

FOREWORD

Science differs from religion and politics in being a search for facts, rather than a fixed statement based on divine intervention or the opinion of someone who is clever, or even the speculative consensus of a large group of geniuses. The call by Popper that a scientific theory is a speculative but predictive theory which is checkable and capable of being falsified if it is by observation or experiment found to be wrong (rather than adjusted slightly), defines one type of science. Caloric, phlogiston, and aether are examples of speculative theories that made predictions that were not in agreement with experimental findings, and so have been discarded as wrong. Speculative theories that cannot be falsified are worse, they are deemed 'not even wrong'.

Examples of these are Ptolemy's epicycle-based Earth centred universe, and modern superstring theory. The only way to discredit a 'not even wrong' theory which becomes a religion or non-factual belief system is to build a better theory which is either fact based and predictive, or is at least predictive and survives checks. However, once a 'not even wrong' theory becomes dogma, alternative ideas – even if better scientifically – are generally ignored and ridiculed for a very long time, because the whole criteria for what is 'science' changes to fit the new orthodoxy. 'Science' thus becomes whatever is needed to meet the groupthink fashion, and 'mere' experimental facts are deemed secondary in importance to the perceived 'beauty' and 'self-consistency' of the mainstream 'not even wrong' theory.

The definition of science, like any word, is not fixed but changes with popular perception. Dictionaries are updated to fit the popular use of a word; in language there are no absolute facts. Another approach to science is that begun with Archimedes, where a theory is built upon facts based on observation or experimental results. One example is his proof of the law of buoyancy. He observes that at a fixed depth under the surface of the water, the equilibrium pressure will end up exactly the same, *whether there is just water above you or whether there is a boat floating above you*. Therefore, the weight of water displaced by the floating boat must be equal to the weight of the boat! So facts are assembled in the theory like a mathematical proof, with all assumptions and steps made clear for all to examine. If the output from the assembled theory predicts more than the sum of the facts that were used to build it, you obtain useful predictions from a fact-based theory. This is one step better than Popper's definition of science. But quantum field theory, and indeed quantum mechanics, is not as yet such a fact-based axiomatic theory. It is fact based, but it makes mathematical guesses whose physical explanations are in need of clarification. In other words, it is still at the Popperian stage of science (a falsifiable theory).

Many people prefer to deny the possibility of progress beyond mathematics, on the basis that quantum phenomena are too small, or because the uncertainty principle rules out determinism. However, the path integral formulation of quantum mechanics, as Feynman explained, does suggest causality (not determinism) for quantum phenomena on small scales: interferences become important on small scales because a smaller number of quantum interactions occurs on small scales than on large ones. Electron motion is more chaotic on small scales because it is affected by a smaller number of quantum interactions that can't average smoothly as the larger number of interactions involved on larger scales. The virtual photons and other field quanta that are exchanged with or interact with moving electrons on the atomic scale play an analogous role, in Feynman's path integral formulation, to that which air molecules play in causing chaotic Brownian motion on small dust particles (less than 5 microns diameter) as seen under a microscope. On large scales, the chaotic motion of dust particles can be statistically described by a random walk using a path integral of the great many random interactions, which is somewhat analogous to Feynman's path integral of quantum field theory. However, the strict representation of existing quantum mechanics by path integrals can lead to a bogus level of complexity, such as an *infinite* series of terms in the power series expansion to even the simplest path integral:

'It always bothers me that, according to the laws as we understand them today, it takes a computing machine an infinite number of logical operations to figure out what goes on in no matter how tiny a region of space, and no matter how tiny a region of time. How can all that be going on in that tiny space? Why should it take an infinite amount of logic to figure out what one tiny piece of spacetime is going to do? So I have often made the hypothesis that ultimately physics will not require a mathematical statement, that in the end the machinery will be revealed, and the laws will turn out to be simple, like the chequer board with all its apparent complexities.'

- R. P. Feynman, *The Character of Physical Law*, BBC Books, 1965, pp. 57-8.

‘... I would like to put the uncertainty principle in its historical place: when the revolutionary ideas of quantum physics were first coming out, people still tried to understand them in terms of old-fashioned ideas ... But at a certain point the old-fashioned ideas would begin to fail, so a warning was developed ... If you get rid of all the old-fashioned ideas and instead use the [path integral] ideas that I’m explaining in these lectures - adding *arrows* for all the ways an event can happen - there is no need for an uncertainty principle!’

- R. P. Feynman, *QED*, Penguin Books, 1990, pp. 55-6.

‘... when the space through which a photon moves becomes too small (such as the tiny holes in the screen), these [classical] rules fail - we discover that light doesn’t have to go in straight lines, there are interferences created by two holes ... The same situation exists with electrons: when seen on a large scale, they travel like particles, on definite paths. But on a small scale, such as inside an atom, the space is so small that there is no main path, no ‘orbit’; there are all sorts of ways the electron could go, each with an amplitude. The phenomenon of interference becomes very important, and we have to sum the arrows to predict where an electron is likely to be.’

- R. P. Feynman, *QED*, Penguin Books, 1990, p. 85.

Dr Thomas Love of California State University has pointed out (in a preprint he kindly sent me):

‘The quantum collapse [in the mainstream interpretation of quantum mechanics, which has wavefunction collapse occur when a measurement is made] occurs when we model the wave moving according to Schroedinger (time-dependent) and then, suddenly at the time of interaction we require it to be in an eigenstate and hence to also be a solution of Schroedinger (time-independent). The collapse of the wave function is due to a discontinuity in the equations used to model the physics, it is not inherent in the physics.’

In genuine science, unlike the case of ‘not even wrong’ speculative religion (or politics), making an error is not (or should not be) turned into a complete disaster. If you think of science as an exploration endeavour, it is not about trying to be a lemming and follow groupthink. It is instead sometimes more about taking individual risks and trying to find things out without having a large backup of fellow travellers to blame for errors. You make a mistake, take a wrong turn. So what? If you have been sticking to ethical scientific behaviour (which has nothing to do with ethical religious behaviour or ethical political behaviour), you will have learned something from the process of failure. The mountaineer who fails to get anywhere by following a particular path may take some comfort from learning something of the difficulties on that particular path. The next time that person (or someone else) tries to make an advance on that mountain, they can gain from the previous person’s findings by using different methods which may enable the route to be tackled with less difficulty, or they can try to look for an alternative path. If mountain climbing were a religious or political activity then all failures would have to be covered up by lying and hype to glorify failure, misleading millions of young explorers into taking lethal routes. This would be done just in order to save the reputations of the glorious, worshipped big-name experts (despite setbacks and difficulties). That religious or political style isn’t the best way for doing science.

Chapter 1: Le Tour de Force

$U(1) \times SU(2) \times SU(3)$ mechanism: a simplified but self-consistent and falsifiable alternative to the Standard Model, changing $U(1)$ to a theory of quantum gravity mediated by spin-1 (push) gravitons that makes checkable predictions, and replacing the electroweak breaking Higgs field with a quantized mass-giving field which only makes a portion of the $SU(2)$ gauge bosons massive at low energy, accounting for the fact that the weak isospin charge only acts on left-handed spinors. The other $SU(2)$ gauge bosons remain massless at low energy and mediate electromagnetic and weak hypercharge interactions.

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1.1 Brief overview of the history of this model

‘Schwinger, as early as 1956, believed that the weak and electromagnetic interactions should be combined into a gauge theory. The charged massive vector intermediary and the massless photon were to be the gauge mesons. As his student, I accepted his faith. ... We used the original SU(2) gauge interaction of Yang and Mills. Things had to be arranged so that the charged current, but not the neutral (electromagnetic) current, would violate parity and strangeness. Such a theory is technically possible to construct, but it is both ugly and experimentally false [H. Georgi and S. L. Glashow, *Physical Review Letters*, **28**, 1494 (1972)]. We know now that neutral currents do exist and that the electroweak gauge group must be larger than SU(2).

‘Another electroweak synthesis without neutral currents was put forward by Salam and Ward in 1959. Again, they failed to see how to incorporate the experimental fact of parity violation. Incidentally, in a continuation of their work in 1961, they suggested a gauge theory of strong, weak and electromagnetic interactions based on the local symmetry group SU(2) x SU(2) [A. Salam and J. Ward, *Nuovo Cimento*, **19**, 165 (1961)]. This was a remarkable portent of the SU(3) x SU(2) x U(1) model which is accepted today.

‘We come to my own work done in Copenhagen in 1960, and done independently by Salam and Ward. We finally saw that a gauge group larger than SU(2) was necessary to describe the electroweak interactions. Salam and Ward were motivated by the compelling beauty of gauge theory. I thought I saw a way to a renormalizable scheme. I was led to SU(2) x U(1) by analogy with the appropriate isospin-hypercharge group which characterizes strong interactions. In this model there were two electrically neutral intermediaries: the massless photon and a massive neutral vector meson which I called B but which is now known as Z. The weak mixing angle determined to what linear combination of SU(2) x U(1) generators B would correspond. The precise form of the predicted neutral-current interaction has been verified by recent

experimental data. ...’ – Sheldon Glashow, Nobel prize acceptance lecture of 8 December 1979, *Towards a Unified Theory - Threads in a Tapestry*.

Glashow hence has already investigated SU(2) as an electromagnetism and weak force unification scheme, but dismissed it out of hand because ‘neutral currents do exist’.

The correct SU(2) gauge symmetry is not, however, the naïve one which Glashow and Schwinger investigated: the correct SU(2) Yang-Mills theory involves three massless gauge bosons, two of which are charged and one of which is neutral. All three of these gauge bosons can only in a certain handedness acquire mass from a vacuum field (which in mainstream Standard Model particle physics is the as-yet-unobserved Higgs field). Others exist in massless forms even at low energy. Glashow’s statement suggests that he sees a disagreement between Z gauge boson mediated massive short-ranged neutral currents and a *massless* version of the Z boson which can co-exist with the Z and neutral currents by introducing an alternative to the Higgs field, which only gives mass to massless gauge bosons interacting only with left-handed spin.

We give extensive factual experimental and observational evidence alleging (strongly) to prove that the real electroweak theory is SU(2) with a new theory of mass to replace existing speculative Higgs field symmetry breaking for U(1) x SU(2) electroweak symmetry. U(1) becomes quantum gravity. Essentially, the *massless* versions of the weak field Z and W gauge bosons which give rise to observed forces of electromagnetism and hypercharge are not the versions which mainstream prejudices would try to associate. Instead of associating the electrically neutral massless Z gauge boson of SU(2) with the gauge boson of electromagnetism, it mediates hypercharge while the two charged massless W’s are the gauge bosons of electromagnetism (one for electrically positive fields, one for negative). This is based on extensive, solid new empirical evidence for such electromagnetic gauge bosons from published experimental studies of ‘displacement current’ in a logic step (see section 1.6 of this chapter).

We preserve the weak-strong Yang-Mills symmetries of the Standard Model, i.e., the SU(2) x SU(3) groups, but restructure the Higgs field and remove the U(1) group of electromagnetism and weak hyper charge, both of which become functions of massless SU(2) gauge bosons which exist at low energy thanks to the change of the Higgs field. Mass is not given to all the SU(2) gauge bosons at low

energy; only some are given mass, accounting for the left-handedness of the weak force. The rest remain massless at low energy and are experienced as hypercharge (mediated by a massless Z) and two electrically charged 'photons' (massless W's). Section 1.6 explains experimental evidence for how the electrically charged massless Z's are exchanged at light velocity without the classically expected problem of infinite self-inductance for charged light velocity (massless) radiation. Thus, this theory retains the weak and strong SU(2) x SU(3) component of the Standard Model, but expands the role of the SU(2) symmetry greatly to include electromagnetic and weak hyper charge. U(1) becomes quantum gravity, mediated by spin-1 gravitons and having only one kind of charge (mass-energy).

Following some ideas of Tony Smith and Carl Brannen, the final section of this chapter (section 1.8) will analyse a deep physical reason for U(1) x SU(2) x SU(3). It has long been known (since 1964 when Nicola Cabibbo investigated it) that quarks and leptons have a near 'universality' in their interactions. The rates of flavour-changing reactions for quarks and leptons are similar to within 4%. The physical model suggested here for unification indicates that all fundamental particles (leptons, quarks) are the same thing: three colour charges for example are an intrinsic property of all leptons but these cancel out. Only when you bring two or three leptons together with immense energy (higher than so far available in physics experiments), does a net colour charge emerge from the 'white' (neutral) colour mixture of a normal lepton. The mechanism for the emergence is a physical asymmetry called 'polarization'. A familiar example is the way that a neutral atom can act as an electric dipole when brought near an electric charge, or the way induced magnetism is produced in iron when it is placed near a magnet. Van der Waals forces arise between neutral atoms or molecules which come close together: this occurs because asymmetry automatically arises in this situation, because electrons are attracted to spend more time in the space between two positively charged nuclei than on the far side of one or the other nucleus. This asymmetry causes attraction of the positive nuclei to the electrons 'piling up' between them, so the two atoms are electrically bonded, even though each is neutral in the sense of containing a similar quantity of positive and negative charges. All leptons contain three colour charges in equal amounts, which normally cancel out. When two or three leptons are

compressed into a small enough space with immense energy, the colour charges within them are polarized, so each then becomes a quark with a different effective colour charge to its two or three close neighbours. This predicts fractional charges.

The emergence of this strong (colour charge) force is powered by the electromagnetic field, which loses energy as we will next explain, reducing the observable electric charge at long distances. As the simplest specific example, the omega minus baryon is composed of three strange quarks each of apparent $-1/3$ charge. The electric field from isolated electrons causes pair production of virtual fermions (which on the average get radially polarized, i.e., *virtual positrons are on average nearer the electron core than virtual electrons*) of the surrounding vacuum out to a radius of $[e^2h/(8\pi^2\epsilon m^2c^3)]^{1/2} = 33$ fm, which is where the electric field strength is $2\pi m^2c^3/(eh) = 1.3 \times 10^{18}$ volts per metre. This formula is known as Schwinger's threshold for pair-production in the vacuum; lesser electric fields are too weak to cause any pair-production from electromagnetic gauge bosons (mediating the electric force field) evaporating particles from the (frozen) so-called 'Dirac sea'. This polarization of charges released briefly by pair production in the vacuum out to 33 fm from an electron reduces the electron's apparent electric charge at a greater distance below the unshielded value. The radial electric field vector from the electric core points inwards (towards negative charge), while the polarization of virtual charges in the surrounding vacuum gives a radial electric field which points the opposite way (outwards, from the virtual positrons near the electron core, towards the virtual electrons which are on average slightly further away). Vacuum polarization therefore cancels out or 'shields' a portion (not all, obviously!) of the electric charge of an electron when that is viewed from distances of 33 fm or more from an electron. (Physically, this shielding is due to the absorption of field quanta by charges, but the classical picture of drawing radial 'electric field lines', while physically misleading, is a useful quantitative description in some ways.) Because all normal measurements of electric charge relied on measuring the electric field at such great distances, they all underestimated the true bare core charge of the electron. *Remember that this shielding effect is powered entirely by the strength of the electric charge at the core of the electron.* So, when three electrons are confined within such a small volume that their polarized vacuum shields overlap, the latter are boosted in shielding

strength by exactly three times, so each electron gets three times more charge shielding than it would sitting all alone by itself. Hence each electron's charge as seen from great distances is reduced by a factor of three, from -1 to just $-1/3$. (Similarly, if you married, the shared bed could be covered by all of the blankets or duvets that you were each using while in separated beds. The thermal radiation emission you are each emitting will be reduced, because you are *combining* the same heat shielding duvets. Particles in close proximity *combine* polarized vacuum shielding and each experience the 'benefits' of sharing overlapping shielding: the electric field per particle seen at a distance falls. The 'lost' electric field energy in the vacuum gets converted into short-range field quanta.)

The 2 and 3 in $SU(2) \times SU(3)$ consequently refer to intrinsic properties of all particles: *two* types of electroweak charge, *three* of colour.

1.2 Quantum gravity and general relativity

The forces of gravity and electromagnetism have a major feature in common: inverse-square dependence (long range), which suggests that they might both be modelled by the same symmetry group. The existing mainstream Standard Model, $U(1) \times SU(2) \times SU(3)$, is a brilliant success in describing nuclear forces and some high energy particle physics (short of making falsifiable predictions about the nature of the Higgs field, which it utilises to explain why electromagnetism is a long range force unlike the weak force), but doesn't include gravity.

General relativity is a generally excellent model of gravitation that is nevertheless based on well-known failures: firstly, matter comes in particles (mass and energy are quantized) and general relativity – being differential geometry – can't deal with discontinuities. To get around the problem that calculus can't model discontinuities, the quantized source of the gravitational field in general relativity (mass and energy) is simply ignored and a stress-energy tensor is constructed which uses a smooth field in space-time to *average out* the discontinuities of the particle-based real world. As a result of this, the imaginary, continuously varying, differential equations for matter and energy spread throughout space-time generates an equally smooth, continuously varying space-time curvature, producing smoothly operating gravitational force. This is a fiction.

Secondly, it is well known that general relativity is supposed to fail on very small scales, such as very close to a mass, where the gravitational field strength is very strong. This

is supposed to occur because the *simplest* model for an all-attractive quantum gravity force is well known to involve a spin-2 vector boson, or 'graviton'. Such a graviton has a mass (because in general relativity, any gravitational field has energy, which acts as a source of gravitation itself), so that individual gravitons should be acting as gravitational charges (emitting and receiving gravitons themselves). In weak fields, this effect is trivial but in strong fields it was believed to make the effective coupling constant for quantum gravity, G , become extremely large. In fact, the electromagnetic coupling constant also has this problem and within a radius of about 1 femtometre it increases as distance from a charge decreases. However, the electromagnetic coupling constant only increases with as a function of the logarithm of about the reciprocal of the distance, and this can be explained by vacuum polarization (charge shielding by pair production fermions). This is resolved using charge renormalization, which consists of taking a cut-off on the distance scale corresponding to the vacuum grain size for pair-production (the minimum distance over which pairs of fermions can physically be created and become polarized in the vacuum). This renormalization technique cannot be applied to solve the problem of the increase in the gravity coupling constant in quantum gravity utilising spin-2 gravitons.

To get around this mainstream graviton problem, some ingenious but non-falsifiable ideas have been proposed and worked on for decades. One is string theory, now M-theory. This theory intriguingly gets around the problem of the non-renormalizability of spin-2 graviton ideas by postulating that all particles of mass and energy in the universe are actually not points but are small one-dimensional 'string' like lines or loops of definite size. The postulated string size is the Planck length, far too small to ever observe, but conveniently big enough to cut off the increasing strength of the small-scale gravitational coupling constant before it reaches an unphysical magnitude as distances approach zero. There are several facts that we will give showing that this basic idea in string theory, in describing particles as small loops of given size, may be helpful, but the real size is far smaller (it's black hole size).

Mainstream attempts to unify the 1-dimensional string and time (which together form a 2-dimensional spacetime or 'worldsheet') with particle physics have utilised a conformal field theory. In order to account for particle physics in string models, at least 8 additional dimensions are required (8 additional dimensions are required if a 1:1

boson:fermion supersymmetry exists, but 24 are required if this supersymmetry doesn't exist). Hence, a total of at least 10 dimensions are required. But general relativity suggests that there are 4 space-time dimensions, not 10 or more. To explain this, it is conveniently assumed that 6 or more dimensions must be conveniently compactified within the Planck length of fundamental particles by convoluted Calabi-Yau manifolds. An 11-dimensional supergravity (spin-2 graviton) theory can be unified with 10-dimensional superstring (supersymmetry) theory in a process known as 'M-theory' discovered by Edward Witten in 1995. In M-theory, the 11-dimensional supergravity theory forms the 'bulk' of the universe, while 10-dimensional superstring theory forms a 'brane' or surface (membrane) upon the bulk, much as a 3-1 = 2 dimensional surface exists on a 3 dimensional football. However, aside from the purely abject speculations involved (about spin-2 gravitons, unification of Standard Model forces and gravity near the Planck scale, and extra-spatial dimensions which are curled up on small scales), there is another serious problem.

This is called the 'landscape' problem of M-theory: a 6-dimensional Calabi-Yau manifold has about 100 parameters or moduli, all with different potential values. All of these values are unknown, and since the Planck scale is so small, no information about them can be obtained from scattering experiments. Particle physics predictions from M-theory depend on knowing the precise values of the moduli, so in the absence of such input the theory 'predicts' a non-falsifiable 'landscape' of solutions. The number of vacua depends on how the moduli are to be stabilized: it's at least 10^{350} vacua.

That's a very large number, and if you know how big it is, you can see that there is a very large difficulty involved in trying to evaluate all those different 'predictions'. The name 'landscape' comes from the fact that each of those many vacua (each is a separate quantum field theory) has a different value of the vacuum energy. This vacuum energy is supposed to power the acceleration of the universe by giving the value of the cosmological constant needed in mainstream general relativity to model physical observations from astronomy, like the redshift of supernovae. By plotting the values of the cosmological constants versus a couple of moduli variables on a three-dimensional graph, you should obtain a graph that superficially looks a bit like a scenery or 'landscape', including valleys of low cosmological constants and mountains with high values. Mainstream general relativity requires a small

positive cosmological constant to be fitted to observations (assuming that you don't choose to do anything heretical like change the basic assumptions of general relativity instead). So the hope for a few years was to evaluate the whole 10^{350} vacua of the landscape using some mathematical tool to 'pick out' a valley with the 'right' ('indirectly observed') cosmological constant, and hence to identify the correct vacua (or at least narrow down the search area).

So far, they have not succeeded. People with alternative ideas like Lee Smolin and Peter Woit, have deemed mainstream string theory a 'failure'. Smolin works on an alternative called 'loop quantum gravity', which lacks the glamour and much of the abject speculation of string theory. However, on balance it doesn't make any more compelling claims than string theory. In fact, because it is less speculative, it makes fewer claims, and doesn't seem to make any falsifiable predictions in its existing state.

Woit argued in a 2002 arXiv paper for building an alternative to the Standard Model using an extension of well-known techniques in quantum field theory which are called 'representation theory'. Representation theory is used to relate symmetry groups to gauge interactions normally, but Woit's point is that it can be used to try to tackle existing issues in the Standard Model: why not search for a deeper understanding to the Standard Model which avoids existing difficulties while explaining more? In other words, *start from known solid facts and build models on such facts*, instead of starting with speculations of spin-2 gravitons, Planck scale unification, and extra spatial dimensions.

This book adopts some points made in the work of both Woit and Smolin. First, it works from established facts to reach a new symmetry group model which represents particle physics and gravity, making falsifiable predictions (some of which have already been confirmed, as we shall see). Second, it utilises the concept of arriving at quantum gravity predictions by using a modification of the technique Smolin highlighted in Perimeter Institute lectures, whereby a quantum field theory is obtained by summing over all pertinent interaction graphs (Feynman diagrams) to represent a 'path integral'. Classically, quantum field theory consists initially of finding a Lagrangian equation for a density, L . This is a differential equation representing the fields of interest to the problem, such as quantum gravity or whatever. A Feynman path integral takes the form $\int DA e^{iS(A)}$ where $S(A)$ is the action, $S(A) = \int d^4x L$. By expanding the Feynman path integral into a series of terms each of which

consist of powers of the fundamental force's coupling constant (G for quantum gravity), each term in the expansion corresponds to a separate Feynman diagram for a *category of interaction* (not for an *individual* interaction).

It's obvious that the expansion of the Feynman path integral into a series of power terms only quantizes *categories* of interactions, not *individual* interactions. Hence, *individual* graviton (or other gauge boson) interactions are not quantized by path integral methods of quantum field theory. The use of differential equations in the Lagrangian field equation guarantees that individual gauge boson interactions are being falsely smoothed out, just as the stress-energy tensor in general relativity falsely smoothes out the quantum irregularities in real world mass distributions to produce differential source terms for the gravitational field which will generate equally fictitious differential curvature terms (Riemann or Ricci tensors). Replacing the Feynman path integral with a discrete summation of *individual interaction* (not *interaction category*) Feynman diagrams is therefore of necessity for achieving a theory of quantum gravity which is a mathematically accurate model of the physical processes involved in quantum field interactions.

It is essential to remember that traditionally Feynman diagrams are drawn to illustrate *qualitatively different* processes. They are not all equally likely to occur: in general, the quantitatively biggest terms in a power series of a coupling constant (generated by expanding a path integral) represent categories of Feynman diagrams which are simple and therefore are more likely to occur than the more complex Feynman diagrams that correspond to higher power terms in the series (ignoring the case of spin-2 graviton unphysical power series expansion problems).

The correct way to mathematically represent a quantum field is to sum over *individual* discrete interaction graphs, one graph representing each individual interaction. Because many of the interactions are essentially identical in nature (although occurring in different space-time locations), this summation is not as difficult as would appear to be the case.

The mainstream quantum field theory model for electromagnetism is basically classical (not quantized) because it just inserts Maxwell's classical equations into a Lagrangian, adds terms for the mass of the photon, then inserts the resulting Lagrangian into a Feynman path integral. It then finds the power series expansion and correlates each term in that expansion to a Feynman diagram which

describes an increasingly complex category of interactions between field quanta and charges.

The problem with this approach is that you are avoiding any real quantization of the field interactions. Yes, you can correlate terms in the perturbative expansion to categories of interaction (Feynman diagrams), but the whole approach is not a true summation of the discrete number of individual interactions per second represented by each Feynman diagram. The use of calculus ensures that the Feynman path integral is *classical by nature*, because you are not summing a finite number of individual quantum interactions, you're summing instead an *infinite* number of differential elements. This is averaging out the quantum effects, just as the use of a wave equation (such as sound wave equation) is a classical approximation that isn't a truly quantized theory because it doesn't deal with the chaotic gas molecules (or quanta) of the gas. In Schroedinger's electron wave equation in quantum mechanics, chaotic individual impacts of Coulomb field quanta are ignored and a classical equation is falsely used. Therefore, a wave equation then has to be used to describe the real chaotic motion of the electron. This false way of dealing with chaos is mathematically very useful (it describes the probability of finding the electron anywhere), but it leads to interpretative problems and it doesn't lead to progress in understanding quantum mechanics. On the contrary, the false mathematical model is increasingly used to argue the case for prolonged ignorance, by claiming that progress is impossible even in principle. Similarly, in the case of quantum field theory (based ultimately on the Dirac equation, which is a relativistic form of Schroedinger equation), the *discrimination* of the path integral expansion into categories (types) of interactions is not quantization, because quantization occurs in the real world at the level of *individual interactions*, not at the (higher) level of *categories of interactions*.

A theory claiming to 'quantize' people into discrete units but which just categorises the groups of people is not dealing with individual people. *If you want to avoid classical physics, you need to deal with field quanta individually.*

If quantum field theory is to represent field quanta individually, it must at the end dispense with the use of calculus, except as a statistical approximation where the number of field quanta involved is so large that individual quanta have no significant effect, i.e., on large scales, and it must replace the path integral with a *sum over individual field quanta interactions*. (This way, the physical origin of the chaos on small scales, such as the lack of

determinism of the trajectory of an electron in an atom, becomes clear: compare the influence of individual air molecules on a fraction of a pollen grain – chaotic Brownian motion – with the smooth motion of a sailboat whose sail receives so many air molecule impacts per second that the randomness in individual strikes is made trivial by the averaging effect of a sheer size of numbers.) Otherwise, by just integrating over differential equations in quantum field theory, you are just *building upon a physically misleading classical theory*.

The Schroedinger and Dirac equations are similarly based on smoothly varying fields characterized by wavefunctions that vary continuously within differential equations. Dr Thomas Love of California State University, in a draft paper, *Towards an Einsteinian Quantum Theory*, points out why mainstream ‘wavefunction collapse’ is just a fiction:

‘The quantum collapse occurs when we model the wave moving according to Schroedinger (time-dependent) and then, suddenly at the time of interaction we require it to be in an eigenstate and hence to also be a solution of Schroedinger (time-independent). The collapse of the wave function is due to a discontinuity in the equations used to model the physics, it is not inherent in the physics.’

It’s important that a mathematical model should correspond to the physical process under examination – such as quantum field interactions – otherwise you start off with a theory which is at best only a statistical approximation and then you run into physical, interpretative, or calculational difficulties. These arise when trying to apply it to individual particles or to understand the reason why differential equations cease applying at certain discrete size scales (e.g., renormalization cut-offs). People start with a *physically flawed* mathematical model of quantum field theory, and then claim that it is ‘beautiful’, or worse, claim there is no physical reality around to be modelled in the first place, and that the false equation *is* physical reality!

1.3 Direct derivation of gravity coupling, G

We will now give a brief demonstration of the theory of the new quantum gravity by using it to calculate the gravity coupling constant, G .

In general relativity, there is direct proportionality between the tensor (differential geometric matrix of terms) which describes the source of a gravitational field (mass, energy, pressure, etc.), \mathbf{T} , and the resulting curvature tensor \mathbf{G} (constructed from the Ricci tensor and its trace) which describes gravitation: $\mathbf{G} = 8\pi\mathbf{T}$. In quantum gravity this relationship,

which is only a statistical approximation anyway (valid where the number of gravitons involved is so large that chaotic indeterminism due to individual gravitons gets averaged, as explained earlier), may break down on certain scales. On *very small scales* and thus strong gravitational fields, it would break down if gravitons were a source of gravity. This would mean that the curvature would increase disproportionately quickly as you increase the field strength; gravitons would increasingly produce (and interact with) other gravitons, instead of merely mediating gravitational interactions between masses.

However, this assumption is defective because – unlike electromagnetism, the weak force and the strong force – gravitation acts not directly as gravitons acting upon particles, but only via an intermediary field (which is the ‘Higgs field’ sector in the Standard Model, which gives mass to all particles). Until the dynamics of the correct mass-giving vacuum field (Higgs field, or a variant theory) have been experimentally justified, there is no evidence for the precise nature of the interaction between gravitons and matter. If the ‘Higgs’-type mass-giving field gives gravitational mass to gravitons and photons, for example, this can physically eliminate the problem of gravitons carrying gravitational charge. Gravitons in this case will not have intrinsic gravitational charge, and will only acquire gravitational charge from another vacuum field. In this case, the presumed small-scale problem of non-renormalizable quantum gravity disappears, and quantum gravity will become a renormalizable theory.

On *very large scales*, there are actually observable effects predicted by quantum gravity. Because the universe is expanding, gravitons exchanged between receding masses over vast distances will be received in a red-shifted condition, with less energy than they had when they were emitted, just as visible light transmitted over such distances between receding objects is red-shifted. This would reduce the strength of the gravitational interaction, reducing the value of the gravitational coupling constant, G . This kind of idea can help explain why no gravitational deceleration of the universe is seen on large scales. However, the mainstream explanation for such a lack of deceleration is quite different: an invisible ‘dark energy’ is assumed to be offsetting gravitation on cosmic distance scales by causing a repulsive force. (This will be examined in more detail in section 1.5 of this chapter.)

Returning to general relativity, the curvature it predicts based on simple conservation

principles is equivalent to a spatial contraction of gravitational field sources. For fields of uniform density, the radial contraction is $(1/3)MG/c^2$ which is 1.5 mm for Earth's radius.

This small contraction in radial distances is accompanied by a contraction of time, called gravitational time-dilation, which has been measured and confirmed using atomic clocks.

General relativity describes these effects and others as being due to the presence of an extra dimension, which is mathematically achieved by treating time as equivalent to a spatial dimension. The three spatial dimensions we observe are distorted as if by the effect of an extra dimension that is manifested in cases of *acceleration* (both gravitational field acceleration and otherwise accelerated motion), so the curvature of trajectories or geodesics is modelled by acceleration-induced distortions in a 4-dimensional space-time.

The quantum gravity theory used below to calculate the gravitational coupling constant is extremely simple, and based entirely upon observable factual evidence. It reproduces all confirmed effects of 'curvature' in general relativity without any actual curvature (many chaotic quantum interactions occurring as discrete interactions add up to *appear* like smooth curvature), including contraction effects which have a simple physical cause.

To start with, both general relativity and quantum field theory postulate some entity in the vacuum (a space-time 'fabric' in general relativity, and a sea of gauge boson radiation in quantum field theory) which causes long-range forces. These models are good approximations to the correct theory of quantum gravity, within their empirically validated realms of application, and therefore a solid approach to building a theory of quantum gravity is to begin with the space-time fabric or gauge boson radiation in the vacuum.

In order to cause forces, individual graviton interactions must carry energy. A falling apple would gain energy from many interactions with gravitons at the fundamental particle scale, causing it to accelerate. The simplest way that this can occur is by straightforward exchange of radiation, which predicts not only gravitation but also the contraction of radial extent of a mass. It's simply a compression effect, similar in some ways to the compression of a ball placed under water, but acting on the fundamental particles and not the macroscopic visible surface area of the object.

The mechanism that allows quantitative falsifiable predictions is tied down to solid facts. The space-time fabric or gravitational field which mediates gravity (as 'curvature' or gravitons, respectively) fills the whole of

empty space between fundamental particles. When fundamental particles move, they disturb the space-time fabric or graviton radiation field. The effects of this disturbance are manifested in several ways. Oscillations of electric charges cause the emission of electromagnetic waves. Oscillations of masses by analogy would be expected to cause the emission of gravitational waves. But because the coupling constant for the force of quantum gravity is typically only 10^{-40} that of electromagnetism, the gravitational waves emitted by oscillating masses are correspondingly weaker than the electromagnetic radio waves from oscillating electric charges. As a consequence of this fact, gravitational waves are exceedingly difficult to detect and measure, unlike radio waves.

Because of the exchange of gravitons between all masses in the universes, the effect of the big bang – resulting in the recession of masses from one another – is important in quantum gravity. The properties of the gravitons exchanged between receding masses are modified when they are received, due to redshift. But there is also another physical mechanism at work that actually causes gravity in the first place, as a result of the cosmological expansion.

This mechanism stems back to the question of what happens when a mass is moved in a gravitational field: is the graviton radiation field affected by the motion of masses? Does the field get compressed ahead of a moving fundamental particle with rest mass, or does it simply flow around it to fill in the void created at the back when a fundamental particle moves? In general relativity, solutions the field equations are successful when they treat the gravitational field as a perfect fluid, so this analogy appears to have empirical validity.

Special relativity describes motion-induced length contraction and mass increase. A particle moving at a velocity v relative to an observer who measures the velocity of light as c is contracted in the direction of its motion by the relative scale factor of $(1 - v^2/c^2)^{1/2}$ while it simultaneously gains inertial mass such that its total energy equivalent increases to the value

$$E = m_0 c^2 (1 - v^2/c^2)^{-1/2}$$

which gives the following approximation using the first couple of terms in the binomial expansion

$$E = m_0 c^2 + \frac{1}{2} m_0 v^2.$$

Here the first term is the well-known energy equivalent corresponding to the inertial rest

mass of the object, and the second term is the well-known kinetic energy of a moving mass.

The physical existence of kinetic energy therefore appears to be associated with the gravitational field. Taking a naïve analogy to drag effects in a fluid, it is well known that the water surrounding a ship (representing a fundamental particle immersed in a graviton field) gives the ship extra inertia and momentum than that provided simply by the mass of material in the ship. This is because some of the surrounding water is caused to flow around the ship, from front to back, as the ship accelerates. Once this displacement wave of thousands of tons of water is set up, it adds a certain extra momentum to the ship. The pressure of fluid against the front of the ship also causes a certain amount of compression. The fluid drag pressure in a fluid is $q = \frac{1}{2} \rho v^2$.

The force acting is therefore the effective cross-sectional area multiplied by this drag pressure, where ρ is the fluid density. Drag pressure is the kinetic energy per unit volume of the fluid. It is easy to draw an analogy to kinetic energy.

$$\text{Force, } F = qA = \frac{1}{2} \rho v^2 A.$$

$$\text{Work energy, } E = Fx = \frac{1}{2} \rho v^2 Ax.$$

If the volume $V = Ax$ corresponds to the effective mass of that volume of the gravitational field which has been added to the mass of the particle (just as the mass of water which is displaced, and is itself flowing around a moving ship, adds to the ship's effective inertial mass by its wave action in pushing in at the rear), it follows that $\rho Ax = m_0$, i.e., the inertial mass gained by the moving body from the surrounding quantum field. Hence,

$$E = \frac{1}{2} \rho v^2 Ax = \frac{1}{2} m_0 v^2.$$

Because the net amount of moving fluid around a moving particle is equal in volume to the volume of the particle, it is expected to have an identical effective mass. The Dirac sea in which positive charge consists of holes in a sea of negative charge, while being an oversimplified picture in many ways, illustrates the basic principle: the density of positive charge in the Dirac sea is identical to that of the negative charge in the surrounding 'sea'. Because the densities are identical, when a moving particle displaces a volume of the surrounding sea equivalent to its own volume, the mass of the surrounding sea which is being displaced is also equal to its own mass. The amount of water displaced by a ship is equal to the ship's mass for a

completely different reason, however (due to the nature of buoyancy), and so care should be taken to avoid confusing the different mechanisms that are involved which explain why the effective mass of the surrounding field which is displaced by a moving particle is equal to the actual mass of that particle. In the case of the Dirac picture of quantum field theory, virtual particles of the vacuum are not physically distinct from real particles: they merely exist with a much shorter lifetime before annihilation. Evidence of this fluid analogy of the field also comes from the success of gravitational predictions (below).

To restate the vital conclusion (so far) in simple terms, the kinetic energy of a moving body is simply the fluid drag energy of the quantum vacuum field that has to flow around moving fundamental particles. The effective increase in mass is just what appears to happen when you cycle in the air and the air pressure stops you from accelerating to ever greater speed: fluid drag effects are identical in some ways to you gaining a lot of extra mass.

In the FitzGerald-Lorentz transformation factor $(1 - v^2/c^2)^{-1/2}$ we that at small velocities very little effect, but an infinite effect arises at light velocity, $v = c$. This is physically explained by the ability of the quantum vacuum field to get out of the way of a moving body. If a moving body goes at a velocity small compared to the velocity of the surrounding quantum field radiation, it has time to move out of the way or be reflected away. If the moving body were able to go at the velocity of light, however, the radiation the moving body would plough into would be unable to vacate the path. It would even be unable to reflect back after hitting the moving object head-on (i.e., at normal incidence), because to be reflected back would require it to travel faster than light. That cannot happen, so a mass moving at light velocity would be continuously retarded to slower speeds due to drag from being hit asymmetrically by gauge bosons (vacuum field quanta). Masses cannot reach that velocity in the first place even in principle because such impacts of gravitons would give rise to an effective mass of infinity.

By the equivalence principle of inertial and gravitational acceleration fields, a gravitational field causes the same contraction as a result of quantum gravity interactions.

Having explained these fundamentals, let us now calculate the force of quantum gravity for a falling particle.

First, we need to know the spin of the graviton. The mainstream way to analyse this is wrong because it neglects the exchange of gravitons between all masses. Ignoring all the

masses in the universe apart from two, spin-1 gravitons would cause masses to repel and a spin of 2 is required to make the path integral of the resulting 5-component tensor field Lagrangian ($1 + 2^2 = 5$ polarizations for spin-2) give an attractive force between masses. Spin-2 is for this reason stipulated by the mainstream to be the spin required for a graviton, since spin-1 would result in repulsion. This false conclusion, which is wrong for failing to acknowledge that to just evaluate the path integral for two masses is to ignore most of the mass in the universe which is also exchanging gravitons with those two masses, has been built upon in 'string theory'.

The correct evaluation is to do a path integral of all the actual graviton interactions between masses in the universe. The conclusion from this analysis is that spin-1 gravitons suffice to produce gravity. Although you might expect two masses exchanging spin-1 radiation (like light) to recoil apart (which is what the mainstream analysis shows to occur), there is some extra physics which must be included.

Going back to the flow of the field around a moving particle, this effective volume of the surrounding field that moves around a moving particle is identical to the volume of the moving particle. The effective mass of the field which is flowing around a moving particle, in the opposite direction to the particle (i.e., being pushed out of its path and flowing around and into to void area being vacated behind it) is equal to the particle's mass.

This means that the motion of matter in one direction results in the motion of an equivalent 'mass' of the field of the vacuum in the opposite direction at the same time. If the matter is accelerating, the same principle applies, and you get an equal acceleration of an equivalent mass of the field in the opposite direction. This implies Newton's 3rd law of motion: every force has an equal and opposite reaction.

One example that at first glance seems to defy this 3rd law of motion is the accelerating mass of the universe. In 1929, Edwin Hubble discovered that the red-shifts in light spectra emitted from galaxies, clusters of galaxies, etc., increased with their apparent distance from us (i.e., looking further and further back in time with distance). There is still religious-style objection made to this since it suggests expansion of the universe. There is solid evidence that red-shifts can be caused by recession of light sources. Some people believe without any evidence whatsoever and contrary to the details of the red-shift that the red-shift is caused by something other than recession. This is not so. For example, if light

is becoming red-shifted for a reason other than recession of light sources, the nature of the red-shifted light would be different to that observed. The most red-shifted radiation observed is the microwave background radiation, emitted as 3,500 K blackbody radiation (mainly infrared) about 400,000 years after the big bang. It has been red-shifted down to an effective blackbody temperature of only 2.7 K, but is still the most perfect example of a blackbody radiation spectrum ever observed in physics because of the terrific uniformity of the universe when it was emitted. This red-shifted light is not the result of dust particles making the light red: such scattering is frequency-dependent and would upset the blackbody radiation spectrum. If light were losing energy or 'getting tired', then this effect could be reproduced in the laboratory. It isn't observed. Astronomer Edward L. Wright has usefully summarised the problems with alternatives to recession as the reason for the red-shift in his internet based page, *Errors in Tired Light Cosmology*:

- 'There is no known interaction that can degrade a photon's energy without also changing its momentum, which leads to a blurring of distant objects which is not observed. The Compton shift in particular does not work.
- 'The tired light model does not predict the observed time dilation of high red-shift supernova light curves. This time dilation is a consequence of the standard interpretation of the red-shift: a supernova that takes 20 days to decay will appear to take 40 days to decay when observed at red-shift $z = 1$. In 2001 Goldhaber and the Supernova Cosmology Project published results of a time dilation analysis of 60 supernovae....
- 'The tired light model can not produce a blackbody spectrum for the Cosmic Microwave Background (CMB) without some incredible coincidences. ... in the tired light model the energy of the CMB photons will go down but the density will not go down to match the density of a cooler blackbody. The local Universe is transparent and has a wide range of temperatures, so it does not produce a blackbody, which requires an isothermal absorbing situation. So the CMB must have come from a far away part of the Universe ... the CMB cannot be redshifted starlight. Some diehards refuse to face these facts, and continue to push tired light models of the CMB, but these models do not agree with the observations.'

In addition, Wright could have added that there is still further evidence of the big bang recession model, e.g., the correct calculation of the abundance of various light elements created by nuclear fusion in the big bang's nuclear fireball. But no amount of fact-based evidence can destroy bigoted beliefs held by fact-ignorers that prefer to worship false ideas like a religion. Now let's examine the recession caused redshift which Hubble discovered in 1929. The observed recession velocity, v is directly proportional to the distance of the light source from us when the light was emitted, R :

$$v = HR,$$

where H is Hubble's 'constant'.

We need to remember space-time here. The distance R is not an instantaneous distance, but is the distance to the receding light source at that time in the past when the light was being emitted. In the period when the light has been travelling to us, the light source will certainly have receded to a still greater distance. (This is something to bear in mind if planning a trip in a spaceship to a distant galaxy!) The time taken for light to reach us from distance R is equal to $t = R/c$. Therefore in this interval, a receding galaxy will recede the additional distance $vt = (HR)(R/c) = HR^2/c$.

Therefore there are two distance scales: the *apparent* distance to the receding light source is $R = v/H$, but if we wanted to reach the light source (even if we could get to it *instantly*) we would need to go the distance $(v/H) + HR^2/c$. To get around this ambiguity of 'distance', we can recall that space and time are interrelated and simply refer to distances as times in the past when the light was emitted. This is in fact exactly what is done when distances are measured in units of time, such as light-years.

The recession velocity proportionality to distance is *therefore equivalent to a recession velocity proportionality to time past*. Acceleration is a variation of velocity as a function of time, so there is acceleration present. Velocity is defined in calculus as $v = dR/dt$, and acceleration is the derivative of velocity, $a = dv/dt$, so

$$a = dv/dt = d(HR)/dt = (H.dR/dt) + (R.dH/dt),$$

where the term $R.dH/dt = 0$ because H is a constant. So the acceleration of our universe is

$$a = dv/dt = H.dR/dt = Hv = H(HR) = H^2R.$$

This *new result* dates back to an idea of April 1996 and was published in a paper via the October 1996 issue of the British periodical *Electronics World*. The outward force of a receding galaxy will be, by Newton's 2nd empirical law (force $F = dp/dt$, where p is momentum, which for our purposes here is about $F = ma$), the mass of that galaxy multiplied by the acceleration H^2R . The outward force of a receding galaxy of mass m requires power $P = dE/dt = Fv = mH^3R^2$, where E is energy. The exchanged gravitons which push nearby bits of matter together, as we will demonstrate shortly, *also push masses apart on large scales*, just as air pressure causes air to expand if there is no boundary to confine the gas. *The energy which gravitons 'lose' over vast distances due to red-shift is actually the energy that is causing the acceleration of the universe in this manner.* (We will treat this and related matters in more depth in section 1.5 on cosmology.) By Newton's 3rd law of motion, there is an equal and opposite force produced in reaction to the outward force of that galaxy which is receding from us. We have already discussed the appropriate dynamics of the space-time fabric or graviton field for explaining what carries this reaction force. The reaction force is graviton radiation! If you want to imagine how graviton radiation can have force, consider the analogy of air molecules hitting your wall. The impacts produce impulses that transfer momentum, and force is the rate of change of momentum. The product of the pressure exerted and the wall area gives you the force. We can now see what is occurring physically. The outward motion of matter in radial symmetry about us results in an inward-directed reaction force, carried by gravitons!

To understand why masses get pushed together, we just have to emphasise that a net force due to graviton exchange in this fact-based model ($v = HR$ is an observational fact, Newton's laws are observational facts) can *only exist where masses are receding from one another*. If you have two particles that are nearby and are not receding (or have only a small recession) then the force of exchanged gravitons between them is nil (or trivial), because neither emits a significant recoil force via gravitons in the other particle's direction. The exchange of gravitons with other distant and faster receding masses in the surrounding universe will not be trivial, however. So the two masses will be *pushed together* by graviton exchange radiation from the surrounding universe. *So gravitons are a repulsive, spin-1 radiation: they simply exert pressure, which pushes things together.* But if

the gravitons are exchanged between masses *so distant* they are receding at almost c , their graviton emission is so red-shifted it is weak.

Two competing factors actually need to be offset against one another when considering the inward force resulting from matter that is receding at great distances. First, as we look to greater distances, we're looking back in time to earlier and denser parts of the universe. The effective rise in density tends to approach infinity as we look back towards the instant of the big bang. This effect would tend to increase the effective outward force and inward reaction force contributing to inward graviton radiation hitting us, but the increasing red-shift of the gravitons arriving here from ever greater distances offsets this effect.

Now let's calculate the actual force of gravity by the spin-1 graviton mechanism. First, let's review what is physically occurring. In the $U(1) \times SU(2) \times SU(3)$ gauge theories we're considering, the charges and field quanta are massless. Masses are supplied to massless $SU(2) \times SU(3)$ charges and some of the gauge bosons by a $U(1)$ quantum gravity field. The gravitational mechanism evidence which predicts the strength of gravity, G , is independent of the mass model to a large extent. But the mass model is itself one for which we have plenty of evidence, as we shall see briefly in this and later sections of this chapter (and in more depth in later chapters).

Basically, the mass model uses a single particle with the 91 GeV mass of the massive weak neutral gauge boson, the Z . The masses of all particles in the universe are derived from combinations of integral numbers of this mass. Smaller masses arise from the shielding, by the polarized vacuum, of the coupling between massive 91 GeV vacuum particles and $SU(2) \times SU(3)$ particles. Gravitons are exchanged between the massive 91 GeV particles in the vacuum which become associated with $SU(2) \times SU(3)$ particles. It is possible that the 91 GeV massive particles (which in this model replace the role of the Higgs field in the Standard Model) have their own gauge symmetry, which would be of the $U(1)$ variety. If this is so, the correct gauge symmetry of the universe would be $U(1) \times SU(2) \times SU(3)$, like the Standard Model, but with a completely different physics assigned to $U(1)$ and also a serious modification of the physics of $SU(2)$. The chief question here is how the massive particles are attracted and bound to $SU(2) \times SU(3)$ charges to give them stabilised masses. It appears to be the case that the neutral massless gauge boson in $SU(2)$ is not the graviton but plays the role of binding the

massive particle to the charges; in which case the graviton is the $U(1)$ gauge boson.

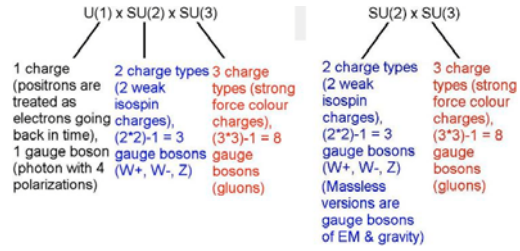
The graviton is a separate particle only operating between the field quanta of the mass-giving field (the replacement for the mainstream Higgs field). Since we have only one type of mass-field charge which gives rise to all masses, this single charge is described by $U(1)$, and the gauge boson of this charge is the graviton. Hence, we're back to $U(1) \times SU(2) \times SU(3)$, but the $U(1) \times SU(2)$ in our (gravity-including) model is different to the electroweak sector of the Standard Model (whose group structure is superficially similar). Whereas, in the Standard Model, $U(1)$ represents electromagnetic charge and photons as gauge bosons, now $U(1)$ represents mass and gravitation. This very interesting and possibly correct alternative scheme will be discussed in detail later in this book.

One further thing to briefly discuss here, before calculating gravity, is the physical mechanism for gravitation. The gauge boson radiation that causes gravity is simple spin-1 exchange radiation travelling at the velocity of light. It acts on the massive particles in the spacetime fabric (the 'Higgs field' or its substitute), and thus causes accelerations that can be approximated by the 'curvature' of trajectories (geodesics) in general relativity. Actually, there is no smooth curvature in a properly quantized quantum gravity theory. The individual graviton interactions change trajectories at discrete points, but where the number of interactions is very large, the randomness in the irregularities of impacts is well approximated by the calculus as a smooth curve on a plot of space versus time, i.e., 'spacetime curvature'.

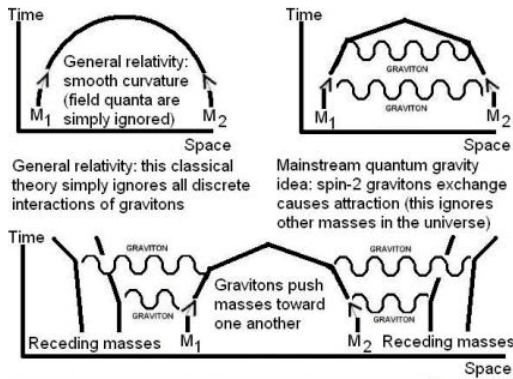
There is some theoretical evidence that individual interactions, of gravitons with massive particles in the vacuum, is actually a black hole radiation emission process. Fundamental particles that participate in Yang-Mills exchange radiation interactions, as we shall demonstrate, are black holes. The Hawking radiation they emit is the source of the gauge bosons. Hawking radiation falls into them normally at a similar rate to the Hawking emission rate (equilibrium of forces occurs). If the rates of reception and mission are different, acceleration of the charge occurs, due to the changing amount of kinetic energy and potential energy from a net flow of Yang-Mills gauge bosons to the particle or away from it. Gravitons fall into massive particles, and the emitted Hawking radiation is the 'exchanged' graviton radiation. Quantitatively, this Yang-Mills exchange radiation process is a type of reflection:

incoming radiation from one direction is absorbed and new Hawking radiation is then emitted back in the same direction from which the incident radiation came.

The SU(2) mechanism for electric charges works similarly, except that we take account of the electric charge of the black hole and its interaction with massless charged electromagnetic gauge bosons. These interactions physically explain the reason why similar electromagnetic charges attract, and dissimilar charges repel, as will be proved in section 1.6.



Calculation of gravitational coupling: quantum gravity field mechanism



Correct model of quantum gravity, including graviton exchanges between all masses including those in the surrounding, receding universe: gravitons are spin-1 gauge bosons, not spin-2. Outward matter recedes at $v = HR$ so has spacetime acceleration, $a = dv/dt = d(HR)/dt = (H.dR/dt) + (R.dH/dt) = Hv = H(HR)$. This produces outward force of receding mass, $F = ma$. Newton's 3rd law implies equal inward force, mediated by inward gravitons. Non-receding masses don't exchange gravitons forcefully, so shadow each other.

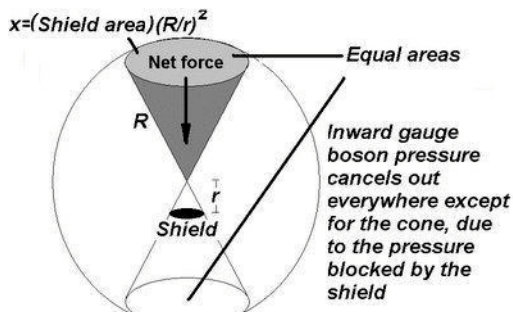
Hubble's empirical law: $v = dR/dt = HR$
 $a = dv/dt = R.dH/dt + H.dR/dt = 0 + Hv = RH^2$

Force, $F = dp/dt = M.dv/dt + v.dM/dt = Ma = MRH^2$

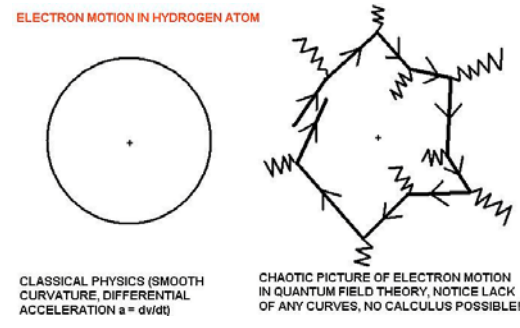
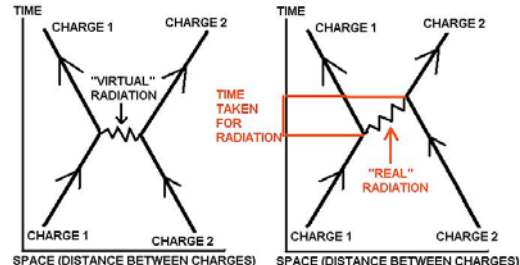
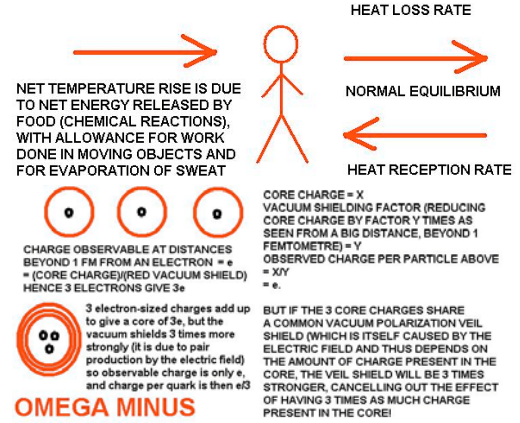
Newton's 3rd law: equal reaction force

Reaction force carried by spacetime fabric (spin-1 gravitons)

=> DISTANT receding matter produces large inward reaction force via gravitons, but NEARBY matter does not. Nearby matter is thus a shield.



Outward force = $ma = m.dv/dt = m.d(HR)/dt = mvH$
 Inward force of big bang = outward force (3rd law)
 Gravity force = (inward force of big bang). $x/(4\pi R^2) = mvH(\text{Shield area})(R/r)^2/(4\pi R^2)$



(Version 1.23, 25 Feb. '08. To be continued by revising, improving, and condensing from blog <http://nige.wordpress.com/about/>, etc.)