

three generations of matter
(fermions)

interactions / forces
(bosons)

I

II

III

mass
charge
spin

≈ 2.2 MeV
 $+2/3$
 $1/2$
u
up

≈ 1.3 GeV
 $+2/3$
 $1/2$
c
charm

≈ 173 GeV
 $+2/3$
 $1/2$
t
top

0
0
1
g
gluon

≈ 125 GeV
0
0
H
Higgs

QUARKS

≈ 4.7 MeV
 $-1/3$
 $1/2$
d
down

≈ 96 MeV
 $-1/3$
 $1/2$
s
strange

≈ 4.2 GeV
 $-1/3$
 $1/2$
b
bottom

0
0
1
 γ
photon

≈ 0.511 MeV
 -1
 $1/2$
e
electron

≈ 106 MeV
 -1
 $1/2$
 μ
muon

≈ 1.777 GeV
 -1
 $1/2$
 τ
tau

≈ 80.4 GeV
 ± 1
1
W
W boson

LEPTONS

< 1.0 eV
0
 $1/2$
 ν_e
electron neutrino

< 0.17 eV
0
 $1/2$
 ν_μ
muon neutrino

< 18.2 MeV
0
 $1/2$
 ν_τ
tau neutrino

≈ 91.2 GeV
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GAUGE BOSONS
VECTOR BOSONS

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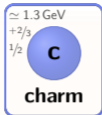
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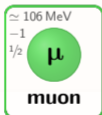
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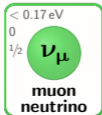


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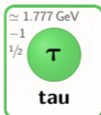
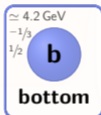
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$\approx 1.777 \text{ GeV}$
 -1
 $1/2$

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
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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

$\approx 1.3 \text{ GeV}$
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H
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QUARKS

$\approx 4.7 \text{ MeV}$
 $-1/3$
 $1/2$
d
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 $1/2$
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 $1/2$
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0
0
1
 γ
photon

$\approx 0.511 \text{ MeV}$
 -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

LEPTONS

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

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

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

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

GAUGE BOSONS
VECTOR BOSONS

SCALAR BOSONS

three generations of matter
(fermions)

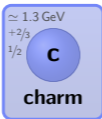
interactions / forces
(bosons)

I

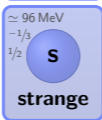
II

III

mass
charge
spin

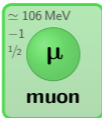


QUARKS



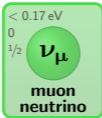
SCALAR BOSONS

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
1

g

gluon

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

H

Higgs

QUARKS

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

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down

$\approx 96 \text{ MeV}$
 $-\frac{1}{3}$
 $\frac{1}{2}$

s

strange

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

b

bottom

0
0
1

γ

photon

SCALAR BOSONS

LEPTONS

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

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electron

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

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

ν_μ

muon neutrino

$< 18.2 \text{ MeV}$
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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

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

$\approx 1.3 \text{ GeV}$
 $+\frac{2}{3}$
 $\frac{1}{2}$
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$\approx 173 \text{ GeV}$
 $+\frac{2}{3}$
 $\frac{1}{2}$
t
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0
1
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gluon

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

QUARKS

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

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

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

0
0
1
 γ
photon

SCALAR BOSONS

LEPTONS

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

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

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

$\approx 1.3 \text{ GeV}$
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 $1/2$
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

≈ 2.2 MeV
 $+2/3$
 $1/2$
u
up

≈ 1.3 GeV
 $+2/3$
 $1/2$
c
charm

≈ 173 GeV
 $+2/3$
 $1/2$
t
top

0
0
1
g
gluon

≈ 125 GeV
0
0
0
H
Higgs

0
0
0
2
G
graviton

QUARKS

≈ 4.7 MeV
 $-1/3$
 $1/2$
d
down

≈ 96 MeV
 $-1/3$
 $1/2$
s
strange

≈ 4.2 GeV
 $-1/3$
 $1/2$
b
bottom

0
0
1
 γ
photon

≈ 0.511 MeV
-1
 $1/2$
e
electron

≈ 106 MeV
-1
 $1/2$
 μ
muon

≈ 1.777 GeV
-1
 $1/2$
 τ
tau

≈ 80.4 GeV
 ± 1
1
W
W boson

LEPTONS

< 1.0 eV
0
 $1/2$
 ν_e
electron neutrino

< 0.17 eV
0
 $1/2$
 ν_μ
muon neutrino

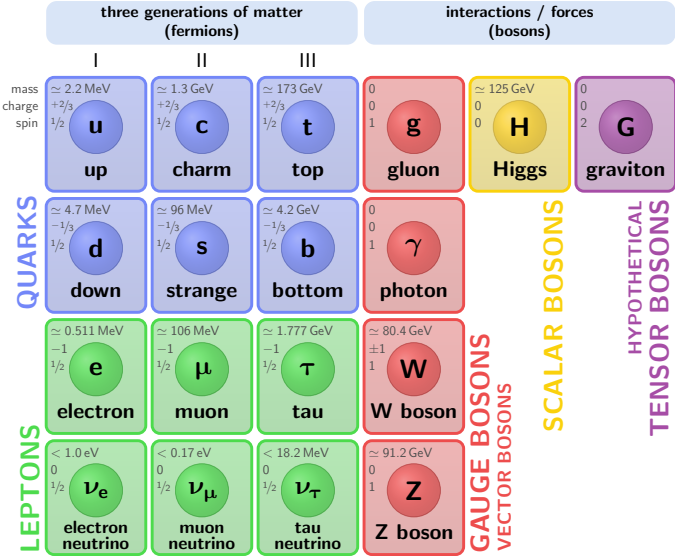
< 18.2 MeV
0
 $1/2$
 ν_τ
tau neutrino

≈ 91.2 GeV
0
1
Z
Z boson

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	≈ 2.2 MeV $+2/3$ $1/2$	≈ 1.3 GeV $+2/3$ $1/2$	≈ 173 GeV $+2/3$ $1/2$	≈ 2.2 MeV $-2/3$ $1/2$	≈ 1.3 GeV $-2/3$ $1/2$	≈ 173 GeV $-2/3$ $1/2$	0 0 1	≈ 125 GeV 0 0
		u up	c charm	t top	\bar{u} antiup	\bar{c} anticharm	\bar{t} antitop	g gluon	H Higgs
		≈ 4.7 MeV $-1/3$ $1/2$	≈ 96 MeV $-1/3$ $1/2$	≈ 4.2 GeV $-1/3$ $1/2$	≈ 4.7 MeV $+1/3$ $1/2$	≈ 96 MeV $+1/3$ $1/2$	≈ 4.2 GeV $+1/3$ $1/2$	0 0 1	
		d down	s strange	b bottom	\bar{d} antidown	\bar{s} antistrange	\bar{b} antibottom	γ photon	
		≈ 0.511 MeV -1 $1/2$	≈ 106 MeV -1 $1/2$	≈ 1.777 GeV -1 $1/2$	≈ 0.511 MeV $+1$ $1/2$	≈ 106 MeV $+1$ $1/2$	≈ 1.777 GeV $+1$ $1/2$	0 0 1	≈ 91.2 GeV 0 1
		e^- electron	μ^- muon	τ^- tau	e^+ electron	μ^+ muon	τ^+ tau	Z^0 Z boson	
LEPTONS		< 1.0 eV 0 $1/2$	< 0.17 eV 0 $1/2$	< 18.2 MeV 0 $1/2$	< 1.0 eV 0 $1/2$	< 0.17 eV 0 $1/2$	< 18.2 MeV 0 $1/2$	≈ 80.4 GeV -1 1	≈ 80.4 GeV $+1$ 1
		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	W^- W boson	W^+ W boson

QUARKS

LEPTONS

GAUGE BOSONS
VECTOR BOSONS

SCALAR BOSONS

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
squark**

?
0
1/2

gluino

?
0
1/2

Higgsino

SQUARKS

?
-1/3
0

**down
squark**

?
-1/3
0

**strange
squark**

?
-1/3
0

**sbottom
squark**

?
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

**up
squark**

?
+2/3
0

**charm
squark**

?
+2/3
0

**stop
squark**

?
0
1/2

gluino

?
0
1/2

**light
Higgsino**

?
-1/3
0

**down
squark**

?
-1/3
0

**strange
squark**

?
-1/3
0

**sbottom
squark**

?
0
1/2

photino

?
0
1/2

**heavy
Higgsino**

?
-1
0

selectron

?
-1
0

smuon

?
-1
0

stau

?
±1
1/2

wino

?
±1
1/2

**charged
Higgsino**

?
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	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