Chapter 4. The Matter Glitch:
An alternative to the standard model

Brian Whitworth, New Zealand

"Scientists who don't question their theories are priests." Brian Whitworth

A *world view* is a way of looking at the world that includes a statement of what is *real*:

1. *Physical realism* is the common view that there is only one reality and the physical world is it, so it is all there is. Its claim to truth is generally based on evidence from the physical world.
2. *Dualism* is the equally common view that a spiritual reality beyond the physical world created it and we return to it after death, implying a higher purpose to life. Its claim to truth is generally based on divine revelation.
3. *Quantum realism* is the view that only the quantum world is real and the physical world is a virtual reality. Its claim to truth is based on evidence from modern physics.

Physical realism is common in science and dualism is common in religion but quantum realism isn't common at all. If only one view is correct, science must choose between them based on evidence. Physical realism seemed the favorite until physics started observing things that are physically impossible, but dualism couldn't capitalize on this as experiments on paranormal effects like extra-sensory perception (ESP) couldn't verify non-physical causes either. Most scientists back one of the traditional options but the outsider, quantum realism, combines the monism of physical realism and the non-physicality of dualism.

Quantum realism, the world view that *everything* arises from a non-physical quantum world, sits between the dominant views of physical realism and dualism. It agrees with physical realism that there is one reality out there apart from us but disagrees that the physical world is it. It agrees with orthodox religion that there is a reality beyond the physical world but disagrees that there are two realities. As a statement about the physical world, it is subject to science. Its main scientific contrast is physical realism, so this chapter addresses the question "*What is Matter?*" to make a *testable prediction* that contradicts physical realism.

4.1. WHAT IS MATTER?

Quantum realism explains space, time and light as follows:

- *Space*. Space is a null quantum process running at a node point, so it is something that outputs "nothing".
- *Time.* Time is processing cycles completed, so if the network slows down, time can "dilate" as Einstein says.
- *Light*. Light is one quantum process distributed over two or more nodes to give the electromagnetic spectrum.

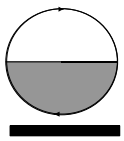
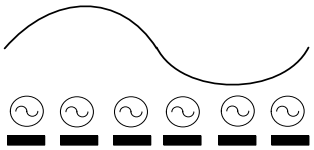
Space	***Light***	***Matter***
		
Null process in one node	*Same process in many nodes*	*What is matter?*

Figure 4.1. If a photon is space stretched out, what is matter?

If space is null processing, time is processing cycles completed and light is space distributed, can *the same model explain matter*? (Figure 4.1) If it can't, the results so far are mere curiosities. Current physics explains matter by the *standard model* so a quantum model must explain all that it does and more.

4.2. THE STANDARD MODEL

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

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

It is currently considered by physicists to be:

> *"...truly the crowning scientific accomplishment of the twentieth century.*" (Oerter, 2006) p75.

The standard model considers all reality to consist of *particles,* which it divides into matter particles called *fermions* and force particles called *bosons* (Table 4.1). Physics currently attributes all matter to fermion particles and all forces to boson particles, where fermions collide with each other and bosons don't.

Matter particles divide into *leptons* like the electron and neutrino, and *quarks* that can be up or down. Both have unstable *higher generations* for some unknown reason. Up and down quarks combine into the protons and neutrons of atomic nuclei that with electrons form the atoms of ordinary matter. Apart from neutrinos that whizz around for no reason and anti-matter that was expected but is nowhere to be found, it all seems 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

Table 4.1. The standard model of particles

PARTICLES	***MATTER PARTICLES***				
	Leptons		***Quarks***		***Anti-Matter***
	Electron like	*Neutrino like*	*Up-like*	*Down-like*	
Generation *1*	Electron (**e**)	Neutrino (**ν**)	Up quark (**u**)	Down quark (**d**)	Same mass, opposite charge
Mass (Charge)	0.511 (-1)	< 3 x 10^{-6} (0)	1.5 - 4.5 (+2/3)	5 – 8.5 (-1/3)	
Generation *2*	Muon (**μ**)	Muon neutrino (ν_μ)	Charm quark (**c**)	Strange quark (**s**)	As above
Mass (Charge)	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 quark (**t**)	Bottom quark (**b**)	As above
Mass (Charge)	1,777 (-1)	< 18 (0)	174,000 (+2/3)	4,000 – 4,500 (-1/3)	
	FORCE PARTICLES				
Field:	***Electromagnetic***	***Strong***	***Weak***	***Gravity***	***Higgs***
Name *Mass (GeV)*	Photon (γ) (0)	Gluon (**g**) (0)	W^+, W^-, W^0 (80.4; 80.4; 91.2)	Graviton (0)	Higgs (125)
Charge	-1 to +1	Eight "colors"	Isospin (+½, -½)	0	0

Some fundamental questions the standard model *doesn't answer* include:

1. Why don't protons decay as neutrons do?
2. Why is our universe made of matter not anti-matter?
3. Why do neutrinos have a tiny but variable mass?
4. Why do leptons and quarks have three particle "generations" then no more?
5. Why do electrons "half spin"?
6. Why do particle masses vary enormously but charges don't?
7. Why do neutrinos always have left-handed spin?
8. Why do quarks have one-third charges?
9. Why does the force binding quarks increase as they move apart?
10. What is the dark matter and dark energy that constitute most of the universe?

It isn't just that these questions are unanswered but that over fifty years has seen no progress at all in answering them. The great hopes of string theory and super-symmetry led nowhere so the next fifty years look like being the same. Can a quantum processing model make progress where the standard model can't?

4.3. ELECTRONS AND NEUTRINOS

If the universe began as a cauldron of *massless* high energy photons, how did matter arise? Electrons and neutrinos are the smallest matter entities, so they are the most likely candidates for the first matter.

4.3.1. Electrons

In current physics, the small mass and negative charge of an electron exists as a *point particle* with zero dimensions. But a particle has mass by means of a matter substance, how can a particle with no extent have substance and hence mass? The standard model doesn't do a good job of explaining what an electron actually **is**.

In quantum realism, matter isn't an inherent substance but a quantum processing output and after the first event, only high energy photons existed as processing passed on by the quantum network. A computer network node passes data to another via a *channel* so let us assume that a quantum node passes on processing by channels. If the neighbors of a node exist as a sphere around it, they represent all the rays of light that can arrive at the node. As a ray of light on one axis can have many different photons, each with a different polarization plane, *let a quantum channel be a quantum node's ability to pass on one photon,* so the number of quantum channels per quantum network node is very large. Computer channels are mostly *duplex*, as they transfer in both directions, so we assume that quantum channels are the same. Finally, as one photon is the smallest possible transfer, the quantum channel bandwidth is expected to be the quantum process defined earlier. This logic suggests that *one quantum node channel*:

1. Receives processing from one axis line
2. For one photon polarization plane
3. Up to a bandwidth of one quantum process per quantum cycle
4. Where photon streams are in lockstep order so they can't overtake
5. And being duplex, can accept photons from either axis direction.

One quantum channel is then represented by a point with a line through it plus a plane that cuts the line at the photon's polarization and it can accept and pass on photons going in opposite directions. It follows that if two photons with the same polarization going in opposite directions meet head-on in a channel, it will accept both and pass both on, unless the total processing of the photons exceeds the bandwidth of one quantum process. If it did, the photons would overload the channel and restart the processing in a physical event. As normal photons are one quantum process spread over many nodes, this doesn't happen for the light we see, so *current physics generally assumes that light rays never collide*.

Photons meeting head-on don't overload a channel if their processing sum is below its bandwidth but what if it isn't? This model allows light at the highest possible frequency, of a wavelength of two nodes. Let an *extreme photon be one quantum process shared over two quantum nodes,* with half a quantum process in each node. If two such photons meet head-on, each requesting a half quantum process, the total processing will be one quantum process, so channel will overload and they will "collide".

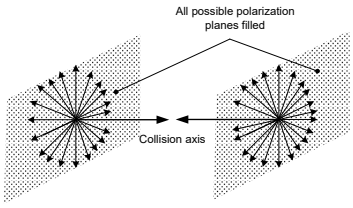


Figure 4.2. Extreme light beams meet head-on on an axis

As photons *spin* on their axis of movement, photons that overload can restart in another axis channel, but this can't occur if every channel overloads. Now *let an extreme light ray be extreme photons filling every channel of a transfer axis*. If two such rays meet head-on, *every* channel on one axis overloads at once (Figure 4.2), with no free channels for the photons to restart in. That extreme light rays meet head-on is obviously unlikely but it must have occurred in the early plasma by the quantum law of all action, that everything possible eventually happens (3.6.3).

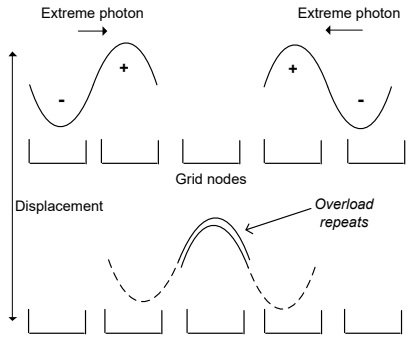


Figure 4.3. An electron channel overload

Figure 4.3 shows the result for one channel, with every channel the same. In this picture, "head" refers to the photon leading half and "tail" to the following half. Two heads, of half a quantum process each, overload the quantum channel bandwidth so both photons restart next cycle. Two new photons then set off in opposite directions but now the tails collide in another overload that restarts the photons again. This overload/restart repeats every quantum cycle because every channel on the axis is the same. *The network that once hosted only waves now has the permanent processing bump that we call an electron*.

It is stable because any processing arriving *on that axis* finds all the channels taken while anything at right angles passes right through using different channels. An electron in network terms is a repeating overload, like a stuck record that endlessly repeats

Experiments show that electromagnetic waves can repeatedly interact to form static states (Audretsch, 2004, p23) as repeated observations can maintain a quantum state if the time delay is short (Itano, Heinzen, Bollinger, & Wineand, 1990). Feynman's PhD partitioned the electron wave equation into opposing advanced and retarded waves but he didn't pursue it, perhaps because electrons are particles. The Wheeler–Feynman absorber theory later proposed that retarded and advanced waves underlie charge (Wheeler & Feynman, 1945). Cramer's transactional theory also uses retarded and advanced waves (Cramer, 1986) and Wolff has suggested that electrons are in and out spherical waves (Wolff, M., 2001). If electromagnetic waves can collide to form standing waves as other waves do (Figure 4.4), *an electron could be a quantum standing wave created when extreme photons collide.*

Figure 4.4. A standing wave on water

This contradicts the standard model in several ways. Instead of a particle of matter substance with no size, which makes no sense, an electron that occupies one "point" node of the quantum network has a size, just as a screen pixel does. Instead of having no structure, an electron is made of photons that fill all the channels of one axis. If matter is light trapped in a never-ending loop, *it isn't inert at all*. It is "frozen" in place but still pulses at the speed of light, like a standing wave that is both static and moving. And as this only applies to the channels of one axis, an electron is only *one-dimensional matter*.

When a computer "hangs" in an infinite loop and doesn't respond to input, we restart it, but sometimes this doesn't work. If a node of our network "locks" in an infinite loop that a restart can't fix, it is called a *glitch* but for the quantum network, the *matter glitch* was an evolution not an error.

4.3.2. The charge byproduct

Current physics defines charge as what causes electrical effects and electrical effects as caused by charge. This circular definition, that charge is what charged particles have, indicates that we don't really understand it. In the standard model, charge is a *self-evident property* like mass, and the two are considered unrelated.

Quantum realism aims to *derive* physics from processing not just *describe* it so if mass is a processing overload that repeats, what is charge? In Figure 4.3, mass as positive processing that repeats endlessly leaves negative processing that never runs as the dotted lines show. The quantum network must keep its processing books in order, so let *an electron's charge be its constant processing deficit.* If a processing overload that repeats is mass and the processing that repeatedly doesn't run is charge, then *charge is a necessary byproduct of matter*.

This definition of charge fits its properties as processing remainder can:

1. Be positive or negative, as charge is.
2. Cancel its opposite, as opposite charges do.
3. Have a constant value as the electron repeatedly restarts, as an electron's charge is.

If mass is the *net processing run* and charge the *net processing not run,* per node per cycle, then matter as a repeating quantum processing overload inevitably has mass and charge by the operation that creates it.

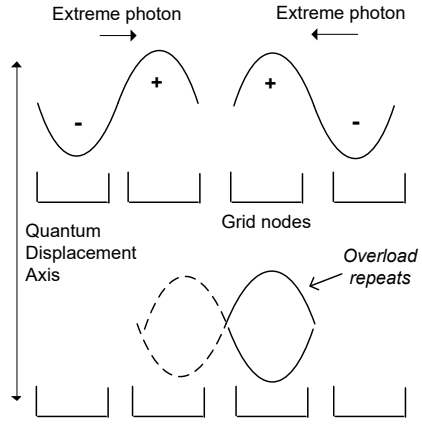


Figure 4.5. A neutrino channel overload

4.3.3. The neutrino byproduct

The processing that explains matter also explains charge but what about the electron's brother neutrino? Electrons are critical to our world, as without them there is no chemistry and no life, but our universe also contains a "little nothing" that until recently we didn't even know existed – the *neutrino*. The sun floods the earth with vast numbers of them each day but they mostly pass through us like ghosts. Neutrinos seem quite pointless, so why did nature make so many of them?

The standard model expects neutrinos to have no mass at all because they have no charge but their tiny mass was how we detected them in the first place. When asked why neutrinos have a *non-zero* mass but *exactly zero* charge, the current physics answer is that it just does. That isn't good enough here.

If extreme photons colliding *in-phase* give an electron (Figure 4.3), they can also collide *out-of-phase* (Figure 4.5), where two nodes overload but only one successfully reboots. Both cases overload all the channels of an axis but while a *head-head* collision gives an electron "bump", the heads and tails cancel in a *head-tail* collision to give the "little nothing" we call a neutrino. It follows that rather than a useless "building block", the neutrino is a necessary byproduct of an electron-type collision.

But if a neutrino is an electron-type collision in a different phase, why isn't its mass zero? If the quantum network was perfectly synchronized, photons entering a node would arrive at exactly the same time to cancel entirely but it isn't, as the universal flow of light doesn't synchronize it perfectly (2.4.4). *Perfectly synchronized* heads and tails would cancel but in our *mostly synchronized* quantum network, the neutrino heads and tails don't exactly cancel. Over many channels, small asynchronies give the small processing excess we call mass but the processing left over still cancels exactly. While an electron is a bump on space, a neutrino is a smudge whose *tiny mass reflects the quantum network's imperfect synchrony*.

Table 4.2. Lepton processing

Lepton	Photon phase	Axis Bandwidth
a. Electron	*Photon heads* from one side *Photon heads* from the other side	+1/2 +1/2
	Total processing (stability) **Net processing** (mass) **Remainder** (charge)	**1 (full)** **+1** **-1**
b. Neutrino	*Photon heads* from one side *Photon tails* from the other side	+1/2 -1/2
	Total processing (stability) **Net processing** (mass) **Remainder** (charge)	**1 (full)** **~ 0** **0**

If a point of space is a network *node* that offers many *quantum channels* for any axis through it, the channel set for that axis has a finite bandwidth just as a channel does. Let the *axis bandwidth* be the amount of processing an axis can accept before it overloads. Table 4.2 then describes electrons and neutrinos in terms of *axis bandwidth,* where:

1. *Total processing.* The processing sum regardless of sign that an axis handles. If it repeatedly "fills" an axis bandwidth, the result is *stable*.

2. *Net processing.* The net processing after opposite displacements cancel defines the *mass*.

3. *Remainder.* The net processing remaining after opposite displacements cancel defines the *charge*.

Note that a tail-tail meet isn't possible because it implies a prior head-head meet. Extreme light at the highest frequency can overload a node axis to give a quantum standing wave. In the initial chaos, it was bound to give electrons and neutrinos as one-axis collision options. Electrons and neutrinos are then brother leptons because they both overload one-axis, though one is something and the other almost nothing. *Quantum processing repeatedly overloading all the channels of a node axis gave electrons and neutrinos as the first matter*.

4.3.4. The anti-matter byproduct

Dirac's equations predicted anti-matter before it was found but didn't say *why* every matter particle had an "evil twin" of the same mass but opposite charge. The standard model added an anti-matter column to fit the facts but that matter has an inverse is one of the most baffling findings of physics. If matter is a substance, what is an "anti-substance"? Why does nature even allow anti-electrons that can instantly annihilate electrons?

In contrast, if matter arises from quantum processing, it is possible to run the same processing *in reverse,* as a process setting a circle of values one-way can set the same values in reverse. In a reverse cycle, instead of a photon first going up on the surface of space and then down, it will first go down and then up. This implies two photon processing possibilities, namely "first-up" or "first-down".

If an anti-electron is the same photons as an electron processing a reverse cycle, the resulting overload gives same net processing *mass* but an opposite remainder *charge,* so an anti-electron has the same mass as an electron but a positive charge, as observed. *Processing implies anti-processing* so the same logic applies to every matter particle. A quantum processing model predicts the existence of anti-matter and also that anti-electrons will annihilate electrons by turning both back into photons. *It follows that anti- matter is to matter as neutrinos are to electrons – necessary byproduct*.

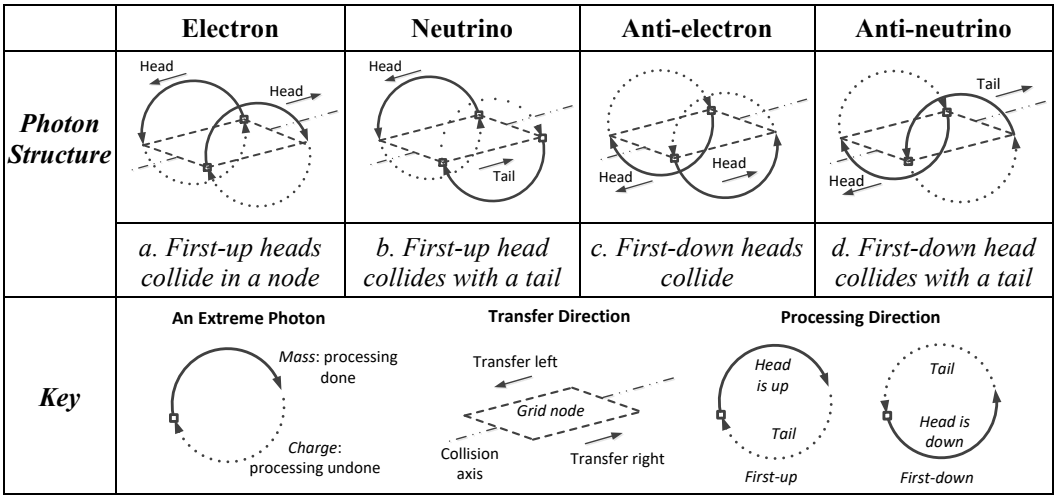


Figure 4.6. Lepton photon structures

Figure 4.6 summarizes the basic leptons of the standard model by their photon constituents as follows:

1. *Matter. First-up* extreme photons collide to give either an:
   i. *Electron (4.6a). First-up heads* collide to give mass and a negative remainder gives a negative charge.
   ii. *Neutrino (4.6b). First-up heads* that are not entirely synchronous mostly cancel *first-down tails* to give a tiny mass but the remainders cancel fully to give zero charge.
2. *Anti-matter. First-down* extreme photons collide to give either an:
   i. *Anti-electron (4.6c). First-down heads* collide to give mass and a positive remainder gives a positive charge.
   ii. *Anti-neutrino* (4.6d). *First-down heads* mostly cancel *first-down tails* to give a tiny mass but the remainders cancel entirely to give zero charge.

In sum, *quantum realism derives all the fundamental leptons of the standard model from extreme photons*.

4.3.5. Where did the anti-matter go?

In physics, matter and anti-matter are equivalent opposites, so while atoms in our universe have negative electrons, an anti-matter universe would have positive electrons but everything in that world would seem the same to its inhabitants *because the laws of physics would be exactly the same*. Why then do we only see matter all around us? Did the big bang produce:

1) No anti-matter, for some unknown reason?

2) Matter and anti-matter equally but the anti-matter in the universe is hidden?

3) Matter and anti-matter equally but matter somehow "overcame" the anti-matter?

Physics dismisses the first option by its equations and the second because no anti-meteors, anti-planets or anti-stars have ever been seen. The current view is that the big bang made equal amounts of matter and anti-matter, but then matter

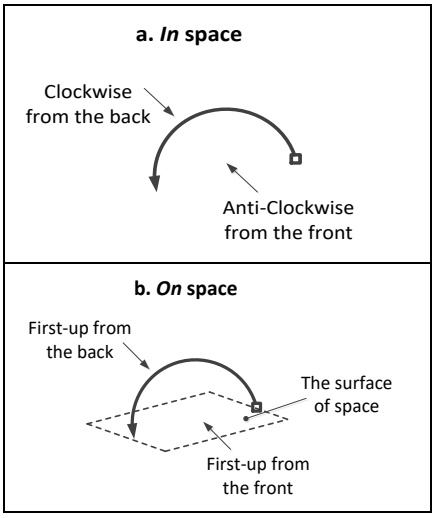


Figure 4.7. Rotation in and on space

somehow overcame the anti-matter to give our universe. That no evidence supports this belief is called a "mystery" of physics:

"*The lack of anti-matter is a deep mystery that cannot be explained using the Standard Model.*" (Oerter, 2006) p101

A clockwise rotation *in* a space is anti-clockwise from the other side (Figure 4.7a) but a first-up rotation *on* a surface will stay that way however it is viewed (Figure 4.7b). If our universe began with one photon, then it had to choose whether to first vibrate *up* or *down* with respect to the surface of space. As it had to choose, let us say that it chose *first-up* processing and all its offspring followed suit.

It follows that when the first photon chose processing over anti-processing, our universe became matter not anti-matter. If the first light evolved into matter only, not matter and anti-matter equally as the standard model assumes, then *the anti-matter the standard model is trying to explain away never was*. The first photon chose to oscillate one way and from then on *anti-matter was a path not taken*. Physical realism can't explain why our universe is matter not anti-matter because that choice occurred before the physical universe began.

4.3.6. Anti-time

The assumption that time works the same way for everything doesn't apply to anti-matter (Ambjorn, Jurkiewicz, & Loll, 2008) as when an anti-electron hits an electron, the Feynman diagram shows it *enters* the collision going *backwards in time* (Figure 4.8), though the logic is symmetric so to the anti-electron, the electron is going backwards in time. Yet despite time going backwards, both the electron and anti-electron are *entering* the interaction not leaving it, so reversing time doesn't mean reversing causality.

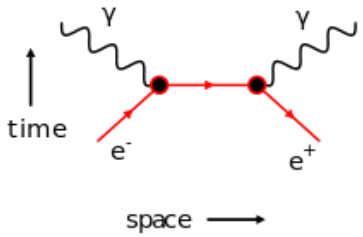


Figure 4.8. A Feynman diagram

Minkowski interpreted Einstein's theory to mean that objects move faster or slower along a time dimension in a *block theory of time,* where every event that ever was or will be can be paged like a book (Barbour, 1999). Minkowski's model has *one* time dimension so a particle going *backwards in time* reverses causality but the anti-matter particle in Figure 4.8 isn't doing that. The anti-electron is *entering* the collision just as the electron does with no causal reversal, so Minkowski's interpretation can't explain how anti-matter time runs backwards. If time is an absolute dimension, to reverse time is to travel back in time and deny the causality behind all physics.

In quantum realism, time passes as quantum cycles complete and there is no space-time "canvas" upon which matter particles exist. Einstein's conclusion, every object in the universe has its own "clock", arises because every node on the quantum network runs at its own rate, which may vary.

If time passes as quantum cycles finish, a tick of matter time passes for every forward cycle but a tick of anti-matter time passes for every reverse cycle. Anti-matter then exists in *anti-time* as matter exists in *time,* except that for matter a forward cycle is a tick of its time and for anti-matter a reverse cycle is a tick of its time. To a matter being, anti-matter runs time in reverse but to an anti-matter being our matter is running time in reverse. Matter exists by processing while anti-matter exists by anti-processing, but in both cases their quantum cycles define their time.

That anti-matter runs time in reverse is only possible if time is virtual. It doesn't mean that anti-matter reverses causality but that *Feynman diagrams need dual time axes, one for matter time and one for anti-matter time*. Anti-time is an alternate virtual time that exists because anti-matter processing is the reverse of matter processing. If processing creates time, not only does every entity in the universe have its own clock, *it also decides its own clock direction*.

If reality is virtual, can time rewind like an Internet browser has a Back button? But a browser back button can only undo *your* last act, it can't undo interactions like online registrations as this must reverse both parties and with six degrees of separation, rolling back six events for one person could affect the entire web! To undo *interactions* one must roll-back the entire network and this is also true for the quantum network.

Anti-time doesn't imply time reversal because a physical event is a reboot that can't be undone. Anti-matter exists in anti-time *between* physical events but it can no more undo its physical interactions than matter can. A series of reboots can't be reversed, rewound or fast-forwarded, whether by matter or anti-matter, so there is no time travel.

4.4. QUARKS

All the matter we see is made of atoms whose mass comes almost entirely from their nuclei, which are made of quarks. Quarks are the fundamental constituent of all the matter we see but their charges come in unexpected thirds for no known reason. Yet they obey the equations of matter, so a model that explains electrons must also explain quarks.

4.4.1 A three-way interaction

In the standard model, *quarks* are fundamental point particles, unrelated to electrons or neutrinos, that come in two types called "up" and "down", with different charges. An *up quark* has a plus two-thirds charge and a *down quark* has a minus one-third charge. This lets two up quarks and a down quark combine into a positively charged *proton* that is the nucleus of Hydrogen, the first element of the periodic table. Each new periodic table element has one more proton plus some *neutrons* which arise from one up quark and two down quarks. Quarks form the protons and neutrons in the nuclei of all known atoms.

If the electron's mass is based on a one-axis interaction of extreme photons, quark mass must also arise in same way. The last section covered all the ways photons can interact on one axis, so a quark can't be a one-axis result but it could be a three-way interaction. If three rays of extreme light meet in a node, the interaction must be on a plane, as shown in Figure 4.9, instead of on an axis. Such an event is unlikely but again it must have occurred in the early plasma by the quantum law of all action.

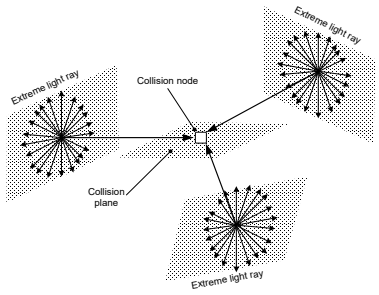


Figure 4.9. Three extreme light rays meet

A three-axis collision has an interesting symmetry, as photons on any axis half exist on the other two by the cosine rule[1], so any quark axis is one ray vs. two others at half strength, which is a lepton type collision. But applying this feature to one axis doesn't leave enough light to do the same to the other two.

A three-way extreme light interaction isn't stable alone but it turns out that unlike electrons, quarks alone are so unstable that they can't exist alone. Had it not been so, the model would fail as there are few other reverse engineering options, but a three-way interaction has a symmetry that may let quarks be stable in a group. But first, consider the processing needed to fill all the channels of a *plane* through a node to achieve the stability that electrons achieve for a *line*.

4.4.2 Filling a node plane

Lambert's cosine law is that the intensity of a light ray hitting a surface varies by the cosine of the angle it hits at, so light hitting 90º to a plane gives all its intensity but at 0º gives none, and in-between the angle *cosine* gives the intensity. A light ray essentially *projects* its intensity onto the plane according to angle.

If ray intensity reflects the channels available across a plane, the channels light occupies *vary as the cosine of its angle to the plane*. The cosine law implies that two rays of light *on the same axis* share all the same channels because Cos(0) is one and *at right angles* share no channels because Cos(90) is zero, and two rays at an angle share channels by the cosine of that angle. In effect, the two rays *project* into each other's channels according to angle.

Two perpendicular light rays on a plane through a node occupy every channel, as every other ray on that plane can be obtained as a projection of those rays by the cosine rule. When two light rays cross at a node point, they fill all the channels of a plane though that point. It follows that if the channel bandwidth of a line axis through a node is one, *the bandwidth of a plane through a node is two*. If an electron is two extreme light rays filling the channels of a line through a node, four extreme light rays are needed to fill a plane though it.

[1] A photon moving on axis X has a quantum amplitude on axis Y cutting X that decreases as Cos(θ), where θ is the angular difference between X and Y. For a quark with three axes, each one has two others cutting it at 60^0, where Cos (60^0) is one half.

In Figure 4.9, three equal-angle extreme rays in a plane meet at a node point. How the photons in these three rays use the node channels may one day be simulated but for now it must be envisaged. If each ray fills half the bandwidth of one axis, three times that is 1.5 but the bandwidth of a plane is two. If the result is a quark, it can't be stable because three extreme rays don't fill the bandwidth of a plane.

Rays that aren't at right angles will share channels at the node so each ray axis has fewer channels than a single axis. *Dividing the plane bandwidth of two between three axes gives each axis a two-thirds bandwidth.* Thus, filling each of the three axes in Figure 4.9 at two-thirds of an electron axis will fill the plane bandwidth, because three times two-thirds is the plane bandwidth of two. It follows that for light rays on three axes to fill all the channels of a node plane, *each of the three axes must fill at two-thirds of an electron axis.* Quarks must fill all the channels of a node plane to achieve stability.

4.4.3 Quark phases

As for an electron, a three-way interaction of extreme photons has phase options that can be expressed in photon head-tail terms. Again, a tail-tail-tail meet isn't possible as it implies a prior head-head-head event. The phase options are:

1. *Head-head-head.* Three sets of photon heads meeting at equal angles in a node allocate processing equally so each axis is only partly filled. There are free channels that let other entities in, so the result isn't stable.
2. *Head-tail-tail.* In this case, two photon rays leave a node as another arrives, as shown in Figure 4.10a, and this is proposed to be an *up quark.*

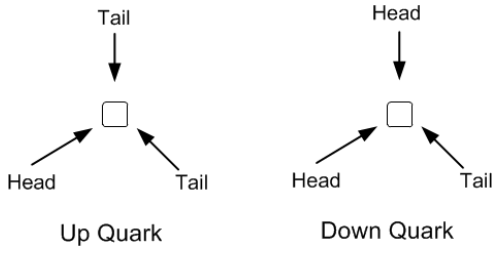


Figure 4.10. Up and down quark structure

3. *Head-head-tail.* In this case one ray has passed through the node as the other two arrive, as shown in Figure 4.10b, and this is proposed to be a *down quark.*

Figure 4.10 shows the proposed up and down quark structures. As photons compete for channels on a first-come-first-served basis, a three-way meeting raises the issue of *interaction order*. If a photon head entering a node meets a photon tail leaving it, the tail must start before the head or it would be a head, giving the rule that *tails fill channels first.* Using this rule, Table 4.3 gives the expected axis bandwidth result as before, except now there are three axes not one and each fills at two-thirds not one. Again, the total processing defines stability, the mass is the net processing and the charge is the net remainder. The details are:

1. *Up quark.* If two extreme photon rays leave a node as another arrives, the tails first fill axis 1, giving a plus two-thirds charge remainder on this *charge axis.* The remaining tail photons then combine with later arriving heads to fill a *neutral axis,* as the remainders cancel. The remaining head photons partly fill the third *free axis* to a sixth instead of its maximum value of two-thirds. The result has a two-thirds charge and is stable on two axes but has spare photons in the third axis.

Table 4.3. Quark processing details by axis

QUARKS	*Photon Phase/Axis*	*Axis result in channel sets*		
		Axis 1	*Axis 2*	*Axis 3*
Up quark	*1. Tail* exits axis 1	-1/3	-1/6	
	2. Tail exits axis 2	-1/3	-1/6	
	3. Head enters axis 3	0	+1/3	+1/6
	Total processing	**2/3 (full)**	**2/3 (full)**	**1/6**
	Net processing	**-2/3**	**0**	**±1/6**
	Remainder	**+2/3**	**0**	**0**
Down quark	*1. Tail* exits axis 1	-1/6	-1/3	
	2. Head enters axis 2	vs +1/3	vs +1/6	
	3. Head enters axis 3	+1/6	+1/6	+1/6
	Total Processing	**2/3 (full)**	**2/3 (full)**	**1/6**
	Net Processing	**+1/3**	**0**	**±1/6**
	Remainder	**-1/3**	**0**	**0**

2. *Down quark.* If one ray has passed through a node as the other two arrive, the tail photons first cancel opposing heads to fill a *neutral axis* as the remainders cancel. Then the heads and the remaining tails fill a *charge axis* with a minus third charge left over. This again leaves a third *free axis* partly filled to a sixth instead of two thirds. The result has a minus third charge and is again stable on two axes with again spare photons in the third axis.

This result is interesting because it gives the correct third charges for quarks which no other

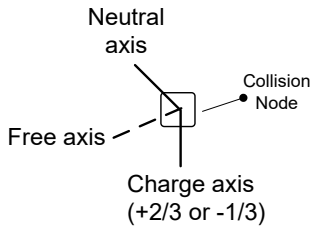


Figure 4.11. Quark axis structure

model does[2]. While the standard model *allocates* one-third charges to quarks after the fact, this model *derives* them. It predicts that quarks occupy one node like leptons but only fill two of the three collision axes.

To sum up, the three-axis structure derived for quarks is:

1. *Charge axis*. Fills with quark charge of up quark +⅔ and down quark -⅓.
2. *Neutral axis*. Fills as heads and tails cancel with no remainder.
3. *Free axis*. Remaining one sixth of head photons partly fills this axis.

Figure 4.11 summarizes the proposed quark axis structure, where the axes are at 60° even though the photons meet at 120° because quarks are head-tail mixes, so some rays are *leaving* as others *arrive*.

That the quark structure proposed isn't itself stable fits the fact that quarks never exist alone but their *symmetric* structure allows a group of them maintain an exterior of stable axes. As quarks are stable in a nucleus, they must somehow connect to fill all the channels of a plane, or the model fails. Physics calls the connection between quarks the *strong force*.

4.4.4 The strong force

The forces that bind protons and neutrons in an atomic nucleus are so strong that they break in a nuclear explosion. A bond that strong is necessary in order to overcome the huge electric repulsion between same charge protons. The standard model logic was that a *strong force* had to hold quark particles together in a nucleus. This force has the odd property that it is zero at short range but *increases* as quarks separate, an effect analogous to stretching a rubber band that was called *asymptotic freedom*. It exchanges no energy so it isn't electromagnetic and increases with distance so it isn't gravity. The standard model needed a new force to explain how the atomic nucleus was held together.

Its answer was *quantum chromodynamics,* a field theory derived by analogy from *quantum electrodynamics* (QED), the theory that explains light. QED explains electromagnetism as perturbations caused when an electromagnetic field absorbs or emits photons as shown in Feynman diagrams. These perturbations gave infinities that were removed by *renormalization*, a mathematical trick that arbitrarily subtracts infinities from the equations to get the finite answers desired.

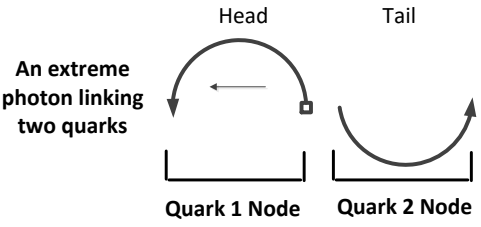


Figure 4.12. Photon sharing between quarks

Aiming to repeat the success of QED, quantum chromodynamics (QCD) proposed that a new *strong field* emitted new particles called *gluons* with a new *color charge*. In essence, the strong field's gluons acted to cause effects just as the electromagnetic field's photons did. The gluons then used red, blue and green charges to bind quarks in a proton just as photons bind electrons in atoms, but with three values not two, where the red, blue and green charges cancel to "white" just as positive and negative charges cancel to neutral. Three colors needed anti-colors to work, so to turn a red quark blue needs an anti-red gluon as well as a blue gluon. It was tricky but the calculations worked, so when in 1978 the PLUTO project managed to interpret a three-jet Upsilon event in gluon terms, gluons joined the standard model pantheon. Meaning didn't matter, so no-one asked why a *universal* field through *all space* existed for an effect that applied only to quarks.

A quantum processing model approaches the same facts differently, based on reverse engineering rather than devising a field to fit the facts. The quark structure in Figure 4.11 shows it has free photons in one axis, so could they link quarks that are close together, in a quark plasma? The free photons of one quark could insert themselves into another as shown in Figure 4.12, where an extreme photon has its head in one node and tail in another. It is now proposed that when quarks are side-by-side, the extra photons in a quark's free axis insert themselves into another nearby quark like "hooks".

[2] Table 4.3 partitions three photon sets colliding as $\frac{2}{3}^{rds} + \frac{2}{3}^{rds} + \frac{1}{6}^{th} = 1.5$ where each axis fills at $\frac{2}{3}^{rds}$ of an axis bandwidth. The result is a half short of the two needed but gives two stable axes with an excess of free photons in the third axis.

Photon sharing results in a bond that is initially zero but increases with distance because as linked quarks separate the shared photon wavelength increases to release the energy needed to pull them back together. In the next chapter, matter moves by a probabilistic reboot so stretching a photon increases the processing in the gap making the quarks more likely to restart there. The more the quarks separate, the stronger the effect, so quarks side-by-side experience no force but are pulled together as they separate. In effect, shared photons are the "elastic bands" that hold quarks together. *Quantum realism attributes the strong force to quarks sharing photons.* Could this let quarks fill all the channels of a node plane to achieve stability?

4.4.5 Protons and neutrons

The atomic nucleus, once thought indivisible, is now known to consist of protons and neutrons that in turn are made up of quarks. A proton is two up quarks and a down quark and a neutron is two down quarks and an up, so the odd quark charges add nicely to give a positive proton and a neutral neutron (Table 4.4). In quantum processing terms, could quarks combine to give stable protons and neutrons?

Table 4.4. Quarks give protons and neutrons

	Quark 1	Quark 2	Quark 3	Charge
Proton	Up $+^{2}/_{3}$	Up $+^{2}/_{3}$	Down $-^{1}/_{3}$	+1
Neutron	Up $+^{2}/_{3}$	Down $-^{1}/_{3}$	Down $-^{1}/_{3}$	0

If the free photon "hooks" of one quark insert into the neutral axis of another quark, this gives a sixth of an axis of processing in *both* quarks (Table 4.5A), where one photon in two adjacent quarks uses all its processing with no remainder. The photons from the second quark's neutral axis can return the favor until the first quark axis is full (Table 4.5B). Both axes are now complete and the positive and negative processing remaining in the neutral axis still cancels to neutral (Table 4.5C). Quark charge is unaffected because the charge axes aren't involved so *free-neutral photon sharing* completes the free axis but the neutral axis is the same. Photon sharing binds quarks and creates the extra processing needed to stabilize the first quark by filling its free axis.

Table 4.5. The strong link completes quark 1

	Quark 1 Free Axis	*Quark 2 Neutral Axis*
A. The free photons of quark1 insert their tails into quark2	[$+^{1}/_{6}^{th}$] ---------->	($-^{1}/_{6}^{th}$)
B. Quark 2 photons reciprocate until the quark 1 axis is full	($-$ ¼) <---------- [+¼] (+¼) <---------- [$-$ ¼]	
Total Processing	$^{2}/_{3}^{rds}$ (full)	$^{2}/_{3}^{rds}$ (full)
C. The quark 2 remainders cancel		+ $^{1}/_{12}$, - $^{1}/_{12}$

This link completes the first quark but the second quark can also complete its free axis by linking to a third quark that can complete by linking back to the first. Figure 4.13 shows how a triangle structure of quarks lets them share photons so they all become stable. If this is possible, then it will happen sometimes by the quantum law of all action. The result is a proton or neutron depending on the mix, as current physics asserts, but now what binds the quarks isn't magical particles from nowhere but *photon sharing*. Quarks then bind to others by sharing photons rather than being "pushed" together.

What then are the gluon "color charges"? Each quark needs a different axis status to link in a triangle so the standard model's red, blue and green "charges" are *quark orientations.* A quark as an inert particle needs an agent to change its axis orientation but dynamic processing does this *naturally,* as every cycle is a new event. Every cycle, photons compete for channels by each trying to occupy any channel it can. If a photon fails because another got there first, it just tries again. There is no predefined plan, just a free-for-all that gives different axis outcomes each time, so all that is needed to change a quark axis orientation is another quantum cycle

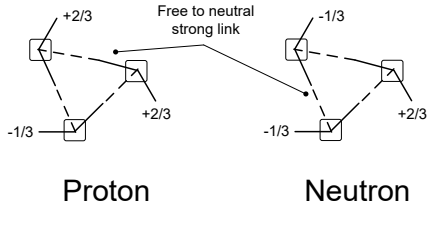


Figure 4.13. Proton and neutron quark structures

To illustrate how photons fill channels, imagine pouring water on a stack of wine glasses. When the water fills one wine glass, the remaining water just flows from it to the next, until every glass is full. *There is no need for any central control to "manage" the allocation of water to glasses.* Now suppose there is exactly enough water to fill all the glasses, and when this happens the weight makes the system restart, so all the glasses empty and another water pouring cycle begins. In the same way, a quark's photons fill all the channels of a node plane to trigger a processing restart that repeats the cycle.

The quantum world tries every option until a *stable* result occurs when all the channels *fill to give a node overload*. To see matter as an inert substance that must be pushed to change is like thinking something in a video must "push" it to the next frame. Likewise, what "pushes" the world to change is quantum processing not invisible particles. If an electron becomes stable by completing the channels of one axis, three quarks can do the same for a plane by sharing photons in a triangle. Protons and neutrons arise when quarks fill the channels of a node plane, not when invisible agents force them together. The strong force occurs because quarks have a processing *excess* while electromagnetism occurs because electrons have a processing *deficit.*

4.4.6 The weak force

A neutron is stable in a nucleus but after about fifteen minutes in empty space it turns into a proton. One of its down quarks "flips" to become an up quark, turning the whole into a proton. Again, the standard model needed *some agent* to cause neutron decay and as gluons couldn't do it, it postulated a new *weak force* that:

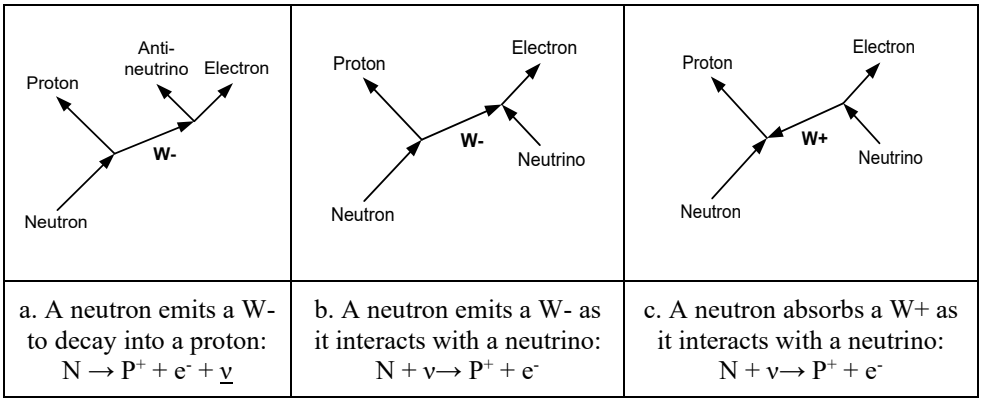
1. *Affects all matter*. Electromagnetism affects charge and gluons affect quarks but the weak force affects all matter.
2. *Violates parity-symmetry*. Weak interactions are left-right different.
3. *Has no bound state*. Electromagnetism binds atoms in molecules, the strong force binds nucleons in the nuclei and gravity binds stars in galaxies but the weak force binds nothing.
4. *Was asymmetric*. Neutrons decay into protons but protons are stable in space.

Neither electromagnetic nor strong forces act like this, so the standard model followed the by now standard practice of inventing a new *field* with new *bosons* and *charges*. The new charge, called *isospin* (+½,-½), was retro-fitted to allow charm quarks to interact with down quarks but not up quarks, etc., as observed. But this time the boson agents needed had to be heavier than protons and a field that *absorbed and emitted mass* was unheard of.

By now, virtual agents were the fashion and if the equations worked, it was accepted practice to "prove" they existed by finding matching accelerator collision resonances, so when in 1983 CERN found a million, million, million, millionth of a second event in the expected range, *weak bosons* immediately joined gluons in the standard model pantheon. On this flimsiest of evidence physicists today claim that:

"*Experiments have observed three bosons that carry the weak force*" (Marburger, 2011) p221.

In fact, bosons haven't been observed carrying anything, and what has been observed is a transient accelerator event. Suppose witness in a murder case said "*I observed the knife that killed the victim*" but cross-examination revealed that he observed a knife of the same size that he made! No court in the land would accept that evidence so why does physics call the same thing "proof"? *CERN observed the energy spikes it created not bosons carrying any force.* No evidence at all links the CERN signal to the weak effect so *it isn't proven at all*. If finding a matching energy spike proves a virtual agent exists, does not finding one for gravitons mean they don't exist? One can't have it both ways. Yet physics now accepts that neutrons decay when a 4.8 MEv down quark "emits" a W boson of mass 80,400 MEv! That such a *tiny* particle emits such a *massive* particle is like saying that an ant gave birth to an elephant.



a. A neutron emits a W- to decay into a proton: $N \rightarrow P^+ + e^- + \underline{\nu}$	b. A neutron emits a W- as it interacts with a neutrino: $N + \nu \rightarrow P^+ + e^-$	c. A neutron absorbs a W+ as it interacts with a neutrino: $N + \nu \rightarrow P^+ + e^-$

Figure 4.14. Standard model neutron decay routes

It doesn't help that the equations allow a neutron to decay in any of three ways, as it could:

1. *Emit* a W^- that decays into an electron and anti-neutrino (Figure 4.14a)
2. *Emit* a W^- boson that is hit by a neutrino to give an electron (Figure 4.14b)
3. *Interact* with a neutrino and a W^+ boson to give an electron (Figure 4.14c).

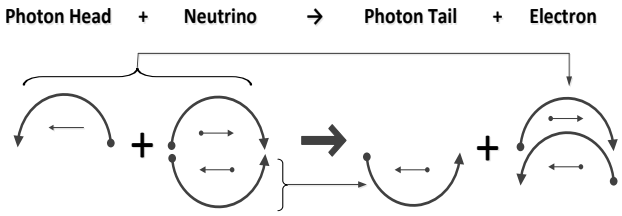


Figure 4.15. A neutrino converts a photon head into a tail

Three different causes might seem better than one but are three different alibis for a murder better than one? That a quark *could* emit a W- into a field or *could* absorb a W+ from one is the sort of after-the-fact reasoning that science is supposed to protect us from.

The reversible equations led to a fruitless thirty-year search for proton decay, ending in the massive Kamioka experiment that estimated the free proton half-life at over a billion, billion, billion years. *The standard model expected protons to decay in space but they don't.*

The quark as a photon head-tail structure suggests a simpler alternative. If a down quark is *head-head-tail* photons and an up quark is *head-tail-tail* photons, *a down quark becomes an up quark, to turn a neutron into a proton, when a set of photon heads become tails*. As Figure 4.15 shows for one channel, if a neutrino hits a photon head directly, the processing can rearrange to turn photon heads into tails. It follows that a neutrino hitting a neutron just right can turn it into a proton as the beta decay equation implies[3]. To do the reverse, a proton needs an *electron* hit to turn its tails into heads, but to get an electron right next to a quark takes a lot of energy so proton decay only occurs in the heart of stars. This effect doesn't alter the net remainder so it isn't electromagnetic, no photons are shared so it isn't strong and it affects any head-tail photon mix, which is all matter.

Quantum realism concludes that the weak effect is due to the neutrinos that are all around. It predicts that neutrons won't decay in a neutrino-free space and that proton decay needs a direct electron strike that takes energy that only occurs in stars. *In quantum realism, weak bosons are made-up agents, like fairies at the bottom of the garden.*

4.4.7 The God particle

The weak force required massive particles to pop out of empty space but the mass had to come from somewhere, so the answer was of course *another field!* The Higgs field was needed to provide mass for the standard model so the search for the Higgs particle became the holy grail of physics. It attracted over 30 billion dollars in funding and in 2012, after a fifty-year search, CERN found a resonance in the right *range*[4] and physicists all over the world breathed a sigh of relief. Some called it the "God particle", perhaps because it answered their prayers. Finding a million, million, million, millionth of a second 125GeV signal meant the standard model lived on! Yet the Higgs particle:

1. *Doesn't explain mass.* The Higgs flash adds no value to general relativity, our best theory of mass to date, nor does it explain the dark energy and dark matter that is most of the universe. Its only role is to rescue the standard model:

   "... the Higgs field allows us to reconcile ... how ... weak interactions work, that's a far cry from explaining the origin of mass or why the different masses have the values they do." (Wilczek, 2008) p202

   The Higgs isn't about mass in general, just a mass to sustain the standard model.

2. *Is medieval circular logic.* If the Higgs particle creates mass, what gives it mass? If another Higgs, what gives it mass and so on? A Higgs particle that begets itself is indeed a God particle! Some say *the field itself* creates the mass but what then does the Higgs boson do? Weren't bosons invented to avoid invisible fields causing visible effects in the first place? That *like creates like* harks back to the medieval fallacy that only water can cause wetness that science debunked by creating water from hydrogen and oxygen *gases* that aren't watery at all. The circular logic that mass has to create mass is medieval thinking.

3. *Is impossible by quantum theory.* In a carefully crafted press release, CERN claimed that zero-spin would confirm the Higgs then found it so, but quantum theory clearly states that a spin-zero point particle with mass is impossible (Comay, 2009). All quantum particles with mass have spin-half and only matter-antimatter mixes like mesons have

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[3] In beta decay, a neutrino hitting a neutron can turn it into a proton by the equation $N + \nu \rightarrow P^+ + e^-$. Equally an electron can turn a proton into a neutron by inverse beta decay $P^+ + e^- \rightarrow N + \nu$. Why insert fictional boson particles into these equations?

[4] The researchers note: "*The theory does not predict a specific mass for the Higgs boson*." (CMS collaboration, 2012) so *any* high mass particle would have done the job.

zero spin. As not-yet-found higher order mesons have zero-spin, are in the right mass range and have the same photon decay and detection frequency, the Higgs particle that CERN found could well be a top or anti-top meson.

In essence, the Higgs is medieval logic that explains at best 4% of the mass of the universe in a way that quantum theory says is impossible. That what at best explains at best a tiny fraction of the mass of the universe is now called the "origin of mass" is a tribute to the power of marketing not science. To sustain the naïve idea that *inert particles* are pushed around by other particles, physics had to invent *virtual particles* that don't exist in any normal sense. *The irony that physical realism is now justified by virtual agents* leads to the strange conclusion that mass is more virtual than physical:

> "*The Higgs mechanism is often said to account for the origins of mass in the visible universe. This statement, however, is incorrect. The mass of quarks accounts for only 2 percent of the mass of the proton and the neutron, respectively. The other 98 percent, we think, arises largely from the actions of gluons. But how gluons help to generate proton and neutron mass is not evident, because they themselves are massless*." (Ent, Ulrich, & Venugopalan, 2015)

Nearly all an atom's mass comes from its nucleus of protons and neutrons but only 2% of their mass comes from their quark constituents so massless gluons that are virtual not real are said create the other 98%. *According to the standard model, most of the mass around us comes from massless virtual particles!*

The Higgs is an imaginary agent invented to explain another imaginary agent that was invented to explain an observed effect, namely neutron decay. A model that uses one invisible thing to explain another becomes a theoretical house of cards, hence finding the "god particle" hasn't led to a single other discovery or benefit.

4.4.8 Mass and energy

Once it seemed that light had energy but no mass and matter had mass but no energy, until Einstein found that light had relativistic mass and matter had a resting energy that could be released in nuclear bombs. It became apparent that mass and energy were somehow related.

Mass was originally defined as *weight* which was later refined to be *gravitational mass*. Newton's discovery that a mass needed a force to accelerate it led to the definition of *inertial mass*. They are different because a weightless object in space still needs a force to move it, so it has inertial mass although it has no gravitational mass. If *momentum* is defined as mass times velocity, a massless photon should have no momentum but solar sails move when the sun shines on them and photons are bent by the gravity of the sun. This led to another revision as a photon with no *rest mass* was said to gain *relativistic mass* as it moves to give it momentum[5].

Light was once seen as pure energy where *Planck's relation* defined a photon's energy E as its frequency f multiplied by Planck's constant h, *so* $E = hf$. The last chapter defined energy as the *processing rate* at the node, so it reduces as the wavelength increases because as more nodes share the process, the processing per node reduces. Equally as frequency increases, wavelength decreases, so fewer nodes running the same process each process faster, giving more energy.

Einstein's equation $E=mc^2$ does for matter what Planck did for light, define its energy. In 1905 he deduced that the energy of matter is its mass times the speed of light squared and atom bombs confirmed this but it has never been clear why mass relates to light at all. *If mass is an inherent substance, why does its energy refer to the speed of light?*

If an electron is extreme photons repeatedly colliding in many node channels, the inherent energy of matter relates to the energy of those photons. Each channel contains the equivalent of *a photon with a one node wavelength,* whose energy by Planck's relation is Planck's constant times the speed of light divided by one Planck length. If Planck's constant is one quantum process transferred over a Planck length squared per Planck time, substituting for Planck's constant in Planck's relation gives Einstein's equation for mass and energy[6]. *Quantum realism derives Einstein's equation from the conclusion that matter is made of extreme light repeatedly colliding*.

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[5] Relativistic mass is defined by special relativity. Rest mass is mass with no relativistic effects.

[6] In this model, the speed of light $c=L_P/T_P$, for L_P Planck length and T_P Planck time. A photon's energy $E_P=h_P.c/\lambda$, for h_P the energy of one quantum process transfer, c the speed of light and λ the wavelength. In an electron λ is one node, so $E_P=h_P.c/L_P$. If mass m_p is the program that repeats, h_p transfers m_p over a Planck length square every cycle, i.e. $h_P=m_p.L_P.L_P/T_P$. Substituting gives $E_P= m_p.L_P.c/T_P$, or $E_P=m_p.c^2$. This derivation doesn't prove $E=mc^2$. Einstein did that based on how our physical world behaves. It just finds this model consistent with Einstein's equation.

4.4.9 Review

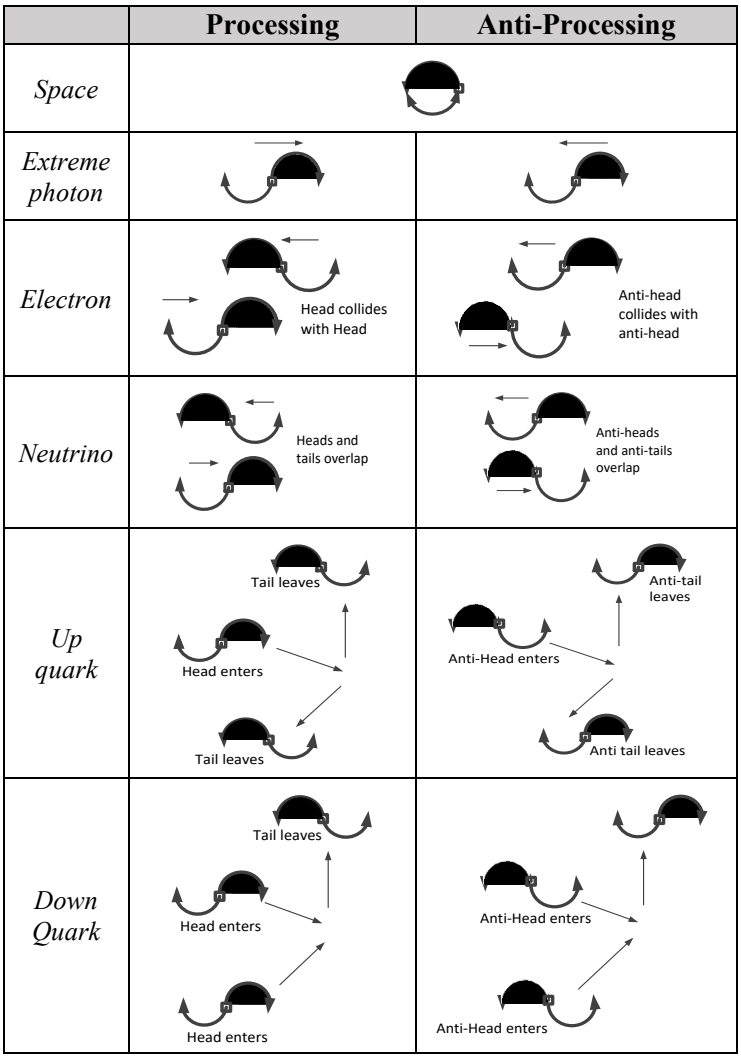


Figure 4.16. The basic processing structures

The standard model describes fundamental particles in terms of mass, charge and energy but quantum realism describes mass, charge and energy in quantum processing terms. Mass is the processing that repeats endlessly when a network node "hangs", charge is the processing left-over that never runs, and energy is the processing transfer rate per cycle. Figure 4.16 summarizes this model based on mass, charge and energy:

1. *Space.* A point of empty space is a node that runs one quantum process in every channel. The net processing is zero so it has no mass, the transfer rate averages zero so it has no net energy and no remainder gives no charge.

2. *Photon.* A photon can't stop to be weighed but its net processing at each node gives it mass, its processing transfer rate gives it energy, and no processing left over gives it no charge.

3. *Electron.* An electron fills the channels of a node axis with positive processing to give mass and the negative remainder gives it a negative charge.

4. *Neutrino.* A neutrino's axis channels are filled with processing that nearly cancels, to give a tiny mass, while the remainders cancel to zero charge.

5. *Quark.* A quark is a three-way photon collision that doesn't quite fill the channels of a plane but its net processing repeats so it has mass and the remainder gives one-third charges according to phase (up or down).

6. *Anti-matter*. Anti-matter versions of quarks, electrons, and neutrinos derive from reverse processing that gives the same net processing mass but opposite charge remainder.

In quantum realism, space is a null processing circle, light is space distributed and matter is extreme light colliding as a standing quantum wave, so mass is a processing demand that repeats, charge is a processing remainder that repeats and energy is the processing transfer rate. This covers the basic properties of all the basic entities of physics.

4.5. FIELDS UPON FIELDS

Physics spent much of last century trying to prove Newton's idea that *particles* cause all the forces in nature. In order to explain forces like magnetism and gravity that act at a distance, with no particles in sight, they argued that fields exert forces by creating unobservable *virtual particles*. The resulting *fields upon fields* made physics what it is today.

4.5.1 Many fields, many choices

Fields are common in physics today, e.g. the earth holds the moon in orbit by a gravitational field that exerts a force on matter particles at every point in space, an electric field exerts a force on charged particles at every point in space, and so on for other fields, where according to Feynman:

"*A real field is a mathematical function we use for avoiding the idea of action at a distance*." (Feynman, Leighton, & Sands, 1977) Vol. II, p15-7

Emboldened by the success of Faraday's electromagnetic field, physics explained the forces it found by inventing fields that added what mathematics calls *degrees of freedom* to space. For example, the force of gravity acting at every point in space added one degree of freedom, the electromagnetic field caused electrical and magnetic forces at every point so it added two degrees of freedom, and so on. It was then realized that adding a degree of freedom to each point of space in effect adds a dimension to it, so *adding many fields is like adding many dimensions to space*. Current physics has fields that explain gravity, electromagnetism, strong and weak forces, where gravity adds one-dimension, electromagnetism adds two, the strong force adds three and the weak force two. These eight extra dimensions plus the three of space are why *string theory needs eleven dimensions to work*.

But when one adds dimensions to space the mathematics soon gets out of control because they *interact*. String theory's attempt to explain physics mathematically using many fields gave so many possible architectures, over 10^{500} at least, that the result didn't predict anything, hence many scientists today don't consider it a useful approach. In effect, many fields or many dimensions give so many options that the result is meaningless.

That a universe of eleven dimensions somehow collapsed into ours is a far-fetched idea, akin to the multiverse story. The standard model tactic of inventing new fields to explain new forces is failing because it predicts nothing.

4.5.2 The frog in the pan

In an apocryphal story, a frog dropped in a pan of boiling water jumps out immediately but if put in tepid water that is *slowly* brought to the boil, by the time it realizes the danger it is too weak to jump out and perishes. It is now proposed that something similar happened to the standard model last century.

When Faraday first proposed that an invisible field around an electric charge made it attract and repel other charges at a distance, it was considered fanciful until the equations worked. Today, fields explain every force in physics but a field is a *disembodied force* that acts at a distance and Newton, centuries earlier, had issues with this:

"*That gravity should be innate, inherent and essential to matter, so that one body may act upon another at a distance thro' a vacuum, without the mediation of anything else … is to me so great an absurdity, that I believe no man … can ever fall into it. Gravity must be caused by an agent…*" (Oerter, 2006) p17

Maxwell created the equations of electromagnetism by imagining physical ball-bearings twisting in vortex tubes but all attempts to develop this into a physical model failed. Driven by the belief that something physical had to make iron filings move in a magnetic field, *field theory* came up with the idea that the field created *force-carrier particles* to do its bidding. Since electromagnetism acted in photon units and Einstein had shown that photons were particles, that *virtual photons* caused electromagnetic effects worked nicely.

The standard model was born when Maxwell's equations were explained by virtual photons from a Faraday field. Unlike real photons, *virtual photons couldn't be observed* as they come into existence, cause an effect, then are consumed by the act. Science doesn't normally accept agents that can't be observed but physicists could *see them in the equations.* This seemed a small price to pay to carry on calculating but the pseudo-science temperature had just gone up a notch.

As photons are bosons, field theory generalized that all fields use *boson agents* so gravity had to work by *gravitons* that to this day have no real-world equivalent. There is no evidence at all that such a particle has ever existed but naming them made them exist in the minds of physicists. To assume a thing exists without evidence because a theory needs it contradicts science, so again the pseudoscience temperature rose a notch.

When the *strong field* was used to explain how protons bind in a nucleus, virtual photons with no mass or charge were joined by virtual *gluons* with color charge, so now an invisible field could create *charge*. Since gluons by definition could never be directly observed, again the pseudoscience temperature rose a notch.

When the *weak field* was used to explain neutron decay, it needed weak bosons with charge and mass so now there was a field that could create *mass*. Things were heating up, so this virtual particle had to be shown to at least exist but when a match was found among billions of particle accelerator events it was declared "proven", although the established scientific method for proving causality was ignored. Adding an invisible cause of mass again raised the pseudoscience temperature.

Finally, to let virtual particles create mass it was necessary to invent yet another field, this time with a virtual particle so massive it needed a billion-dollar accelerator to find it. All this, to support the physical realism canon that:

"…the forces of Nature are deeply entwined with the elementary particles of Nature." (Barrow, 2007) p97

Physics has pasted field upon field to prove Newton's belief until now virtual particles popping in and out of space cause every effect. They are said to be everywhere making everything happen despite *no direct evidence that they cause anything at all*. They are *magical* because an invisible field creates them and the effect absorbs them so by definition, *they can never be verified*. Virtual particles are the scientific version of a blank check and once physics accepted unverifiable causes it couldn't stop. Each new virtual "cause" weakened physics scientifically until, like the frog in the pan of water heating up, it is now in danger of dying as a science. The *age of fairy-tale physics had arrived* (Baggot, 2013).

4.5.3 There are no virtual particles

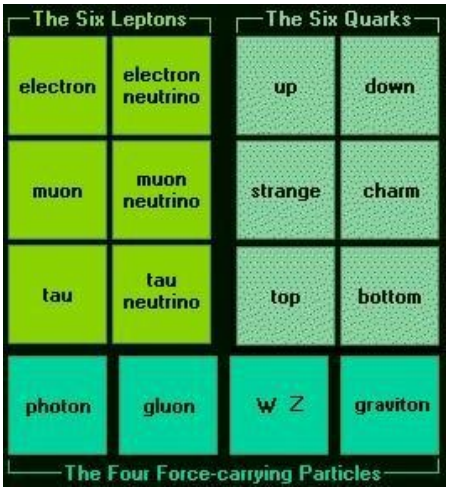


Figure 4.17. The CERN standard model

Suppose one could see a computer screen but had no access the hardware and software that created it. If one saw that screen changes occurred in bit units, does that mean that virtual "bit particles" created them? A better conclusion is that the screen changes in bit units because the bit is the basic unit of the processing that creates the screen. Likewise, the assumption of physics that virtual photons cause electromagnetic effects is premature.

If quantum processing creates physical effects, changes in electromagnetism occur in photon units because the photon is the basic network operation, so all changes just *look like photon effects*. The quantum network changes in photon units for the same reason that a computer screen changes in bit units. The link between photons and electromagnetism is *correlation not causation* and mixing these up is the oldest error in science[7].

Dynamic processing that tries every option doesn't need agents to push it, so an electron can fall to a lower energy orbit without needing an "orbit boson" to make it so. The forces that physics attributes to imaginary particles are produced by quantum processing as follows:

1. Electromagnetism. Where the standard model sees virtual photons quantum realism sees a quantum network re-allocating its basic operation, so no virtual photons are needed to explain electromagnetism (Chapter 5).

2. The strong effect. The standard model needed a new field, three new charges and eight gluons to explain how quarks bind in a nucleus. In quantum realism, quarks share photons to achieve stability and the color charge is the axis orientation needed for a stable result. Again, no magical gluon agents are needed (4.4.4).

3. The weak effect. The standard model needed another field, three more bosons and two new charges to explain how neutrons decay but still couldn't explain why protons don't decay. In quantum realism, neutron decay is a neutrino effect whose reverse is an electron effect only possible in stars, so protons are stable in empty space. Weak bosons are again unnecessary and thus imaginary agents (4.4.6).

4. The Higgs. If weak bosons don't exist, the Higgs boson isn't needed at all. CERN added yet another species to its already overflowing menagerie of "particles" that had no role at all in the evolution of matter. Adding another virtual particle to the standard model house of cards didn't add anything new to our knowledge (4.4.7).

5. Gravity. Every attempt to find gravitons has failed but standard model iconographies still display it as if it were real (Figure 4.17). But if gravity alters space and time, how can particles that exist **in** space and time do that? Something else is needed and Chapter 5 attributes gravity to a *grid processing gradient*.

Finally, if the Higgs can interact with weak bosons to give mass, how do other bosons interact? A quark can be subject to electromagnetic, strong, weak, Higgs and gravity forces, so what happens if a virtual photon, gluon, weak boson, Higgs and graviton appear *at the same time*? That virtual bosons only interact to make our equations work isn't satisfactory. And

[7] The number of ice-creams sold in America correlates with deaths by drowning, so do ice-creams kill? In Europe, number of stork nests correlates with human babies born, so do storks bring babies? In both cases, X and Y correlate because both are caused by a third agent Z, namely the weather, not because they cause each other. *Correlation is not causation*.

as matter bosons imply anti-matter versions, what happens if a Higgs meets an anti-Higgs? The standard model being an ad hoc model doesn't predict anything.

The standard model invents virtual particles for effects that quantum realism derives from a core quantum process. Why invent many virtual particles to explain what one quantum process can? In quantum realism, virtual particles are unnecessary because quantum processing can explain their effects so *there are no virtual particles.*

4.5.4 The standard model feeds on data

Occam's razor, *not to multiply causes unnecessarily*, is the pruning hook of science but the standard model has done just that. Physical realism began as a simple theory of mass, charge and spin but today it has isospin, hypercharge, color, chirality, flavor and other esoteric features. The standard model today needs sixty-two fundamental particles[8], five invisible fields, sixteen charges and fourteen bosons to work (Table 4.6). If it was a machine, one would have to *hand-set* over two dozen knobs just right for it to light up. If physical realism is preferred today, it isn't due to its simplicity.

Table 4.6. Fields, charges and bosons of the standard model

Field	Charges	Bosons
Electromagnetism	+1, 0, -1	Photon (1)
Strong	Red, Green, Blue, White, Cyan, Magenta, Yellow, Clear	Gluon (8)
Weak	+½, 0, -½	W^+, W^- & W^0 (3)
Gravity	1?	Graviton (1?)
Higgs	1?	Higgs particle (1?)
Total = 5	**Total = 16**	**Total = 14**

One might expect completeness for this level of complexity but the standard model is unable to explain gravity, proton stability, anti-matter, quark charges, neutrino mass, neutrino spin, family generations, quantum randomness or why inflation occurred. Nor can it explain dark energy or dark matter, i.e. *most of the universe.* And with each new result *it grows*, so inflation needs a hypothetical *symmetron field* to explain it and neutrino mass needs another 7-8 arbitrary constants:

"*To accommodate nonzero neutrino masses we must add new particles, with exotic properties, for which there's no other motivation or evidence.*" (Wilczek, 2008) p168.

The standard model doesn't explain new data, *it feeds on it,* because it expands itself when it meets new facts. It is a *toolbox* for inventing new fields and particles rather than a theory that successfully predicts.

4.5.5 A particle toolbox

The standard model is *a particle toolbox* that generates new particles to explain results after the fact. For example, when anti-matter was discovered, it just added new columns and when family generations came along, it added new rows. When mesons were found someone said "*Who ordered that?"* until the standard model called them bosons that carried no force! When new facts arrive, the standard model accommodates them in its existing structure or builds a new wing.

It is hard to fault a model that absorbs rather than generates knowledge. It includes gravitons that a long search hasn't found, so was that a fail? It predicted proton decay but twenty years of study have pushed their lifetime to that of the universe, so was that a fail? It sees matter and anti-matter as symmetric so is that our universe is only matter a fail? It expected massless neutrinos until experiments gave them mass and penta-quarks and strange quarks until a two-decade search found neither, *and the list goes on*. Today it "predicts" that weakly interacting particles (WIMPs) will explain dark matter but again a long search has found nothing. The standard model is like a hydra because when the facts cut off one "head", it just grows another. Indeed, it is unclear what exactly it would take to falsify a model whose failures are called "unsolved problems in physics".

The standard model's claim to fame is that the equations associated with it calculate results to many decimal places but in science, *accuracy isn't validity*. An equation that accurately *interpolates* between a known set of data points isn't the

[8] Two leptons with three generations plus anti-matter variants is 12. Two quarks with three generations plus anti-matter variants and three colours is 36. Plus one photon, eight gluons, three weak bosons, one graviton and the Higgs is another 14. The total is 62.

same as a theory that *extrapolates* to new points. Equations are judged on accuracy but theories are judged on their ability to predict. An equation isn't a theory but today generations of physicists, fed on equations not science (Kuhn, 1970), think they are the same, so as Georgi says:

"*Students should learn the difference between physics and mathematics from the start*" (Woit, 2007) p85.

Equations aren't theories because theories should predict new things not just accurately calculate known situations. If a theory isn't *valid*, i.e. represent what it true, it doesn't matter how *reliable* it is. The virtual particles of the standard model aren't valid because ultimately, they don't represent anything that can be verified at all. If the standard model isn't valid, it doesn't matter how accurate it is.

When it comes to prediction, the standard model's success is dubious. It claims to have predicted top and charm quarks before they were found but to "predict" a third quark generation after finding three generations of leptons and two of quarks is like predicting the last move in a tic-tac-toe game. It also claims it predicted gluons, W bosons and the Higgs but inventing agents based on data-fitted equations isn't prediction. Fitting equations to data then matching their terms to ephemeral resonances in billions of accelerator collisions is the research version of tea-leaf reading – look hard enough and you'll find something. The standard model illustrates Wyszkowski's Second Law, that *anything can be made to work if you fiddle with it long enough*.

The standard model *describes* the data we know but doesn't create new knowledge. Its answer to why a top quark is 300,000 times heavier than an electron is "*because it is"*. What baffled physics fifty years ago still baffles it today because equations can't go beyond the data set that created them, only theories can. The last time such a barren model dominated thought so completely was before Newton.

4.5.6 The last standard model

In the second century, Ptolemy's Almagest let experts predict the movements of the stars for the first time based on the idea that heavenly bodies, being heavenly, moved around the earth in perfect circles, or circles within circles (*epicycles*). *It wasn't true but it worked* and Ptolemy's followers *made it work* for centuries. As new stars were found they *altered the model* making it more complex and themselves more expert. This ancient "standard model" only fell when Copernicus, Kepler, Galileo and Newton developed a valid *causal model* to replace it. The standard model of physics and the standard model of Ptolemy have a lot in common, as both are:

1. *Descriptive*. They both describe what is but fail to successfully predict new things. Descriptive models identify *patterns,* ideally in the form of equations, but this is the first step of science not the last. The end goal of science is a causal model that truly predicts.
2. *Parameterized*. Ptolemy's model let experts choose the free parameters of epicycle, eccentric and equant to fit the facts and the standard model of today lets experts choose the free parameters of *field, bosons and charge*.
3. *Retrospective*. Ptolemy's model defined its epicycles *after* a new star was found, just as today's standard model bolts on a new field *after* a new force is found.
4. *Barren*. Descriptive models only interpolate so the Ptolemaic model would *never* have deduced Kepler's laws and likewise today's standard model will *never* deduce that matter is made of extreme light.
5. *Complex*. Medieval astronomers tweaked Ptolemy's model until it became absurdly complex just as the equations of today's standard model fill pages and those of its string theory offspring fill books.
6. *Normative*. The Ptolemaic model was the norm of its day so any critique of it was an attack on the establishment, and likewise today any standard model critique is seen as an attack on physics itself (Smolin, 2006).
7. *Wrong*. Ptolemy's model *mostly worked,* even though planets don't move in circles around the earth, and likewise the standard model *mostly works,* even though virtual particles don't exist.

When the medieval church pressured Galileo to recant they didn't ask him to *deny* the earth went around the sun but to call it a *mathematical fiction,* not a reality description. Today, physicists *volunteer* the same about quantum theory, that it is just a mathematical fiction, but what if quantum reality *really does exist*, just as the earth *really does* go around the sun?

In research methodology, after *describing* patterns comes finding *correlations* and finally attributing *causes* (Rosenthal & Rosnow, 1991) The standard model is a *descriptive model* that failed to evolve into a *causal theory* because physics denies the existence of what quantum theory describes, for as Bohr put it:

"*There is no quantum world. There is only an abstract quantum mechanical description*." Newton, p244

The denial of meaning at Copenhagen led Everett fantasize about many worlds (Everett, 1957) and Witten to go it alone with string theory mathematics, neither of which led anywhere. The choice to prefer equations over meaning halted the scientific growth of physics, as physics abandoned science when it abandoned meaningful causes. To fill the gap, it had to invent magical particles that pop out of empty space to cause the equations. The standard model, as a naive descriptive paradigm ruled by acausal equations that are leading nowhere, *is essentially a scientific dead end in the history of physics*.

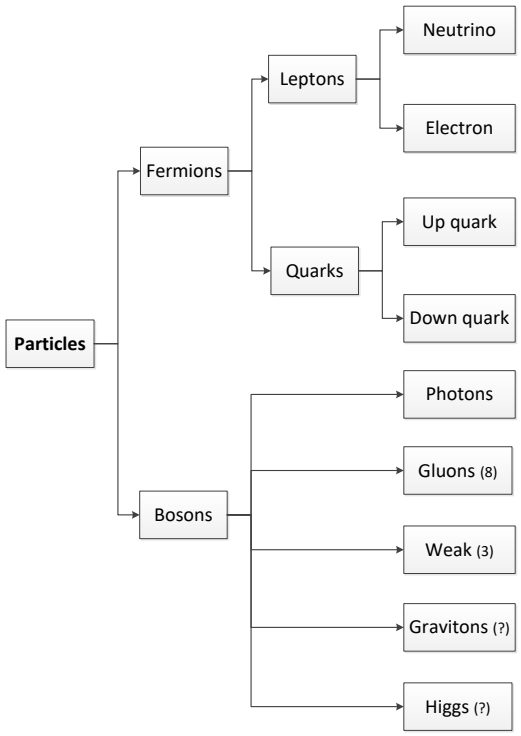


Figure 4.18. The standard particle model

4.5.7 The particle model

Aristotle's ancient idea of a matter substance implies that it can be broken down into *fundamental particles* and battering matter into bits seemed the best way to do that. Physics spent much of last century and billions of dollars smashing matter apart to find fundamental particles, defined as *what can't be broken down further*.

But when pressed on *what a particle actually is,* physicists retreat to wave equations that don't describe particles at all. This bait-and-switch, talking about a particle but giving a meaningless wave equation, is now the physics norm. If one points out that *the equations describe waves not particles*, they reply it doesn't matter because the equations are fictional! Feynman explains how this double-speak began:

"*In fact, both objects (electrons and photons) behave somewhat like waves and somewhat like particles. In order to save ourselves from inventing new words such as wavicles, we have chosen to call these objects particles*." (Richard Feynman, 1985) p85

Imagine if an engineer said "*This vehicle has two wheels like a bicycle and an engine like a car so to avoid inventing a new word like motorcycle we have chosen to call it a car*". A boy with a hammer thinks everything is a nail and likewise physicists with particle accelerators think everything is a particle but it isn't always so. What physics found by battering matter apart turned out to be neither fundamental nor particles, because it was:

1. *Ephemeral*. A lightning bolt is long-lived compared to what physics today calls a particle, e.g. a *tau* is a million, million, millionth of a second energy spike. We don't call a lightning bolt a particle so why call a tau a particle?
2. *Classifiable*. The standard model classifies a tiny electron, a massive tau and a positron as leptons but what can be classified isn't fundamental. Classifying requires common properties that imply something else more fundamental. "Fundamental" in physics today just means that which can't be further smashed apart by high speed protons.
3. *Massive*. The "fundamental" top quark has the same mass as a gold nucleus of 79 protons and 118 neutrons. It is 75,000 times heavier than an up quark, so why does the cosmic Lego-set have such a huge building block? Not surprisingly, this fundamental entity plays no part at all in the function of the universe we see.
4. *Unstable*. If a top quark is fundamental, why does it instantly decay into other particles? When a neutron decays into a proton and an electron, three fundamental particles become four, which is a strange use of the term fundamental.

Entities that decay and transform into each other aren't fundamental because what is fundamental isn't subject to decay or transformation, and energy events that last less than a millionth of a second aren't particles because what is substantial should last longer than that. A brief eddy in a stream isn't a particle, so why is a brief quantum eddy a particle? *It follows that the fundamental particles of the standard model are neither fundamental nor particles but rather quantum events.*

The standard particle model (Figure 4.18) describes fundamental particles that are classifiable and virtual bosons that come from nowhere to make things happen. This, we are told, is the end of the story because particle accelerators can't break *point particles* down any further. How then does a particle that exists at a point take up space? Apparently, they create invisible fields that generate virtual particles to keep them apart. It is a wonderfully circular argument that can't be tested because the agents involved are unobservable.

The particle model survives because physicists are conditioned to not look behind the curtain of physical reality. The wizard of Oz told Dorothy: "*Pay no attention to that man behind the curtain*" to distract her from what really orchestrates events, and likewise the wizards of physics ask us to pay no attention to the quantum waves that quantum theory says create physical reality. *Quantum realism looks behind the curtain to see that quantum processes cause physical events*.

4.5.8 A quantum processing model

A quantum processing model (Figure 4.19) has no virtual bosons to make things happen because dynamic processing on a network, like an ever-flowing river, actively finds stable states. The first event created a plasma of extreme light that diluted to ordinary light as space expanded and collided with itself to give matter as a standing quantum wave. Extreme light overloading one dimension gave electron or neutrino leptons, depending on phase, and extreme light overloading a plane gave semi-stable up or down quarks, again depending on phase. In both cases, the repeating overload caused mass and the repeating remainder caused charge, including the strange one-third charges of quarks.

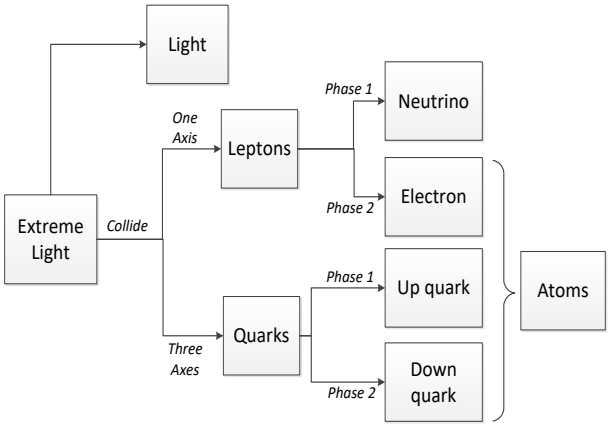


Figure 4.19. A quantum processing model

The only fundamental process in this model is a circle of quantum processing that in one node outputs "nothing", so in quantum realism, *space is null processing.*

Distributing this circle gives the sine wave of light, so the entire electromagnetic spectrum is one process more or less shared so in quantum realism, *light is space distributed*.

Up and down quarks achieve stability by photon-sharing in a proton or neutron triangle and protons, neutrons and electrons then evolved into stable atoms that in time gave us. Matter entities have anti-matter versions with the same mass but opposite charge because processing can run in reverse. In the lines Figure 4.18 are *similarities* between supposed fundamentals but in Figure 4.19 they signify a *dynamic evolution*.

Figure 4.19 is *simpler* because one fundamental quantum process gives space, light and matter and it answers questions that the standard model of particles struggles with, including:

1. How do matter and charge relate? (4.3.2)
2. Why do neutrinos have a tiny but variable mass? (4.3.3)
3. Why does anti-matter with the same mass but opposite charge exist? (4.3.4)
4. Where did the anti-matter go? (4.3.5)
5. Why are quark charges in strange thirds? (4.4.3)
6. Why does the force binding quarks *increase* with distance? (4.4.4)
7. Why don't protons decay in empty space? (4.4.6)
8. Why does the energy of mass depend on the speed of light? (4.4.8)
9. How did atomic nuclei evolve? (4.6.1)
10. How did electron shells evolve? (4.6.2)
11. Why does mass vary enormously but charge doesn't? (4.7.3)
12. Why is the universe charge neutral? (4.7.4)

13. What is dark matter? (4.7.6)
14. What is dark energy? (4.7.7)

Some of the above are covered shortly. If a quantum network defines the pixels of space, nothing is needed to keep point matter entities apart. If the quantum network transfer rate is one node per cycle, the speed of light will be a constant.

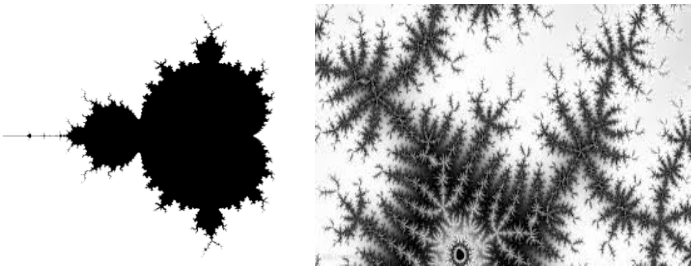


Figure 4.20. Mandelbrot's set, a. Main, b. Detail

If electrons and neutrinos are phases of the same interaction, they will be brother leptons. If up and down quarks are phases of a three-axis interaction, there will be charges in thirds. If a quantum process creates matter, there must be anti-matter. Quantum processing explains more than inert particles pushed around by forces.

It's time to abandon Newton's idea that God put the world together like a clock, from existing bits. The standard model doesn't describe God's Lego-set because most of its "fundamental particles" play no part at all in the world we see.

If only quantum reality existed initially, it had to create physical reality from itself, with no divine shortcuts because there were no basic bits of matter just laying around from which a universe could be made! Given itself alone, it had to create an observer-observed universe by providing the observer and the observed from itself. This couldn't occur in one step, so our was universe booted-up from a single photon, not made from preexisting bits. After that, it was *complexity evolving from simplicity.* The Mandelbrot set illustrates how a simple process can give endless complexity, as one line of code repeated gives rise to endless forms (Figure 4.20). There is no end to the Mandelbrot set not because was "built" from complex bits but because it is an endlessly dynamic interaction.

Quantum realism describes an essential simplicity hidden by complex outputs. If the null process we call space became light, then light became matter and matter became us, so nothing became everything. As Douglas Adams says:

> "***The world is a thing of utter inordinate complexity and richness and strangeness that is absolutely awesome.*** *I mean the idea that such complexity can arise not only out of such simplicity, but probably absolutely out of nothing, is the most fabulous extraordinary idea. And once you get some kind of inkling of how that might have happened, it's just wonderful."* Douglas Adams, quoted by Dawkins in his eulogy for Adams (17 September 2001)

The best argument against physical realism is the ridiculous complexity of the models it needs to describe it. *Quantum realism derives physical complexity from quantum simplicity*.

4.5.9 Testing the theory

In science, a new theory is tested when it predicts what contradicts the old theory. Quantum realism predicts that light, and light alone, collided to create matter. In contrast, the standard model holds that light is made of photon particles that don't collide because they are *bosons* that can occupy the same quantum state without colliding. Table 4.1 is based on a distinction between matter particles (fermions) and force particles (bosons), where fermions collide and bosons don't. If matter collides by a basic substantiality that light does not have, then:

> "*Two photons cannot ever collide. In fact light is quantized only when interacting with matter.*" Wikipedia 2019.

In contrast, quantum realism predicts that *extreme light in empty space will collide to form matter.* Evidence to support this includes that:

1. *Photons confined have mass*. A free photon is massless but if confined in a hypothetical 100% reflecting mirror box it has a rest mass because as the box accelerates unequal photon pressure on its reflecting walls creates inertia (van der Mark & t'Hooft, 2011). By the same logic, photons entangled in a node will have mass.
2. *Einstein's formula.* That matter is energy works both ways so if nuclear bombs can turn mass into energy, photon energy can create mass. The Breit-Wheeler process describes how high energy photons can create matter.

3. *Particle accelerator collisions routinely create new matter*. Protons that collide and stay intact give new matter that didn't exist before. If this matter comes from the collision energy, high energy photons can do the same.
4. *Pair production.* High-frequency light near a nucleus gives electrons and positrons that annihilate back into space.
5. *Light collides.* When high-energy photons at the Stanford Linear Accelerator hit an electron beam to accelerate it at almost the speed of light, some electrons knocked a photon back with enough energy to hit the photon behind it, giving matter pairs that a magnetic field pulled apart to detect (Burke & et al, 1997).

That extreme light alone colliding in a vacuum gives matter is a prediction that no experiment has yet tested.

If beams of pure light can collide in pure space to create matter, the boson-fermion distinction of the standard model is challenged as then bosons can create fermions. If matter evolved from light, the future of physics lies in colliding light not matter so physics should build light colliders rather than particle colliders. Recent experiments support the idea that matter can arise from light, although the light colliding came from high-energy particle collisions creating intense photon bursts rather than directly from lasers.

The standard model expected the short-lived energy flashes of its accelerators to unlock the secrets of the universe but it didn't happen and quantum realism says it never will. If *matter evolved*, our billion-dollar accelerators are just finding transient evolutionary dead-ends that led nowhere because in evolution, what doesn't survive doesn't change the future. The standard model assumes that matter came first but in quantum realism, light was the first existence.

Physical realism is *just a theory* and scientists who don't question their theories are priests. Last century, it was the only game in town but today quantum realism is the rational alternative that space is *network* null processing, time is its processing *cycles,* light is the basic *quantum process* and matter is entangled light *rebooting.* This theory, based on reverse engineering, is testable, so if it is wrong, let the facts decide.

4.6. THE EVOLUTION OF MATTER

People once thought we were created as we are now by God, until science discovered that we evolved from animals over millions of years. Likewise, the particle model assumes that matter always was, but we now know that complex atoms from came from simpler ones by a process called *nucleosynthesis* that continues today in stars and supernovae. The periodic table of elements (Figure 4.21) would not exist without it and neither would we, but while the evolution of life is about survival, the evolution of matter is about *stability*.

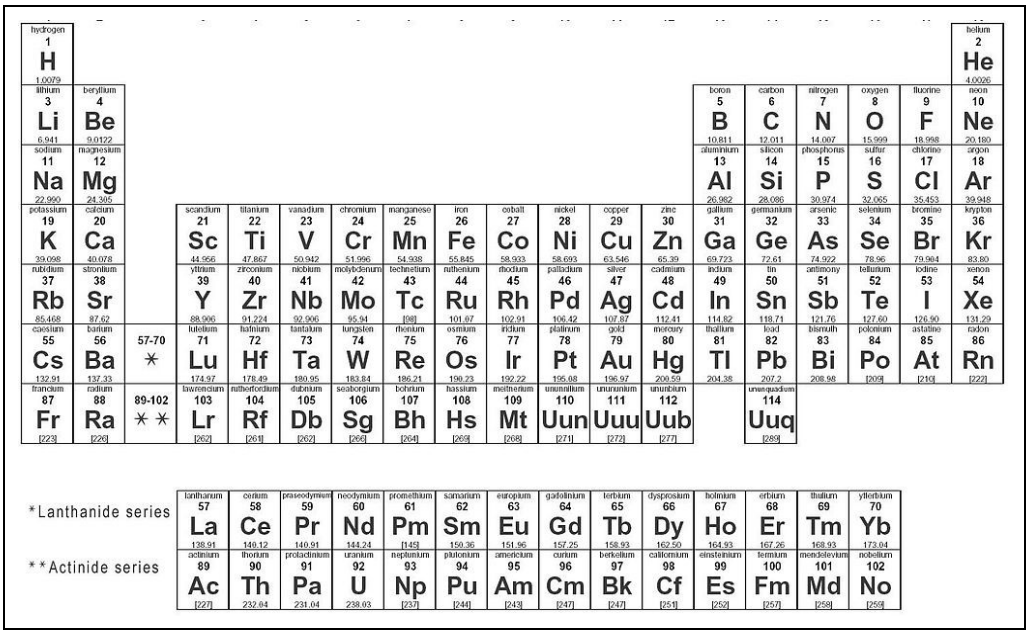


Figure 4.21. The Periodic Table

4.6.1 Nuclei evolved

In the periodic table, a Hydrogen nucleus has one proton surrounded by one electron. A Helium nucleus has two protons and two electrons and it also has two neutrons but no-one knows why. Each higher element has not only one more proton and electron but also one or more neutrons, so:

> *"... all the stable nuclei have more neutrons than protons (or equal numbers), and the heavier nuclei are increasingly neutron-rich.*" (Marburger, 2011) p254

For some reason, heavier nuclei need more neutrons to be stable (Figure 4.22) but no theory can explain how neutrons keep the nucleus stable. The shell model that explains electrons doesn't work because some nuclei aren't spherical. The standard model doesn't help because if gluons hold the protons together, why have neutrons? And how do the gluons know how many neutrons are needed to stabilize a heavy nucleus? Current nuclear models generally represent the nucleus as proton and neutrons sitting side-by-side with gluons forcing the protons together, like fruits in a bowl.

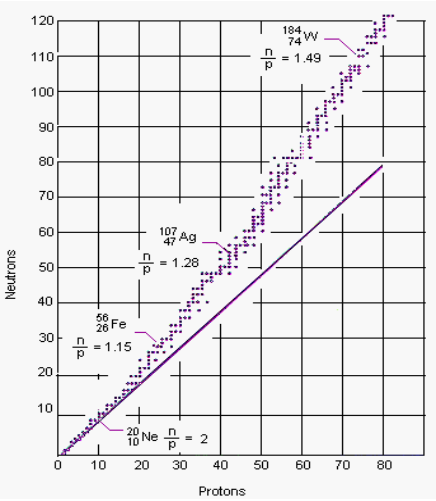


Figure 4.22 Nuclear neutrons by protons

The quark structure given earlier describes protons and neutrons as quarks sharing photons in a closed triangle string. This allows such triangles to open up and recombine in longer quark strings if the same rules are satisfied: namely a *closed string* shape with the *internal angles* of an equilateral triangle.

This suggests that a Helium nucleus isn't proton and neutron particles sitting separately together like fruit in a bowl but *a single quark string that closes back on itself* made from the quarks of two protons and two neutrons sharing photons.

The fruit-bowl model sees a Helium nucleus as separate proton and neutron *particles* just sitting together but a quark string model sees the Helium nucleus as a single string held together as protons and neutrons are, *by photon sharing*. The only restriction is that each link must bend the string 60º which requires quarks to rotate to make a connection. Higher nuclei then also form in the same way.

The quark string model explains why neutrons are needed. As photon sharing needs direct proximity, a proton can't come that close to another proton because they repel, so neutrons are needed as *buffers*. When the quark string nucleus forms, neutrons are needed in between same-charge protons that can't exist side-by-side. This requires at least as many neutrons as protons, as observed, so a Helium nucleus of two protons needs two neutrons to act as buffers between the protons in the closed string.

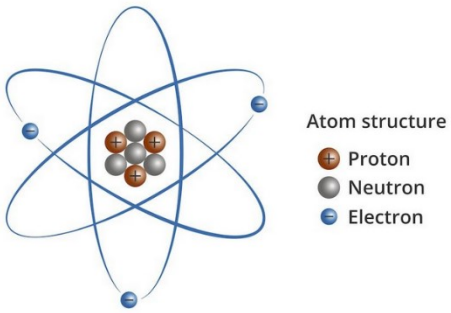
Closed quark strings will be compact and nearly spheres, as observed, but larger nuclei may need more neutrons to avoid fold-back loci that happen to make protons adjacent. In this *nuclear evolution* certain shapes will be more stable:

> "*Nuclei with either protons or neutron equal to certain "magic" numbers (2, 8, 20, 28, 50, 82, 126) are particularly stable*." (Marburger, 2011) p253

If atomic nuclei are closed quark strings, those with a magic number of nucleons are more stable because they form the symmetric shapes that gave rise to magic numbers in the first place.

A quark string model explains the properties of atomic nuclei and why they need neutrons. In quantum realism, atomic nuclei are *not* bundles of proton and neutrons but *single* closed quark strings that fold in space as proteins do.

4.6.2 Electrons can be waves



Over a hundred years ago, Rutherford's model of the atom saw the atom as a nucleus of protons and neutrons around which electrons orbited, much as the planets orbit the sun. Then it was realized that if electron particles really did *orbit* atomic nuclei as planets orbit the sun, they would occasionally collide, but they *never do*. An atom of lead has 82 electrons whizzing around in close proximity but is stable for billions of years, so why do all those particles never meet? And a particle in orbit is accelerating, so it should lose energy and spiral inwards but again electrons never do this. Are the laws of physics different for electrons in an atom?

Current physics handles this by saying a cloud of virtual photons shield electrons from the nuclear attraction and other electrons. In addition, while an electron is a particle in space, it can be a wave in an atom by the miracle of wave-particle duality. Everyone knows that a particle isn't a wave nor is a wave a

particle but this miracle lets physics choose one set of equations for electrons in orbit and another for electrons in space, but *how does the electron know to be a particle in one place and a wave in another?*

Apparently, electrons know *Pauli's exclusion rule* that they can overlap like waves if they have different *quantum numbers*. The shell model lets electrons co-exist in "orbits" by quantum numbers that aren't based on or compatible with any other physical laws. It is a classic case of backward logic, as quantum numbers were made up after the fact.

In quantum realism, an electron is *one-dimensional matter* so it is matter-like on one dimension but light-like on the other two, and its matter dimension is why it moves slower than light in space. In contrast, on a *two-dimensional surface* around an atom, it can be entirely light, i.e. entirely wavelike. A particle circling a center needs an agent to stop it falling in but wave can pulse forever on a circumference that matches its wavelength and it can't spiral in because its wavelength has a minimum orbit circumference. It follows that if different electrons around an atom vibrate at different wavelengths and harmonics, they will never "collide" (see next section).

Electrons as *matter-light hybrids* lets an electron be a particle in space and a wave in an atom. It predicts that electrons move slower than light in three-dimensional space but *pulsate* in atoms at the speed of light.

4.6.3 Electron shells evolved

Every periodic table element has a different number of electrons organized in *shells*. The number of electrons in a shell is the number of elements in a row of the periodic table and each row ends in an *inert* element like Neon. Neon doesn't interact with other elements because all its electron shells are *full* so it doesn't exchange electrons. In contrast, non-inert elements do exchange electrons in chemical reactions. Every chemical reaction, from acidity to oxidation, is atoms exchanging electrons to complete their outer shells in the now familiar search for stability. *Stable molecules* form when atoms with extra electrons donate them to those with deficits in chemical bonds that complete their electron shells.

The current electron shell description is based on two quantum numbers:

1. *Shell* ***n*** (1, 2, 3 …). Initially the orbit radius.
2. *Sub-shell* ***l*** (*s, p, d* …). Has no agreed meaning.

Table 4.7. Particle shell and sub-shell predictions

Shell	**Sub-shell**						**No**
n	*s*	*p*	*d*	*f*	*g*	*h*	
1	1s=2						*2*
2	2s=2	2p=6					*8*
3	3s=2	3p=6	3d=10				*18*
4	4s=2	4p=6	4d=10	4f=14			*32*
5	5s=2	5p=6	5d=10	5f=14	5g=18		*50*
6	6s=2	6p=6	6d=10	6f=14	6g=18	6h=22	*72*

The shells and sub-shells were deduced from spectroscopic data analysis as shown in Table 4.7, where sub-shells called *s, p, d, f, g* and *h* contain 2, 6, 10, 14, 18 and 22 electrons. The logic was that the shell orbit could fit more electrons as it increased, so doubling the first two electron orbit quadrupled the area to allow eight electrons, tripling it allowed eighteen, quadrupling it thirty-two, and so on. sub-shells. Electrons then filled shells and sub-shells according to quantum numbers, so the inner orbits with fewer electrons filled before outer orbits. Hence the first row of the periodic table has the two elements Hydrogen and Helium, the second row has the eight elements Lithium to Neon, and so on as the periodic table grew.

This worked nicely except the third row is still only eight elements, including the carbon and oxygen we need to live, and the expected eighteen elements only occur in the next row. The initial model predicted periodic table rows of 2, 8, 18, 32, 50 and 72 but instead the rows were 2, 8, 8, 18, 18, 32 and 32. So in the by now well-established practice, theory was fitted to fact by tweaking the model so the *sub-shells* fill in this odd order:

Row 1: 1s Hydrogen-Helium (two elements)

Row 2: 2s, 2p Lithium-Neon (eight elements)

Row 3: 3s, 3p Sodium-Argon (eight elements)

Row 4: 4s, 3d, 4p Potassium-Krypton (eighteen elements)

Row 5: 5s, 4d, 5p Rubidium-Xenon (eighteen elements)

Row 6: 6s, 4f, 5d, 6p Cesium-Radon (thirty-two elements)

Row 7: 7s, 5f, 6d, 7p Francium-? (thirty-two elements)

The "logic" here is that it works if the third shell "fills" with an empty sub-shell, so generations of chemistry students have had to learn that Argon completes its third shell without the *3d* sub-shell, even though that denies what a sub-shell *means*. If they asked why, the answer was *because it does!*

Instead of using abstract quantum numbers, that electrons actually exist as quantum waves predicts these properties:

1. *Shell*. Shell *circumference* around the atom nucleus that fits the electron's lowest wavelength.
2. *Sub-shell.* The *harmonics* that the shell circumference allows.
3. *Direction.* The electron wave *direction*, where quantum waves at right angles don't interfere.

The electron wavelength arises from its photon structure. If an electron is extreme photons entangled in a collision on one axis, they will also restart on other axes as extreme photons that vibrate up one cycle and down the next. The minimum shell circumference will be half this wavelength and *this fundamental harmonic is the s sub-shell*.

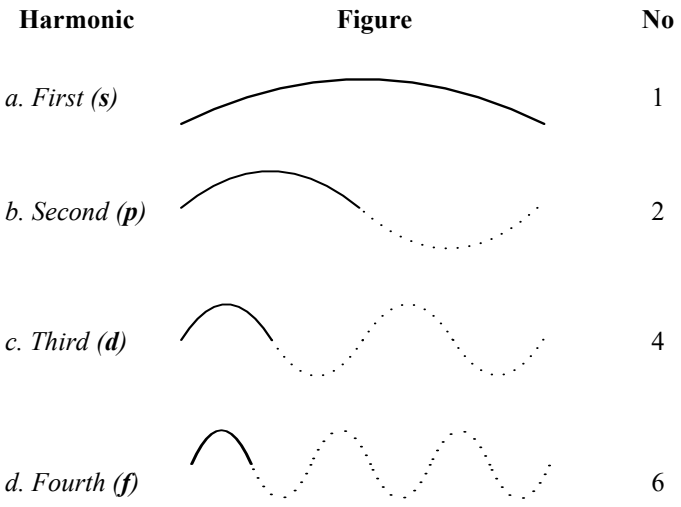


Figure 4.23. Wave harmonics for a length

The next shell will have a circumference double that of the first shell, to allow not only a bigger fundamental but also a second harmonic that is twice the frequency. *This second harmonic is the d sub-shell*.

Figure 4.23 shows how larger shell circumferences can have more harmonics where the number of waves that concurrently occupy each length is given in the right-hand column. The periodic table can now be explained using electron waves as follows:

1. The first shell has a half wavelength circumference that lets a bipolar wave vibrate up and down on alternate cycles (Figure 4.23a). *The first harmonic of the first shell is the 1s sub-shell.* This shell can accommodate two waves at right angles because a sphere has two *directions* at right angles to allow two electron waves, so the first shell completes with two electrons to give the first row of the periodic table, which is Hydrogen plus the inert gas Helium.

2. The second shell has a one wavelength circumference, which is double that of the first. The *first harmonic* for this circumference again alternates up and down giving a *2s* sub-shell with two electrons. The *second harmonic* (Figure 4.23b) can accommodate two electron waves at the same time which for two *directions* is four electrons. The complex harmonics of two-dimensional waves, such as appear on a drum surface, allow two more electrons, giving six in total for the *2p* sub-shell. The second shell thus allows eight electrons, giving the second row of the periodic table, Lithium to Neon.

3. The third shell has a one and a half wavelength compared to the first, as it triples the first circumference. This again gives *3s* and *3p* sub-shells *but the next harmonic can't occur*. A bipolar (up-down) wave can vibrate once on a string half its wavelength and twice on a string of its wavelength but on a string one and a half times that, the result self-destructs. Adding another half-wavelength adds no new harmonics so the third shell, like the second, allows only eight electrons giving eight elements in the periodic table third row. *An electron wave model has no 3d sub-shell*.

4. The fourth shell has a two-wavelength circumference, which quadruples the first. Four times the first radius *allows a new harmonic* that accommodates four electrons per circumference which for two directions is eight (Figure 4.23c), plus two complex harmonics is ten. The *4s, 4p* and *4d* sub-shells give 18 elements in the periodic table fourth row as observed.

5. The fifth shell, like the third, allows no new harmonic, so its *5s, 5p* and *5d* sub-shells repeat the previous total of eighteen, giving the periodic table fifth row, again as observed.

6. The sixth shell allows a fourth *f* harmonic with six electrons (Figure 4.23d) which doubled is twelve plus two complex harmonics is fourteen. This plus eighteen from the *s, p* and *d* harmonics gives the thirty-two elements of the sixth periodic table row[9] that include the Lanthanide series.

7. *The seventh shell* again has no new harmonic so it also has 32 elements, including the periodic table Actinide series.

An electron wave model then fills the periodic table as follows:

1. 1s Hydrogen-Helium (2 elements)
2. 2s, 2p Lithium-Neon (8 elements)
3. 3s, 3p Sodium-Argon (8 elements)
4. 4s, 4p, 4d Potassium-Krypton (18 elements)
5. 5s, 5p, 5d Rubidium-Xenon (18 elements)
6. 6s, 6p, 6d, 6f Cesium-Radon (32 elements)
7. 7s, 7p, 7d, 7f Francium-? (32 elements)

Electrons now fill shells and sub-shells in strict order, with no strange jumping between them, based on:

1. *Shell.* The first shell circumference is half the wavelength of the highest frequency of light, i.e. a Planck length. The larger shells are multiples of this (1, 2, 3, 4, …).
2. *Sub-shell harmonic.* Where *s* is the first harmonic, *p* is the second harmonic, and so on.
3. *Direction.* The great circle axis orientation, where opposite waves don't interact.

Electrons fill in the order they do based on:

1. *Shell order*. Each shell is a greater circumference. If an electron were pure light a longer wavelength would be less energy but it has a mass dimension so larger orbits require more processing and more energy. Shells then fill in the order 1, 2, 3 etc. because smaller orbits need less processing.
2. *Harmonic order*. Each sub-shell harmonic is a shorter wavelength for the same orbit circumference, so it involves more energy. Sub-shells fill in the order *s, p, d etc.* because lower harmonics need less processing

An *electron wave model* explains the rows of the periodic table as caused by the harmonics that a shell circumference can accommodate, so electrons fill the shells with no tweaks needed. *In quantum realism, electrons in atoms are quantum waves described by wave harmonics not abstract quantum numbers.*

4.7. MATTER REVISITED

Aristotle looked around to see an earth of mainly matter but astronomers looking at the cosmos today see mainly space and light with earth-like matter only about 4% of all the mass of the universe. In cosmic terms, the universe is firstly full of space, then light, with matter a distant third in the scheme of things. Quantum realism agrees, as if space is a null process and light is a processing wave, they use far more quantum processing than matter does. That matter came after space and light is why this book addresses space, light and matter in that order. Seeing matter as the third product of the universe, not the first, allows us to revisit matter mysteries that still puzzle physics today.

4.7.1 Why does matter half spin?

In quantum mechanics, all elementary entities spin but matter only half-spins. To us, spinning an object 360 degrees in space returns its original state but spinning an electron 360 degrees only *half-turns* it — it takes 720 degrees of turning to return an electron to its original state! As this applies to all matter, quantum matter entities are said to have a spin of half. Yet again, the quantum world does what the physical world can't.

[9] If *the first shell has circumference C*, the sixth shell has circumference 6C, with subshell harmonic wavelengths: 6s (λ=12C), 6*p* (λ=6C), 6*d* (λ=3C) and 6f (λ=1C).

Even worse, current physics can't explain spin in general, let alone half spin, because an electron is a dimensionless point that can't physically spin, so particle physics has simply given up trying to understand quantum spin:

"*We simply have to give up the idea that we can model an electron's structure at all. How can something with no size have mass? How can something with no structure have spin?*" *(Oerter, 2006) p95*

In contrast, if a photon is a quantum wave that vibrates into an unseen dimension outside space, it has a structure that can *really spin*[10]. In quantum realism, a photon is a *two-dimensional structure* in quantum space that, like an ideal sheet of paper, is invisible when viewed edge-on.

That our three-dimensional space exists with a four-dimensional quantum space adds *three new quantum directions* to every point, all at right angles to each other as well as our space[11]. The result is that photon structures that are polarized at right angles occupy different spaces that don't overlap. This explains why horizontal filters stop horizontally polarized light but not vertically polarized light (see 3.7.2).

If an electron is photon structures filling the channels of an axis, only half of them will be visible for any line of view, as the others, like our ideal paper sheets, will be invisible because they are being viewed edge on. If one photon is 100% visible, another at right angles will be 0%, for one that projects 99% there is another that projects only 1%, and so on. If only half an electron's photons register with us, we can only measure half its spin and so say it *half spins.*

Quantum space explains why it takes two 360 degrees turn to return an electron to its original state. This is impossible in three dimensions but an electron in four dimensions has two planes to turn into not one. A 360 turn in one dimension only turns half its photons and so another turn is needed to turn the other half. The quantum spin of matter is one half because *we are Flatlanders in four-dimensional quantum space*.

4.7.2 Neutrino asymmetry

If the laws of physics varied with position, each new location would need new rules. In our world, changing direction changes the values but not the equations and this *spatial symmetry* is basic to physics itself. Yet neutrinos violate this principle because they *always spin left-handed*, an asymmetry that is reflected neither in the world we see nor the laws that describe it. As Pauli said:

"*I cannot believe God is a weak left hander*" (Lederman & Teresi, 2012) (p. 256)

What is spin-handedness? If you point your left thumb forward, the fingers of your hand curl in a left-handed spin and if you point your right thumb forward, the fingers curl in a right-handed spin. If your hands only move *forward* the spin stays the same but move one hand *backwards* and they both have the same spin, as reversing direction reverses the spin. Reversing an electron's direction should create a mirror image of it that spins the other way by spatial symmetry and electrons do indeed spin both ways. In contrast *all* neutrinos are left-handed and *all* anti-neutrinos are right-handed (Figure 4.24). While electrons spin either way, a neutrino reversing direction still spins left and an anti-neutrino reversing direction still spins right. The standard model can't explain why neutrinos spin the same way when they reverse direction or why changing a neutrino's spin makes it an anti-neutrino. That the mirror image of a neutrino isn't a neutrino contradicts spatial symmetry.

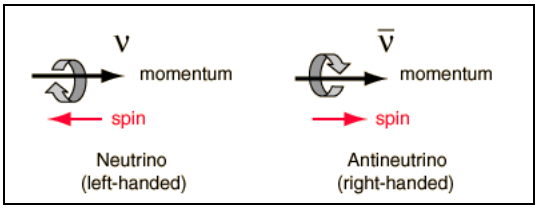


Figure 4.24. Left and right-handed spin

The photon structure derived earlier for a neutrino suggests an answer. When the first photon moved up or down on space to make matter or anti-matter, it also had to spin left or right and apparently it went left. The electron's entangled photon set *both* spin left so their opposite directions let it have both left and right spin at once. In a physical event, an electron can spin either way and changing direction reverses both spins so it still spins either way, randomly.

[10] For a photon moving in direction X, its quantum amplitude Q vibrates in plane QX. The structure QX can then spin.

[11] The orthogonal directions X, Y, Z of space give three orthogonal planes XY, YZ and XZ. A fourth dimension Q adds three more orthogonal planes Q_1X, Q_2Y, Q_2Z, where Q_1, Q_2 and Q_3 are at right angles.

One might expect the same for neutrinos but while the electron's mass comes from *both* photon sets colliding, neutrino mass comes from only *one* of the photon sets. A neutrino reversing direction changes phase *so what create its mass is now the other set of photons, which also spin left*. When electrons reverse direction their mass origin doesn't change but when neutrinos change direction the *other* set of left spinning photons create the mass. Neutrinos always spin left because when they reverse direction the source of their tiny mass changes.

Since a neutrino processing in reverse is an anti-neutrino, they always have right-handed spin for the same reason that neutrinos always spin left. The mirror image of a particle should be the same particle but the mirror image of a neutrino's processing is not the same by the asymmetry that created our matter universe. A quantum processing model explains why neutrinos *always* spin left and anti-neutrinos *always* spin right.

4.7.3 The mass problem

A proton's charge is one, the simple sum of its constituent quark charges, but its mass is a hundred times that of three quark masses. Quark charges add when they combine but their masses somehow multiply. Current physics attributes the extra mass to the gluons that bind quarks but can't say how *massless gluons* make mass or why gluons don't increase charge as well? The standard model *describes* particles with hugely varying masses but can offer no *reason* at all for the variation:

> *"… though the actual value of the basic electric charge … remains a theoretical mystery … all other charges found in the universe are … multiples of this value. Nothing like this appears to be the case for rest-mass, and the underlying reason for the particular values of the rest-masses of … particle types is completely unknown.*" (Penrose, 2010) p153.

The mass problem is that the masses of elementary particle vary enormously for no apparent reason.

If charge is left-over processing, its limit is one quantum process per channel so charges can't exceed the standard plus or minus one. Why then isn't the total processing done, or mass, limited in the same way? The answer now suggested is that the *processing done can interfere*.

Interference in networks occurs when two processes seek the same resource at the same time. They *interfere,* just as two cars coming to an intersection at the same time can't both enter the same space. Studies show that traffic flow slows down when traffic merges at motorway on-ramps because the cars have to negotiate who goes first. And the run-on effects of such slow-downs can cause traffic jams that extend for miles, so *interference effects aren't linear*.

The same thing happens on a computer network as when processing interferes it must stop and try again, just as cars at an uncontrolled intersection must stop to agree who goes first. This wastes processing time so interference slows down computer networks just as it slows down traffic networks and again the effect isn't linear as one clash can cause another. When computer networks tried central controls like the traffic lights on road networks, it was found to be inefficient. A better solution was protocols like Ethernet that lets processes access network resource when they want to but if a collision is detected, both stop and retry after a random time interval (to avoid repeat collisions). Computer networks under load slow down for the same reason that traffic networks slow down at rush hour, *because parties can't access the same resources at the same time*.

The quantum network is essentially a first-come-first-served system with no central control, where interference occurs when photons compete for the same channels so some have to try again elsewhere. This wastes processing and, in this model, *the total processing required is mass*.

The mass increase can be estimated by *the number of channel overlaps in the photon structure*, as photons compete for channels. For example, an electron has two photon streams intersecting but a quark has three photon streams intersecting so a quark has more overlapping channels, more interference and hence more mass than an electron. Each quantum cycle, every photon has to find a channel and every time two or more photons try to access the same channel there is interference that uses up processing, so quarks end up with about ten times the mass of an electron. Quarks in a proton have even more overlap and thus more interference giving more mass. *Mass as total processing done explains the "creation of mass" without recourse to magical gluons*.

Interference even suggests why down quarks are heavier than up quarks. If an up quark is two photon tail sets colliding with a set of photon heads (Table 4.3), the tails fill channels first, leaving one set of heads to fight over the remaining channels. In a down quark, one tail set gets first access, leaving the two sets of photon heads to fight over the rest, giving more interference and so slightly more mass.

If we could simulate how photons fill channels in quarks and electrons, the time taken up by interference would reflect the extra mass created. In Table 4.1, the masses of leptons, quarks and neutrinos aren't fixed like charge but vary over a range of values. The standard model assumes that quarks come in different sizes with different masses but in this model, *every quark is exactly the same* but its mass varies for the same reason that every day's traffic jam delay is different. A quantum processing model explains why the mass of elementary particles varies enormously but their charges don't.

4.7.4 Charge neutrality

In the standard model, matter arose like Venus from the sea, complete and perfect with positive and negative charge an optional accessory. Our galaxy is charge neutral so physics supposes the universe as a whole is the same, but how did that happen? If charge is an inherent property arbitrarily allotted, why did its creation dole out equal amounts of it? The current answer, that the universe is charge neutral because it was made "just so", is unsatisfactory.

Quantum events repeat at a fantastic rate so anything not 100% stable reconfigures sooner or later. *Every* option is tried until one "sticks" and is stable. Electrons, neutrinos and quarks survived the initial chaos and the first atom arose because a proton and an electron survive better together than apart. Every periodic table atom has equal protons and electrons for the same reason, that they survive better together than apart.

It follows that the universe is charge neutral because matter survived as atoms that are charge-neutral, so *the universe is charge neutral by evolution, not because some designer allocated charge that way*.

4.7.5 Family generations

Electrons, quarks and neutrinos have *family generations,* each like the last but heavier, so an electron has a *muon* elder brother of the same charge but two hundred times heavier and a *tau* eldest brother that is three and a half thousand times heavier! Up and down quarks have heavier *charm* and *strange* quarks and very heavy *top* and *bottom* quarks but again after three generations, no more. The standard model *describes* family generations but doesn't explain:

1. Why do family generations occur?
2. Why only three generations then no more?
3. Why are higher generations *so heavy*?

If an electron fills the channels of *one* axis, a muon could do the same on *two* axes and a taon on *three* (Figure 4.25). All are still point entities and no more generations occur because space only has three dimensions. Each is heavier than the last because more overlapping channels increase the photon *interference* to increase the processing that is mass. Taons are *so* heavy because interference cumulates, just as one traffic delay can cause another.

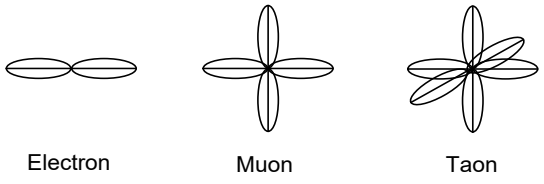


Figure 4.25. Electron generations as dimension repeats

If a muon is an electron collision doubled, why doesn't it have a minus two charge? It does but we can only measure charge one axis at a time and after each measurement the system resets. On *any one axis*, a muon's charge is minus one because the other remainders occupy orthogonal quantum dimensions. *A quantum processing model suggest that the three family generations reflect the three dimensions of space*.

One can't dimensionally repeat a quark structure three times, so quark generations aren't simple duplicates but the tail-tail-head planar *triangle* of an up quark can form a charm quark *pyramid* whose every side presents an up-quark's charge but with more mass by interference. A tail-head-head down quark could likewise form a strange quark pyramid. Top and bottom quarks then fill a node with two up and down quark planes at right angles, with again more mass by interference. *The mysterious generations of matter could arise from the dimensions of space and their large masses from quantum processing interference*.

4.7.6 Dark matter

In the 1950s, astronomers discovered that our galaxy rotated as if it had more matter than its visible stars allowed, five times more in fact. They concluded that most of the galaxy was "dark matter", dark because it can't be seen and matter

because it caused gravity. Studying the rotation curves of other galaxies extended this conclusion to them and dark matter is now thought to be about 85% of the matter of the universe and quarter of its total energy. From its effects, we infer that dark matter exists as a halo around the supermassive black hole at the center of almost every galaxy, including ours.

Dark matter essentially allows a galaxy to hold its stars together more tightly than their gravity allows. It isn't the matter we see because no light can detect it, it isn't anti-matter because it has no gamma ray signature and it isn't a black hole because there is no gravitational lensing, but without it, the stars of our galaxy would fly apart. Dark matter is the "glue" that binds galaxies together but its cause is unknown. Yet without it, the matter-producing factories we call stars would not have had the stability they needed to build up the periodic table elements necessary for life.

The existence of dark matter, deduced from its effect, was a problem for a physics that sees all mass as particle based. Its only option was to propose that weakly interacting massive particles (WIMPs) caused it. The result was yet another expensive wild-goose chase, despite talk of super-WIMPs (Feng, Rajaraman, & Takayama, 2003). WIMPs, like gravitons, proton decay and squarks, were another standard model misdirection, as any particle-like mass would have been seen by now. *That no particle exists to explain 85% of our galaxy's mass is a significant standard model failure.*

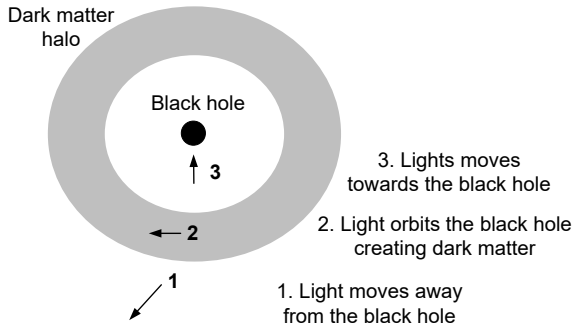


Figure 4.26. Dark matter is light in orbit

If mass arises when a quantum processing excess repeats over time, what else could give a halo that generates mass? One possibility is that the black hole at the galaxy center traps light in an "orbit" around it. This is possible because light too close to a black hole is pulled in and light too far away escapes but at some radius, light will constantly circle in a large loop (Figure 4.26).

If light rotates in vast but finite loop around the galaxy center, from which it can't escape, a *halo of circling light* would build-up over time as more photons are added than leave. This halo wouldn't be visible as light cannot be seen from the side.

By the pass-it-on protocol, nodes are *interrupt driven,* so each cycle they *first* pass on current processing *then* receive any input to process. If any node gets more processing than it can handle, it immediately passes it on. This allows an infinite pass-it-on repeat but as argued earlier, such repeats would be sooner or later absorbed by a node of new space. But if the halo of rotating light around a black hole is massive enough, new space may not add fast enough to do this. The result would be a permanent net processing excess, which in this model is *mass*.

A dense enough stream of light constantly circling around a black hole will generate mass. It follows that dark matter is created by light like ordinary matter, but instead of being a "particle" confined to a node, it is spread out through a vast stream of light. Light trapped in an orbit around a black hole gives rise to dark matter just as light trapped in a node gives rise to particle matter.

Ordinary and dark matter are processing that repeats but while ordinary matter is a stand-alone particle, dark matter is spread through the photon halo that builds up around a massive black hole. It isn't seen because photons either pass through at right angles or join the stream. Dark matter doesn't collide like particle matter because it doesn't have a particle structure, so when galaxies collide, the dark matter doesn't collide but stays with the black hole that creates it when they separate. This model allows small galaxies to exist with no black holes and even galaxies that have lost their stars to consist of 99.99% dark matter. *Dark matter arises because mass can arise in a way other than as a "particle".*

4.7.7 Dark energy

After confirming dark matter, in 1998 astronomers discovered that the expansion of universe, previously thought to be slowing down under the force of gravity, was actually *accelerating*. Some sort of *negative gravity* had to be pushing the universe apart against the gravity that pulls it together. The force stopping gravity from collapsing the universe was called *dark energy.* Cosmologists estimate that dark energy is 68% of the energy of the universe, dark matter is 27% and the standard model's particle matter is at best only 5%. Since the standard model's particles only account for a tiny fraction of the energy of the universe, it isn't even close to being a theory of everything.

Dark energy is a weak effect, spread evenly through space that seems to have changed little over time. In equations, it makes space flat so some call it a property of space itself but if so, it should increase as space expands. If it is caused by

particles, as the standard model assumes every force is, it should weaken over time as space expands but it doesn't. Particles of any sort should clump together not remain evenly spread and what particle could cancel gravity to push the universe apart? The standard model can't explain dark energy at all because a particle can't have a negative energy.

In quantum realism, our space is the inner surface of a bubble expanding into a quantum bulk so an expanding universe must lose energy, just as expanding a box cools the gas within it. New points of space are added all the time throughout space and since they are new, for their first cycle they receive but don't transmit energy. This negative energy effect, spread over all space, is then dark energy. It does not diminish as space expands because more of it continually pops into existence to keep pace with the expanding universe and indeed it may be gradually increasing.

If dark energy comes from new space, no particle cause will ever explain it.

4.8. THE LIVING UNIVERSE

Physical realists see the universe as dead matter while theologians see it as divinely inspired. In one case we are just an accident in *a dead universe that is winding down* and in the other we are the chosen ones in a *universe built just for us*. The difference couldn't be greater but both assume a universe of matter that unlike us, isn't alive.

Is the universe we live in alive or dead? Dictionaries define living as having life or being alive not dead, a circular approach that amounts to saying that life is what living things do. In medicine, a body is alive as long as the *processes* maintaining it continue, like heartbeat. When they stop, the body *dissolves* into atoms that become part of other entities. In these terms, an *active entity that is born and evolves in unpredictable ways is alive if dynamic processes maintain it*.

Applying this definition to the universe, if it is active, was born and is developing in unpredictable ways, it is alive as long as quantum processes maintain it and it will die when they stop. That the universe is alive answers the question *how did dead matter create life?* Otherwise, how could a universe that is itself dead give rise to life? It is ironic that we who consider ourselves alive now claim that what made us dead! If the universe is constantly generated by quantum processes, then if it *is active not inert, born not made, evolving not designed and emerging not decreed, then it is alive.*

4.8.1 Active not inert

The standard model has no null particle so it sees empty space as empty but modern physics doesn't support this view. In quantum theory, quantum fields are alive with quantum activity that is entirely spontaneous, so we can't predict when a physical event will occur and these fluctuations occur at mind-boggling speeds of 10^{-24} second or less (Wilczek, 2008) p74. That all physical events result from interactions between constantly active quantum fields explains why the world we see is constantly active and the Casimir effect shows that even space is a seething cauldron of quantum events.

Applying this discovery to matter, it may look inert but electrons are constantly active as shown by chemical reactions and electricity. Equally the nucleus may seem inert but we know from nuclear bombs that there is great power within it. Appearances deceive, as we see the sun rising and setting when in fact we come and go while the sun shines constantly. Likewise, the world of substance we see is actually a constant series of quantum events.

Quantum realism sees space as a constantly active null process and matter as light pulsing at a fantastic rate. The sun contains over 99% of the mass of the solar system, so it represents matter better than the rocks lying around on earth. Its constant activity depicts the quantum furnace that made matter. We call earth the "*third rock from the sun*" but the Gaia Hypothesis describes an *autopoietic* or self-organizing system that maintains a homeostasis of climate, atmosphere and ocean salinity, so it isn't an inert at all (Margulis, 1999). That the cosmic systems around us actively maintain themselves as our bodies do is expected for a living universe. Conversely, one doesn't expect constant activity from a dead universe, but that is what we see, so was the universe also "born"?

4.8.2 Born not made

Humanity has long wondered how the stars, galaxies and life itself began? For stars to create atoms needs the stability of galaxies that would fly apart without dark matter that just so happens to stop that. We make energy by *nuclear fission* that breaks nuclei apart but stars make energy by *nuclear fusion* that merges Hydrogen nuclei into Helium, which needs neutrons that the weak force also just happens to allow. The laws of physics didn't let nuclear fusion create the carbon atoms life needs until a *just right* energy resonance was found:

"*The energy at which the carbon resonance occurs is determined by the interplay between the strong nuclear force and the electromagnetic force. If the strong force were slightly stronger or slightly weaker … the universe might very well be devoid of life and go unobserved.*" (Davies, 2006)

The *Goldilocks Effect* is that our universe has an unreasonable number of parameters set just right for life, without which we couldn't exist. For example:

"*Take, for instance, the neutron. It is 1.00137841870 times heavier than the proton, which is what allows it to decay into a proton, electron and neutrino—a process that determined the relative abundances of hydrogen and helium after the big bang and gave us a universe dominated by hydrogen. If the neutron-to-proton mass ratio were even slightly different, we would be living in a very different universe: one, perhaps, with far too much helium, in which stars would have burned out too quickly for life to evolve, or one in which protons decayed into neutrons rather than the other way around, leaving the universe without atoms. So, in fact, we wouldn't be living here at all—we wouldn't exist.*" Ananthaswamy (2012)

Were these values set "just so" by a kind creator or did a vast system spawn many universes and we just happen to be on the life-supporting one? The conclusion isn't that the universe is *designed* for life as if so, it is a poor design because most of the universe is inhospitable to life. Yet it is true that the parameters of our universe are balanced on a knife edge, for as Susskind says:

"The great mystery is not why there is dark energy. The great mystery is why there is so little of it [10^{-122}]... The fact that we are just on the knife edge of existence, [that] if dark energy were very much bigger we wouldn't be here, that's the mystery."

Other "cosmic coincidences" are (Barnes, 2012):

1. *Strong force*. If the strong force was stronger or weaker by just 1% there would be no carbon or heavier elements anywhere in the universe.
2. *Weak force*. If the weak force was any weaker the hydrogen in the universe would be greatly decreased, starving stars of nuclear fuel and leaving the universe a cold and lifeless place.
3. *Neutrons.* If neutrons were slightly less massive the universe would be entirely protons and if lower by 1%, then all protons would decay into neutrons so no atoms other than hydrogen, helium, lithium and beryllium could form.
4. *Cosmic microwave background.* This radiation has a slight anisotropy, roughly one part in 100,000, just enough to allow stars and galaxies to form. Any smaller and the early universe would have been too smooth for stars and galaxies to form and any larger and stable stars with planetary systems would be extremely rare.
5. *Cosmological constant*. The positive and negative contributions to the vacuum energy density cancel to 120-digit accuracy, but the 121st digit makes our universe possible.

Since all the above and more apply, our "luck" is hard to explain. If the *entire universe* is fine-tuned to evolve, one can't conclude a lucky accident from a sample of one, unless there are many universes, so multiverse theory is popular despite it being scientifically worthless. Yet to conclude that there *had to be* many universes *in order to make our universe an accident* isn't scientific. The fine-tuning of our universe is based on evidence but the multiverse is based on no evidence at all:

"The multiverse has only ever existed, so far as we know, in the mind of man. Its most promising research programs, string theory and early rapid cosmic inflation theory, have bounced along on enthusiasm alone, prompting ever more arcane speculations for which there may never be any possibility of evidence." (O'Leary, 2017)

In a recent variant, Smolin speculates that black holes spawn universes based on Hawking's 1987 proposal, again with no evidence, but that a black hole is a mathematical infinity doesn't mean it can create a universe.

In quantum realism, our universe was *born* from a *preexisting* quantum reality whose nature defined every universal parameter from the start. This predicts that the key parameters of nature reduce to core network properties like refresh rate (the speed of light), density (Planck's constant) and expansion rate (the cosmological constant). From these, simulations based on quantum reverse engineering could derive other parameters, such as electron mass and charge. *Our universe has the laws it does because it was born from quantum reality.*

It follows that if other "bubble universes" arose in the quantum bulk as ours did, they would have *exactly the same laws of physics* except they might break the anti-matter way. In this view, the parameters of our universe were neither accidental nor chosen but inherited from the primal quantum reality. Again, that our universe was *born from quantum reality* suggests it is alive, so does it have the ability to evolve?

4.8.3 Evolving not designed

Darwin's great idea was that the human species was *naturally selected* by evolution over millions of years rather than made by a divine intelligence as it is today. The conditions necessary for *species* to evolve are identified as:

1. *Generation*. Species generate offspring that carry on their traits.
2. *Variation*. The offspring's traits vary, for example by mutation.
3. *Selection*. Offspring that survive are selected to continue their traits.

Evolution is essentially an *iterative method* that tries out various biological *patterns* and selects those that survive to define the future. It contradicts the orthodox religious view of a divine creator with a preconceived plan.

If the quantum world explores every option and selects one to be a physical event, Darwin's theory can then apply if *species* is replaced by *quantum entity,* so a photon is subject to evolution as it has:

1. *Generation*. The photon process generates "offspring" by instantiation.
2. *Variation*. Photon instances vary in properties like location and direction.
3. *Selection*. One instance is selected to restart the photon in a physical event.

When a photon cloud passes through Young's slits to hit a screen point, it *generates* many instance *variants,* one of which triggers a server restart that *selects* how the photon is reborn. Light finds the fastest path to any destination by a *quantum evolution,* where the instance that restarts the server first is "more fit". It succeeded accidentally but that the photon as a whole finds the fastest path wasn't an accident at all, as some instance *always* finds the fastest way.

By trying every option, photons combined into electrons, a new entity "species" that behaves differently from light. An electron occupies the channels of a node axis as a species occupies a niche in nature, so it is constantly bombarded by competitors for its quantum niche as a species faces competition in a biological niche. The electron structure is only *stable* if it *survives* to exclude other entities from its niche. In the evolution of matter, *stability* replaces biological *survival*.

Quantum randomness is a problem for both physical realism and conventional theology. It is pointless in a clockwork universe because it introduces errors in the machine, as what use is a clock that gives random time or a machine that does random things? Randomness is equally unhelpful in a god-designed universe because it interferes with the divine plan, hence Einstein didn't like the idea that God plays dice with universe. To evolve requires randomness which denies God's supremacy in theism and denies the supremacy of physical laws in physics. A God that exerts control by *rolling dice* is as embarrassing to theology as physical laws that work by *random choices* is to science, but are these the only options?

Quantum realism accepts what physical realism and theism reject because the evolution of matter needs randomness no less that the evolution of life does. In biological evolution, species generate gene blends and what survives is selected to carry on. In the evolution of matter, quantum entities generate processing blends and what is stable is selected to carry on. In both cases, *evolution needs randomness to succeed* so the world of matter is finding what survives, just as life is.

In current science, evolution began with life but in quantum realism, a *grand evolution* began when the universe did, as electrons, neutrinos, quarks, protons, neutrons and atoms evolved long before life did. Why differentiate the evolution of matter from the evolution on life, if the same principles of generation, variation and selection operate? Even if biological evolution is restricted to our tiny earth, the grand evolution continues throughout the universe, as stars continue to make matter to this day. Without stars creating heavy atoms like carbon, we couldn't have evolved so the lesser evolution of life requires the greater evolution of matter, and both are ongoing.

The standard model assumes the big bang created "fundamental particles" of matter but in quantum realism, matter had to *evolve from photons* because there were *no divine shortcuts.* Higher elements had to be made in the matter factories we call stars or in a supernova sacrifice. What drives our universe to evolve isn't dead matter following fixed laws or the plan of a divine being but the nature of quantum reality. *That the grand evolution of the universe was built-in at its quantum birth suggests a living universe evolving up not a dead universe running down*.

That a river is finely-tuned for crocodiles to live in doesn't mean it was *designed* for them but that crocodiles *evolved* to live as rivers allowed. In the same way, the physical world evolved as it did because the quantum environment allowed it. The physical universe wasn't fine-tuned to evolve any more than crocodiles were fine-tuned to in rivers. It inherited the ability to evolve from its quantum origin so *it is fine-tuned because it evolved not because it was designed so*. Evolution, like life, always finds a way. Again, that our universe is evolving suggests it is alive, so is it unpredictable?

4.8.4 Emerging not decreed

Apparently, inert matter made galaxies, stars, planets and life *by accident* and whatever made the universe abandoned it to physical laws long ago. The laws of thermodynamics doom everything to run down, whether our bodies, the sun or the universe, so the expected end state is an eternally empty big freeze. If the universe is ultimately *pointless* then we are too, so it doesn't matter what we do because *nothing really matters at all.* This dismal vision, that the laws of matter drive us, denies the accountability that societies need to work (Whitworth & Ahmad, 2013), so civilization would collapse if it was widely accepted.

This *cosmic nihilism* calls itself the voice of reason but genuine reason suggests otherwise. Our universe began, so something else must have made it. Quantum randomness has no physical cause, so matter isn't all there is. Claims that consciousness arises from physical complexity (Zizzi, 2003) fail because supercomputers show no signs of consciousness. A universe that has been decaying for billions of years had to begin very ordered, which the primal chaos wasn't, so decay isn't the only principle at work. That quantum laws are probable not certain means that the universe isn't a machine whose future is written. When examined closely, the story of a *dead world going nowhere that made us by accident* makes no more sense than that of a world *built just for us by a supreme being*.

A machine is *designed* to a blueprint, *built* from inert parts, then *runs* in a predictable way. A universal machine should arise like this but it isn't possible. If the physical universe began from nothing, where was the blueprint kept? If matter was built from fundamental parts, where did they initially exist? And if the universe is a predictable machine, why does quantum randomness have no physical cause? Newton's vision of a *universal machine* designed, built and run by God isn't supported by modern physics.

Nor does the evidence suggest that we are powerless servants of a divine plan. That our universe is evolving at every scale suggests it wasn't *built* as a watchmaker builds a watch but *born* like a baby, not knowing where it is going or why. An acorn that will become an oak in the right setting wasn't designed to be a tree but inherited "tree-ness" from its origin. Its genes aren't the "blueprint" to *build* a tree but *grow* one and it always becomes an oak tree not some random thing.

In the same way, a baby's birth may be accidental but that babies in general are born is no accident because that is how species survive. Baby's brains are predisposed to learn language and recognize faces so a specific baby can learn any language and recognize any face. The details may be accidental but the overall result isn't. If the universe itself is likewise *predisposed to evolve,* evolution may involve accidents but what is *emerging* isn't entirely random.

Emergence means to become a new sort of being, as a butterfly with wings emerges from the pupa of a caterpillar that crawls. Given time and the stability of a shell, caterpillar genes recombine to form a butterfly that is a new sort of being. The same thing happens to matter when hydrogen and oxygen *gases* combine to form *liquid* water. In both cases, what existed already combines to form a new way of existing with entirely different properties from its predecessors.

To say a butterfly contains a caterpillar within it or that water has a gaseous base is to misunderstand emergence, yet physics today assumes that its fundamental matter parts persist when they combine, so a nucleus is just a bunch of protons and neutrons sitting side by side. In essence, it denies emergence but in quantum realism, emergence is a key feature of the universe at every scale. Emergence allowed light to combine into electrons, quarks to combine into protons, protons and electrons to combine into Hydrogen atoms, and this was just the start.

Ideas of designing, building and controlling don't work when it comes to emergence. If the universe is emerging from simple parts to complex wholes, it is doing so in a way that even it can't foresee. It is becoming what it can be so we exist because we can, not due to some plan. Evolution works by accident but isn't itself accidental, as trying every option eventually leads to what works. We are neither accidental nor designed but rather emerged naturally from the universe.

Table 4.8 compares quantum realism and physical realism for matter so the reader can decide for themselves. It implies a living universe born to actively evolve into an emerging future but if so, *what might that be?*

Table 4.8. Chapter 4 summary: Physical realism vs. quantum realism for matter

Physical realism	Quantum realism
Matter. If matter is made of *fundamental particles,* then: a) *Space*. Space is nothing as there is no null particle b) *Light*. Is a wavy particle without mass or charge! c) *Mass*. Represents the *particle substance* d) *Charge*. Represents a property unrelated to mass e) *Anti-matter.* Is matter that for some reason has the same mass but opposite charge f) *Our universe* was *built* from a standard model Lego-set of 62 fundamental particles	*Matter*. If matter is generated by *quantum processing,* then: a) *Space*. Space is null process not nothing b) *Light.* Is the same process shared by many nodes c) *Mass.* Represents the *net processing done* in a node d) *Charge.* Represents the net processing remainder e) *Anti-matter.* Is matter processing in reverse that gives the same mass but opposite charge f) *Our universe* was *born* from quantum vibrations that combined to create everything we see
Electron. A fundamental matter particle that: a) Is a structureless point with no dimensions, even though that implies no mass, charge or spin b) Has mass even though no extent implies no substance c) Has negative charge just because it does and charge is not related to its mass d) Has *imaginary spin* that is half of its total spin for some reason e) Moves but for some reason is slower than light f) Never collides in an atomic shell even though it is a particle with mass, for some unknown reason	*Electron.* A *head-head* extreme photon collision that: a) Is the repeating overload of all the channels of *one axis through one node* b) Has mass as net quantum processing that repeats c) Has negative charge because negative processing is left-over after a head-head photon overload d) *Really spins* in quantum space but only half its photon's amplitudes are seen from any angle e) Moves like light on two dimensions only f) Never collides because it is entirely light-like in a two-dimensional atomic shell
Neutrino. A fundamental matter particle that: a) Is a structureless point with no dimensions b) Has a tiny mass that varies unpredictably despite its predicted zero mass c) Has zero charge despite not having zero mass d) Always has left-handed spin for no known reason even though this contradicts spatial symmetry e) Is a lepton like an electron just "because it is" for no structural reason	*Neutrino*. An ongoing *head-tail* version of an electron that: a) Fills the channels of *one axis through one node* b) Has a tiny mass since its heads and tails don't quite cancel due to the *asynchrony* of the quantum network c) Has zero charge because process remainders cancel d) Always has left-handed spin because reversing direction changes phase to swap its mass photons e) Is a lepton like an electron because it is the alternate *phase* of one-axis quantum wave collision
Quark. A fundamental matter particle that: a) Is a structureless point with no dimensions b) Comes in two types, up and down, with different masses and charges, for a reason that is never given c) Exists in groups but is never observed alone, for some unknown reason d) Has unexpected one-third charges for some reason	*Quark.* A repeating *three-axis* extreme photon collision that: a) Has a three-axis structure in a node plane b) A three-axis photon collision has two viable phases: *head-tail-tail* (up) and *head-head-tail* (down) c) Three photon sets don't fill the channels of a node plane so it isn't stable alone d) A three-axis collision predicts one-third remainders
Many fields. All the forces of nature are from invisible fields that invoke virtual particles from space to do their work: a) *Gravity.* Acts at a distance by creating virtual gravitons despite no evidence whatsoever that they exist b) *Electromagnetism.* Acts at a distance by an invisible field that creates virtual photons to cause effects c) *Strong force.* Acts when a strong field creates virtual *gluons* that let quarks with a red, green and blue *color*	*One field.* All the forces of nature are from quantum processes spreading and interacting on a quantum network: a) *Gravity.* The spreading processing of matter creates a processing gradient that has effects (next chapter) b) *Electromagnetism.* Acts in photon units because the photon is the basic process of the quantum network c) *Strong force.* Occurs when quarks *share photons in a* triangle structure if their three axes *orientate* in

charge form a proton as the colors cancel to clear, and massless gluons create the proton's extra mass d) *Weak force.* Acts when a weak field creates massive virtual particles called W bosons that turn a neutron into a proton but *never* turn protons into neutrons for some unknown reason, except in stars e) *The Higgs.* The virtual particle needed to create the mass of the W bosons that cause the weak force f) *Virtual particles*. Virtual particles cause all effects and create almost all the mass we see around us	complementary ways, where the increased *interference* creates the proton's mass d) *Weak force.* Occurs when a neutrino turns a set of photon heads into tails to convert a neutron into a proton but to turn a proton into a neutron requires an electron to get close, which only occurs in stars e) *The Higgs.* The imaginary cause invoked to explain another imaginary cause that explains an effect f) *Virtual particles*. Virtual particles are imaginary agents that don't exist at all
The universe of matter was *built* from basic particles as an engineer builds a building from bricks and wood a) *Atoms.* Electron particles with mass that "orbit" a nucleus should collapse or collide but they never do b) *Electron shells*. Electrons as particles fill shells in periodic table atoms based on data-fitted quantum numbers that represent nothing c) *Atomic nuclei*. Proton and neutron particles cram into the atomic nucleus like raisins in a plum pudding mix, giving no reason for more neutrons in higher nuclei d) *Family generations.* Two higher variants of the basic particles exist then no more, for no known reason e) *Dark matter.* A "halo" that is over 85% of the matter of our galaxy for which no particle cause has been found f) *Dark energy.* Is over two-thirds of the energy of the universe for which no particle cause is even conceived	*The universe* of matter *evolved* from quantum processing as it tries all the options to find out what works a) *Atoms*. Electron waves find different harmonics and distances to constantly vibrate so they never interfere b) *Electron shells*. Electrons as waves fill atomic shell circumferences based on wavelength, wave harmonics and great circle orientation c) *Atomic nuclei*. The proton and neutron quark triangles in an atom nucleus open up to re-link in a single closed string that needs neutron buffers to fold correctly d) *Family generations.* Higher basic matter variants repeat on the two extra dimensions of space only e) *Dark matter.* Is a constant net processing created by light orbiting the galaxy black hole f) *Dark energy.* Is generated by the ongoing creation of new space that absorbs energy for its first cycle
A dead universe made of inert matter and empty space accidentally created life and us for no reason	*A living universe born of quantum reality actively evolves by emerging into an unknown future*

DISCUSSION QUESTIONS

The following questions are addressed in this chapter. They are better discussed in a group to allow a variety of opinions to emerge. The relevant section link is given after each question:

1. How do mass and charge relate? (4.3.2)
2. Why are electrons and neutrinos both classified as leptons? (4.3.3)
3. Why do neutrinos have a tiny mass but no charge? (4.3.3)
4. Why is our universe made of matter instead of anti-matter? (4.3.5)
5. If anti-particles run time in reverse, can they go backwards in time? (4.3.6)
6. Why do quarks have strange one-third charges? (4.4.3)
7. What causes the strong force that binds quarks in the nucleus of an atom? (4.4.4)
8. Why does this quark binding get stronger with distance? (4.4.4)
9. Why are three quarks needed to form a proton or neutron? (4.4.5)
10. What do the quark "colors" of the standard model represent? (4.4.5)
11. What turns neutrons in space into protons? Why don't protons in space decay? (4.4.6)
12. Does the Higgs cause any of the mass around us? Why is it said to "cause mass"? (4.4.7)
13. Why does the energy inherent in all matter depend on the speed of light? (4.4.8)
14. Why does string theory need *eleven* dimensions to work? (4.5.1)
15. What did Newton think caused gravity? Does current physics agree? What does the evidence suggest? (4.5.2)

16. Why are virtual particles magical despite having lawful effects? (4.5.2)
17. How does current physics decide when virtual particles interact? (4.5.3)
18. How does the standard model explain new and unexpected findings? (4.5.4)
19. What is the difference between an equation and a theory? (4.5.5)
20. How is the standard model of physics similar to the standard model of medieval astronomy? (4.5.6)
21. Are the standard model's fundamental particles actually particles? Are they fundamental? Explain. (4.5.7)
22. How does a processing model classify the basic entities of physics? (4.5.8)
23. Why does quantum realism's claim that matter is made of light contradict the standard model? (4.5.9)
24. What came first, matter or light? Give a reason for your answer (4.5.9)
25. Why do all higher atomic nuclei need neutrons? (4.6.1)
26. An atom of lead has 82 electrons in a small space. Why don't they collide with each other? (4.6.2)
27. How do electrons "fill" the shells and subshells of an atom? (4.6.3)
28. Can electrons as point-particles spin? Why do electrons "half-spin"? (4.7.1)
29. Why are neutrinos always left-handed? (4.7.2)
30. Why are protons much heavier than the quarks from which they are made? (4.7.3)
31. Why is the universe charge neutral? (4.7.4)
32. Why do leptons and quarks have three family generations, then no more? (4.7.5)
33. Why are the higher generations of leptons and quarks increasingly heavy? (4.7.5)
34. What is dark matter? Why can't we see it? How does it differ from ordinary matter? (4.7.6)
35. What is dark energy? Why can't a particle model explain it? (4.7.7)
36. Is our universe dead or alive? Give reasons. (4.8.1)
37. Why is our universe "finely tuned" for life? (4.8.2)
38. What are the quantum evolution equivalents of biology's generation, variation and selection? (4.8.3)
39. Was our universe "built" as a watchmaker builds a watch? If not, how did we arise? (4.8.4)

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