{\text{MeV}}{\text{c}^2}$
Electric Charge:	+ 2/3
Strong Charge:	blue
Weak Charge:	+\frac{1}{2}
Lifetime:	$6 \cdot 10^{-25} \text{s}$



Mass:	$\sim 173000\frac{\text{MeV}}{\text{c}^2}$
Electric Charge:	+ \frac{2}{3}
Strong Charge:	red_
Weak Charge:	+\frac{1}{2}
Lifetime:	6 · 10 ⁻²⁵ s



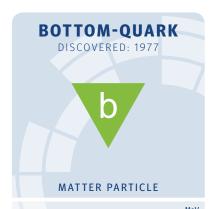




4200 MeV c2
- <u>1</u>
blue
$-\frac{1}{2}$
2 · 10 ⁻¹² s



Mass:	~ 4200 MeV/c²
Electric Charge:	$-\frac{1}{3}$
Strong Charge:	red_
Weak Charge:	-1/2
Lifetime:	2 · 10 ⁻¹² s

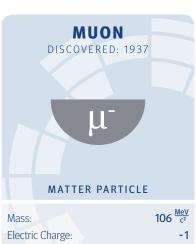


Mass:	$\sim 4200 \frac{\text{MeV}}{\text{c}^2}$
Electric Charge:	$-\frac{1}{3}$
Strong Charge:	green
Weak Charge:	-1/2
Lifetime:	$2 \cdot 10^{-12} s$

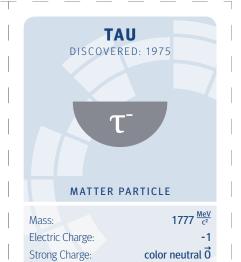


MATTER PARTICLES: LEPTONS



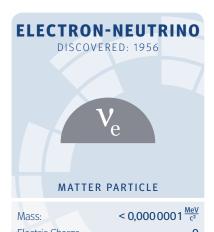






Weak Charge:

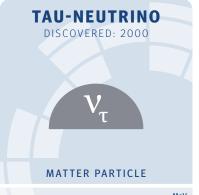
Lifetime:







Mass:	$< 0.0000001 \frac{\text{MeV}}{\text{c}^2}$
Electric Charge:	0
Strong Charge:	color neutral $\vec{0}$
Weak Charge:	+ 1/2
Lifetime:	undefined



2,9 · 10⁻¹³ s

Mass:	< 0,000 000 1 MeV/c²
Electric Charge:	0
Strong Charge:	color neutral $\vec{0}$
Weak Charge:	+ 1/2
Lifetime:	undefined



MATTER PARTICLES: ANTI-QUARKS





Mass:	$\sim 2 \frac{\text{MeV}}{\text{c}^2}$
Electric Charge:	- 2 /3
Strong Charge:	anti-blue
Weak Charge:	- 1/2
Lifetime:	unlimited



Mass:	~ 2 MeV c²
Electric Charge:	- 2/3
Strong Charge:	anti-red 🖊
Weak Charge:	$-\frac{1}{2}$
Lifetime:	unlimited











Mass:	~ 1300 MeV/c²
Electric Charge:	-2 -3
Strong Charge:	anti-red 🖊
Weak Charge:	-1/2
Lifations	10 ⁻¹² s
Lifetime:	10 5







Mass:	$\sim 173000\frac{\text{MeV}}{c^2}$
Electric Charge:	-2/3
Strong Charge:	anti-blue†
Weak Charge:	$-\frac{1}{2}$
	25
Lifetime:	6 · 10 ⁻²⁵ s



Mass:	$\sim 173000\frac{\text{MeV}}{c^2}$
Electric Charge:	-2/3
Strong Charge:	anti-red Weak Charge:
	-1/2
Lifetime:	6 · 10 ⁻²⁵ s



Mass:	$\sim 173000\frac{\text{MeV}}{\text{c}^2}$
Electric Charge:	$-\frac{2}{3}$
Strong Charge:	anti-green
Weak Charge:	-1/2
Lifetime:	6 · 10 ⁻²⁵ s



MATTER PARTICLES: ANTI-QUARKS





ANTIMATTER PARTICLE

Mass:	$\sim 5 \frac{\text{MeV}}{\text{c}^2}$
Electric Charge:	+ 1/3
Strong Charge:	anti-blue
Weak Charge:	+ 1/2
Lifetime:	880 s

ANTI-DOWN QUARK DISCOVERED: 1969 ANTIMATTER PARTICLE

Mass:	$\sim 5\frac{\text{MeV}}{c^2}$
Electric Charge:	+ 1/3
Strong Charge:	anti-red 🗸
Weak Charge:	+ 1/2
Lifetime:	880 s







DISCOVERED: 1969



ANTIMATTER PARTICLE

Mass:	$\sim 100 \frac{\text{MeV}}{\text{c}^2}$
Electric Charge:	+ \frac{1}{3}
Strong Charge:	anti-blue
Weak Charge:	$+\frac{1}{2}$
Lifetime:	5 · 10 ⁻⁸ s



ANTIMATTER PARTICLE

Mass:	$\sim 100 \frac{\text{MeV}}{\text{c}^2}$
Electric Charge:	+ 1/3
Strong Charge:	anti-red 🖊
Weak Charge:	+ 1/2
Lifetime:	5 · 10 ⁻⁸ s



Mass:	$\sim 100 \frac{\text{MeV}}{c^2}$
Electric Charge:	+ \frac{1}{3}
Strong Charge:	anti-green
Weak Charge:	+ 1/2
Lifetime:	5 · 10 ⁻⁸ s

ANTI-BOTTOM QUARK

DISCOVERED: 1977



ANTIMATTER PARTICLE

Mass:	$\sim 4200\frac{\text{MeV}}{c^2}$
Electric Charge:	+ 1/3
Strong Charge:	anti-blue
Weak Charge:	+ 1/2
Lifetime:	$2 \cdot 10^{-12} \text{s}$

ANTI-BOTTOM QUARK DISCOVERED: 1977



ANTIMATTER PARTICLE

Mass:	$\sim 4200\frac{\text{MeV}}{c^2}$
Electric Charge:	+ \frac{1}{3}
Strong Charge:	anti-red 🖊
Weak Charge:	+ \frac{1}{2}
Lifetime:	2 · 10 ⁻¹² s

ANTI-BOTTOM QUARK

DISCOVERED: 1977



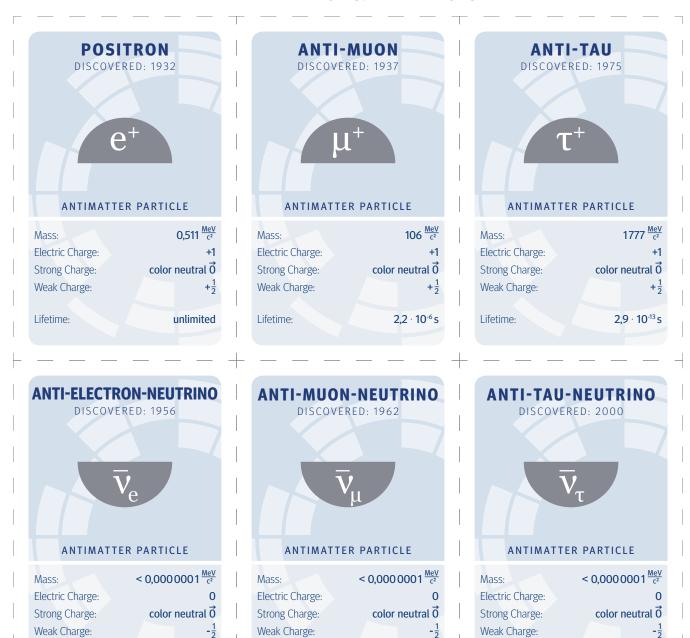
ANTIMATTER PARTICLE

Mass:	$\sim 4200\frac{\text{MeV}}{\text{c}^2}$
Electric Charge:	+ 1/3
Strong Charge:	anti-green
Weak Charge:	+ 1/2
Lifetime:	$2 \cdot 10^{-12} s$





MATTER PARTICLES: ANTI-LEPTONS





Lifetime:

undefined

Lifetime:

undefined

Lifetime:

undefined

EXCHANGE PARTICLES: GLUONS





Mass: Electric Charge:	$0 \frac{\text{MeV}}{\text{c}^2}$
Strong Charge: Weak Charge:	red + anti-green 0
Lifetime: Range:	unlimited 10 ⁻¹⁵ m

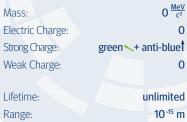


$0 \frac{\text{MeV}}{\text{c}^2}$
0
red + anti-blue
0
unlimited
10 ⁻¹⁵ m



Mass:	$0 \frac{\text{MeV}}{\text{C}^2}$
Electric Charge:	0
Strong Charge:	green + anti-red
Weak Charge:	0
Lifetime:	unlimited
Range:	10 ⁻¹⁵ m



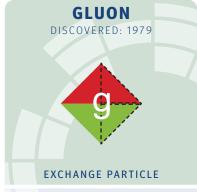




$0^{\frac{c}{C^2}}$	Mass:
0	Electric Charge:
blue+ anti-red	Strong Charge:
0	Weak Charge:
unlimited	Lifetime:
10 ⁻¹⁵ m	Range:







Mass:	$0 \frac{\text{MeV}}{c^2}$
Electric Charge:	0
Strong Charge:	red + anti-red
or gre	een + anti-green
Weak Charge:	0
Lifetime:	unlimited
Range:	10 ⁻¹⁵ m



Mass:	$0 \frac{\text{MeV}}{\text{c}^2}$
Electric Charge:	0
Strong Charge: red green + anti-green or b	l → + anti-red → or blue
Weak Charge:	0
Lifetime:	unlimited
Range:	10 ⁻¹⁵ m

