

three generations of matter
(fermions)

interactions / forces
(bosons)

	I	II	III	
mass	$\approx 2.2 \text{ MeV}$	$\approx 1.3 \text{ GeV}$	$\approx 173 \text{ GeV}$	0
charge	$+2/3$	$+2/3$	$+2/3$	0
spin	$1/2$	$1/2$	$1/2$	1
	u up	c charm	t top	g gluon
	d down	s strange	b bottom	γ photon
	e electron	μ muon	τ tau	W W boson
	ν_e electron neutrino	ν_μ muon neutrino	ν_τ tau neutrino	Z Z boson
				$\approx 125 \text{ GeV}$ 0 0 H Higgs

QUARKS

LEPTONS

GAUGE BOSONS
VECTOR BOSONS

SCALAR BOSONS

three generations of matter
(fermions)

interactions / forces
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I

II

III

mass
charge
spin

$\approx 2.2 \text{ MeV}$
 $+2/3$
 $1/2$
u
up

$\approx 1.3 \text{ GeV}$
 $+2/3$
 $1/2$
c
charm

$\approx 173 \text{ GeV}$
 $+2/3$
 $1/2$
t
top

0
0
1
g
gluon

$\approx 125 \text{ GeV}$
0
0
H
Higgs

QUARKS

$\approx 4.7 \text{ MeV}$
 $-1/3$
 $1/2$
d
down

$\approx 96 \text{ MeV}$
 $-1/3$
 $1/2$
s
strange

$\approx 4.2 \text{ GeV}$
 $-1/3$
 $1/2$
b
bottom

0
0
1
 γ
photon

SCALAR BOSONS

$\approx 0.511 \text{ MeV}$
 -1
 $1/2$
e
electron

$\approx 106 \text{ MeV}$
 -1
 $1/2$
 μ
muon

$\approx 1.777 \text{ GeV}$
 -1
 $1/2$
 τ
tau

$\approx 80.4 \text{ GeV}$
 ± 1
1
W
W boson

GAUGE BOSONS

VECTOR BOSONS

LEPTONS

$< 1.0 \text{ eV}$
0
 $1/2$
 ν_e
electron neutrino

$< 0.17 \text{ eV}$
0
 $1/2$
 ν_μ
muon neutrino

$< 18.2 \text{ MeV}$
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$\approx 91.2 \text{ GeV}$
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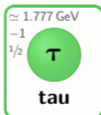
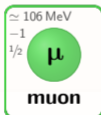


QUARKS



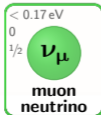
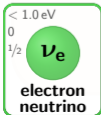
SCALAR BOSONS

LEPTONS



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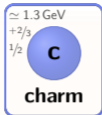
interactions / forces
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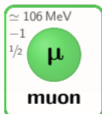
II

III

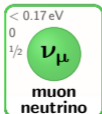
mass
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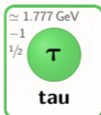
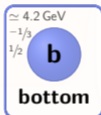
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 $\frac{1}{2}$
 ν_τ
tau neutrino

$\approx 91.2 \text{ GeV}$
0
1
Z
Z boson

three generations of matter
(fermions)

interactions / forces
(bosons)

I

II

III

mass
charge
spin

$\approx 2.2 \text{ MeV}$
 $+2/3$
 $1/2$
u
up

$\approx 1.3 \text{ GeV}$
 $+2/3$
 $1/2$
c
charm

$\approx 173 \text{ GeV}$
 $+2/3$
 $1/2$
t
top

0
0
1
g
gluon

$\approx 125 \text{ GeV}$
0
0
H
Higgs

QUARKS

$\approx 4.7 \text{ MeV}$
 $-1/3$
 $1/2$
d
down

$\approx 96 \text{ MeV}$
 $-1/3$
 $1/2$
s
strange

$\approx 4.2 \text{ GeV}$
 $-1/3$
 $1/2$
b
bottom

0
0
1
 γ
photon

SCALAR BOSONS

LEPTONS

$\approx 0.511 \text{ MeV}$
 -1
 $1/2$
e
electron

$\approx 106 \text{ MeV}$
 -1
 $1/2$
 μ
muon

$\approx 1.777 \text{ GeV}$
 -1
 $1/2$
 τ
tau

$\approx 80.4 \text{ GeV}$
 ± 1
1
W
W boson

GAUGE BOSONS
VECTOR BOSONS

$< 1.0 \text{ eV}$
0
 $1/2$
 ν_e
electron neutrino

$< 0.17 \text{ eV}$
0
 $1/2$
 ν_μ
muon neutrino

$< 18.2 \text{ MeV}$
0
 $1/2$
 ν_τ
tau neutrino

$\approx 91.2 \text{ GeV}$
0
1
Z
Z boson

three generations of matter
(fermions)

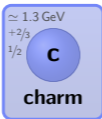
interactions / forces
(bosons)

I

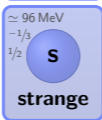
II

III

mass
charge
spin

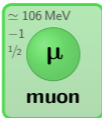


QUARKS



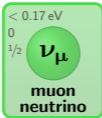
SCALAR BOSONS

LEPTONS



GAUGE BOSONS

VECTOR BOSONS



three generations of matter
(fermions)

interactions / forces
(bosons)

I

II

III

mass
charge
spin

$\simeq 2.2 \text{ MeV}$
 $+2/3$
 $1/2$
u
up

$\simeq 1.3 \text{ GeV}$
 $+2/3$
 $1/2$
c
charm

$\simeq 173 \text{ GeV}$
 $+2/3$
 $1/2$
t
top

0
0
1
g
gluon

$\simeq 125 \text{ GeV}$
0
0
H
Higgs

QUARKS

$\simeq 4.7 \text{ MeV}$
 $-1/3$
 $1/2$
d
down

$\simeq 96 \text{ MeV}$
 $-1/3$
 $1/2$
s
strange

$\simeq 4.2 \text{ GeV}$
 $-1/3$
 $1/2$
b
bottom

0
0
1
 γ
photon

SCALAR BOSONS

LEPTONS

$\simeq 0.511 \text{ MeV}$
 -1
 $1/2$
e
electron

$\simeq 106 \text{ MeV}$
 -1
 $1/2$
 μ
muon

$\simeq 1.777 \text{ GeV}$
 -1
 $1/2$
 τ
tau

$\simeq 80.4 \text{ GeV}$
 ± 1
1
W
W boson

GAUGE BOSONS
VECTOR BOSONS

$< 1.0 \text{ eV}$
0
 $1/2$
 ν_e
electron neutrino

$< 0.17 \text{ eV}$
0
 $1/2$
 ν_μ
muon neutrino

$< 18.2 \text{ MeV}$
0
 $1/2$
 ν_τ
tau neutrino

$\simeq 91.2 \text{ GeV}$
0
1
Z
Z boson

three generations of matter
(fermions)

interactions / forces
(bosons)

I

II

III

mass
charge
spin

$\approx 2.2 \text{ MeV}$
 $+\frac{2}{3}$
 $\frac{1}{2}$

u

up

$\approx 1.3 \text{ GeV}$
 $+\frac{2}{3}$
 $\frac{1}{2}$

c

charm

$\approx 173 \text{ GeV}$
 $+\frac{2}{3}$
 $\frac{1}{2}$

t

top

0
0
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H

Higgs

QUARKS

$\approx 4.7 \text{ MeV}$
 $-\frac{1}{3}$
 $\frac{1}{2}$

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s

strange

$\approx 4.2 \text{ GeV}$
 $-\frac{1}{3}$
 $\frac{1}{2}$

b

bottom

0
0
1

γ

photon

SCALAR BOSONS

LEPTONS

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 -1
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$\approx 106 \text{ MeV}$
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 $\frac{1}{2}$

μ

muon

$\approx 1.777 \text{ GeV}$
 -1
 $\frac{1}{2}$

τ

tau

$\approx 80.4 \text{ GeV}$
 ± 1
1

W

W boson

GAUGE BOSONS
VECTOR BOSONS

$< 1.0 \text{ eV}$
0
 $\frac{1}{2}$

ν_e

electron neutrino

$< 0.17 \text{ eV}$
0
 $\frac{1}{2}$

ν_μ

muon neutrino

$< 18.2 \text{ MeV}$
0
 $\frac{1}{2}$

ν_τ

tau neutrino

$\approx 91.2 \text{ GeV}$
0
1

Z

Z boson

three generations of matter
(fermions)

interactions / forces
(bosons)

I

II

III

mass
charge
spin

$\approx 2.2 \text{ MeV}$
 $+\frac{2}{3}$
 $\frac{1}{2}$
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up

$\approx 1.3 \text{ GeV}$
 $+\frac{2}{3}$
 $\frac{1}{2}$
c
charm

$\approx 173 \text{ GeV}$
 $+\frac{2}{3}$
 $\frac{1}{2}$
t
top

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1
g
gluon

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0
0
H
Higgs

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$\approx 4.7 \text{ MeV}$
 $-\frac{1}{3}$
 $\frac{1}{2}$
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down

$\approx 96 \text{ MeV}$
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 $\frac{1}{2}$
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$\approx 4.2 \text{ GeV}$
 $-\frac{1}{3}$
 $\frac{1}{2}$
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0
1
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photon

SCALAR BOSONS

LEPTONS

$\approx 0.511 \text{ MeV}$
 -1
 $\frac{1}{2}$
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electron

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 -1
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 μ
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$\approx 1.777 \text{ GeV}$
 -1
 $\frac{1}{2}$
 τ
tau

$\approx 80.4 \text{ GeV}$
 ± 1
1
W
W boson

GAUGE BOSONS
VECTOR BOSONS

$< 1.0 \text{ eV}$
0
 $\frac{1}{2}$
 ν_e
electron neutrino

$< 0.17 \text{ eV}$
0
 $\frac{1}{2}$
 ν_μ
muon neutrino

$< 18.2 \text{ MeV}$
0
 $\frac{1}{2}$
 ν_τ
tau neutrino

$\approx 91.2 \text{ GeV}$
0
1
Z
Z boson

three generations of matter
(fermions)

interactions / forces
(bosons)

I

II

III

mass
charge
spin

$\approx 2.2 \text{ MeV}$
 $+2/3$
 $1/2$
u
up

$\approx 1.3 \text{ GeV}$
 $+2/3$
 $1/2$
c
charm

$\approx 173 \text{ GeV}$
 $+2/3$
 $1/2$
t
top

0
0
1
g
gluon

$\approx 125 \text{ GeV}$
0
0
H
Higgs

QUARKS

$\approx 4.7 \text{ MeV}$
 $-1/3$
 $1/2$
d
down

$\approx 96 \text{ MeV}$
 $-1/3$
 $1/2$
s
strange

$\approx 4.2 \text{ GeV}$
 $-1/3$
 $1/2$
b
bottom

0
0
1
 γ
photon

SCALAR BOSONS

LEPTONS

$\approx 0.511 \text{ MeV}$
 -1
 $1/2$
e
electron

$\approx 106 \text{ MeV}$
 -1
 $1/2$
 μ
muon

$\approx 1.777 \text{ GeV}$
 -1
 $1/2$
 τ
tau

$\approx 80.4 \text{ GeV}$
 ± 1
1
W
W boson

GAUGE BOSONS
VECTOR BOSONS

$< 1.0 \text{ eV}$
0
 $1/2$
 ν_e
electron neutrino

$< 0.17 \text{ eV}$
0
 $1/2$
 ν_μ
muon neutrino

$< 18.2 \text{ MeV}$
0
 $1/2$
 ν_τ
tau neutrino

$\approx 91.2 \text{ GeV}$
0
1
Z
Z boson

three generations of matter
(fermions)

interactions / forces
(bosons)

I

II

III

mass
charge
spin

$\approx 2.2 \text{ MeV}$
 $+2/3$
 $1/2$
u
up

$\approx 1.3 \text{ GeV}$
 $+2/3$
 $1/2$
c
charm

$\approx 173 \text{ GeV}$
 $+2/3$
 $1/2$
t
top

0
0
1
g
gluon

$\approx 125 \text{ GeV}$
0
0
H
Higgs

QUARKS

$\approx 4.7 \text{ MeV}$
 $-1/3$
 $1/2$
d
down

$\approx 96 \text{ MeV}$
 $-1/3$
 $1/2$
s
strange

$\approx 4.2 \text{ GeV}$
 $-1/3$
 $1/2$
b
bottom

0
0
1
 γ
photon

SCALAR BOSONS

LEPTONS

$\approx 0.511 \text{ MeV}$
 -1
 $1/2$
e
electron

$\approx 106 \text{ MeV}$
 -1
 $1/2$
 μ
muon

$\approx 1.777 \text{ GeV}$
 -1
 $1/2$
 τ
tau

$\approx 80.4 \text{ GeV}$
 ± 1
1
W
W boson

GAUGE BOSONS
VECTOR BOSONS

$< 1.0 \text{ eV}$
0
 $1/2$
 ν_e
electron neutrino

$< 0.17 \text{ eV}$
0
 $1/2$
 ν_μ
muon neutrino

$< 18.2 \text{ MeV}$
0
 $1/2$
 ν_τ
tau neutrino

$\approx 91.2 \text{ GeV}$
0
1
Z
Z boson

three generations of matter
(fermions)

interactions / forces
(bosons)

I

II

III

mass
charge
spin

$\approx 2.2 \text{ MeV}$
 $+2/3$
 $1/2$
u
up

$\approx 1.3 \text{ GeV}$
 $+2/3$
 $1/2$
c
charm

$\approx 173 \text{ GeV}$
 $+2/3$
 $1/2$
t
top

0
0
1
g
gluon

$\approx 125 \text{ GeV}$
0
0
H
Higgs

QUARKS

$\approx 4.7 \text{ MeV}$
 $-1/3$
 $1/2$
d
down

$\approx 96 \text{ MeV}$
 $-1/3$
 $1/2$
s
strange

$\approx 4.2 \text{ GeV}$
 $-1/3$
 $1/2$
b
bottom

0
0
1
 γ
photon

SCALAR BOSONS

LEPTONS

$\approx 0.511 \text{ MeV}$
 -1
 $1/2$
e
electron

$\approx 106 \text{ MeV}$
 -1
 $1/2$
 μ
muon

$\approx 1.777 \text{ GeV}$
 -1
 $1/2$
 τ
tau

$\approx 80.4 \text{ GeV}$
 ± 1
1
W
W boson

GAUGE BOSONS
VECTOR BOSONS

$< 1.0 \text{ eV}$
0
 $1/2$
 ν_e
electron neutrino

$< 0.17 \text{ eV}$
0
 $1/2$
 ν_μ
muon neutrino

$< 18.2 \text{ MeV}$
0
 $1/2$
 ν_τ
tau neutrino

$\approx 91.2 \text{ GeV}$
0
1
Z
Z boson

three generations of matter
(fermions)

interactions / forces
(bosons)

I

II

III

mass
charge
spin

$\approx 2.2 \text{ MeV}$
 $+2/3$
 $1/2$
u
up

$\approx 1.3 \text{ GeV}$
 $+2/3$
 $1/2$
c
charm

$\approx 173 \text{ GeV}$
 $+2/3$
 $1/2$
t
top

0
0
1
g
gluon

$\approx 125 \text{ GeV}$
0
0
H
Higgs

QUARKS

$\approx 4.7 \text{ MeV}$
 $-1/3$
 $1/2$
d
down

$\approx 96 \text{ MeV}$
 $-1/3$
 $1/2$
s
strange

$\approx 4.2 \text{ GeV}$
 $-1/3$
 $1/2$
b
bottom

0
0
1
 γ
photon

SCALAR BOSONS

LEPTONS

$\approx 0.511 \text{ MeV}$
 -1
 $1/2$
e
electron

$\approx 106 \text{ MeV}$
 -1
 $1/2$
 μ
muon

$\approx 1.777 \text{ GeV}$
 -1
 $1/2$
 τ
tau

$\approx 80.4 \text{ GeV}$
 ± 1
1
W
W boson

GAUGE BOSONS
VECTOR BOSONS

$< 1.0 \text{ eV}$
0
 $1/2$
 ν_e
electron neutrino

$< 0.17 \text{ eV}$
0
 $1/2$
 ν_μ
muon neutrino

$< 18.2 \text{ MeV}$
0
 $1/2$
 ν_τ
tau neutrino

$\approx 91.2 \text{ GeV}$
0
1
Z
Z boson

three generations of matter
(fermions)

interactions / forces
(bosons)

	I	II	III			
mass	$\approx 2.2 \text{ MeV}$	$\approx 1.3 \text{ GeV}$	$\approx 173 \text{ GeV}$	0	$\approx 125 \text{ GeV}$	0
charge	$+2/3$	$+2/3$	$+2/3$	0	0	0
spin	$1/2$	$1/2$	$1/2$	1	0	2
	u up	c charm	t top	g gluon	H Higgs	G graviton
	d down	s strange	b bottom	γ photon		
	e electron	μ muon	τ tau	W W boson		
	ν_e electron neutrino	ν_μ muon neutrino	ν_τ tau neutrino	Z Z boson		

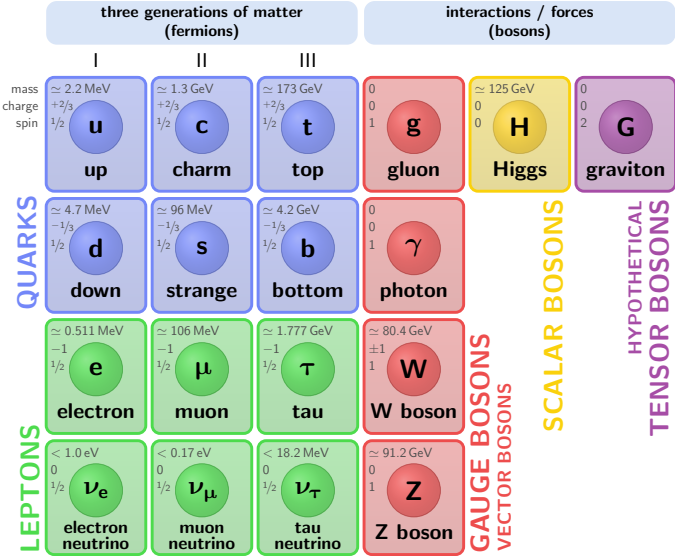
QUARKS

LEPTONS

Gauge bosons
vector bosons

SCALAR BOSONS

HYPOTHETICAL
TENSOR BOSONS



			three generations of matter (fermions)			three generations of antimatter (antifermions)			interactions / forces (bosons)	
			I	II	III	I	II	III		
QUARKS	mass charge spin	$\approx 2.2 \text{ MeV}$ $+2/3$ $1/2$	$\approx 1.3 \text{ GeV}$ $+2/3$ $1/2$	$\approx 173 \text{ GeV}$ $+2/3$ $1/2$	$\approx 2.2 \text{ MeV}$ $-2/3$ $1/2$	$\approx 1.3 \text{ GeV}$ $-2/3$ $1/2$	$\approx 173 \text{ GeV}$ $-2/3$ $1/2$	0 0 1	$\approx 125 \text{ GeV}$ 0 0	SCALAR BOSONS
		u up	c charm	t top	\bar{u} antiup	\bar{c} anticharm	\bar{t} antitop	g gluon	H Higgs	
		$\approx 4.7 \text{ MeV}$ $-1/3$ $1/2$	$\approx 96 \text{ MeV}$ $-1/3$ $1/2$	$\approx 4.2 \text{ GeV}$ $-1/3$ $1/2$	$\approx 4.7 \text{ MeV}$ $+1/3$ $1/2$	$\approx 96 \text{ MeV}$ $+1/3$ $1/2$	$\approx 4.2 \text{ GeV}$ $+1/3$ $1/2$	0 0 1	γ	
d down	s strange	b bottom	\bar{d} antidown	\bar{s} antistrange	\bar{b} antibottom	γ photon				
$\approx 0.511 \text{ MeV}$ -1 $1/2$	$\approx 106 \text{ MeV}$ -1 $1/2$	$\approx 1.777 \text{ GeV}$ -1 $1/2$	$\approx 0.511 \text{ MeV}$ $+1$ $1/2$	$\approx 106 \text{ MeV}$ $+1$ $1/2$	$\approx 1.777 \text{ GeV}$ $+1$ $1/2$	$\approx 91.2 \text{ GeV}$ 0 1	Z^0 Z boson			
LEPTONS	mass charge spin	$\approx 0.511 \text{ MeV}$ -1 $1/2$	$\approx 106 \text{ MeV}$ -1 $1/2$	$\approx 1.777 \text{ GeV}$ -1 $1/2$	$\approx 0.511 \text{ MeV}$ $+1$ $1/2$	$\approx 106 \text{ MeV}$ $+1$ $1/2$	$\approx 1.777 \text{ GeV}$ $+1$ $1/2$	$\approx 80.4 \text{ GeV}$ -1 1	$\approx 80.4 \text{ GeV}$ $+1$ 1	
		e^- electron	μ^- muon	τ^- tau	e^+ positron	μ^+ antimuon	τ^+ antitau	W^- W boson	W^+ W boson	
		$< 1.0 \text{ eV}$ 0 $1/2$	$< 0.17 \text{ eV}$ 0 $1/2$	$< 18.2 \text{ MeV}$ 0 $1/2$	$< 1.0 \text{ eV}$ 0 $1/2$	$< 0.17 \text{ eV}$ 0 $1/2$	$< 18.2 \text{ MeV}$ 0 $1/2$			
		ν_e electron neutrino	ν_μ muon neutrino	ν_τ tau neutrino	$\bar{\nu}_e$ electron antineutrino	$\bar{\nu}_\mu$ muon antineutrino	$\bar{\nu}_\tau$ tau antineutrino			

three generations of matter
(fermions)

interactions / forces
(bosons)

	I	II	III		
mass	$\approx 2.2 \text{ MeV}$	$\approx 1.3 \text{ GeV}$	$\approx 173 \text{ GeV}$	0	$\approx 125 \text{ GeV?}$
charge	$+2/3$	$+2/3$	$+2/3$	0	0
spin	$1/2$	$1/2$	$1/2$	1	0
	u up	c charm	t top	g gluon	h light Higgs
	d down	s strange	b bottom	γ photon	H heavy Higgs
	e electron	μ muon	τ tau	W W boson	A pseudoscalar Higgs
	ν_e electron neutrino	ν_μ muon neutrino	ν_τ tau neutrino	Z Z boson	H$^\pm$ charged Higgs

QUARKS

LEPTONS

(PSEUDO)SCALAR BOSONS

GAUGE BOSONS
VECTOR BOSONS

superpartners of SM fermions
(sfermions, bosons)

superpartners of SM bosons
(bosinos, fermions)

I

II

III

mass
charge
spin

?
+2/3
0

**up
squark**

?
+2/3
0

**charm
squark**

?
+2/3
0

stop

?
0
1/2

gluino

?
0
1/2

Higgsino

SQUARKS

?
-1/3
0

**down
squark**

?
-1/3
0

**strange
squark**

?
-1/3
0

sbottom

?
0
1/2

photino

SCALAR BOSONS

SLEPTONS

?
-1
0

selectron

?
-1
0

smuon

?
-1
0

stau

?
±1
1/2

wino

GAUGINOS

?
0
0

**electron
sneutrino**

?
0
0

**muon
sneutrino**

?
0
0

**tau
sneutrino**

?
0
1/2

zino

superpartners of SM fermions
(sfermions, bosons)

superpartners of SM bosons
(bosinos, fermions)

I

II

III

GAUGINOS HIGGSINOS

mass
charge
spin

SQUARKS

SLEPTONS

?
+2/3
0

\tilde{u}

up squark

?
+2/3
0

\tilde{c}

charm squark

?
+2/3
0

\tilde{t}

stop

?
0
1/2

\tilde{g}

gluino

?
0
1/2

\tilde{h}

light Higgsino

?
-1/3
0

\tilde{d}

down squark

?
-1/3
0

\tilde{s}

strange squark

?
-1/3
0

\tilde{b}

sbottom

?
0
1/2

$\tilde{\gamma}$

photino

?
0
1/2

\tilde{H}

heavy Higgsino

?
-1
0

\tilde{e}

selectron

?
-1
0

$\tilde{\mu}$

smuon

?
-1
0

$\tilde{\tau}$

stau

?
 ± 1
1/2

\tilde{W}

wino

?
 ± 1
1/2

\tilde{H}^{\pm}

charged Higgsino

?
0
0

$\tilde{\nu}_e$

electron sneutrino

?
0
0

$\tilde{\nu}_\mu$

muon sneutrino

?
0
0

$\tilde{\nu}_\tau$

tau sneutrino




















?
0
1/2

\tilde{Z}

zino

superpartners of SM fermions
(sfermions, bosons)

superpartners of SM bosons
(bosinos, fermions)

	I	II	III	GLUINO	NEUTRALINOS
SQUARKS	? +2/3 0  up squark	? +2/3 0  charm squark	? +2/3 0  stop squark	? 0 1/2  gluino	? 0 1/2  lightest neutralino
	? -1/3 0  down squark	? -1/3 0  strange squark	? -1/3 0  sbottom		? 0 1/2  2 nd lightest neutralino
	? -1 0  selectron	? -1 0  smuon	? -1 0  stau		? 0 1/2  2 nd heaviest neutralino
SLEPTONS	? 0 0  electron sneutrino	? 0 0  muon sneutrino	? 0 0  tau sneutrino	? ±1 1/2  light chargino	? 0 1/2  heavy chargino
					? 0 1/2  heaviest neutralino