QFT'S non-speculative, automatic predictions of particle masses: a re-presentation of the model on page 48 of our paper vixra 1111.0111, U(1)xSU(2)xSU(3) QG successes

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ABSTRACT

We re-present a theory *entirely based on observed, accepted components of QFT, re-arranged more logically to produce checkable calculations of particle masses*. Consider first the heavy isomers of the electron, the decaying muon and the tauon. These heavy leptons particles have additional mass, and the ability to undergo decay. A simple theory for heavy masses is readily available in QFT, in the well-checked phenomenon of mass and charge renormalization. Where enough energy is available in a collision, virtual particle pairs that form in the force field around an electron due to normal vacuum pair production, may be sufficiently radially polarized that they acquire enough energy to form a metastable, beta decaying, effectively onshell arrangement rather than annihilating quickly as predicted by the offshell (Heisenberg) energy-time law. Pair production with vacuum polarization of the pair by the field is a process which absorbs energy from the field, and enough potential energy from the field can be absorbed by the pair to enable them to approach a effectively onshell, metastable state that enables them to live longer than predicted by Heisenberg's law (which strictly applies to offshell, or virtual, particles). This accounts for the significant decay lifetimes of the case of heavy generations, muons and tauons. Generalized, it predicts the generations of the Standard Model.

1. Virtual fermions are radially polarized (driven further apart) by the electric field in which they formed.

2. This polarization supplies the virtual fermions energy, at the expense of electric field, which is thus partly "screened."

3. The energy supplied to virtual fermions by their radial polarization extends their lifetime beyond Heisenberg's $\hbar/E$.

4. This supply of extra energy moves "virtual" fermions towards the real mass shell, so they briefly obey Pauli's principle.

5. As a result of this, the "virtual" fermions become structured like electron orbits, thereby contributing quantized mass. Different isomers are possible which allow various weak decay routes, thereby predicting the CKM matrix mechanism.

6. Neutrino mass data suggests flavor oscillations are geometric differences in the vacuum structuring of their masses.

In other words, pairs of virtual fermions formed around an electron core can in collision processes gain enough energy to effectively become onshell particles. Thus, the virtual pairs of fermions becomes non-virtual, so they survive long enough to become structured by the Pauli exclusion principle into a shell structure. By analogy to electron or nucleon shells, they have particularly "stable" structures consisting of certain numbers of virtual particles, and *only these relatively stable structures persist long enough to actually be observed with the half lives of the muon and the tauon*. Other combinations also exist, but because they are less stable they disappear too quickly, leaving the muon and tauon observable.

This *step-by-step listing of the key physical processes in mixing and mass mechanisms* is not included explicitly on pages 48-49 etc., of our 30 November 2011 paper, vixra 1111.0111, "U(1)XSU(2)XSU(3) Quantum Gravity successes". The reason for this new paper is an effort to avert the superficial appearance of brievity and to overcome what Professor Jacques Distler has kindly described as a dyslexic "word salad" physics confusion. (While vixra 1111.0111 briefly compiles all the key details, it is clearly not a student textbook. We have published journal articles, but with time restrictions the quality of the organization of the writing of a scientific paper decreases if efforts are focussed instead upon the difficult challenge of forestalling a vast number of possible potential objections and and queries.)

In an ideal world, we would have resolved all the problems and foreseen all the consequences within 10 minutes of coming up with our original QG calculation in 1996, and then we could have concentrated on organizing the material into a textbook. In the real world, science isn't like that. Put it this way: if it was that quick and easy then somebody else would have done so, probably Feynman, fifty years ago. It has absorbed a lot of effort, and the brief literary write up doesn't make it easy for a reader to grasp. The theory needs consolidation by re-organization and improved presentation, which will make it easier and faster for outsiders with limited interest in "mere mechanisms" to understand.

INTRODUCTION

We won't repeat the abstract over again here, but will discuss other aspects. Fermion "bare core" charges (which become more observable in high energy collisions) are greater than their normal textbook (low energy measurement) values, due to the fact that the cores are normally "shielded" by pair-production of virtual fermions. The virtual fermions only exist for practical purposes between two radii, one being a very short radius (normally taken to be the Planck scale) and giving a UV (high energy) cutoff on the logarithmic running of the effective charge (force field coupling) and the other is a larger radius on the order of the classical electron radius for low-energy (Thomson) scattering.

The reason why a short-ranged (UV) cutoff exist is simply that QFT requires it, to prevent vacuum polarization giving unphysically large amounts of momentum and energy to field quanta as zero radius is approached. (By analogy, the "inverse square law"applied to sunlight intensity "predicts" infinity at zero radius inside the sun; in reality that's clearly false because the sun's core is at 14 million K or so, not infinity. The geometric "inverse square law" is useful when you are at a distance large compared to radius of the light source. It doesn't include all the detailed mathematics of the fusion mechanism within the sun, so it breaks down within the sun's radius, where ionized matter is opaque to sunlight so that light intensity is dependent on local physical processes of absorption and emission.)

The physical limit of the UV cutoff energy is not needed in existing mainstream experimentally confirmed calculations, since you only need to calculate the running of the coupling to energies achievable in particle colliders, currently the LHC TeV energy scale, which is far from the Planck scale. However, consensus or groupthink orthodoxy currently asserts that the Planck scale is the ultimate short ranged UV cutoff energy, based not on direct experimental data but on various speculations and interpretations of extrapolations which don't carry any water (from our perspective). One is Planck worship: Max Planck's numerology of combining constants (including his own Planck constant), results in a Planck length and other related parameters. Since he discovered the Planck radiation spectrum formula, this is taken as fact. Another argument for the Planck length is that it has become part of the prattle of "string theorists" like non-Nobel Laureate Edward Witten, who are deemed to explain the UV cutoff as being due to the unproved fact the particles are Planck length-sized strings or loops.

Thirdly, and most interestingly, the Planck length corresponds to a collision energy that leads to the Standard Model's electroweak and strong running couplings all "unifying" at a "Marxist equality" point on a graph of coupling strength versus collision energy, provided that you merely

(1) double the number of particles in the universe by adding supersymmetric particles ("sparticles"), each with half inter spin difference to the known particles,

(2) make these extra particles of much higher energy than the existing particles (over 100 GeV), to explain why they have not so far been observed,

(3) add over 100 extra (and unknown valued) parameters to the Standard Model, to make at least a Minimally Supersymmetric Standard Model,

(4) explain away the extra 6 dimensions of space needed to account for this supersymmetry by compactifying them in in a "landscape" of 10^{500} different ways (parallel universes) using unknown, unproved metastable Calibi-Yau manifolds stabilized by charged branes or other imaginary constructs of eite genuises.

We reject it as physical garbage, unproved either by a meaningful theory: after all, the black hole radius of an electron is far smaller than Planck's length and has physical significance as proved in our 2011 paper, so why not use that instead? The running couplings don't need supersymmetry to produce a grand unified theory if you both go over to the black hole scale as the UV limit, and also switch your ideology from Marxist "equality" to force field energy conservation, wherein the *decreasing energy density* of the strong force coupling with increasing energy (or decreasing distance) is physically connected to the *increasing energy density* of the electric field as you approach a quark.

In other words, the physical mechanism for the opposite variation of the strong and electromagnetic running couplings with energy is simply this: the energy used by the electromagnetic field to create virtual pairs *automatically makes some quark pairs with colour charged gluons which effectively creates the running of the strong charge around a quark.*

What we're saying is that there's a simple mechanism involved, just as Feynman was originally ridiculed at Pocono in 1947 for coming up with simple Feynman interaction diagrams to understand, organize, explain and develop the hitherto obstruse mathematical "theory" of QFT. This renormalization mechanism, while originally considered a mathematical tool only, has well established experimental evidence for its mechanism of pair-production. Quarks have large masses because their strong color charge field produces a great effective mass of virtual particles, electrically charged leptons like electrons have smaller masses because electric charge is weaker than the strong force, and neutrinos have very small masses because their weak isospin charge is of weak strength compared to strong and electromagnetic charge.

This detailed mechanism yields checkable, non-*ad hoc* predictions of particle masses.Vacuum polarization of virtual fermions supplies them energy, by moving the oppositely charged virtual fermions apart, extending their lifespan (time to annihilation) beyond Heisenberg's $t = \hbar/E$, at the expense of the energy density of the Coulomb field which is polarizing them. Hence, vacuum polarization "screens" the Coulomb field, causing the well-established basis for renormalization (the running of the coupling or effective charge in the region between a low energy "infrared" cutoff and the high energy "ultraviolet" cutoff). Thus, vacuum polarization pushes truly off-shell particles towards the being on (mass) shell, so like real particles, they are no longer totally chaotic, but instead survive long enough to be subjected to orbit-type structuring by the Pauli exclusion principle, so they contribute a quantized mass to the total mass of the particle in a simple, predictable way. We prove this mechanism and give its predictions.

The radial charge-polarization mechanism for pair production around lepton cores of virtual color charged quarks (at high energy, beyond existing experiments) spontaneously transforms the "screened" electric charge energy into geometrically "emergent" strong color charge (i.e. radially polarized color charge surrounding a lepton core). This explains the fractional (screened) electric charges of quarks which are observed, and binding pairs and triplets of leptons into effective mesons and baryons of quarks with the observed strong running coupling. This unified the running couplings for electroweak symmetry with quantum chromodynamics without requiring supersymmetry, and it also resolves two major existing SM beta decay anomalies and predicts existing ad hoc SM couplings and mixing angles.

A quantum field basis for particle mass is established. The charge of a particle causes pair production of off-shell (virtual) particles in the surrounding vacuum with a lifetime given by Heisenberg's uncertainty principle, but because of vacuum polarization, these virtual particles are pulled apart, extending their lifetime beyond that predicted by the Heisenberg uncertainty principle, making them approach the mass shell and hence giving them a transient real mass. Virtual fermions which are polarized and approach the mass shell condition are influenced by the Pauli exclusion principle, which therefore structures the polarized vacuum particles into shell structures analogous to electron or nucleon shells, which predicts the three generations of the Standard Model by analogy to isotopes of nuclides (e.g. the different masses and stability for electrons, muons, and tauons), the CKM matrix amplitudes for weak decays to result in different generations, and neutrino mixing.

Quarks have large masses because their strong color charge field produces a great effective mass of virtual particles, electrically charged leptons like electrons have smaller masses because electric charge is weaker than the strong force, and neutrinos have very small masses because their weak isospin charge is of weak strength compared to strong and electromagnetic charge. Comparisons between the predictions and observations are provided. This theory makes checkable quantitative predictions which are more accurate and extensive than the usual lattice (non-perturbative) QCD calculations which of course do not include predictions of lepton masses.

HISTORY: RELEVANT LITERATURE SUMMARY

Nobel Laureate Yoichiro Nambu, the proposer of QCD color charge and the discoverer of the Nambu-Goldstone spontaneous symmetry breaking theory for strong interactions in 1960, in 1952 published *An Empirical Mass Spectrum of Elementary Particles* (*Progress in Theoretical Physics,* v7, 1952, pp. 595-6), arguing:

"It seems to be a general conviction of current physicists that the theory of elementary particles in its ultimate form could or should give the mass spectrum of these particles just in the same way as quantum mechanics has succeeded in accounting for the regularity of atomic spectra. ... it may perhaps be too ambitious and rather unsound to look for an empirical 'Balmer's law'. Nevertheless we should like here to present one such attempt because it happens to be extremely simple ... The π-meson [pion] mass, being ~274 = 137 x 2 electron masses (m_e), gives us a second, rather fanciful hint that $137m_e$ could be chosen as the unit ... the adopted mass unit incidentally agrees with Heisenberg's natural unit. ... Bosons seem to have integral, while fermions half-integral, mass numbers. ... The small mass value of the electron ... as well as the proton-neutron and [charged pion compared to uncharged pion] mass differences correspond to a kind of fine structure. Indeed, their magnitude is just of the order of 1/137 mass units. ... only those particles which have favorable lives as well as abundances for detection have so far been observed, and we have to grounds at all to exclude the possibility that there exist other particles which are liable to escape direct observation."

Nambu showed that the muon and the nucleon are 1.5 and 13.5 respectively, in mass units of $137m_e$ or m_e/α just as expected for half-integer fermion spin, while the Pion is 2.0 in similar units, as expected for integer boson spin. Nambu's theory is therefore that fermionic (half-integer spin) particles should have a mass of $\frac{1}{2}\ nm_e/\alpha = 35.0n$ MeV, where n is an integer, while bosonic particles should have a mass of $1\ nm_e/\alpha = 70.0n$ MeV. He attributed lepton masses and the "mass splittings" or differences in mass between charged and neutral versions of particles like pions to "fine structure," namely, masses smaller than the unit for hadrons by a factor of 1/α. Another mechanism affecting Nambu's mass predictions lies in a constant coupling α, due to the fact α runs as a function of the logarithm of the energy, and is only a constant for energies below the IR cutoff, $m_e \sim 0.5$ MeV. This is the energy needed for colliding particles to experience an electric field exceeding Schwinger's threshold electric field strength for pair production, 1.3 x 10^{18} v/m.

In 1978, the three generations of leptons and quarks of varying masses led Sheldon Glashow (*Comments Nuclear and Particle Physics*, v8, 1978, pp. 105) to remark:

"We have no plausible precedent for, nor any theoretical understanding of this kind of superfluous replication of fundamental entities. Nor is any vision in sight wherein the various fermions may be regarded as composites of more elementary stuff. No problem is more basic than the property of flavor, and it has been with us since the discovery of muons. Sadly, we are today no closer to a solution."

While some investigators attempted to tackle this problem using "top down" grand unified theories like SO(10) and later superstrings, A. O. Barut in 1979 responded to Sheldon's challenge by publishing a mechanism to explain and predict the three generations of leptons in a paper called *Lepton Mass Formula* (Physical Review Letters, v42, 1979, p. 1251), arguing for a link to the anomalous magnetic moment of leptons, $1 + \frac{1}{2\pi}\alpha$ Bohr magnetons:

"Recently I have suggested that the mass formula for the muon, $m_\mu = m_e + \frac{3}{2}m_e/\alpha$, can be derived on the basis of magnetic self-interaction of the electron. The radiative effects give an anomalous magnetic moment to the electron which, when coupled to the self-field of the electron, imply extra magnetic energy. ... The magnetic energy of a system consisting of a charge and a magnetic moment quantized according to the Bohr-Sommerfeld procedure implies quantized energies $E_n = \lambda n^4$, where n is a principal quantum number. [Bohr-Sommerfeld quantization gives $mvr = n\hbar$ so that $r = n\hbar / (mv)$, which is inserted into the magnetic dipole force $F = ma = mv^2/r = q\mu\, v/r^3$ giving quantized magnetic energy $\frac{1}{2} mv^2 = \frac{1}{2}\, n^4\, \hbar^2/(q\, v)^2$. So energy is proportional to n^4 where n is an integer.] Determining the proportionality constant λ from the muon-mass formula (n = 1), we obtain $m_\tau = m_\mu + \frac{3}{2}\; n^4 m_e/\alpha = m_e + \frac{3}{2}m_e/\alpha + \frac{3}{2}\; (2)^4 m_e/\alpha$ = 1,786 MeV."

Barut's theory gives electrically charged leptons quantized masses of

Electrons (n = 0):	m_e
Muons (n = 1):	$m_\mu = m_e\, [1 + \frac{3}{2}\; (1)^4/\alpha]$
Tauons (n = 2):	$m_\tau = m_e\, [1 + \frac{3}{2}\; (1)^4/\alpha + \frac{3}{2}\; (2)^4 m_e/\alpha]$.

Hans de Vries and Alejandro Rivero[4] (4: arxiv hep-ph/0503104 v1) in 2006 published *Evidence for Radiative Generation of Lepton Masses,* correlating Schwinger's tree-level lepton magnetic dipole moment anomaly with weak boson masses:

$$\frac{1}{2\pi}\,\alpha = m_\mu / m_z = 0.00116, \text{ giving } m_\mu = \frac{1}{2\pi}\,\alpha m_z.$$

and the vacuum polarization (loop) difference between magnetic dipole moment anomalies for the muon and electron:

$$(\alpha/\pi)^2 = m_e / m_z = 5.60 \times 10^{-6}, \text{ giving } m_e = (\alpha/\pi)^2\, m_z,$$

after allowing for the running of α to the collision energy scale for measurement of m_z = 91.19 GeV. The muon's magnetic dipole moment anomaly is larger than the electron's because of the muon's larger mass, yet the perturbative expansion used to calculate the factor of roughly $(\alpha/\pi)^2$ did *not* involve the mass m_z so it is not "circular reasoning".

There is a simple physical mechanism for Z bosons arising from pair production in the weak force fields around a *moving* lepton to act as massive *neutral currents,* physically miring the motion of the lepton, and thus contributing mass.

Robert A. Stone, Jr.,[5] (5: *Progress in Physics,* v1, 2010, pp. 8-10) in 2010 published *Is Fundamental Particle Mass 4π Quantized?,* finds that $m_w = 2m_p/m_e$ = 80.4 GeV, where m_p is uniquely significant because it is the only stable hadron. A similar factor 2 occurs in a correlation between weak and Higgs boson mass[6]: $m_H = (2m_w + m_z)/2$ = 126 GeV.

The Higgs "mechanism" for particle mass in the Standard Model doesn't predict any masses, so is unsatisfactory. Once the mass of the Higgs boson is put into the Standard Model, Feynman's rules easily permit the spin-0 massive propagator to be evaluated in a perturbative expansion to calculate the interaction probability cross-sections for various different Higgs reaction rates, and these agree with measurements. This just "validates" the Feynman rules, the empirical laws of the Standard Model, and the existence of a spin-0 boson. It doesn't prove that the exact structure of the Standard Model is completely correct. Our evidence (see our 30 November 2011 paper) suggests that the mathematics of the SM groups, U(1) x SU(2) x SU(3) is correct but also shows that there is a mainstream misunderstanding in the U(1) x SU(2) electroweak group, affecting the details of the mixing and symmetry breaking (which occurs in a slightly different way to Higgs's idea, although you still of course get a spin-0 boson).

In short, U(1) hypercharge is the symmetry group for the repulsive, universal "dark energy" that produces "quantum gravity" predicted in 1996 by our first paper, as a LeSage effect by analogy to the Casimir force mechanism of electromagnetism. SU(2)'s massless charged bosons gives a two-charged boson electromagnetic theory, since SU(2) unmixed with the mass-giving quantum gravity U(1) gives charged massless bosons that correctly have infinite magnetic self-inductance (preventing one-way propagation). This physical mechanism (infinite magnetic self-inductance) that prevents any one-way propagation of massless electrically charged bosons automatically cancels the charge-transfer term out from the Yang-Mills (non-Abelian) equations so they appear to use as the Maxwell equations.

To put it another way, the quadratic term is zero for charged massless gauge bosons. For the exchange (two-way propagation) of similar sign charged, massless bosons between two similar charges, the curls of the magnetic fields cancel out and so does the problem of infinite magnetic self-inductance. Hence, there's a physical basis for saying that SU(2) with massless charged bosons is the symmetry group for electromagnetism.

Not only that, but by getting rid of U(1) as the electroweak kernal for Maxwell's electrodynamics (it becomes the kernal for mass, because dark energy causes effects traditionally attributed to quantum gravity), we get rid of Dirac's antimatter problems. E.g., if U(1) is behind electromagnetism, then all positive charges must be anti-particles of negative particles, because U(1) has only one charge element! This causes terrible problems in physics, because matter predominates over anti-matter.

As we stated in the 30 November 2011 paper, the particular (non-random) handedness of the magnetic field's curl around the direction of propagation of electrons or electric current was explained by a chiral mechanical model of spin by James Clerk Maxwell. This theory is a chiral SU(2) theory, akin to the chiral (left-handed) weak interaction! Mathematical obfuscation since Maxwell's time has censored out his model of gauge boson spin using Einstein's arguments against quantum field particles, which went out of fashion when the SM was validated in the early 1970s. But by that time, Maxwell's SU(2) physical model of gauge boson spin processes had become as popular as Lamarkian evolution was in Darwin's time, and anybody mentioning it was basically wearing a target circle for the bigots of physics to shoot at in an effort to be awarded prizes like censorship ("peer" reviewer) jobs for "professional" (i.e. $) journals.

Our point is that SU(2) with massless bosons - i.e. when SU(2) is unmixed with U(1) which provides the mass - gives you the Yang-Mills equations of electrodynamics which due to the self-inductance mechanism automatically lose their quadratic term, effectively reducing them to the regular Maxwell equations we all know so well. But the mixed portion of SU(2) gives rise to the massive SU(2) bosons which media the weak force just as in the regular SM. In other words, we're pointing out that not all the SU(2) bosons undergo mixing with U(1), and arguing that this *partial* mixing only, explains why the weak interaction (via massive SU(2) bosons) is *left-handed.* Weyl showed that the Dirac equation's spinor can be decoupled into two handed terms, and these can be used for SU(2) representations.

HIGGS BOSONS AND THE MECHANISM OF U(1) X SU(2) ELECTROWEAK SYMMETRY BREAKING

Weak boson "mass" is given by combining 1 longitudinal polarization from a spin-0 Goldstone boson to 2 transverse spin polarizations from a massless spin-1 boson, giving 3 polarizations, i.e. a massive spin-1 boson. This combination is analogous to symmetry-breaking condensates, like Cooper pairs of electrons.

Anderson's 1963 paper "Plasmons, gauge invariance and mass" (*Physical Review,* v. 130, p. 439) argued that Nambu's 1960 idea that pions are low-energy, symmetry-breaking Goldstone bosons is analogous to the idea that in superconductivity, Cooper pairs of electrons are a symmetry-breaking bosonic condensate. The "symmetry" in the gas of conduction-band electron current flow at high energy is broken at low energy, where conduction electrons move slowly and so are able pair up (under the Pauli exclusion principle) into condensates, which behave like massive bosons, allowing electric currents to flow with very little resistance. The surfaces of such conductors are superfluids. But the massive Cooper pairs of low-energy electrons in superconductivity are a non-relativistic situation. Anderson didn't prove that it applied to relativistic gauge theories, and Gilbert claimed incorrectly in 1964 that Lorentz invariance prevents Anderson's non-relativistic analogy from applying to gauge theory (*Physical Review Letters,* v12, p. 713).

Higgs's 1964 paper, "Broken symmetries and the masses of gauge bosons" (*Physical Rev. Letters,* v. 13, p. 508) overcomes Gilbert's objection in the *relativistic* case, by showing that massless gauge bosons can gain mass when a spin-0 Goldstone boson from a broken local symmetry mixes with a massless gauge boson. Two polarizations from a massless spin-1 vector boson combine with the single polarization of the spin-0 Goldstone boson to give three polarizations which constitute mass (2 + 1 = 3 polarizations). Applying this to broken electroweak symmetry, an additional spin-0 boson with 3 polarizations was predicted, a "Higgs boson". Anderson has a physical mechanism, but Higgs did the arithmetic and made a prediction. (Higgs original paper didn't mention his spin-0 boson, and the referee turned the

paper down. This forced Higgs to think about implications, leading to his prediction of a spin-0 boson.)
CONCLUSIONS

Feynman's 1985 book *QED* forcefully argued that the Standard Model is inconsistent, inelegant and incomplete. We highlighted in our 20 November 2011 paper a typical inconsistency in the beta decay scheme interpretation, which arose after the introduction of weak vector bosons (the previous beta decay of Fermi lacked this inconsistency because it contained no weak boson). Note that the existence of weak bosons is an experimental fact. The problem is therefore in the *dogmatic interpretation of beta decay,* which distinguishes leptons from quarks by the fact that leptons don't have strong color charge but quarks do. We predict is that color charge emerges at extremely high energy at the expense of electric charge: the fractional electric charges of quarks is due to vacuum pair production (including production of colour charged particles with colour charged gluons) and associated vacuum polarization screening, which permits a mechanism for strong color charge effects to emerge spontaneously from the fields around leptons at extremely high energy, beyond existing experiments.

In addition, the mechanism makes a new prediction which unifies leptons and quarks at an energy beyond existing experiments, since the pair production of virtual color charged particles with color charged gluons in very strong (high energy) lepton electromagnetic fields gives a mechanism by which leptons can be transformed into quarks, by transforming some electric charge energy into effectively into "emergent" strong color charge. This makes new predictions about unification of the running couplings, and also resolves existing anomalies and calculates existing ad hoc SM couplings, etc.

A quantum field basis for particle mass is established. The charge of a particle causes pair production of off-shell (virtual) particles in the surrounding vacuum with a lifetime given by Heisenberg's uncertainty principle, but because of vacuum polarization, these virtual particles are pulled apart, extending their lifetime beyond that predicted by the Heisenberg uncertainty principle, making them approach the mass shell and hence giving them a transient real mass. Virtual fermions which are polarized and approach the mass shell condition are influenced by the Pauli exclusion principle, which therefore structures the polarized vacuum particles into shell structures analogous to electron or nucleon shells, which predicts the three generations of the Standard Model by analogy to isotopes of nuclides (e.g. the different masses and stability for electrons, muons, and tauons), the CKM matrix amplitudes for weak decays to result in different generations, and neutrino mixing. Quarks have large masses because their strong color charge field produces a great effective mass of virtual particles, electrically charged leptons like electrons have smaller masses because electric charge is weaker than the strong force, and neutrinos have very small masses because their weak isospin charge is of weak strength compared to strong and electromagnetic charge. Comparisons between the predictions and observations are provided. This theory is quantitative and allows physical predictions which have been confirmed, and are more accurate and extensive (including leptons) than the usual lattice (non-perturbative) QCD calculations (which obviously don't include any predictions of lepton masses).

Our 30 November 2011 paper contains the following predictions and comparisons to experiment:

❒Dark energy: equation... comparison to observational data ... (see 30 November 2011 paper for details)
❒Gravity coupling: equation... comparison to observational data ... (see 30 November 2011 paper for details)
❒Masses of hadrons: equation... comparison to observational data ... (see 30 November 2011 paper for details)
❒Masses of leptons: equation... comparison to observational data ... (see 30 November 2011 paper for details)

1. Simple energy conservation mechanism for local wavefunction invariance in gauge field theory

By Noether's theorem, gauge field theory's local and global symmetries are physical processes for energy and charge conservation mechanisms, respectively. In 1929, Weyl differentiated the complex exponential solution to the Schroedinger equation, $\Psi_S = \Psi_0 e^{iS/\hbar}$ as follows, using just the product rule, $d(uv) = (u\, dv) + (v\, du)$, and the rule $de^{f(x)}/dx = f'(x)e^{f(x)}$.

$$
\begin{aligned}
d_\mu \Psi_S &= d_\mu(\Psi_0 e^{iS/\hbar}) \\
&= e^{iS/\hbar}\, d_\mu\Psi_0 + \Psi_0(d_\mu\, e^{iS/\hbar}) = e^{iS/\hbar}\, d_\mu\Psi_0 + \Psi_0(ie^{iS/\hbar}\, d_\mu S/\hbar) \\
&= e^{iS/\hbar}\, [d_\mu \Psi_0 + (i/\hbar)(d_\mu S)\Psi_0]
\end{aligned}
$$

The new term $(i/\hbar)(d_\mu S)\Psi_0$ prevents local wavefunction phase invariance, which requires $d_\mu \Psi_S = e^{iS/\hbar}\, d_\mu\Psi_0$ instead of $e^{iS/\hbar}\, [d_\mu \Psi_0 + (i/\hbar)(d_\mu S)\Psi_0]$. Physically this extra term $(i/\hbar)(d_\mu S)\Psi_0$ accounts for the conservation of energy, because a field must supply energy to a particle in order to make its wavefunction amplitude change by the amount $\psi_S = \psi_0 e^{iS/\hbar}$. This *work done changing a wavefunction simply takes some energy away from the Dirac field lagrangian*, thereby automatically replacing

$$\mathcal{L}_{\text{Dirac}} = \bar{\psi}\,(i\gamma^{\mu}\, d_{\mu} - m)\psi$$

by a lagrangian containing the "interaction term" iqA_{μ} for the interaction between charge q and field potential A_{μ}:

$$\mathcal{L} = \bar{\psi}[i\gamma^{\mu}\,(d_{\mu} - iqA_{\mu}) - m\,]\psi, \text{ where } (d_{\mu} - iqA_{\mu}) = D_{\mu}\text{, which is called the "covariant derivative."}$$

The substitution of Dirac's non-covariant derivative d_{μ} with Weyl's covariant derivative $D_{\mu} = d_{\mu} - iqA_{\mu}$, preserves gauge invariance by allowing for the change in the potential of the field vector, $(A_{\mu})_S = (A_{\mu})_0 + d_{\mu}S/(q\hbar)$ where q is the charge (or coupling). *The point we emphasise is that there is a simple energy conservation mechanism for local wavefunction phase invariance.*

2. Propagators for evaluating Feynman's perturbative expansion (S-matrix components) to the path integral

Feynman's "path integral" replaces the *single* wavefunction amplitude in Dirac's "interaction picture" of quantum mechanics, $\psi_{H,t} = \psi_0 e^{iHt/\hbar}$ (which is the time-dependent solution to Schroedinger's equation) with interferences between *multiple* wavefunction amplitudes for *mechanical* interactions, each represented by a Feynman diagram consisting of the exchange of a gauge boson which hits an effective interaction cross-section which is proportional to the square of the running coupling. The probability or relative cross-section for a reaction is proportional to

$$|\psi_{\text{effective}}|^2 = |\psi_1 + \psi_2 + \psi_3 + \psi_4 + \dots|^2 = |\int e^{iS/\hbar}\, Dx|^2 = |\int e^{i\int L dt/\hbar}\, Dx|^2.$$

where ψ_1, ψ_2, ψ_3, and ψ_4 are individual wavefunctions (path amplitudes) representing all the different ways that gauge boson exchanges mediated forces between charges in the path integral, $\int e^{iS/\hbar}\, Dx$. The complex wavefunction amplitude e^{iS} where S is the path action in quantum action units, is unjustified by the successes of quantum field theory where measurables (probabilities or cross-sections) are *real* scalars. So the observable resultant arrow for a path integral on an Argand diagram must be always parallel to the real axis, thus instead of e^{iS} as a unit length arrow with variable direction, can replace it by a single variable scalar quantity, $e^{iS} \rightarrow \cos S$, eliminating Hilbert space and Haag's theorem to renormalization. Distler points out that in the Optical Theorem (by Bethe) in QM, you use complex space in making calculations. Sure you do, because the direction of arrow on the Argand diagram represents effects like the direction of spin for spin-polarized particles, which have different cross-sections when colliding, depending on whether they collide with their spins parallel or anti-parallel. This is a physical effect, however, and doesn't "prove" complex Hilbert space is the only description of reality possible. We could for instance simply add a suitable cosine angular term to carry the information on spin polarizations in particle collisions. Put another way, while complex space *can* be used helpfully in QFT, that fact alone doesn't prove that Hilbert space is the *only* way or even the *best* way. It depends on whether we *really want to understand* dynamics, or not!

Just because one mathematical tool proves useful, you can't use that to ban other tools being applied if they yield more light and prove more helpful to physics! Occam's Razor favours simplicity, yet the world often turns out to be complex, not simple; so Occam's often plain wrong. Sure, try a simple theory first, but don't use Occam's Razor to ban development of a more complex theory if you can't get the simple theory to work. This seems a key failure of modern "professional" science, where a copule of big star theories are falsely used with Occam's Razor to ban any forrays into the outback to think about totally radical ideas. Someone else once developed a similar piece of sophistry to Distler's, when he argued using Occam's Razor that because electromagnetic energy transfer can be accounted for by the electromagnetic field, the physical mechanism of electron currents is unnecessary redundant, a myth! This sophistry is like saying that because you can walk, bicycles and cars are consequently "disproved" by Occam's Razor. In a sense, Einstein's "derivation" (using assumed postulates based oin the invariances of Maxwell's equation and light velocity measurements) of the Lorentz contraction without recourse to Maxwell's physical model of a vacuum containing particles that cause forces. Then, after Heisenberg's bootstrap S-matrix theory finally gave way to quantum field theory in the early 70s with the rise of the SM, nobody dared to revisit Einstein's use of Occam's Razor. It had become a political taboo, shutting down mechanisms in fundamental particle physics forever in the interests of "defending" the statue of Einstein (elitism that Einstein hated!).

This reduction of quantum field theory to real space gives a provably self-consistent, experimentally checked quantum gravity. Path integral $\int e^{iS/\hbar} Dx$ is a double integral because action S is itself the integral of the lagrangian energy for a given Feynman diagram, which must be integrated over all paths not merely the classical path of least action, which only emerges classically as a result of multipath interferences, where paths with higher than minimal action cancel out.

E.g., if a magnet causes an electron's spin direction to flip, or a compass needle to rotate, then some energy of the magnetic field is used, so the magnetic field is affected. This is an undeniable, provable consequence of energy conservation or, viewed (even more simply), work-energy mechanics. Work must be paid for. Newton's classical theory *simply makes no correction for the Earth's gravitational field energy when some of it is used up when accelerating an apple's fall to the ground* (which converts gravitational potential energy of the Earth's field - the apple's gravitational field is relatively trivial - into sound waves and mechanical action, bruising the apple). Weyl's utilization of Noether's theorem to relate symmetry to conservation of field energy, correcting the field potential for the energy that is used in doing work by changing a wavefunction amplitude, is thus applicable to gravitational as well as electromagnetic fields. Hence, there is no physical inconsistency.

Dirac's bra-ket notation was introduced a decade later, in 1939, and isn't of interest to us since we're only interested in obtaining real numbers, i.e. "resultant vectors" which as arrows always lie parallel to the real plane on a complex/Argand diagram; for all real world tested probability and cross-section predictions from the path integral of 2nd quantization we can thus replace $e^{iS/\hbar}$ with real scalar cos $(S/\hbar)$. In other words, complex wavefunctions solutions to $\psi_S = \psi_0 e^{iS/\hbar}$ are irrelevant and discarded ... [care - Distler!!].

General relativity predictions from Newtonian gravity lagrangian, with a relativistic metric

In 1915, Einstein and Hilbert derived the field equation of general relativity from a very simple lagrangian. The classical "proper path" of a particle in a gravitational field is the minimization of action:

$$S = \int L dt = \int \mathcal{L} d^4x = \int R(-g)^{1/2} c^4/(16\pi G) d^4x$$

where the Lagrangian energy $L = E_{\text{kinetic}} - E_{\text{potential}}$, and energy density is $\mathcal{L} = L/\text{volume}$), which gives Einstein's field equation of general relativity when action is minimized, i.e. when $dS = 0$, found by "varying" the action S using the Euler-Lagrange law. To Weyl and his followers today, the "Holy Grail" of quantum gravity research remains the task of obtaining a theory which at low energy has the Lagrangian gravitational field energy density component, $\mathcal{L} = R(-g)^{1/2} c^4/(16\pi G)$, so that it yields produces Einstein's field equation as a "weak field" limit or approximation.

But the Einstein-Hilbert Lagrangian density $R(-g)^{1/2} c^4/(16\pi G)$ is a relativistic, spacetime curvature-based generalization of classical Newtonian gravity, since Ricci's scalar, in the isotropic radial symmetry of gravitational fields produced by a fundamental particle, is: $R = g^{\mu\nu} R_{\mu\nu} = R_{00} = \nabla^2 k = 4\pi G\rho$. Since the Newtonian gravitational potential energy is proportional to mass, $L_{\text{field}} = - E_{\text{potential}} = -\int_r^\infty (-GMm/x^2) dx = GMm/r$, it follows that Poisson's equation is the weak field, non-relativistic Newtonian limit for the Ricci scalar, $R = 4\pi G\rho$, so the non-relativistic Lagrangian energy density is:

$$\mathcal{L} = \rho = (\nabla^2 k)/(4\pi G) = R/(4\pi G),$$

which upon multiplication by $(-g)^{1/2} c^4/4$ gives general relativity's Einstein-Hilbert relativistic lagrangian. This $c^4/4$ factor is the conversion from time to space units for 4-dimensional spacetime (d^4t is changed into d^4x by employing multiplication factor $d^4x / d^4t = c^4$), and the fact that the fraction of the gravitational field energy density acting in one dimension (say the x direction) out of four dimensions is only 1/4 of the total isotropic energy density. The relativistic multiplication factor $(-g)^{1/2}$ occurs because g is the determinant $g = |g_{\mu\nu}|$ of metric tensor $g_{\mu\nu}$ and Ricci's scalar, $R = g^{\mu\nu} R_{\mu\nu}$, is clearly a function of the metric.

For isotropic radial symmetry ("spherical symmetry") coordinates ($r = y = z = x$), the Schwarzschild metric implies $(-g)^{1/2} = [1 + 2GM/(r c^2)]^{1/2}$, the gravitational field equivalent of the inertial mass Lorentzian spacetime contraction, $(1 - v^2/c^2)^{1/2}$. In other words, the Schwarzschild metric is the Lorentzian metric converted from velocity v to gravitational field effect $2GM/r$ by Einstein's equivalence principle between inertial and gravitational mass, which states that *the effects of a given inertial acceleration are indistinguishable from those of a corresponding gravitational acceleration*, or equivalently (if the accelerations on

both sides of this equivalence may be integrated to yield velocities), that the properties of any body having velocity v are equivalent to those of a similar body which has acquired an identical velocity as a result of a gravitational, e.g., $v = (2GM/r)^{1/2}$ (the escape velocity of any body from mass M, which is equivalent to the velocity acquired in falling to the same mass). For weak gravitational fields, $(-g)^{1/2} \approx 1$, thus the non-relativistic approximation: $R(-g)^{1/2}/(16\pi G) \approx R/(16\pi G)$. So general relativity by writing Newton's law as $\mathcal{L}_{\text{Newtonian}} = R/(16\pi G)$ and then including a relativistic metric determinant $(-g)^{1/2} = [1 + 2GM/(r c^2)]^{1/2}$, i.e. the empirical Lorentz contraction factor with Einstein's equivalence principle to convert from inertial accelerations and velocities to corresponding gravitational accelerations and velocities.
However, while $\mathcal{L} = R(-g)^{1/2}c^4/(16\pi G)$ appears mathematically incontrovertible for the Lagrangian energy density of quantum gravity, it isn't logical or correct physically, simply because this Lagrangian is *contrived to model only the classical path of least action (i.e. the real or onshell path in a path integral), unlike quantum field theory Lagrangians, which are generally applicable for all paths.*

Hence, we point out that the Einstein-Hilbert free-field classical lagrangian of general relativity $\mathcal{L} = R(-g)^{1/2}c^4/(16\pi G)$ is "Newtonian-Poisson gravity, $Rc^4/(16\pi G)$, multiplied by a relativistic spacetime contraction correction factor, $(-g)^{1/2}$, which the contraction due to motion in Lorentzian/FitzGerald/special relativity, $[1 + 2GM/(r c^2)]^{1/2}$, with Einstein's equivalence principle of inertial and gravitational motion, $v = (2GM/r)^{1/2}$." However, the fact remains that the Einstein-Hilbert lagrangian $\mathcal{L} = R(-g)^{1/2}c^4/(16\pi G)$ cannot itself be taken as a "rigorous piece of mathematics" when it merely gives the correct path of *least action*. In quantum field theory, we need a lagrangian that holds good for *all paths,* not merely the path of *least action.* The way that Einstein and Hilbert "derived" $\mathcal{L} = R(-g)^{1/2}c^4/(16\pi G)$ was contrived as the simplest free-field lagrangian that would - when "varied" with respect to action - yield the correct path of least action. In other words, while we accept $\mathcal{L} = R(-g)^{1/2}c^4/(16\pi G)$ to *include* correctly the classical path of least action, that *doesn't mean that we accept it to also include off-shell (non-least action) paths that must be included in a quantum gravity theory, and which in the low energy limit are merely unobservational due to multipath interference in the path integral.*

Our approach to quantum gravity consistency with "general relativity" in http://vixra.org/abs/1111.0111 is to point out that general relativity was derived by Hilbert and Einstein in the first place as a rank-2 spacetime curvature mathematical modelling exercise, as opposed to the rank-1 curving field lines of Maxwell's equations for electromagnetism. If only Maxwell's laws of electromagnetism were reformulated as spacetime curvature, we'd have a rank-2 version of electromagnetism in which forced are propagated by spin-1 field quanta, thus breaking the popular but mathematically false dogma that the rank of the field equation model is equal to the spin of the field quanta (as spin-1 for rank-1 Maxwell equations, and spin-2 for rank-2 general relativity).

There are numerous deficiencies mathematically and physically in the dogma that gravitons are spin-2, some of which are discussed in http://vixra.org/abs/1111.0111. First of all, it's reductionist. If only two masses existed in this universe, and they were found to attract, then yes, that observation could prove the need for a spin-2 graviton. But this is not the case, since the Casimir effect shows how metal places can be "attracted" (pushed together) by spin-1 electromagnetic field quanta in the surrounding vacuum (virtual photons with wavelengths longer than the separation distance between the metal plates don't contribute, so the force of repulsion between the plates is less than the force pressing them together). This Casimir effect relies on offshell field quanta, so the old arguments against LeSage onshell gas pressures in a vacuum are negated. No offshell field quanta cause drag or heating effects on planets (the traditional anti-mechanism no-go theorem).

So it is quite possible for spin-1 gravitons to exist, causing repulsion of masses (e.g. our correct quantitative prediction in 1996 of the positive sign amount of "dark" graviton energy causing the cosmological acceleration first observed by Perlmutter in 1998). The only reason why apparent "attraction" ("gravity") arises is that the immense surrounding masses in the universe are practically isotropic and are unable to avoid exchanging gravitons with all other masses. Local masses are proved in http://vixra.org/abs/1111.0111 to precisely have the right gravitational interaction cross-section to produce the cosmological acceleration. The real reason why spin-2 gravitons have become dogma, aside from the simplistic reductionist idea of ignoring graviton exchange with distant masses (Occam Razor's, gone too far) is Edward Witten's M-theory, which relies on a spin-2 graviton to defend 11 dimensional supergravity bulk and its 10 dimensional superstring brane as being the only intelligent theory of quantum gravity. In Witten's marketing process (*Physics Today,* April 1996), all the caveates that should be included about the assumptions behind the Pauli-Fierz spin-2 gravity wave are eliminated, to leave the impression that the mere existence of observed gravity is itself proof that gravitons have spin-2. (Similarly, Ptolemy dismissed Aristarchus's solar system with the allegation that anybody can see that the sun orbits the earth. This kind of political claim to "close down the debate" before the facts are checked, is very convenient for censors and peer-reviewers!)

What we point out in http://vixra.org/abs/1111.0111 is that the correct theory of quantum graviton is in effect what is now taken to be QED, namely an Abelian U(1) theory. This quantum gravity U(1) gauge theory literally replaces the electromagnetic (hypercharge, prior to mixing) U(1) in the Standard Model, and electromagnetism is transferred to SU(2) massless gauge bosons, replacing Maxwell's equations by the SU(2) charge-carrying Yang-Mills equations, which merely reduce to what appear to be Maxwell equations when the field quanta are massless. This is because the two charged SU(2) massless field quanta of electromagnetism have infinite magnetic self-inductance which prevents a net flow of charge. Their magnetic fields (self inductance) are only cancelled when there is an equilibrium in the exchange of charged massless field quanta between similar charges. Thus, the positive electric field around a proton is simply composed of virtual photons with a positive charge sign. The dynamics of this are inherent in the properties of the Heaviside energy current, which is precisely the charged electromagnetic field quanta in electricity. The two "extra polarizations" which the electromagnetic gauge boson has in order to allow both attraction and repulsion are simply the two electric charge signs.

The charge transfer term of the Yang-Mills equations is constrained to a value of zero, because two protons can only exchange positively charged massless gauge bosons for "electromagnetic" repulsion when the rates of transfer of charge from one to the other and vice-versa are identical. This means that there is an equilibrium in the transfer of positive charge between the two protons, so they both appear to have a static, constant amount of positive charge. Hence, the Yang-Mills charge transfer term is effectively suppressed, reducing the Yang-Mills equations for SU(2) into Maxwell equations, and this explains why historically Maxwell's equations look good superficially (like Ptolemy's superficially good-looking dogma that the sun orbits the earth daily), but it obfuscates electroweak theory.

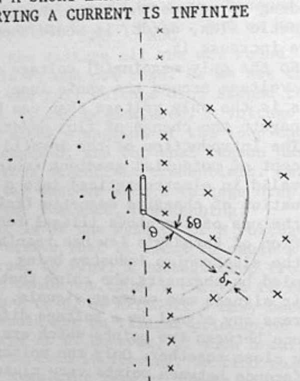
Schwinger argued correctly but disingeniously in 1949 (see *Physical Review,* v76, p790) that electric charge conservation forces the photon to be massless. We reverse this: massive electrically neutral photons do exist but have 91 GeV so Maxwell never discovered them or had any need to include them in his equations! The photon is not forced to be massless. The Z boson (which is the field quanta of neutral currents) is a photon which has acquired mass and thus has "weak isospin charge." The only reason why these massive Z photons were not known to Schwinger in 1949 is that their energy is 91 GeV, far beyond 1949 physics. In other words, what happens in the history of physics is that incomplete observations are "explained" in a contrived way, and these explanations become hardened dogma. So theories are developed in an ad hoc way to incorporate previous dogma, so that they will overcome peer-review and get published, without questioning dogma.

We conclude that the mathematics of general relativity and quantum field gauge (interaction) theory are fully consistent with the simple mechanism in http://vixra.org/abs/1111.0111; the the quantum gravity lagrangian is similar to U(1) QED.

The hardened fanatics of Ptolemy's epicycles developed trignometry, but that didn't prove their sloppy muddled-up physics. Vacuum polarization causes the running of all effective charges or couplings with collision energy, or distance from the core of the particle. When similar charged particles are collided, the distance of minimum approach occurs when the potential energy of the Coulomb field repulsion is equal to the kinetic energy of collision, so there is a relationship between distance and collision energy. For electromagnetism, the coupling is expressed in terms of the Sommerfeld fine structure constant of quantum mechanics, α which predicts the correct black hole unification scale on a plot of energy versus running coupling charges; for further details please see http://vixra.org/abs/1111.0111.

The infinite magnetic self-inductance of charge is given in the calculation by I. Catt, reproduced below:

PROOF THAT THE TOTAL FLUX GENERATED BY EVEN A SHORT LENGTH OF STRAIGHT WIRE CARRYING A CURRENT IS INFINITE



Consider a short length of wire Δs radius a carrying a current i. Let us integrate the total magnetic flux entering the paper by first finding the flux in a small area $\delta r \times r\delta\theta$, integrating from $\theta = 0$ to $\theta = \propto$ so as to get the total flux, φ_{ring}, through the half-ring, and then integrating outwards to get the total flux through the whole surface, starting at a distance r, from the wire and ending at infinity.

$$\delta\varphi = \text{area of element} \times \text{flux density}$$
$$= \delta r \,.\, r\delta\theta \quad \times \quad \mu\,\delta H$$
$$= \delta r \,.\, r\delta\theta \quad \times \frac{\mu i \Delta s \sin\theta}{4\pi r^2}$$

by the Biot-Savart Law.

$$\varphi_{ring} = \frac{\delta r}{4\pi r}\,\mu i \Delta s \int_0^{\pi} \sin\theta d\theta$$
$$= \frac{2\,\delta r \mu i \Delta s}{4\pi r}$$

Now let us integrate the flux in the half-rings, from r to ∞.

$$\int_r^{\infty} d\varphi = \varphi = \frac{2\mu i \Delta s}{4\pi}\int_{r_1}^{\infty}\frac{dr}{r} = \infty$$

So if a current flows down a short length of straight wire, the resulting total magnetic flux is infinite.