

# ELEMENTARY PARTICLES

NOVA

	CONTEXT	MASS	CHARGE	SPIN	STRENGTH	RANGE	OBSERVED?	SPARTICLE
<b>BOSONS (forces)</b>								
GRAVITON	gravity	0	0	2	$10^{-38}$	infinite	no	gravitino
PHOTON	electromagnetism	0	0	1	$10^{-2}$	infinite	yes	photino
GLUON	strong force	0	0	1	$10^{-10}$	$10^{-13}$	indirectly	gluino
<b>WEAK GAUGE BOSONS</b>								
W <sup>+</sup>	weak force	80,000	1	1	$10^{-13}$	$10^{-16}$	yes	W <sup>+</sup> wino
W <sup>-</sup>	weak force	80,000	-1	1	$10^{-13}$	$10^{-16}$	yes	W <sup>-</sup> wino
Z <sup>0</sup>	weak force	91,000	0	1	$10^{-13}$	$10^{-16}$	yes	zino
HIGGS BOSON	weak force	>78,000	0	0	[ ? ]	[ ? ]	no	Higgsino
<b>FERMIONS (matter)</b>								
<i>LEPTONS, FAMILY 1:</i>								
ELECTRON	radioactive decay	0.51	-1	1/2	n/a	n/a	yes	selectron
ELECTRON NEUTRINO	atomic structure	0?	0	1/2	n/a	n/a	yes	electron sneutrino
<i>QUARKS, FAMILY 1:</i>								
UP	atomic nuclei	5	2/3	1/2	n/a	n/a	indirectly	up squark
DOWN	atomic nuclei	9	-1/3	1/2	n/a	n/a	indirectly	down squark
<i>LEPTONS, FAMILY 2:</i>								
MUON		106	-1	1/2	n/a	n/a	yes	muon slepton
MUON NEUTRINO		~0	0	1/2	n/a	n/a	yes	muon sneutrino
<i>QUARKS, FAMILY 2:</i>								
CHARM		1,400	2/3	1/2	n/a	n/a	indirectly	charm squark
STRANGE		170	-1/3	1/2	n/a	n/a	indirectly	strange squark
<i>LEPTONS, FAMILY 3:</i>								
TAU		1,784	-1	1/2	n/a	n/a	yes	tau slepton
TAU NEUTRINO		>35	0	1/2	n/a	n/a	yes	tau sneutrino
<i>QUARKS, FAMILY 3:</i>								
TOP		174,000	2/3	1/2	n/a	n/a	indirectly	top squark
BOTTOM		4,400	-1/3	1/2	n/a	n/a	indirectly	bottom squark

### First Generation Fermions

Particle	Symbol	Spin	Charge	Mass (GeV)
Electron Neutrino	$\nu_e$	1/2	0	$< 7.2 \times 10^{-9}$
Electron	e	1/2	-1	$0.51 \times 10^{-3}$
Up Quark	u	1/2	2/3	$\sim 5 \times 10^{-3}$
Down Quark	d	1/2	-1/3	$\sim 9 \times 10^{-3}$

### Second Generation Fermions

Particle	Symbol	Spin	Charge	Mass (GeV)
Muon Neutrino	$\nu_\mu$	1/2	0	$< 2.7 \times 10^{-4}$
Muon	$\mu$	1/2	-1	0.106
Charm Quark	c	1/2	2/3	$\sim 1.35$
Strange Quark	s	1/2	-1/3	$\sim 0.175$

### Third Generation Fermions

Particle	Symbol	Spin	Charge	Mass (GeV)
Tau Neutrino	$\nu_\tau$	1/2	0	$< 3 \times 10^{-2}$
Tau Lepton	t	1/2	-1	1.78
Top Quark	t	1/2	2/3	$174 \pm 17$
Bottom Quark	b	1/2	-1/3	$\sim 4.5$

### Gauge Bosons

Particle	Symbol	Spin	Charge	Mass (GeV)
Photon	$\gamma$	1	0	0
W Boson	W	1	$\pm 1$	80.22
Z Boson	Z	1	0	91.19
Gluons	g	1	0	0

### Higgs Boson

Particle	Symbol	Spin	Charge	Mass (GeV)
Higgs Boson	H	0	0	$63 < M_H < 800$

