

The Standard Model of Physics¹

The standard model of physics took over a century to build. It summarizes:

“... in a remarkably compact form, almost everything we know about the fundamental laws of physics.” (Wilczek, 2008) (p164)

Table The standard model of particles

PARTICLES	FERMIONS (Matter)				Anti-Matter
	Leptons		Quarks		
	Electron like	Neutrino like	Up-like	Down-like	
Generation 1	Electron (e)	Neutrino (ν)	Up quark (u)	Down quark (d)	Same mass, opposite charge
<i>Mass (Charge)</i>	0.511 (-1)	$< 3 \times 10^{-6}$ (0)	1.5 - 4.5 (+2/3)	5 - 8.5 (-1/3)	
Generation 2	Muon (μ)	Muon neutrino (ν_μ)	Charm (c)	Strange (s)	As above
<i>Mass (Charge)</i>	105.7 (-1)	< 0.19 (0)	1,000 - 1,400 (+2/3)	80-155 (-1/3)	
Generation 3	Tau (τ)	Tau neutrino (ν_τ)	Top (t)	Bottom (b)	As above
<i>Mass (Charge)</i>	1,777 (-1)	< 18 (0)	174,000 (+2/3)	4,000 - 4,500 (-1/3)	
BOSONS (Forces)					
Field:	Electromagnetic	Strong	Weak	Gravity	Higgs
<i>Name</i>	Photon (γ)	Gluon (g)	W ⁺ , W ⁻ , W ⁰	Graviton	The Higgs
<i>Mass (GeV)</i>	(0)	(0)	(80.4; 80.4; 91.2)	(?)	(125)
<i>Charge</i>	-1 to +1	Eight colors	Isospin (+½, -½)	?	?

The standard model is currently considered by physicists to be:

“...truly the crowning scientific accomplishment of the twentieth century.” (Oerter, 2006) p75.

It sees all reality as *particles*, divided into light-like *bosons* that don't collide with each other and matter-like *fermions* that do (Table). It attributes *all* the forces of physics to *bosons*, and splits all matter into *leptons* (electrons and neutrinos) and *quarks* (up and down), where quarks give the protons and neutrons of the atomic nuclei that electrons orbit around. Apart from neutrinos, that seem to whizz around for no reason, and anti-matter that has no reason to be, it is all fairly tidy, but as Woit notes:

“By 1973, physicists had in place what was to become a fantastically successful theory ... that was soon to acquire the name of the ‘standard model’. Since that time, the overwhelming triumph of the standard model has been matched by a similarly overwhelming failure to find any way to make further progress on fundamental questions.” (Woit, 2007) p1

The standard model isn't generating answers to fundamental questions, like:

- Why don't protons decay, just as neutrons do?
- Why is our universe made of matter and not anti-matter?
- Why do neutrinos have a tiny but variable mass?
- Why are there three particle “generations”, and then no more?
- Why do electrons "half spin"?
- Why does the mass of its particles vary so enormously, but their charges don't?
- Why are neutrinos always left-handed with respect to spin?
- Why do quarks have one-third charges?

¹ This is section 4.2 from Chapter 4 [The Matter Glitch: An Alternative to the Standard Model](#), of the forthcoming book Quantum Realism by Brian Whitworth. The link gives a free early access to the whole chapter. This work is ©Brian Whitworth 2014 but shared under a [Creative Commons Attribution-Noncommercial license](#).

- i. Why does anti-matter have negative spin?
- j. Why does the force binding quarks *increase* as they move apart?
- k. What is the dark matter and dark energy that constitute most of the universe?

The standard model not only can't answer such questions but probably never will, as its two best hopes, string theory and super-symmetry, aren't going anywhere. This chapter explores why, and suggests answers to the above questions based on information processing instead of particles.