Feynman Diagrams & the Higgs Boson

IB PHYSICS | ATOMIC PHYSICS

IB Physics Data Booklet

Sub-topic 7.1 – Discrete energy and radioactivity	Sub-topic 7.2 – Nuclear reactions
$E = hf$ $\lambda = \frac{hc}{E}$	$\Delta E = \Delta m\, c^2$

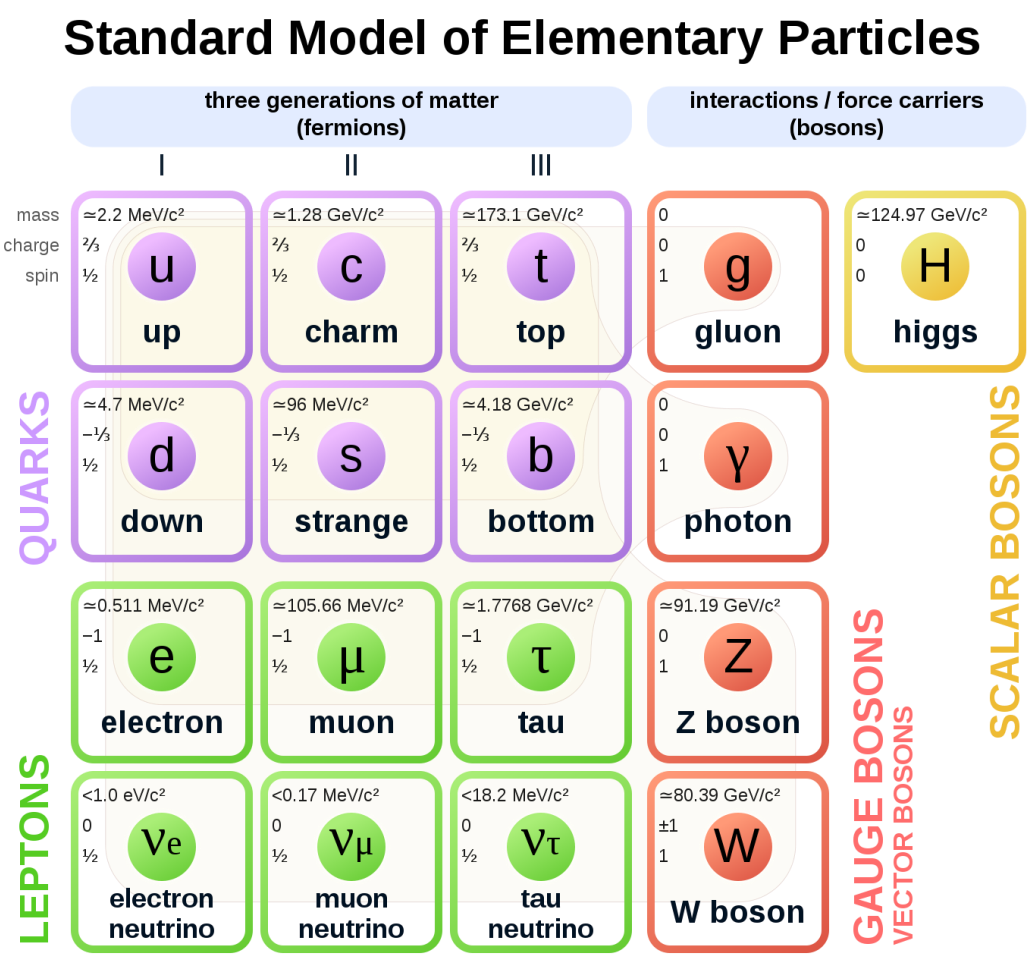
Sub-topic 7.3 – The structure of matter

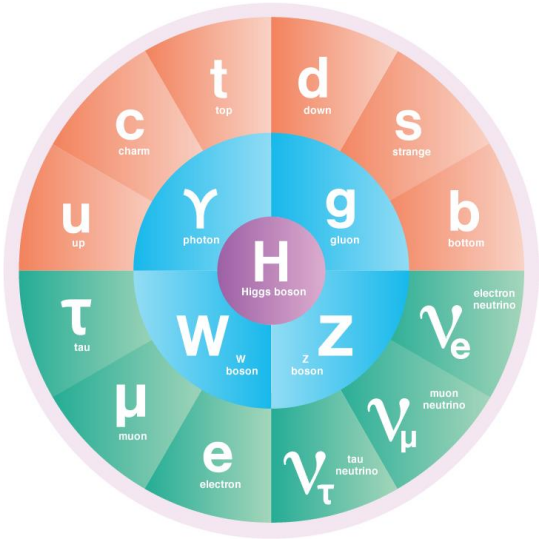
Charge	Quarks			Baryon number
$\frac{2}{3}e$	u	c	t	$\frac{1}{3}$
$-\frac{1}{3}e$	d	s	b	$\frac{1}{3}$
All quarks have a strangeness number of 0 except the strange quark that has a strangeness number of –1				

Charge	Leptons		
–1	e	μ	τ
0	υ_e	υ_μ	υ_τ
All leptons have a lepton number of 1 and antileptons have a lepton number of –1			

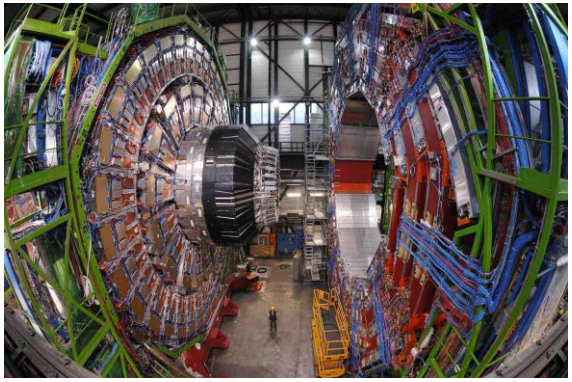
	Gravitational	Weak	Electromagnetic	Strong
Particles experiencing	All	Quarks, leptons	Charged	Quarks, gluons
Particles mediating	Graviton	W^+, W^-, Z^0	γ	Gluons

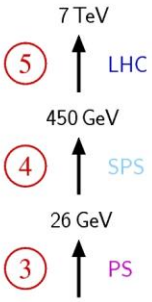
The Standard Model

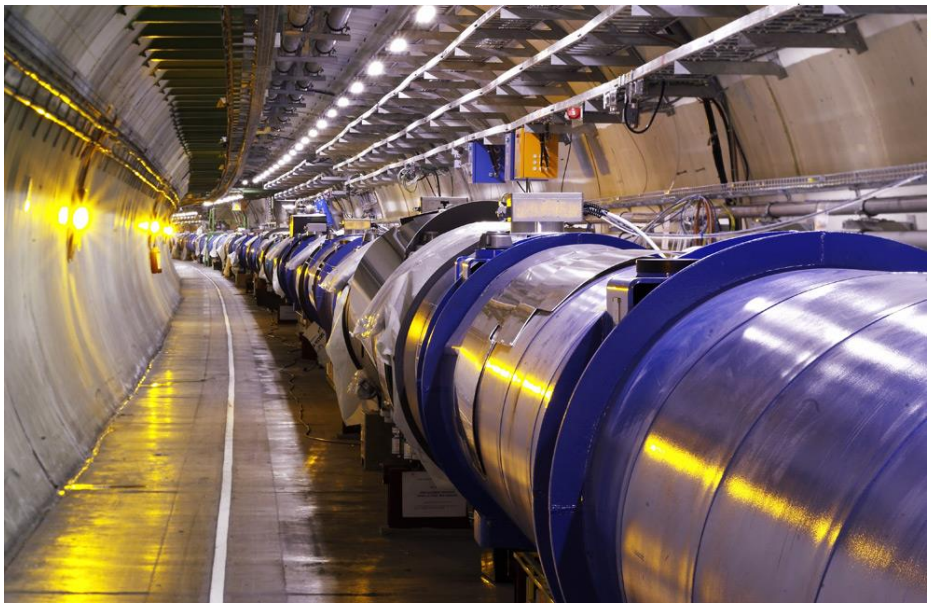


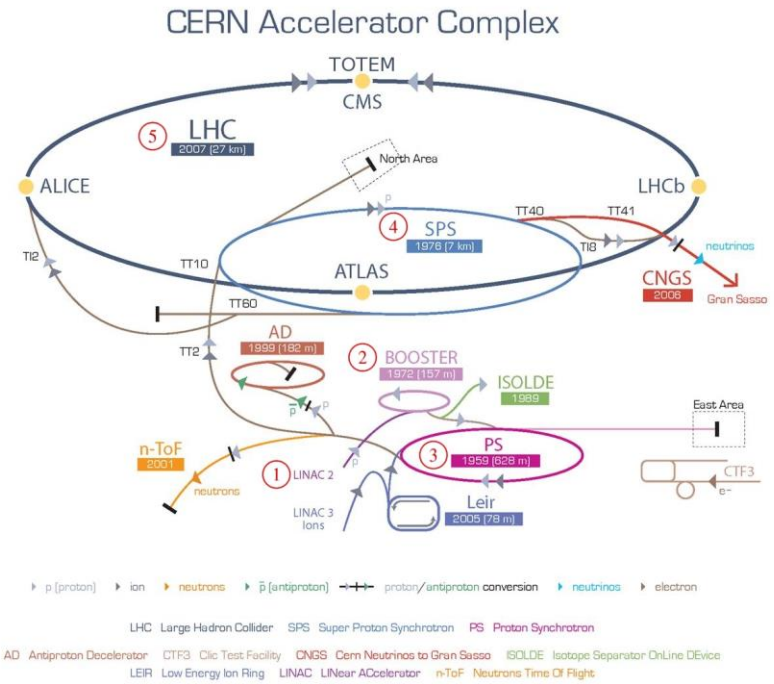


The Large Hadron Collider

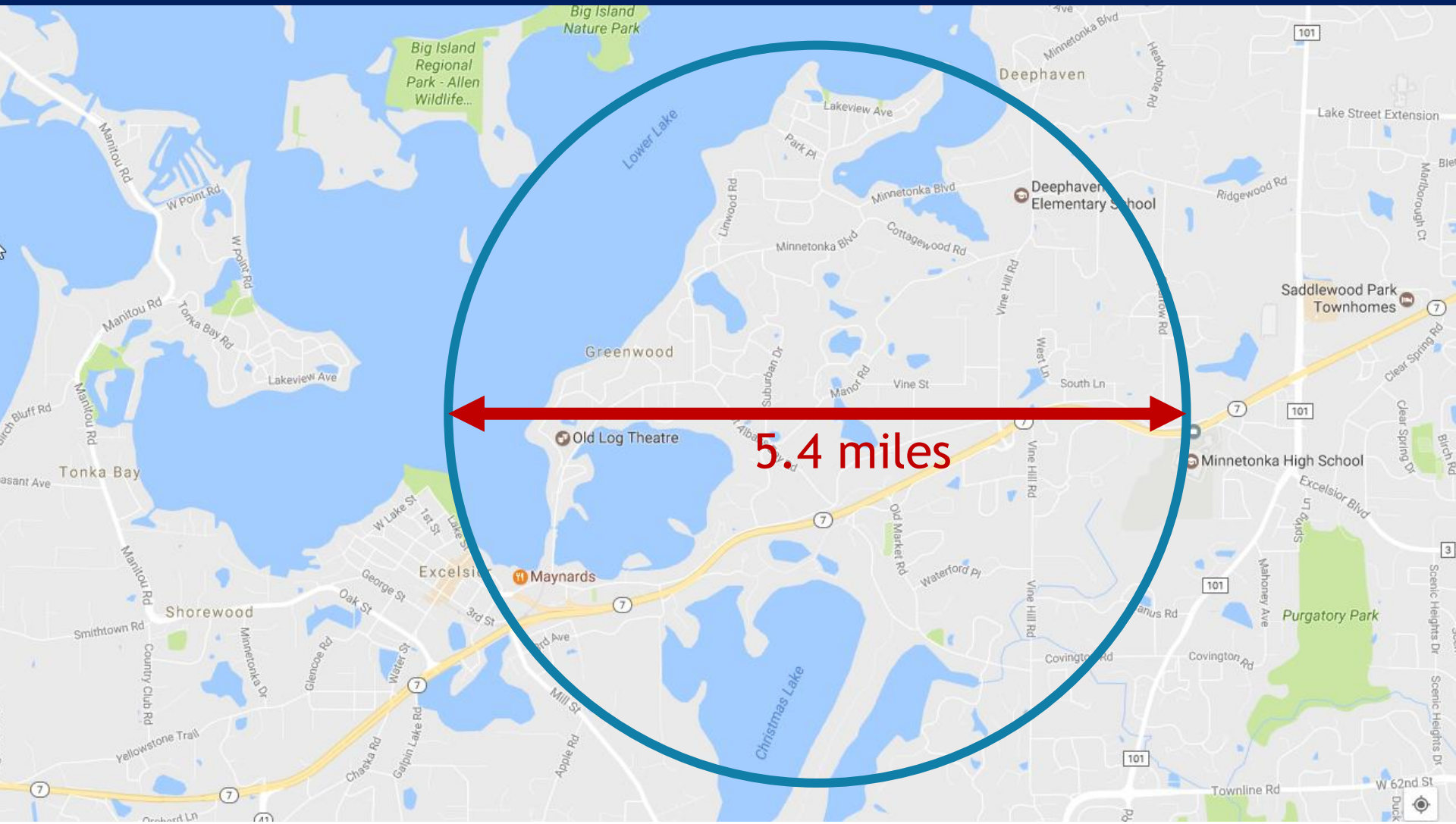




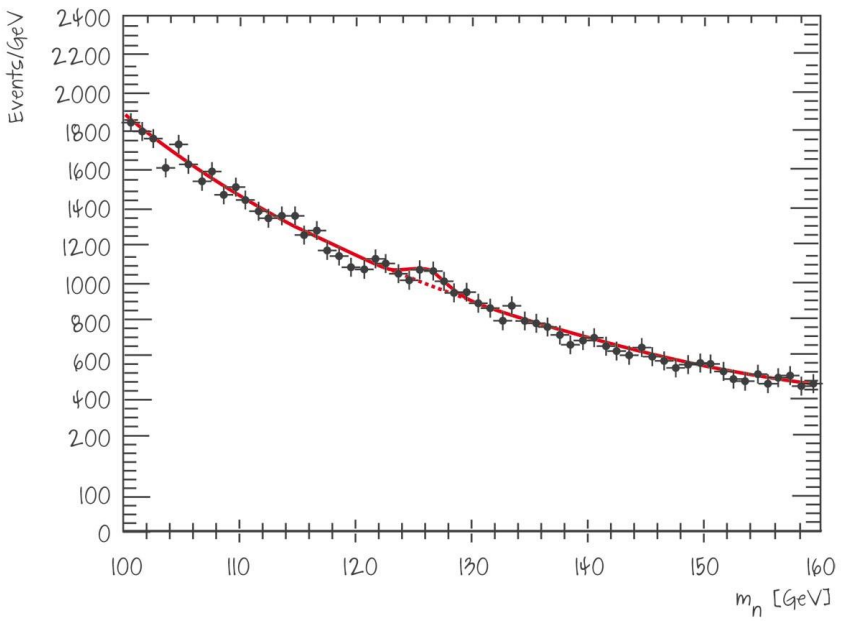


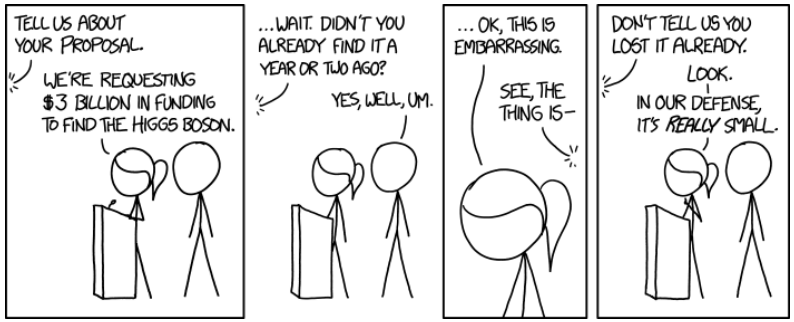


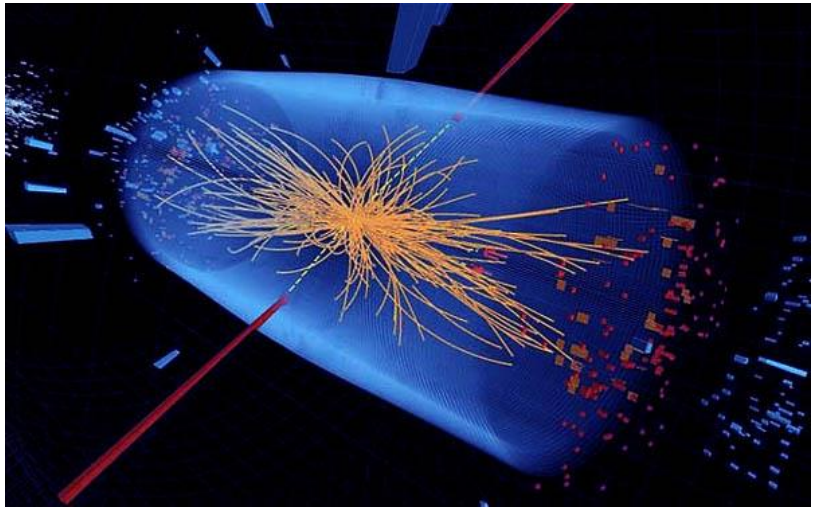
The Large Hadron Collider



The Higgs Boson

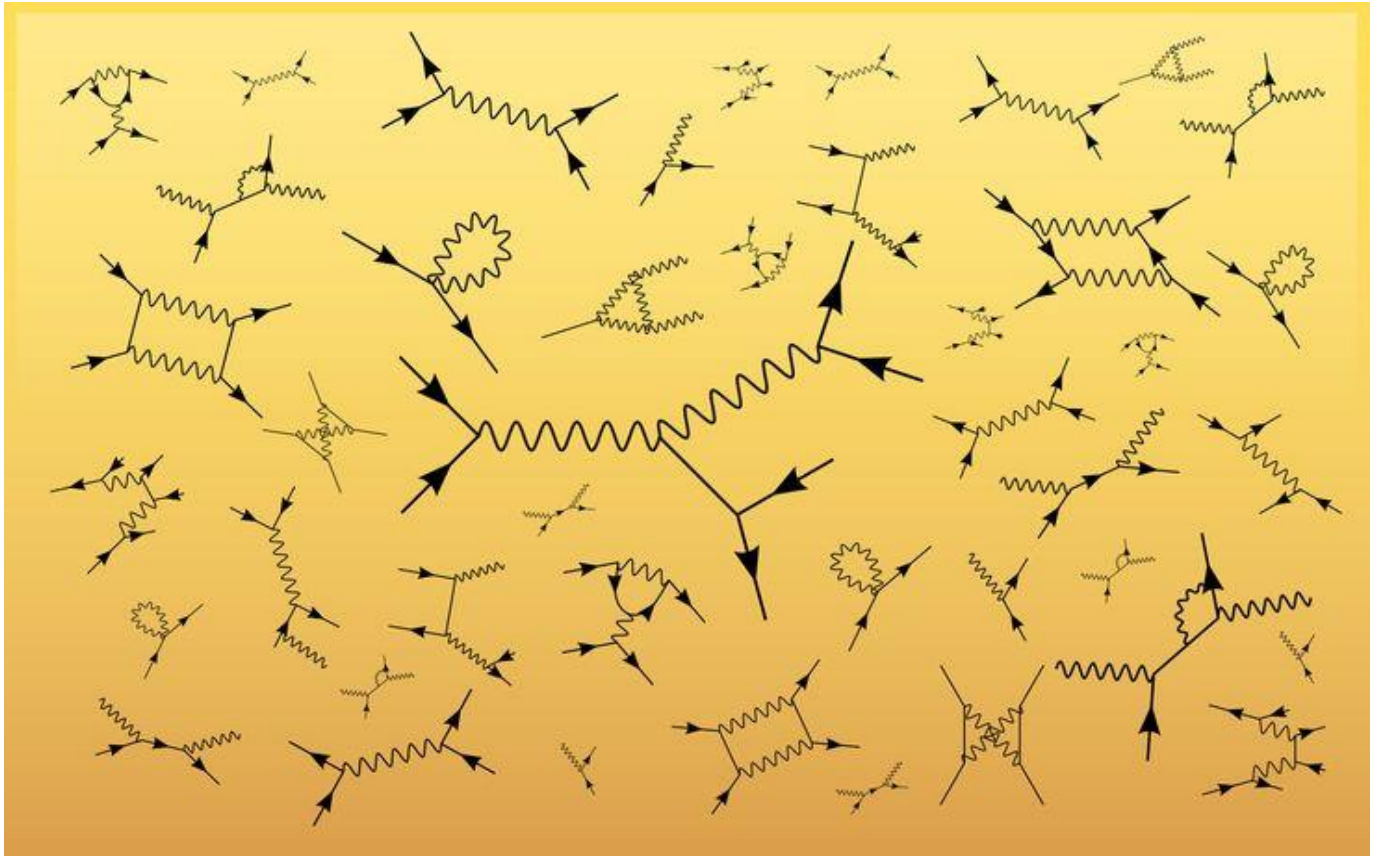




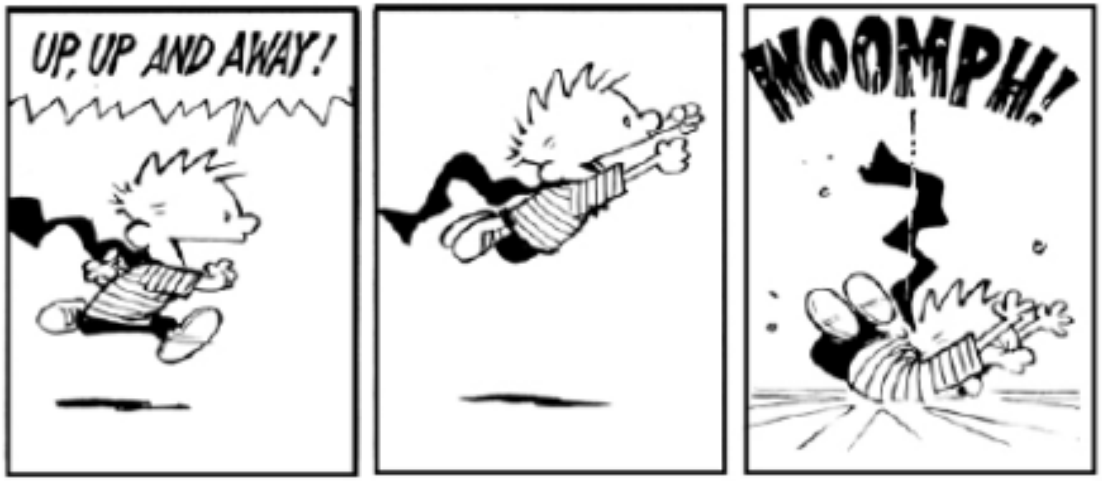


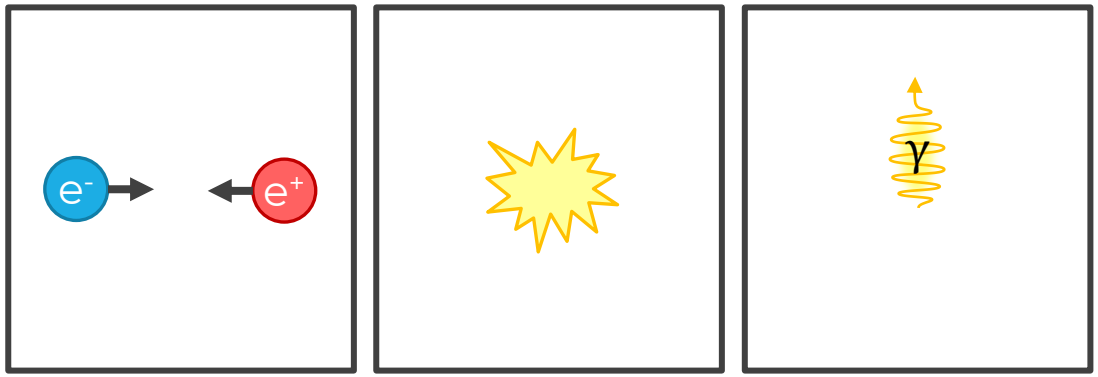
Feynman Diagrams

Useful to represent, analyze, and predict particle interactions



Feynman Diagrams are like Comics



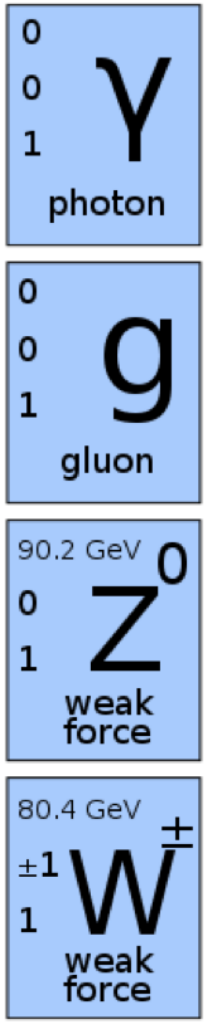


An electron and positron (antielectron) annihilate into a photon

“The Characters”

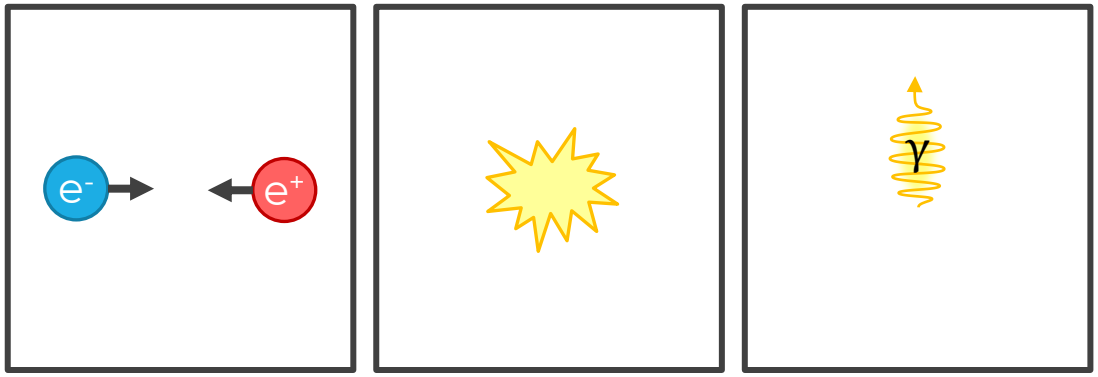
Matter Particle

Antimatter Particle

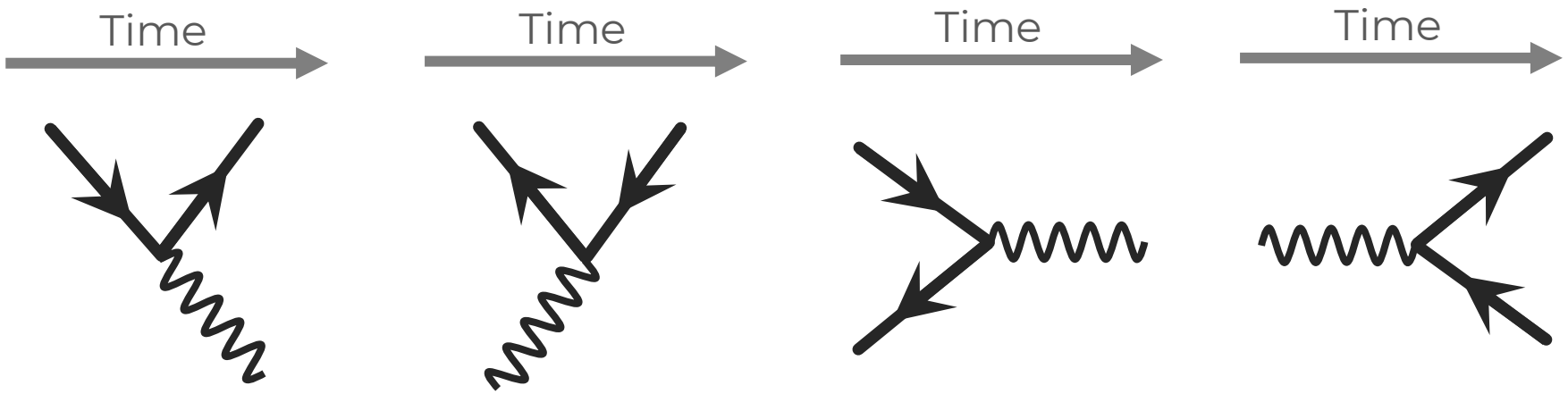


Representing Time

An electron and positron (antielectron) annihilate into a photon



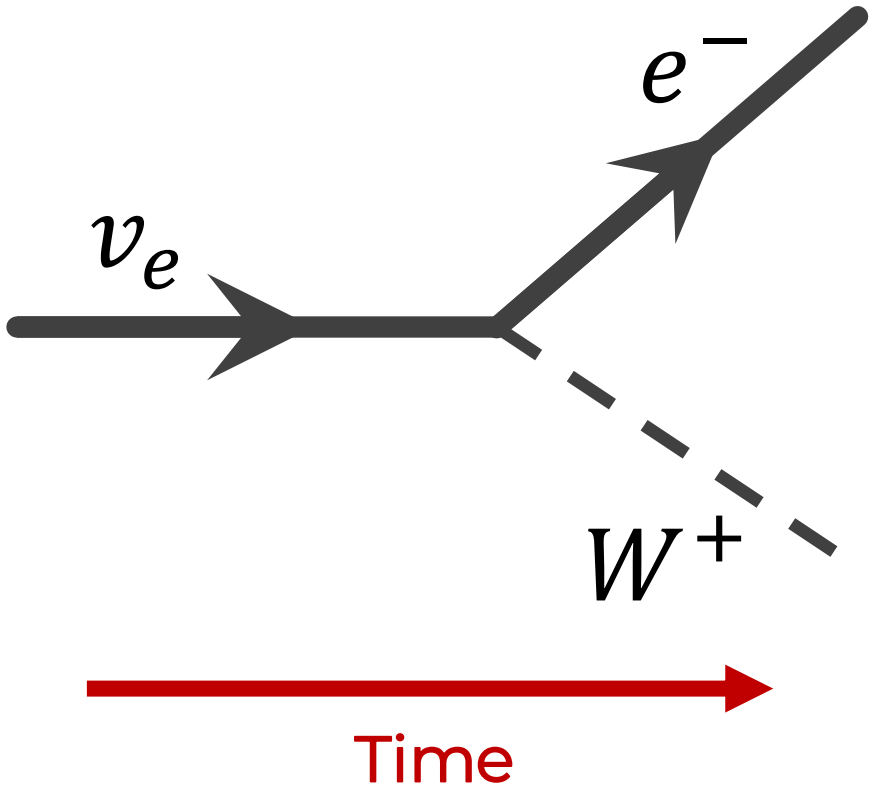
Match these!



a photon spontaneously “pair produces” an electron and positron	a positron absorbs a photon and keeps going	an electron emits a photon and keeps going	an electron and positron annihilate into a photon

Junction Conservation

Every junction will have two lines with arrows (one pointing in, one pointing out) meeting a single exchange particle and all properties are conserved before/after



	ν_e	e^-	W^+
Baryon #			
Lepton #			
Charge			

Beta-Negative Decay

$$n \rightarrow p + e^{-} + \bar{\nu}_e$$

Time 

Beta-Positive Decay

$$p \rightarrow n + e^{+} + \nu_e$$

Time