

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

$\approx 0.511 \text{ MeV}$
 -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

$< 1.0 \text{ eV}$
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

LEPTONS

GAUGE BOSONS
VECTOR BOSONS

SCALAR BOSONS

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SCALAR BOSONS

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W boson

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VECTOR BOSONS

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tau neutrino

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

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

0
0
1
g
gluon

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

0
0
0
2
G
graviton

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

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

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

HYPOTHETICAL
TENSOR BOSONS

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
0
H
Higgs

0
0
0
2
G
graviton

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

HYPOTHETICAL
TENSOR 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)

three generations of antimatter
(antifermions)

interactions / forces
(bosons)

I

II

III

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

$\approx 2.2 \text{ MeV}$
 $-2/3$
 $1/2$
 \bar{u}
antiup

$\approx 1.3 \text{ GeV}$
 $-2/3$
 $1/2$
 \bar{c}
anticharm

$\approx 173 \text{ GeV}$
 $-2/3$
 $1/2$
 \bar{t}
antitop

0
0
1
g
gluon

$\approx 125 \text{ GeV}$
0
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

$\approx 4.7 \text{ MeV}$
 $+1/3$
 $1/2$
 \bar{d}
antidown

$\approx 96 \text{ MeV}$
 $+1/3$
 $1/2$
 \bar{s}
antistrange

$\approx 4.2 \text{ GeV}$
 $+1/3$
 $1/2$
 \bar{b}
antibottom

0
0
1
 γ
photon

**GAUGE BOSONS
VECTOR BOSONS**

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

$\approx 0.511 \text{ MeV}$
 $+1$
 $1/2$
 e^+
positron

$\approx 106 \text{ MeV}$
 $+1$
 $1/2$
 μ^+
antimuon

$\approx 1.777 \text{ GeV}$
 $+1$
 $1/2$
 τ^+
antitau

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

$< 1.0 \text{ eV}$
0
 $1/2$
 $\bar{\nu}_e$
electron antineutrino

$< 0.17 \text{ eV}$
0
 $1/2$
 $\bar{\nu}_\mu$
muon antineutrino

$< 18.2 \text{ MeV}$
0
 $1/2$
 $\bar{\nu}_\tau$
tau antineutrino

$\approx 80.4 \text{ GeV}$
 -1
1
 W^-
W boson

$\approx 80.4 \text{ GeV}$
 $+1$
1
 W^+
W boson

three generations of matter (fermions)

interactions / forces (bosons)

	I	II	III		
mass	$\simeq 2.2 \text{ MeV}$	$\simeq 1.3 \text{ GeV}$	$\simeq 173 \text{ GeV}$	0	$\simeq 125 \text{ GeV?}$
charge	$+\frac{2}{3}$	$+\frac{2}{3}$	$+\frac{2}{3}$	0	0
spin	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	1	0
QUARKS	u up	c charm	t top	g gluon	h light Higgs
	$\simeq 4.7 \text{ MeV}$	$\simeq 96 \text{ MeV}$	$\simeq 4.2 \text{ GeV}$	0	$\simeq 125 \text{ GeV?}$
	$-\frac{1}{3}$	$-\frac{1}{3}$	$-\frac{1}{3}$	0	0
	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	1	0
	d down	s strange	b bottom	γ photon	H heavy Higgs
LEPTONS	$\simeq 0.511 \text{ MeV}$	$\simeq 106 \text{ MeV}$	$\simeq 1.777 \text{ GeV}$	± 1	?
	-1	-1	-1	1	0
	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	1	0
	e electron	μ muon	τ tau	W W boson	A pseudoscalar Higgs
	$< 1.0 \text{ eV}$	$< 0.17 \text{ eV}$	$< 18.2 \text{ MeV}$	$\simeq 91.2 \text{ GeV}$?
	0	0	0	0	0
	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	1	0
	ν_e electron neutrino	ν_μ muon neutrino	ν_τ tau neutrino	Z Z boson	H^\pm charged Higgs
				GAUGE BOSONS VECTOR BOSONS	
				(PSEUDO)SCALAR BOSONS	

superpartners of SM fermions
(sfermions, bosons)

superpartners of SM bosons
(bosinos, fermions)

I

II

III

mass
charge
spin

?
+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}

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

?
-1
0

\tilde{e}

selectron

?
-1
0

$\tilde{\mu}$

smuon

?
-1
0

$\tilde{\tau}$

stau

?
 ± 1
1/2

\tilde{W}

wino

?
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

SQUARKS

SLEPTONS

SCALAR BOSONS

GAUGINOS

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

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

$\tilde{\chi}_1^0$

lightest
neutralino

?
-1/3
0

\tilde{d}

down
squark

?
-1/3
0

\tilde{s}

strange
squark

?
-1/3
0

\tilde{b}

sbottom

?
0
1/2

$\tilde{\chi}_2^0$

2nd lightest
neutralino

CHARGINOS

?
-1
0

\tilde{e}

selectron

?
-1
0

$\tilde{\mu}$

smuon

?
-1
0

$\tilde{\tau}$

stau

?
 ± 1
1/2

$\tilde{\chi}_1^{\pm}$

light
chargino

?
0
1/2

$\tilde{\chi}_3^0$

2nd heaviest
neutralino

?
0
0

$\tilde{\nu}_e$

electron
sneutrino

?
0
0

$\tilde{\nu}_\mu$

muon
sneutrino

?
0
0

$\tilde{\nu}_\tau$

tau
sneutrino

?
 ± 1
1/2

$\tilde{\chi}_2^{\pm}$

heavy
chargino

?
0
1/2

$\tilde{\chi}_4^0$

heaviest
neutralino