Quantum Realism Part I. The Observed Reality

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

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“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. Physical realism is the world view that there is one reality out there apart from us and the physical world is it. Its claim to truth is based on evidence from the physical world. Dualism is the equally common religious world view that behind the real physical world is a spiritual reality that created it and to which one can return at death, implying a higher purpose to physical life. Its claim to truth is divine revelation from the spiritual world.

Quantum realism as a world view sits in between these two dominant ideologies. 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. Its claim to truth is that as a statement about the physical world, it is subject to science. This chapter develops a testable prediction to separate quantum realism from physical realism.

4.1. WHAT IS MATTER?

Quantum realism explains space, time and light as follows:

- **Space.** Space as null processing is both something and nothing.
- **Time.** Time as processing cycles completed can “dilate”, as Einstein says it does.
- **Light.** Light as one process distributed more or less explains the unity of the electromagnetic spectrum.

The challenge now is to explain matter using the same quantum processes used for space, time and light (Figure 4.1). If the model can’t explain matter it fails, making the results so far mere curiosities. Current physics explains matter using the particles of the standard model. Quantum realism must explain everything it does and more to succeed.

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). The difference essentially is that fermions collide with each other and bosons don’t. Physics currently attributes all forces to force particles and attributes all matter to matter particles.
Table 4.1. The standard model of particles

<table>
<thead>
<tr>
<th>PARTICLES</th>
<th>ELECTRONS</th>
<th>MATTER PARTICLES</th>
<th>QUARKS</th>
<th>ANTI-MATTER</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Electron-like</td>
<td>Neutrino-like</td>
<td>Up-like</td>
<td>Down-like</td>
</tr>
<tr>
<td>Generation 1</td>
<td>Electron (e)</td>
<td>Neutrino (ν)</td>
<td>Up quark (u)</td>
<td>Down quark (d)</td>
</tr>
<tr>
<td>Mass (Charge)</td>
<td>0.511 (-1)</td>
<td>&lt; 3 x 10^-6 (0)</td>
<td>1.5 - 4.5 (+2/3)</td>
<td>5 - 8.5 [-1/3]</td>
</tr>
<tr>
<td>Generation 2</td>
<td>Muon (μ)</td>
<td>Muon neutrino (νμ)</td>
<td>Charm quark (c)</td>
<td>Strange quark (s)</td>
</tr>
<tr>
<td>Mass (Charge)</td>
<td>105.7 (-1)</td>
<td>&lt; 0.19 (0)</td>
<td>1,000 – 1,400 (+2/3)</td>
<td>80-155 (-1/3)</td>
</tr>
<tr>
<td>Generation 3</td>
<td>Tau (τ)</td>
<td>Tau neutrino (ντ)</td>
<td>Top quark (t)</td>
<td>Bottom quark (b)</td>
</tr>
<tr>
<td>Mass (Charge)</td>
<td>1,777 (-1)</td>
<td>&lt; 18 (0)</td>
<td>174,000 (+2/3)</td>
<td>4,000 – 4,500 (-1/3)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>FORCE PARTICLES</th>
<th>ELECTROMAGNETIC</th>
<th>STRONG</th>
<th>WEAK</th>
<th>GRAVITY</th>
<th>HIGGS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>Photon (γ)</td>
<td>Gluon (g)</td>
<td>W⁺, W⁻, W⁰</td>
<td>Graviton</td>
<td>Higgs</td>
</tr>
<tr>
<td>Mass (GeV)</td>
<td>(0)</td>
<td>(80.4; 80.4; 91.2)</td>
<td>(0)</td>
<td>(125)</td>
<td></td>
</tr>
<tr>
<td>Charge</td>
<td>-1 to +1</td>
<td>Eight “colors”</td>
<td>Isospin (+1/2, -1/2)</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Matter particles are divided into electron and neutrino **leptons** and up and down **quarks**, both of which have unstable higher generation variants for some unknown reason. Up and down quarks then combine into the protons and neutrons of atomic nuclei that electrons orbit around, giving all 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. Yet 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

Some fundamental questions the standard model doesn’t answer include:
- Why don’t protons decay as neutrons do?
- Why is our universe matter not anti-matter?
- Why do neutrinos have a tiny but variable mass?
  - Why do leptons and quarks have three particle “generations” then no more?
  - Why do electrons “half spin”?
  - Why do particle masses vary enormously but charges don’t?
  - Why do neutrinos always have left-handed spin?
  - Why do quarks have one-third charges?
  - Why does the force binding quarks increase as they move apart?
  - What is the dark matter and dark energy that constitute most of the universe?

The issue isn’t that these questions are unanswered but that over fifty years has seen no progress in answering them. As the great hopes of string theory and super-symmetry led nowhere, the next fifty years look like being the same. This chapter answers these questions based on quantum processing not physical particles.

**4.3. ELECTRONS AND NEUTRINOS**

In quantum realism, the universe began as a plasma of massless high energy photons, so how did matter arise from this energy cauldron? Since electrons and neutrinos are the smallest matter entities, they are the most likely candidates for the first matter.

**4.3.1. Electrons**
In current physics, an electron has a small mass and a negative charge. It is a zero-dimensional point particle that doesn’t occupy any space. Its “size” then is exactly zero but how an entity with no spatial extent has mass substance is never really explained. The standard model does not answer the question of what an electron actually is.

In quantum realism, an electron is processing that occupies one node of the quantum network, so it has a “size” just as a screen pixel has a size. A photon is a distributed quantum process being passed on, so:

1. One photon is accepted at a node by one channel that vibrates at right angles to its polarization plane.

2. The bandwidth of one channel is one quantum process per quantum cycle.

3. Channels transmit photon streams in lockstep order so they can’t overtake.

4. If two photons meet head-on in a channel, it accepts both.

Normal photons meeting head-on don’t overload a channel it as its bandwidth exceeds their processing total but extreme light is different. An extreme photon has a two-node wavelength so it has half a quantum process in each node. If two such photons meet head-on, each requesting a half quantum process, the channel bandwidth overloads, i.e. they “collide”.

Since photons spin on their axis of movement, a photon that collides can restart in another axis channel to disentangle but this can’t happen if the overload occurs in every channel. An extreme light beam has extreme photons filling every channel of its movement axis so if two such beams meet head-on, every channel on one axis overloads at once (Figure 4.2), so now there are no free channels for photons to restart in. That extreme light beams meet head-on is obviously unlikely but it must have occurred in the early plasma by the law of all action, that everything possible eventually happens (3.6.3).

Figure 4.3 shows the result for one channel, with every channel the same. In this and other pictures, a “head” is the leading half of an extreme photon and a “tail” is the following half. When two heads of half a quantum process meet, they overload the channel bandwidth so both photons restart the next cycle. Two new photons then set off in different directions but that gives another overload that restarts them again and the overload/restart repeats every quantum cycle from then on. The network that once hosted only waves now has a permanent processing bump - an electron. It is stable because any entity arriving on that axis finds all the channels taken while anything at right angles just passes right through.

In his PhD, Feynman partitioned the electron wave equation into opposing advanced and retarded waves but didn’t pursue it, perhaps thinking that electron particles can’t be waves. Since then, Wolff has argued that electrons are in and out spherical waves (Wolff, M., 2001), Cramer’s transactional theory uses retarded and advanced waves (Cramer, 1986), and Wheeler–Feynman’s absorber theory does the same (Wheeler & Feynman, 1945). Experiments show that electromagnetic waves can repeatedly interact to form static states (Audretsch, 2004, p23) and repeated observations can maintain a quantum state if the time delay is short (Itano, Heinzen, Bollinger, & Wineand, 1990). It follows that electromagnetic waves can collides to form static standing waves just as other waves do (Figure 4.4). Quantum realism concludes that an electron is a quantum standing wave created when extreme photons collide.

This contradicts the standard model in several ways. Instead of a point particle made of nothing else, an electron is made of photons in a single quantum node. Instead of having no structure, those photons fill the channels of one axis. If matter is light trapped in a never-ending loop, it isn’t inert at all. Matter is light “frozen” in place but still pulsing at the speed of light, like a stuck record endlessly repeating. Matter as a standing wave is both stationary and moving. But since this only applies on one axis, an electron is only one-dimensional matter.
When a computing processor gets in an infinite loop, it “hangs” and doesn’t respond to input. When our devices hang, we just restart them but this doesn’t work for the infinite loop of restarts described above. If a network node “locked” in an infinite loop that even a restart can’t fix, it would be a major 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, means we don’t really understand it. In the standard model, charge is a self-evident property, like mass, and the two are considered unrelated.

In contrast, quantum realism aims to derive physics not just describe it, so if mass is a processing overload that repeats, what is charge? An electron as positive quantum processing that repeats endlessly must leave negative processing that never runs, shown as the dotted lines in Figure 4.3. That a quantum network must keep its processing books in order suggests that the charge of an electron is its permanent processing deficit. So instead of an unrelated property, quantum realism suggests that charge is the direct byproduct of matter.

This conception fits the properties of charge. Charge as a processing remainder can be positive or negative as charge is, and opposite processing cancels just as opposite charges do. And since the electron repeatedly restarts, the processing remainder is constant, again as an electron’s charge is. Quantum realism connects mass and charge, with mass the net processing done and charge the net processing undone per cycle. The next chapter covers how charge spreads on the quantum network to cause effects.

#### 4.3.3. The neutrino option

Electrons are critical to our world as without them there would be 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 that mostly pass through us like ghosts. The neutrino seems quite pointless, so why did nature make so many of them?

The standard model expects neutrinos to have no mass at all as 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 standard model is silent.

In this model, the same photons that collide in-phase to give an electron in Figure 4.3 can collide out-of-phase as in Figure 4.5. Both “collisions” overload all the channels of an axis but while photon heads meeting gives an electron, heads and tails meeting mostly cancel to give the smudge on space we call a neutrino. So rather than a “building block” that seems to have no use, a neutrino is an alternative option required by the creation of electrons. Note that a tail-tail meet isn’t possible because it implies a prior head-head meet.

But if a neutrino is an electron-type collision in a different phase, why doesn’t its mass processing cancel entirely as its charge does? Perfectly synchronized head and tail processes would cancel but the quantum network, like the Internet, has no central control to synchronize it. The universal flow of light synchronizes adjacent nodes (2.4.4) but it isn’t perfect, so the photons in a neutrino don’t exactly cancel. Over many channels, these asynchronies give the small processing excess we call its mass, although the processing left over still exactly cancels. The neutrino’s tiny mass but zero charge reflect the asynchrony of the quantum network.

![Figure 4.5. A neutrino channel reboot](image)

**Table 4.2. Lepton processing**

<table>
<thead>
<tr>
<th>Lepton</th>
<th>Photons “collide” in a node</th>
<th>Channel sets</th>
</tr>
</thead>
</table>
| **a. Electron** | Photon heads from one side  
Photon heads from the other side 
Total processing (stability) 
Net processing (mass) 
Remainder (charge) | +1/2 
+1/2 
1 (full) 
+1 
-1 |
| **b. Neutrino** | Photon heads from one side  
Photon tails from one side 
Total processing (stability) 
Net processing (mass) 
Remainder (charge) | +1/2 
-1/2 
1 (full) 
~0 
0 |
To recap, a point of space node offers many quantum channels for every axis through it. The full set of channels for any transfer axis are a channel set, and it has a finite bandwidth just as each channel does. Table 4.2 describes electrons and neutrinos in terms of channel set bandwidth, where:

1. Total processing. Is the total processing, regardless of sign, that the local node must handle. If this “fills” the channel set bandwidth, the channels repeatedly overload in a stable result.
2. Net processing. Is the net processing after opposite displacements cancel out. It defines the mass as the ongoing server processing calls needed.
3. Remainder. The net processing left undone is charge.

Electrons and neutrinos are then brother leptons by their common one-axis photon structure, even 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. Anti-matter

Dirac’s equations predicted anti-matter before it was found but they didn’t say why nature had given every matter particle an “evil twin” of the same mass but opposite charge. The standard model just added an anti-matter column to fit the facts but that the matter we see has an inverse remains one of the most baffling discoveries of physics. Why does nature even allow anti-electrons that can instantly annihilate electrons?

In quantum realism, anti-matter is to matter as neutrinos are to electrons – a necessary alternative. If our universe began with one photon, then it had to first vibrate up or down with respect to the surface of space. A clockwise rotation in space is anti-clockwise from the other side (Figure 4.6a) but a first-up rotation on a surface stays that way however it is viewed (Figure 4.6b). The first photon had to choose between first-up or first-down processing and all its offspring followed suit. So all the photons in an electron process the same way, say first-up.

All processing has the property that it can run in reverse so processing implies anti-processing, e.g. a quantum process that sets a circle of values from a start point can set the same values in reverse. So if an electron is photons processing one way, the same processing in reverse is an anti-electron. And if reversing an electron’s processing gives an anti-electron, the same logic applies to every matter particle.

<table>
<thead>
<tr>
<th>Photon Structure</th>
<th>Electron</th>
<th>Neutrino</th>
<th>Anti-electron</th>
<th>Anti-neutrino</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>a. First-up heads collide in a node</strong></td>
<td>Head</td>
<td>Head</td>
<td>Head</td>
<td>Head</td>
</tr>
<tr>
<td><strong>b. First-up head collides with a tail</strong></td>
<td>Head</td>
<td>Tail</td>
<td>Head</td>
<td>Head</td>
</tr>
<tr>
<td><strong>c. First-down heads collide</strong></td>
<td>Head</td>
<td>Head</td>
<td>Tail</td>
<td>Tail</td>
</tr>
<tr>
<td><strong>d. First-down head collides with a tail</strong></td>
<td>Head</td>
<td>Head</td>
<td>Tail</td>
<td>Tail</td>
</tr>
</tbody>
</table>

**Figure 4.6. Rotation in and on space**

![Figure 4.6. Rotation in and on space](image)

<table>
<thead>
<tr>
<th>Table 4.2</th>
<th>An Extreme Photon</th>
<th>Transfer Direction</th>
<th>Processing Direction</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Key</strong></td>
<td>Mass: processing done</td>
<td>Transfer left</td>
<td>Head is up</td>
</tr>
<tr>
<td></td>
<td>Charge: processing undone</td>
<td>Grid node</td>
<td>Tail</td>
</tr>
<tr>
<td></td>
<td>Collision axis</td>
<td>Transfer right</td>
<td>First-up</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>First-down</td>
</tr>
</tbody>
</table>

**Figure 4.7. Lepton photon structures**

i. Electron (4.7a). “Up” heads collide to give mass and the negative remainders give negative charge.

If mass is the net processing and charge is processing left-over, an anti-electron will have the same mass as an electron but opposite charge. A processing model of matter predicts the existence of anti-matter and its properties, including that an anti-electron will “annihilate” an electron, as both turn back into photons.

Figure 4.7 defines the basic leptons by their photon components as follows:

1. Matter. First-up photons collide to give either an:
ii. **Neutrino (4.7b).** “Up” heads mostly cancel “down” tails to give a tiny mass but the remainders cancel fully giving no charge.

2. **Anti-matter.** First-down photons collide to give either an:
   i. **Anti-electron (4.7c).** “Down” heads collide to give mass and the processing remainder gives a positive charge.
   ii. **Anti-neutrino (4.7d).** “Down” heads mostly cancel “up” tails to give a tiny mass but the remainders cancel entirely to give no charge.

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

### 4.3.5. Where did the anti-matter go?

The standard model treats matter and anti-matter as equivalent opposites, so while in our universe atoms have negative electrons there could be an anti-universe with positive electrons. In that world, everything would seem the same to its inhabitants because the laws of physics would be exactly the same. The problem then is, why do we only see matter all around us? Did the big bang produce:

1) No anti-matter, for some unknown reason?
2) Matter and antimatter equally but the antimatter in the universe is hidden?
3) Matter and antimatter equally but matter somehow “overcame” antimatter?

Physics dismisses the first option by the standard model and the second because no anti-meteors, anti-planets or anti-stars have been seen. The current view is that the big bang made equal amounts of matter and anti-matter, as per the standard model, then “somehow” matter overcame anti-matter. 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

The standard model requires the first event to make equal amounts of matter and anti-matter because it treats them as equivalent but in quantum realism, our universe began with a single photon that had to choose whether to vibrate first-up or first-down on the surface of space. When our first photon chose processing over anti-processing, our universe became matter not anti-matter. The first light then evolved into matter only, not matter and anti-matter equally as the standard model says. *It follows that 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 always works the same way doesn’t apply to anti-matter (Ambjorn, Jurkiewicz, & Loll, 2008). For example, in the Feynman diagram of an electron hitting an anti-electron, the latter enters the collision going backwards in time (Figure 4.8). The logic is symmetric, so to the anti-electron the electron is going back in time. Yet both the electron and anti-electron are entering the interaction not leaving it.

Minkowski interpreted Einstein’s theory to mean that objects can move faster or slower along the 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” is reversing 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 struggles to explain how time runs backwards for anti-matter. If time is an independent dimension, to reverse time is to travel back in time and deny the causality behind all physics.

In quantum realism, time is a construct that passes as processing cycles complete, not part of a spacetime “canvas” upon which matter exists. This fits Einstein’s conclusion that every particle in the universe in effect has its own “clock”, because in a distributed quantum network, every node runs at a rate that varies with the local load.
If time passes as processing cycles finish, matter has a tick of time for every forward processing cycle and anti-matter has a tick of time for every backward cycle. Anti-matter exists in anti-time as matter exists in time because for matter a forward cycle is a tick of time and for anti-matter a reverse cycle is a tick of time. To a matter being, anti-matter runs time in reverse but to an anti-matter being we are the ones running time in reverse. Matter exists by processing while anti-matter exists by anti-processing, but in both cases there is "forward" processing that defines their time.

That anti-matter runs time in reverse is possible because our time is virtual. This doesn’t mean that anti-matter time can reverse causality but that Feynman diagrams need dual time axes, one for matter time and one for anti-matter anti-time. Anti-time is an alternate virtual time that exists because anti-matter processing is the reverse of matter processing. That processing creates time means that not only does every particle in the universe have its own clock, it also decides its own clock direction.

One might suppose that if reality is virtual, then time can re-wind just as an Internet browser has a “Back” button. But a browser back button only undoes your last act, it doesn’t undo interactions like online registrations as this must reverse both parties. With six degrees of separation, rolling back just 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.

In quantum realism, anti-time doesn’t imply time reversal because a physical event is a processing 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. In our universe, physical events cannot be reversed, rewound or fast-forwarded, whether by matter or anti-matter, so there is no time travel. If the past is gone and the future is not yet defined, there is only an eternal now.

### 4.4. QUARKS

Quarks constitute the atomic nuclei that make up nearly all the matter we see. If neutrinos are strange then quarks are stranger, as their charges come in unexpected thirds and their nuclear binding increases with distance. Yet they obey the equations of matter, so can the processing that explains electrons and neutrinos be extended to account for quarks? Quarks must somehow be more than the one-dimensional matter of electrons and neutrinos.

#### 4.4.1 A triple collision

Standard model quarks are fundamental particles not related to electrons and neutrinos. and they come in two types called “up” and “down”, with different masses and charges. An up quark has a plus ⅓rdcs charge and a down quark has a minus ⅓rd charge for no known reason, except this conveniently lets two down quarks combine with an up quark to give a proton that is the nucleus of Hydrogen, the first periodic table element.

For quark mass to arise like that of an electron, it must also be based on an extreme photon collision. So if leptons are a two-way collision, quarks must be a three-way collision, where three beams of extreme light meet in one node (Figure 4.9). Again, this unlikely event must have occurred in the first plasma by the quantum law of all action. The collision is in a plane, so if one axis line needs two beams to fill its channels, it needs four beams to fill the dimensions of a plane. Two beams colliding fill the channel set of one axis but three beams colliding fill only 1.5 channel sets, not the two that a plane has.

Hence the result can’t be stable alone and indeed quarks are never observed alone. Had this not been so, the model would fail, leaving few other options for consistent reverse engineering at this point.

A three-axis collision has an interesting symmetry, as photons on any of the three axes half exist on the other two by the cosine rule so any quark axis is one beam vs. two others at half strength, i.e. a lepton type collision. That a quark is a semi-stable symmetry that can combine with other quarks to give a stable planar structure is now explored.

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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°, where Cos (60°) is one half.
4.4.2 The phase options

One day, how three beams of extreme light at equal angles meeting at a point interact may be resolved by simulation or experiment but for now it must be envisaged. In the lepton case, two beams meeting head-on can complete the one channel set bandwidth of one node axis, as each contributes half a channel set. This gives the repeating overload we call matter and the charge remainders correctly for leptons and anti-leptons.

In the quark case, three beams meet in a node where again each provides half a channel set. To give stable matter by the same logic, the result must fill the channels of a plane not just a line. A node plane has two dimensions so its bandwidth is two channel sets. Dividing the two channel sets of a plane by three-axes of colliding photons means each collision axis fills at two-thirds of a channel set.

A tail-tail-tail meet isn’t possible as it implies a prior head-head-head event so the phase options are:

1. **Head-head-head.** Three sets of photon heads meeting at equal angles in a node will allocate processing equally. Every axis is only partly filled so it has free channels that let other entities in so the result isn’t stable.

2. **Head-tail-tail.** Now two photon beams leave a node as another arrives, as shown in Figure 4.10a. For the reasons given next, this is proposed to be an up quark.

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

Of these options, the last two are proposed to be up and down quarks (Figure 4.10).

4.4.3 A three-way structure

A three-way meeting raises the issue of interaction order as photons compete for channels on a first-come-first-served basis. 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. Following this logic, Table 4.3 gives the expected processing result in channel sets as before, except now there are three collision axes not just one. Again, mass is the net processing and charge is the net remainder but now the axis bandwidth is only two-thirds of a channel set. The details are:

<table>
<thead>
<tr>
<th>QUARKS</th>
<th>Photons meet in a node</th>
<th>Processing channel sets by axis</th>
<th>Charge</th>
<th>Neutral</th>
<th>Free</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Up quark</strong></td>
<td>Tail exits charge axis</td>
<td>-1/3</td>
<td>-1/6</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Tail exits neutral axis</td>
<td>-1/3</td>
<td>-1/6</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Head enters free axis</td>
<td>0</td>
<td>+1/3</td>
<td>+1/6</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total processing</td>
<td>2/3 (full)</td>
<td>2/3 (full)</td>
<td>1/6</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Net processing</td>
<td>-2/3</td>
<td>0</td>
<td>±1/6</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Remainder</td>
<td>+2/3</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td><strong>Down quark</strong></td>
<td>Tail exits neutral axis</td>
<td>-1/6</td>
<td>-1/3</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Head enters charge axis</td>
<td>vs +1/3</td>
<td>vs +1/6</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Head enters free axis</td>
<td>+1/6</td>
<td>+1/6</td>
<td>+1/6</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total Processing</td>
<td>2/3 (full)</td>
<td>2/3 (full)</td>
<td>1/6</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Net Processing</td>
<td>+1/3</td>
<td>~ 0</td>
<td>±1/6</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Remainder</td>
<td>-1/3</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

Through a node as the other two arrive, the tails 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 with a sixth of a channel set of entangled photons. The result has a minus third charge and is again stable on two axes with again extra photons in the third axis.

1. **Up quark.** If two extreme photon beams leave a node as another arrives, the tail sets first fill a charge axis with a plus two-thirds charge left over. The remaining tails and the later arriving heads then fill a neutral axis where the remainders cancel. This leaves a free axis with a sixth of a channel set of entangled photons. The result has two-thirds charge and is stable on two axes but has extra photons in the third axis.

2. **Down quark.** If one beam has passed through a node as the other two arrive, the tails 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 with a sixth of a channel set of entangled photons. The result has a minus third charge and is again stable on two axes with again extra photons in the third axis.
This result is interesting because it gives the correct third charges for quarks which no other model does\textsuperscript{2}. While the standard model allocates one-third charges to quarks after the fact, quantum realism derives them. It predicts that quarks occupy one node like leptons but only fill two of the three collision axes.

To sum up, the proposed quark structure is:

1. **Charge axis.** Holds the quark charge, of up quark $+\frac{2}{3}$ and down quark $-\frac{1}{3}$.
2. **Neutral axis.** Heads and tails cancel with no remainder.
3. **Free axis.** The remaining one sixth channel set of photons is “extra”.

Figure 4.11 summarizes the proposed structure where the axes are at 60° even though the photons meet at 120° because quarks are head-tail mixes, so one beam is always leaving as the others arrive.

That quarks aren’t stable individually fits the fact that they never exist alone. Their symmetric structure might let a group of them maintain an exterior of stable axes but as quarks are stable in a nucleus, they must somehow connect to fill all the channels of a plane, or again the model fails. Physics calls that connection the strong force.

### 4.4.4 The strong force

The forces that bind protons and neutrons in an atomic nucleus are so strong that when they break there is a nuclear explosion. The bond has to be that strong to overcome the huge electric repulsion between same charge protons. Since protons and neutrons consist of quarks, particle physics needs a strong force to bind them in the nucleus. This force has the peculiar property that it has no effect at very short range but gets stronger as quarks get further apart. It exchanges no energy so it isn’t electro-magnetic and it increases with distance so it isn’t gravity. The standard model required a new field that generated new particles, as described by quantum chromodynamics.

Quantum chromodynamics was a field theory derived by analogy to quantum electrodynamics, the field that generated electromagnetism. It described a new strong field that emitted new particles called gluons with a new color charge. In essence, the strong field acted via massless gluons just as the electromagnetic field acted via photons. These gluons are said to carry red, blue and green charges that bind quarks in a proton just as photons bind electrons in atoms, but with three values not two. These red, blue and green charges cancel to “white” just as positive and negative charges cancel to neutral. But three colors need anti-colors so to turn a red quark blue needs an anti-red gluon as well as a blue gluon. Yet 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. No-one spoiled the party by asking why a universal field through all space was needed for a quark-only effect.

Quantum realism interprets the same facts quite differently, as it attributes the strong force to quarks sharing photons. As shown in Figure 4.12, an extreme photon with its head in one node and tail in another can exist across two quarks that are side-by-side. It is proposed that the extra photons in the quark free axis essentially act as “hooks” that can insert themselves into other nearby quarks. In this view, quarks bind to other quarks by sharing photons rather than being “pushed” together.

Photon sharing gives a bond that is initially zero but increases with distance, for 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, hence quarks side-by-side experience no force when close but are pulled together as they separate. In effect, shared extreme photons are the “elastic bands” that hold quarks together.

---

\textsuperscript{2} Table 4.3 partitions three half channel sets colliding as $2/3 \gamma ds + 2/3 \gamma ds + 1/6 \gamma th = 1.5$ where each axis fills at $2/3 \gamma ds$ of a channel set. 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.
Does photon sharing let quarks fill all the channels of a node plane to achieve stability? Unless this is possible, the quantum processing model again fails.

4.4.5 Protons and neutrons

The atomic nucleus that was 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). How do quarks achieve this?

If the free photon “hooks” of one quark insert themselves into the neutral axis of another quark, this gives a sixth of a channel set of processing in both quarks (Table 4.5A). Note that one photon in two adjacent quarks uses all its processing with no remainder. Now let photons from the second quark neutral axis 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 and leaves the neutral axis the same. Photon sharing not only binds quarks but also creates the extra processing needed to stabilize the free axis of the first quark.

This link only completes one quark but the second quark can also complete its free axis by linking to a third quark that can also complete by linking back to the first. Figure 4.13 shows how the triangular structure of quarks lets them share photons in a triangle so that all become stable. The result is a proton or neutron depending on the quark mix, just as current physics asserts, but now what binds the quarks isn’t magical particles from nowhere but photon sharing between quarks.

What then are the gluon “color charges”? That each quark needs a different axis status to link in a triangle suggests that the standard model’s red, blue and green “charges” are quark orientations. A quark as an inert particle might need an agent to change its axis orientation but quarks as dynamic processing swap axes naturally, as every cycle is a new event. Every cycle, photons compete for channels by each trying to occupy any channel they can. If it fails because another got there first, it just tries elsewhere. 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.

An analogy might illustrate how quantum processing fills channels. Imagine a stack of wine glasses upon which water is falling. When the water fills one wine glass, the remaining water just flows from it to the next, until every glass is full. Hence 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 system restarts, i.e. all the glasses empty and another water pouring cycle begins. In the same way, the quantum processing of a quark fills all the channels of a node plane to trigger a restart that repeats the cycle.

This approach reflects the earlier conclusion that the quantum world tries every option until a stable result occurs, which here means that all the channels of an axis complete. To see matter as an inert thing that must be pushed to change is like thinking a running video has to be “pushed” when actually the processing does that. Likewise, what “pushes” the world to change is quantum processing not invisible particles.

Table 4.4. Quarks give protons and neutrons

<table>
<thead>
<tr>
<th></th>
<th>Quark 1</th>
<th>Quark 2</th>
<th>Quark 3</th>
<th>Charge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proton</td>
<td>Up (\pm\frac{2}{3})</td>
<td>Up (\pm\frac{2}{3})</td>
<td>Down (-\frac{1}{3})</td>
<td>+1</td>
</tr>
<tr>
<td>Neutron</td>
<td>Up (\pm\frac{2}{3})</td>
<td>Down (-\frac{1}{3})</td>
<td>Down (-\frac{1}{3})</td>
<td>0</td>
</tr>
</tbody>
</table>

Figure 4.13. Proton and neutron quark structures
In quantum realism, an electron becomes stable by completing the channels of one axis and three quarks do the same for two axes by sharing photons in a triangle. Protons and neutrons evolved because they filled the channels of two dimensions not because invisible agents forced them together. The strong force arises because quarks have a processing excess while electromagnetism arises because electrons have a processing deficit.

4.4.6 The weak force

Physics then discovered that while a neutron is stable in a nucleus, 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.

Since neither strong nor electromagnetic forces act like this, 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.

Yet by now, virtual agents were the norm and given the equations worked, it was accepted practice to “prove” they existed by finding matching accelerator collision resonances. So when in 1983 CERN found million, million, million, millionth of a second values 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.

Now suppose a murder case witness said “I have observed the knife that killed the victim” but on cross-examination revealed that he made a knife of the same size in his knife shop! No court in the land would accept that evidence so why does physics call the same thing “proof”? CERN observed the energy spikes that it created not bosons carrying any force! Since no evidence whatsoever links the CERN signal to the weak effect, 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. Even so, physics now accepts that neutrons decay when a 4.8 MEv down quark “emits” a W boson of mass 80,400 MEV! No-one questions how such a tiny particle could ever emit such a massive particle.

Even worse, the equations testify that a neutron can decay in any of three ways, as it could:

1. Emit a W+ that decays into an electron and anti-neutrino (Figure 4.14a), OR
2. Emit a W+ boson that is hit by a neutrino to give an electron (Figure 4.14b), OR
3. Interact with a neutrino and a W+ boson to give an electron (Figure 4.14c). 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 equations were also reversible, leading to a fruitless thirty-year search for proton decay. Currently, the massive Kamioka experiment estimates the free proton half-life is over a billion, billion, billion years, so protons definitely don’t decay as the standard model predicts.

The reverse engineered quark structure given earlier suggests a simpler alternative. If a down quark is a head-head-tail photon mix and an up quark is head-tail-tail set, a neutron becomes a proton when a set of photon heads become tails. As Figure 4.15 shows for one channel, if a neutrino hits a quark head directly the processing can rearrange to turn quark heads into tails. A neutrino hitting a neutron just right can turn it into a proton as the beta decay equation implies³. Conversely 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 hence proton decay occurs only in the hearts of stars. The effect described 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, i.e. all matter.

Quantum realism concludes that the weak effect is due to neutrinos that are all around us. It predicts that a neutron in a neutrino-free space won’t decay. Hence weak bosons, like fairies at the bottom of the garden, are made-up agents.

4.4.7 The God particle

That massive particles pop out of empty space created a problem for the standard model. The W boson mass had to come from somewhere so the answer was of course another field! The Higgs particle proposed was needed to sustain the particle business, so the search for the Higgs became the holy grail of physics, attracting over 30 billion dollars in funding. Then in 2012, after a fifty-year search, CERN found a resonance in the right range⁴ and physicists all over the world breathed a sigh of relief, calling it the “God particle”, perhaps because it answered their prayers. Finding a 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

   So the Higgs isn’t about mass creation at all but about sustaining the standard model of particles.

2. Is medieval circular logic. If a massive 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. Science debunked this by showing that water comes from hydrogen and oxygen gases that aren’t watery at all. Instead of the circular logic that mass creates mass, in quantum realism mass comes from the energy of photons.

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 known point particles with mass are spin-half particles and only matter-antimatter mixes like mesons have spin zero. Since not-yet-found higher order mesons have zero-spin, are in that mass range and have the same photon decay and detection frequency, “The Higgs” is more likely a top or anti-top meson.

³ In beta decay, a neutrino hitting a neutron can turn it into a proton by the equation N + ν → P⁺ + e⁻. Equally an electron can turn a proton into a neutron by inverse beta decay P⁺ + e⁻ → N + ν. 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.
In essence, the Higgs is a medieval circular logic that explains at best 4% of the mass of the universe in a way that is impossible according to quantum theory. 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.

The Higgs is the culmination of the belief that inert particles can only be pushed around by other particles. To sustain this vision, physics had to invent virtual particles that don't exist in any normal sense. The grand irony of it all is that physical realism today is now justified by a multitude of unreal virtual agents! For example, consider what it implies about the matter around us:

“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)

It is true that nearly all an atom’s mass comes from the protons and neutrons in its nucleus and most of their mass comes not from quarks but the virtual gluons binding them. It follows that, according to current physics, nearly all the mass we see around us comes from massless virtual particles!

Actually, the Higgs is an imaginary agent created to explain another imaginary agent created to explain an observed effect, namely neutron decay. When a theory uses one invisible thing to explain another it becomes a theoretical house of cards. It is telling that years after apparently finding the “god particle”, it hasn’t led to a single other discovery or benefit.

### 4.4.8 Mass and energy

It originally seemed that light had the property of energy but no rest mass and matter had the property of mass but no rest energy, until Einstein concluded that light had a 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 but this was later changed to be called *gravitational mass*. Newton’s discovery that a mass needed a force to accelerate it led to the different definition of *inertial mass*. They are different because a weightless object in space still needs a force to move it, i.e. it has inertial mass even though 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 definition upgrade as a photon with no rest mass was said to gain relativistic mass as it moves to give it momentum.

**Light** was originally seen as pure energy, where Planck’s relation \( E = hf \) defined the energy \( E \) of a photon as its frequency \( f \) multiplied by Planck’s constant \( h \). The last chapter interpreted this relation in processing terms. If a photon is one quantum process spread out, its energy was the *processing transfer rate* at the node. Since the throughput per node reduces as more nodes share the process, a photon’s energy decreases as wavelength increases. Conversely as wavelength decreases, fewer nodes running the same process each get a bigger share so photon energy increases with frequency. If matter is made of photons running at the highest possible frequency, it follows that the inherent energy of matter relates to the energy of those photons.

_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?_

In quantum realism, an electron is many photons repeatedly colliding in many node channels. 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. Quantum realism thus derives Einstein’s equation from the conclusion that matter is light condensed.

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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 \( \lambda \) the wavelength. In an electron \( \lambda \) 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. \( h_P = m_P L_P L_P c/T_P \). Substituting gives \( E_P = m_P L_P c/T_P \).
4.4.9 A summary

In current physics, the fundamental entities of the standard model are described in terms of mass, charge and energy, where energy relates directly to mass.

Quantum realism describes the basic entities of physics in terms of quantum processing. Quantum realism describes the basic entities of physics in terms of quantum processing. Mass is the net processing that repeats endlessly when a node “hangs” the quantum network, charge is the net 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 transfer and a zero 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 defines its energy, and no processing left over means it has no charge.

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

4. **Neutrino.** A neutrino’s axis channels are filled with positive and negative instructions that nearly cancel 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 electrons, neutrinos and quarks are derived by reversing the processing. The net processing demand is the same giving the same mass but an opposite remainder gives an opposite charge.

Quantum realism represents the mass, charge and energy of the basic entities of physics in processing terms.

### 4.5. FIELDS UPON FIELDS

Following Newton’s idea that only particles affect other particles, physics spent most of last century trying to prove that particles cause all the forces in nature. The aim was to explain forces like magnetism and charge that act at a distance with no actual particles in sight. They succeeded in inventing a world where unseen virtual particles vastly outnumber real particles.

\[ E = m_c^2. \]

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.
4.5.1 The many fields problem

Currently, light is seen as a vibration of the electromagnetic field, 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

Fields are common in physics today, e.g. the earth holds the moon in orbit by a gravitational field that exerts a force at every point in space, an electric field sets values at every point in space, and so on for other fields. Emboldened by the success of Faraday’s fields, physics began to invent fields that added what mathematics calls degrees of freedom to space.

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. Gravity required one-dimension, electromagnetism two, the strong force three and the weak force two. These eight extra dimensions plus the three of space are why string theory needs eleven dimensions to work.

Yet the mathematics soon gets out of control because all these dimensions interact. Indeed, the main “discovery” of string theory’s attempt to explain the fields of physics mathematically was that it gives an almost unlimited number of possible architectures, over $10^{500}$ at least. This is why string theory doesn’t predict anything, so few scientists today see it as a fruitful approach. That a universe of eleven dimensions somehow collapsed into ours is a far-fetched idea akin to the multiverse story.

The alternative is some sort of field unification that reduces all the fields of physics to one. This is said to be a primary goal of physics today but the standard model only offers more fields not less, as its only answer to an unexplained effect is a new field. Quantum realism proposes that one field, the quantum field, generates all the effects we see.

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. The standard model seems to have done something similar last century. It began when Faraday proposed that an invisible field around an electric charge caused it to attract and repel other charges at a distance. This was considered fanciful until equations defined the electromagnetic field but today, fields explain every force in physics. Yet 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 derived his equations by imagining ball-bearings twisting in vortex tubes but attempts to develop his 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, this worked nicely.

The standard model was born when Maxwell’s equations were interpreted as virtual photon effects made by Faraday’s invisible field. Yet these virtual photons, unlike real photons, couldn’t be independently verified because they come into existence, cause an effect and then are instantly consumed by the act. Agents that can’t be verified contradict science but physicists could see them in the equations. This scientific flaw seemed a small price to pay to carry on calculating, but the pseudo-science temperature had just gone up a notch.

Since a photon is a boson, field theory generalized that all fields act via boson agents. Hence gravitational fields had to work via virtual particles called gravitons that to this day have no real-world equivalent. There is no evidence at all that any such particle has ever existed yet they are accepted by the fallacy that to name a cause is to offer an explanation. To suppose a thing exists just because a theory says so contradicts science, so again the pseudoscience temperature rose as scientific rigor fell.

Then field theory turned to the strong force that binds protons and neutrons in the nucleus. In this next step, massless, charge-less virtual photons were joined by virtual gluons with color charge, so fields could now create charge. Soon after the weak force was attributed to a weak field that generated weak bosons with both charge and mass. Things were heating up so it was essential to show that this virtual particle at least existed. When a match was found among billions of particle accelerator events it was declared “proven”, ignoring established scientific methods for establishing causality.
Finally, to allow virtual particles with mass it was necessary to invent another field 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 this belief until now virtual particles pop in and out of space to cause every effect. They are said to be everywhere making everything happen despite no scientific evidence they cause anything all. Despite being lawful, they are magical, because an invisible field creates them and their 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 go back. Each new field invention has weakened physics scientifically until, like the frog in the pan of water heating up, it is now in danger of dying as a science.

### 4.5.3 Virtual particles aren’t necessary

Suppose one could see a computer output but had no access the hardware and software that created it. If one saw that every change occurred in bit amounts, would one assume that virtual “bit particles” created them? A better conclusion is that the bit is the basic unit of processing. When physics deduced virtual photons, all it really knew was that photons exist and electromagnetism changes in photon amounts. Following Newton, it concluded that virtual photons were the cause.

Quantum realism sees the same facts differently. Electromagnetic effects occur in photon units because the photon is the basic network operation, so all changes inevitably look like photon effects. The quantum network changes in photon units for the same reason that computer outputs change in bit units. The link between photons and electromagnetism is correlation not causation, and confusing the two is the oldest error in science. Quantum processing that tries every option doesn’t need agents to push it, e.g. an electron can fall to a lower energy orbit without an “orbit boson” to make it so. The forces that physics attributes to particles are the natural results of quantum processing as follows:

1. *Electromagnetism.* Where the standard model sees virtual photons quantum realism sees a network re-allocating its basic operation. No virtual photons are needed to explain electromagnetism.

2. *The strong effect.* The standard model needed a new field, three new charges and eight gluons to bind quarks in a nucleus but 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.

3. *The weak effect.* The standard model needed another field, three more bosons and two new charges to explain neutron decay but still couldn’t explain why photons don’t decay. In quantum realism, neutron decay is a neutrino effect and the reverse is an electron effect that only occurs in stars so protons are stable in empty space. Weak bosons are again unnecessary and thus imaginary agents.

4. *The Higgs.* If weak bosons don’t exist, the Higgs boson isn’t needed at all. CERN just added yet another species to its already overflowing menagerie of pointless “particles” that played no role whatsoever in the evolution of matter.

5. *Gravity.* Gravity was the first field and every attempt to find gravitons has failed but standard model iconographies still display it as if it were proven (Figure 4.17). In quantum realism, particles will never explain gravity as what is in a space-time canvas can’t alter space and time as gravity does. Chapter 5 attributes gravity to the grid processing gradient.

What rules apply in this brave new world of virtual particles? The standard model lets the Higgs interact with weak bosons to give them mass but how do the other bosons interact? A quark is subject to electromagnetic, strong, weak, Higgs and gravity forces, so if a virtual photon, gluon, weak boson, Higgs and graviton appear at the same time, what

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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.
happens? To say that virtual bosons only interact to make our equations work is quite unsatisfactory. And as matter bosons need anti-matter versions, what happens when a Higgs meets an anti-Higgs?

The standard model invents virtual particles for effects that quantum realism derives from a core quantum process. Why invent a multitude of virtual particles to explain what a single quantum process can? Quantum realism concludes that virtual particles are unnecessary because quantum processing can explain their effects.

### 4.5.4 The standard model grows

Occam’s razor, **not to multiply causes unnecessarily**, is the pruning hook of science but the standard model ignores it. Last century physical realism was a simple theory of mass, charge and spin but today it needs isospin, hypercharge, color, chirality, flavor and other esoteric features to work. The standard model needs sixty-two core particles, five invisible fields, sixteen charges and fourteen bosons to work (Table 4.6). It has so many ad-hoc parameters that if it were 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 because of its simplicity.

For this complexity one might expect **completeness** but the standard model doesn’t explain gravity, proton stability, the absence of anti-matter, quark charges, neutrino mass, neutrino spin, family generations, quantum randomness or why inflation occurred. Nor does it explain dark energy or dark matter, i.e. **most of the universe**. And with each new discovery it grows, so inflation needs a hypothetical symmetron field 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 grows on the data around it, as when it meets new facts it expands itself.

### 4.5.5 A particle toolbox

The standard model is less a theory than a particle toolbox that can be tailored to accommodate results after the fact. 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?” then the standard model made them bosons that carried no force! When new facts arrive, the standard model accommodates them in an existing structure or builds a new wing.

It is hard to fault a model that absorbs knowledge rather than generates it, e.g. 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 does that our universe is only matter constitute 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 in that 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”. All this is in the name of mere equations.

The standard model’s claim to fame is that it **accurately** calculates results to many decimal places but in science, **accuracy doesn’t define a theory's validity**. An equation that accurately **interpolates** between a known set of data points is

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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.
not a theory that can extrapolate to new points. This is why an equation is not a theory but today, generations of physicists fed on equations not science (Kuhn, 1970) think that equations are theory. Yet as Georgi says:

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

Theories are expected to predict new situations not just accurately calculate known situations. If a theory construct isn't valid, i.e. represent what it is supposed to, 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 to exist at all.

When it comes to prediction, the standard model’s validity is dubious, e.g. it claims it predicted top and charm quarks before they were found but after finding three generations of leptons and two of quarks, “predicting” a third quark generation is like predicting the last move in a tic-tac-toe game. It also claims to have predicted gluons, W bosons and the Higgs but inventing magical 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 reflects the data we know, it doesn’t generate knowledge. Hence 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 valid theories can. The last time such a barren and invalid model dominated thought so completely was before Newton.

4.5.6 The last “standard model”

In the second century, Ptolemy’s Almagest let people 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 to make it more complex and themselves more expert. This ancient standard model only fell when Copernicus, Kepler, Galileo and Newton developed a causal model to replace it. The standard model of physics and the Ptolemaic standard model have a lot in common as both are:

1. Descriptive. Descriptive models describe what is by identifying patterns, ideally in the form of equations, but this is the first step of science not the last. Only causal models truly predict.

2. Parameterized. Ptolemy’s model let experts choose the free parameters of epicycle, eccentric and equant to fit the facts just as 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 each new star was found just as today’s standard model bolts on a new field after each 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 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 seen as 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 calculations mostly work 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 just call it a mathematical fiction, rather than a reality description. Today, physicists volunteer the same about quantum theory but what quantum theory describes really does happen, 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), so the standard model is a descriptive model that should have evolved into a causal theory but didn’t. The reason it didn’t is that physics denies the existence of what quantum theory describes, for as Bohr said:

“There is no quantum world. There is only an abstract quantum mechanical description.” Newton, p244
This view led him to deny the need for meaning at Copenhagen, led Everett fantasize about many worlds (Everett, 1957) and led Witten to try to go it alone with mathematics in string theory, none of which led anywhere. This one choice, to deny meaning and just calculate equations, arrested the scientific growth of physics, which abandoned science when it abandoned meaningful causes. The only option left was to invent magical particles that pop out of empty space to cause what the equations describe, and this is the standard model. The standard model is a naive descriptive paradigm ruled by acausal equations that are leading nowhere. In the history of physics, it is essentially a scientific dead end.

### 4.5.7 The current particle model

Matter as a substance implies that it can be broken down into fundamental particles and battering matter into bits seemed the best way to do that. So physics spent most of last century and billions of dollars smashing matter apart to find what it called fundamental particles, defined as those that 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, displaying a particle but giving a wave equation, is now routine in physics. 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

It seems that physicists with particle accelerators see everything as a particle, just as a boy with a hammer sees everything as a nail. But the “fundamental particles” that physics found turned out to be:

1. **Ephemeral.** A lightning bolt is long-lived compared to most of the particles in physics today, e.g. a tau is a million, million, millionth of a second energy spike. Since we don’t call a lightning bolt a particle, why does physics 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 can’t be fundamental because classifying requires common properties that imply that something else is more fundamental. “Fundamental” in physics just means a point entity that can’t be further smashed apart.

3. **Massive.** A top quark has the mass of 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 one “building block” 75,000 times bigger than another? Not surprisingly, this “fundamental block” plays no part whatsoever in the function of the universe we see.

4. **Unstable.** If a top quark is “fundamental”, why does it immediately decay into other particles? Equally, when a neutron emits an electron to become a proton, three fundamental particles become four! This is a strange use of the word “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 substantive particles should last longer than that. A brief eddy in a stream isn’t called a particle, so why does physics call a brief quantum eddy a particle? *Quantum realism concludes that the fundamental particles of the standard model are neither fundamental nor particles.* In this view, what current physics calls particles are actually quantum reboot events.

Figure 4.18 summarizes the current particle model. It shows a set of "fundamental" matter particles that are classified plus virtual bosons that come from nowhere to make things happen. Light is clearly a wave but a photon with no mass is still called a particle for convenience. This, we are told, is the end of the story simply because particle accelerators can’t break things down any further.
Meanwhile, the fundamental particles of matter are said to have no size at all despite their "substance". The conundrum that matter takes up space, and particles with no extent can't add up to do that, is said to be resolved because virtual particles from invisible fields keep them apart. It is a wonderfully circular argument.

This model is accepted because physicists are conditioned not to look behind the curtain of physical reality. One is reminded of the wizard of Oz telling Dorothy: “Pay no attention to that man behind the curtain”, to distract her from what is really orchestrating events. The wizards we call physicists ask us to pay no attention to the quantum waves that quantum theory tells us are creating physical reality. Quantum realism is an attempt to look behind the curtain.

4.5.8 A quantum wave model

Figure 4.19 is the quantum wave alternative proposed here. It is simpler because it doesn't need bosons to push particles around since quantum waves act like an ever-flowing river that actively finds a stable state. Quantum waves spread at the speed of light to act at a distance, so virtual particles aren't necessary. While the lines in Figure 4.18 are similarities between supposed fundamentals, the lines in Figure 4.19 signify a dynamic evolution.

Quantum realism begins with a basic quantum process that generates the first entity, a photon, as a quantum wave. Light then goes on to form the leptons and quarks that go on to form the atoms that in time formed us. In this physical evolution, the entire physical universe “booted-up” from a single photon rather than being “made” from a matter Lego-set. It is a vision of something alive that grows rather than inert particles pushed around by magical forces.

The quantum network defines the smallest unit of space, so there is no need for virtual particles to keep dimensionless points of matter apart. It also explains why the speed of light is a maximum, as the maximum transfer rate of a network is one node per cycle. If matter is a standing quantum wave, electrons and neutrinos are brother leptons because they are phase versions of the same quantum collision, as are up and down quarks. Matter is now an evolution not a given.

The standard model tries to reduce complexity to a matter Lego-set but ultimately it fails. A quantum wave model evolves complexity from quantum simplicity. The Mandelbrot set illustrates how dynamic simplicity gives complexity, as one line of complex code repeated gives rise to endless forms (Figure 4.20). The Mandelbrot set is endlessly complex not because was "built" from many components but because it is an endlessly dynamic interaction.

Quantum realism derives the complexity of the physical world from quantum simplicity.

4.5.9 Testing quantum realism

According to the standard model, matter collides by a basic substantiality that light does not have, so:

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

In contrast, quantum realism predicts that extreme light in empty space will collide to form matter. Lest this seem fanciful note 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, why can’t high energy photons 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 light alone can collide in a vacuum to give matter is a testable prediction but no experiment has yet unequivocally confirmed it. When beams of pure light collide in pure space to create matter, the boson-fermion distinction will fall and with it the standard model. Quantum realism predicts that matter evolved from light, so the future of physics lies in colliding light not matter. The standard model expects the short-lived energy flashes of its accelerators to unlock the secrets of the universe but it isn’t happening, and quantum realism says that it never will. If matter evolved, billion-dollar accelerators are just discovering evolutionary dead-ends, as in evolution, what doesn’t survive doesn’t matter. Particle models assume that matter came first but in quantum realism, light was the first existence.

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 other life forms over millions of years. Particle models implicitly assume that matter always was but cosmology suggests that the atoms of the periodic table also evolved in a process called **nucleosynthesis.** This building-up of complex atoms from simple ones occurs in stars and supernovae and is ongoing today. Without this **grand evolution** of matter, the periodic table of elements (Figure 4.21) would not exist and neither would we. This section suggests that the evolution of matter is the **evolution of stability.**

![The Periodic Table](image-url)
4.6.1 Nuclear evolution

In the periodic table, a Hydrogen nucleus has one proton and a Helium nucleus has two protons but in addition, it also has two neutrons and no-one knows why. Higher elements have even more neutrons but what they do is a mystery: “… 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) until in Uranium, proton repulsion breaks apart the nucleus in nuclear radiation. There is currently no theory that explains the neutron’s role in keeping the nucleus stable. The shell model used to explain electrons doesn’t work because some nuclei aren’t spherical. The standard model doesn’t help because if neutrons are holding the protons together, why have neutrons? And how do the gluons know how many neutrons are needed to stabilize a heavy nucleus?

The quark structure described earlier sheds light on the issue as it describes protons and neutrons as quarks linking in a closed triangle. It follows that such triangles can open up and recombine in longer quark strings if the same rules are satisfied: namely a closed shape with the internal angles of an equilateral triangle.

In this view, a Helium nucleus is not two protons and two neutrons sitting separately together, like fruit in a bowl. It is the quarks of two protons and two neutrons linking by photon sharing to form a single string that closes back on itself.

So it is quite incorrect to envisage a Helium nucleus as separate proton and neutron particles sitting side-by-side with gluons somehow forcing the protons together. Instead, the Helium nucleus is a single quark string held together by photon sharing, just as protons and neutrons are. Higher nuclei are then bound just as protons are, by photon sharing. The only restriction is that each link must bend the string 60° which requires quarks to rotate to make a connection.

That this configuration arises dynamically then explains why neutrons are needed. Since photon sharing needs direct proximity, a proton is unlikely to come that close to another proton because they repel so neutrons are needed to link to the protons. When forming a quark string, neutrons act as string buffers in between same-charge protons that repel when side-by-side. This requires at least as many neutrons as protons, as observed. Hence Helium with a two-proton string ideally needs two neutrons to act as buffers between the two protons in a string.

Folded 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 folded quark strings, those with a “magic” number of nucleons will be 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 the role neutrons play in their creation. In quantum realism, nuclei are single 3D shapes that fold in space as proteins do.

4.6.2 Particles can’t “orbit” an atom

In current physics, an electron is a particle in space but 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” exists because it lets physics choose one set of equations for electrons in orbit and another for electrons in space. No-one asks “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 when they have different quantum numbers. The shell model lets electrons co-exist in “orbits” by quantum numbers that aren’t based on or even compatible with any other physical laws. Since quantum numbers were made up after the fact, it is a classic case of “backward logic”.
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. How 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 matter in an atom? Current theory handles this by inventing a cloud of virtual photons to shield electrons from the nuclear attraction and other electrons.

In quantum realism, an electron is one-dimensional matter, that is matter-like on one dimension but light-like on the other two. In three-dimensional space, the matter dimension makes the electron slower than light on average but on a two-dimensional surface around an atom it can be entirely light, i.e. entirely wave. A particle circling a center needs an agent to stop it falling in but wave can pulse forever if the circumference matches its wavelength. It can’t spiral in because its wavelength sets a minimum orbit circumference and waves of different harmonics can accommodate many waves that 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 while electrons move slower than light in three-dimensional space they pulsate in atoms at the speed of light.

4.6.3 The evolution of electron shells

Every element in the periodic table has different number of electrons organized in shells. Each shell can hold a certain number of electrons and when the outer shell fills the result is an inert element like Neon. Each periodic table row ends in an inert element that doesn’t chemically react because it doesn’t exchange electrons. In contrast, other 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. Atoms form stable molecules when those with extra electrons donate them to those with deficits giving chemical bonds that complete the shells of both parties.

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

1. Shell n (1, 2, 3 …). Was initially the orbit radius.
2. Sub-shell I (s, p, d …). Has no clear meaning.

The s, p and d sub-shells were deduced from spectroscopic data analysis to contain 2, 6 and 10 electrons. Electrons then fill shells and sub-shells according to quantum numbers. In the initial model, inner orbits with fewer electrons filled before outer orbits and so the periodic table grew. Doubling the first orbit of two electrons quadrupled the orbit area to allow eight electrons, tripling allowed eighteen, quadrupling it thirty-two and so on. Hence the first row of the periodic table has two elements, Hydrogen and Helium and the second row has the eight elements Lithium-Neon.

This worked nicely but 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. As Table 4.7 shows, the initial model predicted periodic table rows of 2, 8, 18, 32, 50 and 72 but instead the rows were 2, 8, 18, 18, 32 and 32. So in the by now well-established practice, theory was fitted to fact by tweaking the quantum numbers so the sub-shells occur in this odd order:

Table 4.7. Particle shell and sub-shell predictions

<table>
<thead>
<tr>
<th>Shell</th>
<th>Sub-shell</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n s p d f g h</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>1s=2</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>2s=2 2p=6</td>
<td>8</td>
</tr>
<tr>
<td>3</td>
<td>3s=2 3p=6 3d=10</td>
<td>18</td>
</tr>
<tr>
<td>4</td>
<td>4s=2 4p=6 4d=10 4f=14</td>
<td>32</td>
</tr>
<tr>
<td>5</td>
<td>5s=2 5p=6 5d=10 5f=14 5g=18</td>
<td>50</td>
</tr>
<tr>
<td>6</td>
<td>6s=2 6p=6 6d=10 6f=14 6g=18 6h=22</td>
<td>72</td>
</tr>
</tbody>
</table>

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. The third shell “fills” with one of its sub-shells empty, 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 describing electrons by quantum numbers we invent, electrons as quantum waves expects these properties:

1. **Shell.** A sphere circumference around the atom nucleus that fits the electron as a quantum wave.
2. **Sub-shell.** A higher wave frequency that the shell circumference allows.
3. **Direction.** The electron wave direction, where quantum waves at right angles don’t interfere.

If an electron is extreme photons entangled in a collision on one axis, its other axes will also have entangled photons. If these are also extreme photons, they will be up one cycle and down the next so the minimum shell circumference is half this wavelength. This **fundamental harmonic** is currently called the s subshell.

The next shell will have a circumference double that of the first shell. This allows not only another fundamental but also a second harmonic that is twice the frequency. This **second harmonic** is currently called the d sub-shell. Figure 4.23 shows how a given shell circumference can accommodate different harmonics to represent different sub-shells. The number of waves that can concurrently occupy each harmonic is given on the right-hand column.

The periodic table can now be explained in terms of electron waves as follows:

1. **The first shell** has a half wavelength circumference so a bipolar wave can go up and down on alternate cycles (Figure 4.23a) as the first harmonic of the first shell or Is sub-shell. This shell can accommodate two waves at right angle directions so the first shell completes with two electrons. This gives the first row of the periodic as Hydrogen plus the inert gas Helium.

2. **The second shell** has a one wavelength circumference compared to the first and the first harmonic again alternates up and down at this length 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 **extra 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 total is thus 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 the same wavelength but it can’t do more on a string one and a half times that as 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. A harmonic wave model has no 3d sub-shell.

4. **The fourth shell** has a two-wavelength circumference compared to 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. This 4d sub-shell plus the 4s and 4p sub-shells gives the eighteen elements of the periodic table fourth row.

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.

6. **The sixth shell** allows a new harmonic with six electrons per axis (Figure 4.23d), which doubled again 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\(^9\) and the seventh orbit also has 32 elements.

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9 If the first shell has circumference \(C\), the sixth shell has circumference \(6C\), with subshell harmonic wavelengths: 6s (\(\lambda=12C\)), 6p (\(\lambda=6C\)), 6d (\(\lambda=3C\)) and 6f (\(\lambda=1C\)).
An electron wave model 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 following 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 mass so larger orbits require more processing, i.e. more energy. Shells 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 whose behavior is better described by wave harmonics than abstract quantum numbers.*

### 4.7. OTHER MATTERS

Looking around the earth, Aristotle saw a world of mainly matter, but looking around the cosmos today, scientists see mainly space and light, and the matter we see is about 4% of the universe. In quantum realism, matter is a distant third in the scheme of things hence this book addressed space, light and matter in that order. This approach suggests answers to questions about matter that have puzzled physics for some time.

#### 4.7.1 Why do electrons “half spin”?

In current physics, an electron is a dimensionless point. Since a point of no extent can't physically spin, physics has given up trying to understand quantum spin in general, let alone how matter half-spins:

*“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 quantum realism, a photon is a quantum wave that vibrates into a quantum dimension orthogonal to its polarization plane, so it has a structure that really does spin\(^\text{10}\). As earlier concluded, quantum space adds three new quantum directions to every point, all at right angles to each other\(^\text{11}\) as well as our space (see 3.7.2).

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\(^\text{10}\) For a photon moving in direction X, its quantum amplitude Q vibrates in plane QX. The structure QX can then spin.

\(^\text{11}\) 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 Q1X, Q2Y, Q3Z, where Q1, Q2 and Q3 are at right angles.
A photon is a two-dimensional structure in quantum space that, like a paper sheet, is invisible when viewed edge-on. So horizontal filters stop horizontal but not vertically polarized light because photons polarized at right angles occupy different spaces that don’t exist to each other.

An electron is photons filling the channels of one axis so for any line of view, only half of their quantum amplitudes are visible. 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.

This also explains another interesting property of electrons. Turning an object 360 degrees in our space returns its original state but turning an electron 360 degrees only half-turns it — it takes 720 degrees of turning 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. It must always be remembered that we are 3D Flatlanders in a four-dimensional quantum reality (Abbott, 1884).

### 4.7.2 Neutrino asymmetry

If the laws of physics varied with position, each new location would need new rules. That in our world, view direction changes the values but not the equations gives a spatial symmetry that 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 direction and if you point your right thumb forward, the fingers curl in a right-handed spin direction. 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 neutrons are left-handed and all anti-neutrinos are right-handed (Figure 4.24). So while electrons spin either way, a neutrino reversing direction still spins left and an anti-neutrino still spins right when it reverses.

The standard model can’t explain how a fundamental particle can spin the same way when it reverses direction, as when a neutrino changes spin it becomes an anti-neutrino that it isn’t the same as its mirror image, contradicting spatial symmetry.

The photon structures of quantum realism suggest an answer. When the first photon chose to move up or down on space to make matter or anti-matter, it also had to choose left or right spin and apparently it went left. The electron’s entangled photon sets 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.

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 universe of matter. A 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. When quarks combine, their charges just add but for some reason their masses don’t:

“... 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.

Current physics attributes the extra mass to the virtual particles binding quarks but how do massless gluons make mass? And why don’t they multiply charge as well? The standard model has no answer because it just describes what is.

In quantum realism, charge as left-over processing is limited to one quantum process per channel so charges simply add and can never be more than plus one or less than minus one. Why then isn’t the net processing done, or mass, limited in the same way? The answer now suggested is that the dynamic action of processing interferes.

Interference occurs in networks 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, as at motorway on-ramps, because the cars have to negotiate who goes first. And such slowdowns can have run-on effects to cause traffic jams that extend for miles so the effect of interference is not linear.

The same thing happens on a computer network, as when processing “collides” it must stop and try again, just as cars do at an uncontrolled intersection. This wastes time, so interference slows down computer networks just as it slows down traffic networks and again the effect is not linear but can cumulate. Computer networks initially tried central controls like the traffic lights we have on road networks but this was found to be inefficient. A better solution was distributed protocols like Ethernet that let any process access a network resource when it wants to but if a collision is detected both stop and retry after a random time interval (to avoid a repeat collision). A computer network under load slows down for the same reason that a traffic network slows down at rush hour, because many entities are seeking access to the same resources.

In quantum realism, the quantum network is essentially a first-come-first-served system with no central control. So interference will occur when photons compete for the same channels and some have to try again elsewhere. This wastes processing and in this model, processing is mass.

The mass increase expected can be estimated by the number of channel overlaps, where photons compete for channels. For example, an electron has two photon streams intersecting but a quark has three photon streams intersecting. Since this gives more overlapping channels, interference causes a quark to have more than 50% of an electron’s mass. Each quantum cycle, every entangled photon has to find a channel and every case of interference 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 and so more mass. Mass as processing explains the “creation of mass” without recourse to magical gluons.

Interference also suggests why down quarks are heavier than up quarks. If an up quark is two photon tail sets colliding with one set of photon heads (Table 4.3), the tails access channels first leaving one set of heads to fill the remaining channels. In a down quark, one tail set gets first access, leaving two sets of photon heads to fight over the rest, giving more interference and more mass. The masses the standard model allocates could be derived from simulations that model the quantum processing that creates them.

4.7.4 Charge neutrality

The standard model seems to assume that matter began like Venus from the sea, complete and perfect, with charge just an accessory. Our galaxy is largely 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 the big bang dole out equal amounts of it? The current answer, that the universe is charge neutral because it was made “just so” is unsatisfactory.

In quantum realism, matter evolved just as life on earth did. Quantum events repeat at a fantastic rate, so anything not 100% stable reconfigures sooner or later. Every option is tried until one “sticks”, i.e. doesn’t change. This is how electrons, neutrinos and quarks survived the initial chaos and the first atom occurred because a proton plus an electron survive better together than apart. Every periodic table atom has the same number of protons and electrons for the same reason, that they survive better together than apart. Hence the universe is charge neutral because atoms are a stable
evolution of matter and they are charge-neutral. 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, e.g. 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 quark older brothers and top and bottom eldest brothers 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 three generations then no more?
3. Why are higher generations so heavy?

In this model, the three family generations reflect the three dimensions of space. 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 can occur in a space of three dimensions. Each is heavier than before because overlapping channels interfere to increase the processing that is mass. Taons are so heavy because interference cumulates, just as one traffic delay can cause another.

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.

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 more mass again by interference. The mysterious generations of matter arise from the dimensions of space, and their large masses from quantum processing interference.

### 4.7.6 Dark matter

Dark matter was discovered in the 1950s after astronomers found that our galaxy rotated as if it had more matter than its visible stars, 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, scientists infer that dark matter exists as a halo around the supermassive black holes at the center of almost every galaxy, including ours.

Dark matter 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, 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 no one knows what it is. Without it, the matter-producing factories we call stars would not have the stability needed to create the elements of the periodic table.

The existence of dark matter, deduced from its effects, created a problem for the standard model which sees all matter as particles. It had to propose weakly interacting massive particles, or WIMPs, initiating another costly wild-goose chase despite talk of super-WIMPs (Feng, Rajaraman, & Takayama, 2003). WIMPs have now joined gravitons, proton decay and squarks as fruitless predictions of the standard model. That no particle exists to explain 85% of our galaxy's mass is a significant standard model failure.
In a processing model, mass arises when net processing sustains over time. Any particle mass would have been seen by now so how else could net processing be sustained in a halo? One option is light trapped in “orbit” around the black hole at the center of most galaxies. This halo is possible, for if light is too close to a black hole it is pulled in and if light is too far away it escapes, but at a certain radius light will repeatedly circle in a very large loop (Figure 4.26).

Some light then rotates in vast but finite loop from which it can’t escape. Over time this would build-up to a stream of circling light as more photons are added than leave. This stream would not be visible as light cannot be seen from the side.

Recall that in the pass-it-on protocol, nodes are interrupt driven so each cycle they first pass on current processing then receive any input to process, so if any node gets more processing than it can handle, it immediately passes it on. This allows the possibility of an infinite pass-it-on repeat but as argued earlier, any such repeat would be sooner or later absorbed by a node of new space. However, 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 matter.

A dense enough stream of light constantly circling around a black hole will generate overloads. If they build up to be more than new space can absorb, they will pass-on permanent interrupts of excess processing. It follows that dark matter is created by light like ordinary matter, but it isn’t a "particle" confined to a node but rather 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 both net processing that repeats but while ordinary matter is a stand-alone repeat, dark matter is a repeat that builds up due to a massive black hole. It isn’t seen because photons don’t collide with it but either pass through at right angles or join the stream. Matter generated in this way doesn’t collide with itself because it doesn’t have a particle structure. Particles as excess processing confined to a node collide with each other but dark matter as processing interrupts passed on in a loop halo don’t collide. Hence when galaxies collide, the dark matter stays with the black hole that creates it when they separate, rather than colliding. 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 confirms that 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 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 doesn’t seem to have changed much 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 in space, 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 doesn’t have any explanation at all for dark energy because no particle can have a negative energy.

In quantum realism, our space is the inner surface of a bubble expanding into a quantum bulk that adds nodes as it expands. It follows that an expanding universe must lose energy, just as expanding a box cools the gas within it. New points of space are adding all the time evenly throughout space. 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 even be gradually increasing. That dark energy comes from new space means that no particle cause will ever explain it.

4.8. COSMIC EVOLUTION

The alternative to the clockwork universe of current physics is a cosmic evolution driven by natural selection at the quantum level. Quantum realism envisages a living universe constantly giving birth to itself rather than a dead universe winding down while being pushed around by lawful but magical forces.

4.8.1 Is the universe dead or alive?

According to current physics, dead matter made galaxies, stars, planets, life and us by accident. Even if something made the universe, it long ago abandoned it to matter interactions based on the laws of physics. In this view, the laws that control matter also control people, so consciousness is considered to be just an illusion - an epiphenomenon of matter complexity (Zizzi, 2003). Physicists assert that the laws of thermodynamics doom everything to run down, whether it is our bodies, the sun or the universe, so everything will end in an eternal emptiness or "big freeze". It follows that the universe, and its life, is ultimately pointless, so it doesn't matter what we do.

This cosmic nihilism calls itself the voice of reason but actual reason suggests a different direction. That the physical universe began implies that it came from something else, so we are not alone. That quantum randomness has no physical source implies there are non-physical causes, so matter is not all there is. That the universe always decays implies that it began ordered, which the primordial chaos wasn’t, so decay is not the only principle operating. That the laws of physics are based on probability not certainty means that this is no machine, so the future is not written. When examined closely, the story of a mechanistic world going nowhere that accidentally made us makes no more sense than that of a world built just for us by a supreme being.

One concludes that physical realism is just a theory, and scientists who don’t question their theories are priests. Last century, it was the only game in the town but today quantum realism is a rational alternative. It proposes that space is a processing network, time is processing cycles, light is the basic process and matter is entangled light rebooting. This theory, based on the method of reverse engineering, is testable, so if it is wrong, let the facts decide not preconceived beliefs.

The standard model assumes that its bits of matter began at the big bang as they are now, but in quantum realism the universe had to evolve, as it booted up from one photon in one unit of space. This boot-up began small, just as Windows boots from a tiny CMOS that loads a kernel that loads a bigger BIOS that loads the full operating system. Booting up a computer isn’t booting up a universe but if one photon spawned the first light that made matter, life and eventually us, it is the same on a vast scale. This means there were no divine shortcuts, as every element had to evolve in the matter factories we call stars or in a supernova sacrifice. The evidence suggests that rather than being in a dead universe running down, we are part of a living universe evolving up.

4.8.2 Our fine-tuned universe

Why is our universe suited for stars, galaxies and life to evolve? For stars to create atoms needs the stability of galaxies that would fly apart without dark matter. We make energy by nuclear fission that breaks higher nuclei apart but stars make energy by nuclear fusion that merges nuclei, as when two Hydrogen atoms form Helium. This process requires neutrons that the weak force just so happens to let stars create from protons. The laws of physics did not allow nuclear fusion to create the carbon atoms needed for life 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. Were these values set “just so” by a kind creator or did an impartial system spawn many universes and we just happen to be on the life-supporting one? Ananthaswamy (2012) gives one example in detail:

“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.”

The conclusion isn’t that the universe is designed for life, as if so, it would be 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 (from Barnes, 2012):

1. **Strong force.** If the strong force were slightly 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, and 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 have been 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. And it is the entire universe that is fine-tuned to
evolve, not just some part of it, so one can’t conclude it is a “lucky accident” based on a sample of one. Unless of course
there are many universes, hence the popularity of multiverse theory despite it being a scientifically worthless idea. But to
conclude that there had to be many universes in order to make our universe an accident is not science. To be clear, the
fine-tuning of our universe is based on evidence but the multiverse is based on no evidence at all. As O’Leary notes:

“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)

A recent variant is Smolin’s speculation that black holes spawn universes, based on an old idea suggested by Hawking
in 1987, again with no evidence. Just because a black hole is a mathematical infinity doesn’t mean it can create a universe.

In quantum realism, the physical universe came from a pre-existing quantum reality, so every universal parameter was
defined from the start by the nature of that reality. A processing model expects the many parameters of the standard model
to reduce to the core properties of a processing network, such as the network refresh rate (the speed of light), the network
density (Planck’s constant) and the rate the network is expanding (the cosmological constant). From these, simulations
based on quantum reverse engineering could derive the other parameters.

In this view, if other “bubble universes” arose in the quantum bulk as ours did, they would have exactly the same laws
of physics except the initial symmetry might break the anti-matter way. Each universe would then undergo a quantum
evolution, just as ours has. In this view, our universe is as it is based on the quantum reality that preceded it and there is no
benefit to speculate why. Its parameters were neither accidental nor chosen, so the universe is neither designed for life nor
not designed so. It just did what it could given the original quantum reality. 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 in rivers. In the same way our universe is
finely-tuned for life because life evolved to fit what it was given. In quantum realism, the conditions for the evolution of
the universe were established when it began.
4.8.3 Quantum evolution

Darwin’s “great idea” was that the human species was naturally selected by the evolution of life over millions of years rather than created by a divine intelligence. The conditions necessary for a species to evolve are identified as:

1. Reproduction. Species produce offspring that carry on their traits.
2. Variation. The offspring’s traits vary, e.g. by mutation.
3. Selection. Those offspring better fitted to survive reproduce more to pass on their traits.

Evolution is essentially an iterative method that lets biological patterns suited to survive arise naturally based on trial-and-error rather than a preconceived plan, a view that was taken to contradict the orthodox religious view of a divine creator.

In quantum realism, the physical world evolves because the quantum world explores every option. To apply Darwin’s theory to the quantum world, replace “species” by “quantum entity”, defined as a quantum server process. A photon as a quantum entity is then subject to evolutionary conditions as follows:

1. Reproduction. The photon quantum wave generates “offspring” by instantiation.
2. Variation. The “clone” instances in the photon cloud vary in properties like location and direction.
3. Selection. Quantum collapse then selects one instance to restart the photon in a physical event.

When a photon cloud passes through Young’s slits to hit the screen at a point, one instance is selected from many variants to trigger a server restart that reproduces the photon. Likewise, light finds the shortest path to any destination by a quantum evolution, where the instance that accidentally finds the shortest path to restart the server first is “more fit”. Yet while the “success” of that photon instance is accidental, that some instance will find the fastest possible way is not.

Young’s experiment doesn’t change the photon but many photons merging into an electron do constitute a new “species” as an electron has different properties from light. An electron can be said to occupy an “niche” of quantum space just as a species occupies a niche in nature. And just as an organism has competitors that seek to displace it, so an electron is constantly bombarded with competitors for its channels. The photon pattern we call an electron is constantly bombarded with competitors for its channels.

The evolution of matter did not stop at the electron but went on to give neutrinos, quarks, protons, neutrons and all the atoms of the periodic table, and this physical evolution was in play long before Darwin’s biological evolution began. If this were not so, how else could dead physical particles that in themselves have no life at all give rise to self-directed life? In contrast if processing cycles create change and quantum randomness gives variety then stable matter end-states are naturally selected in a physical evolution.

Quantum randomness illustrates the conundrum. In a clockwork universe randomness is pointless as it just introduces errors in the clock. Randomness is equally unhelpful in a god-designed universe as it just interferes with the divine plan. Hence neither mechanists nor theists welcome the randomness of quantum theory, but in quantum realism it is as necessary for physical evolution as genetic variety is for biological evolution. One concludes that what drives the universe is not dead matter following fixed laws nor a divine plan prepared by a super being but a dynamic quantum evolution discovering its future.

4.8.4 Our universe was borne not made

Is our universe following a plan? If it is following a pre-set route to a pre-defined end-state then we are pointless cogs in a big machine, powerless to change the divine plan. Conversely, that there is no plan and all it is just accident leads to the nihilism that nothing really matters at all, which denies the accountability that societies need to work, so society would collapse and we wouldn’t be here (Whitworth & Ahmad, 2013). Yet plan vs. no-plan aren’t the only options.

An air-conditioning system with a thermostat has no plan to turn on or off at certain times, just a temperature setting it is programmed to maintain and it follows that “law” and acts accordingly, given an electrical power source. It is not random but equally its acts aren’t planned in advance. A computer simulation is more complex but again there is no plan for what it does moment-to-moment as what evolves may surprise even its designer, but it also follows built-in laws and again needs an ongoing source, in this case a computer processor. It isn’t planned but neither is it acting by accident. Even
more complex is a baby, where again one cannot say it has a plan but nor is what it does just accident. Psychology tells us that the brain is pre-set to learn a language, identify faces and form relationships but it can be any language, any face or any relationship. In all these cases, a system driven by some source of its activity is predisposed a certain way but has no preconceived plan of action nor is anything external directing it to follow a plan.

If evolution was built-in to our universe at the beginning, it was predisposed to evolve, subject to pre-set limits or laws, and supported by the power of ongoing quantum activity. This evolution was a trial-and-error process with no master plan nor any blueprints of what will happen, just as science says, but to call the evolution itself an accident is a step too far. If we do not even know how our universe began, how can we seriously conclude that it was an accident? That a universe structured to evolve doesn’t have a central director to tell it what to do doesn’t make it accidental. Evolution works by accidental means but evolution itself is not accidental because it tries every option to eventually find what works.

Our universe wasn’t built as a watchmaker builds a watch to a pre-set design but was borne, like a baby not knowing where it is going or why but containing the essence of its parentage. Hence it was predisposed to evolve just as a baby is predisposed to learn. The birth of a particular baby may be accidental but that babies are borne isn’t an accident because that is how species survive. Nor can the baby itself be considered an accident because its nature directly derives from its ancestry.

In quantum realism, the "parent" of physical reality is a quantum reality that is “alive” in the sense that it acts from its own nature rather than having to be “pushed”. Instead of fundamental particles that always existed following fixed laws set by some distant deity or accident, quantum realism sees a fecund universe where quantum reality continually “gives birth” to physical reality. In this view, the physical world is constantly being created by something beyond itself.

The next chapter extends quantum realism to include the fields of gravity, charge and magnetism.

Table 4.8 compares how quantum realism and physical realism explain matter so the reader can decide.

Table 4.8. Physical realism vs. quantum realism for matter

<table>
<thead>
<tr>
<th>Physical realism</th>
<th>Quantum realism</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Matter.</strong> If matter is made of fundamental particles then particles cause everything, so:</td>
<td><strong>Matter.</strong> Is generated by quantum processing that is the cause of everything, so:</td>
</tr>
<tr>
<td>a) <em>Space.</em> Space is nothing as there is no null particle</td>
<td>a) <em>Space.</em> Space is a null process not nothing</td>
</tr>
<tr>
<td>b) <em>Light.</em> Is a wave-particle without mass or charge!</td>
<td>b) <em>Light.</em> Is the same process shared by many nodes</td>
</tr>
<tr>
<td>c) <em>Mass.</em> Measures the particle substance</td>
<td>c) <em>Mass.</em> Measures the net processing repeating in a node</td>
</tr>
<tr>
<td>d) <em>Charge.</em> A property of matter unrelated to mass</td>
<td>d) <em>Charge.</em> The net remainder of the repeat processing</td>
</tr>
<tr>
<td>e) <em>Anti-matter.</em> Negative matter that for some reason has the same mass but opposite charge</td>
<td>e) <em>Anti-matter.</em> Matter processing in reverse that gives the same mass but opposite charge</td>
</tr>
<tr>
<td>f) <em>Our universe was built</em> from the standard model Lego-set of 62 fundamental particles</td>
<td>f) <em>Our universe was borne</em> from vibrations on the inner surface of a bubble expanding in a quantum bulk</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th><strong>Electron.</strong> A fundamental matter particle created from nothing that:</th>
<th><strong>Electron.</strong> An ongoing head-head extreme photon collision that:</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Is a structureless point with no dimensions, even though that implies no mass, charge or spin</td>
<td>a) Is the repeating overload of all the channels of one axis through one node</td>
</tr>
<tr>
<td>b) Has mass even though no extent implies no substance</td>
<td>b) Has mass as net quantum processing that repeats</td>
</tr>
<tr>
<td>c) Has negative charge just because it does and charge is not related to its mass</td>
<td>c) Has negative charge because negative processing is left-over for a head-head photon overload</td>
</tr>
<tr>
<td>d) Has imaginary spin which is half of its total spin for some reason</td>
<td>d) Really spins in quantum space but only half its photons amplitudes are seen from any angle</td>
</tr>
<tr>
<td>e) Always moves for some reason but is slower than light</td>
<td>e) Always moves like light but only on two dimensions</td>
</tr>
<tr>
<td>f) Never collides in an atomic shell even though it is a particle with mass for some unknown reason</td>
<td>f) Never collides because it is entirely light-like in a two-dimensional atomic shell</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th><strong>Neutrino.</strong> A fundamental matter particle that:</th>
<th><strong>Neutrino.</strong> An ongoing head-tail version of an electron that:</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Is a structureless point with no dimensions</td>
<td>a) Fills the channels of one axis through one node</td>
</tr>
</tbody>
</table>
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

**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

**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 charge form a proton as the colors cancel to clear, and massless gluons create the proton’s 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.** Is 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

**Quark.** A repeating three-axis extreme photon collision that:

a) Has a three-axis node structure

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 plane so it isn’t stable alone

d) A three-axis collision predicts one-third remainders

**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.** Acts because quarks share photons when their three axes orientate to form a proton, in a triangle structure where 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.** Is 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 dead physical world is decaying, accidental and inert**

**The universe of matter evolved** from quantum processing as life evolves by trying 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 atomic 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

**The living quantum world is changing, choosing and active**
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? (4.4.4.5)
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 forces due to virtual particles called “magical” despite being lawful? (4.5.2)
17. What rules does current physics apply to decide when virtual particles interact? (4.5.3)
18. Has the standard model ever explained any new evidence without expanding itself? (4.5.4)
19. What is the key difference between an equation and a theory? How do you assess each? (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 photons 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? What can 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. What is dark matter? Why can’t we see it? How does it differ from ordinary matter? (4.7.6)
32. What is dark energy? Why can’t a particle model explain it? (4.7.7)
33. Is our universe dead or alive? Give reasons. (4.8.1)
34. Why is our universe “finely tuned” for life? (4.8.2)
35. What are the quantum evolution equivalents of biology’s reproduction, variation and selection? (4.8.3)
36. Was our universe “built” as a watchmaker builds a watch? If not, how did we arise? (4.8.4)
REFERENCES


Lederman, L., & Teresi, D. (2012). The God Particle: If the Universe Is the Answer, What Is the Question?


