Supporting Equations

My starting assumption is that the universe is only spacetime. You will notice that this assumption does not have any equations. It is necessary to characterize the properties of spacetime to see if it is possible to build everything in the universe out of the single building block of 4 dimensional spacetime. I independently determined the impedance of spacetime Z_s and used it for about 5 years before I found that this constant of nature is well known to the experts in gravitational wave detection. The impedance of spacetime is:

$$Z_s \equiv c^3/G \approx 4.04 \times 10^{35} \text{ kg/s} \qquad (1)$$

This allows me to quantify the properties of spacetime and waves in spacetime. Any material which exhibits impedance must be capable of propagating waves. Field theory says that the vacuum has zero point energy (ZPE) with harmonic oscillators with energy of: $E = \frac{1}{2}\hbar\omega$ where $c = \omega ƛ$. Therefore $ƛ \equiv \lambda/2\pi = c/\omega$. The uncertainty principle allows the distance between points to vary by ± Planck length (± L_p) and the rate of time to be modulated such that perfect clocks can vary by ± Planck time T_p. I postulated that this was an allowed wave amplitude. but compatibility requires displacement amplitude be converted to dimensionless strain amplitude (maximum slope). The strain amplitude (A) of the waves allowed by the uncertainty principle is:

$$A = L_p/ƛ = T_p\omega \qquad (2)$$

The waves that form fundamental particles have waves with Compton angular frequency $\omega_c = E_i/\hbar = c/ƛ_c$ and reduced wavelength $ƛ_c = \hbar c/E_i = c/\omega_c = \hbar/mc$ where E_i is the internal energy of the particle. Therefore the strain amplitude A_s of a fundamental particle is: $A_s = L_p/ƛ_c = T_p\omega_c$.
In the "Foundation" paper I generate several useful equations which can be used with waves in spacetime to yield force (F) over area (a), and Energy (E) in volume V. This is explained in more detail in the Foundation paper.

$$F = kA^2\omega^2 \mathcal{Z} a/c \qquad (3)$$

$$E = kA^2\omega^2 \mathcal{Z} V/c \qquad (5)$$

We will test the concept that ZPE is caused by the Planck length/time fluctuations in spacetime permitted by the uncertainty principle. We will use Eq. (5) and assume a wave with strain amplitude $A = L_p/ƛ$ at angular frequency $\omega = ƛ/c$ in volume $V = kƛ^3$.

$$E = \frac{kA^2\omega^2 \mathcal{Z} V}{c} = k\left(\frac{L_p}{ƛ}\right)^2 \omega^2 \left(\frac{c^3}{G}\right)\left(\frac{ƛ^3}{c}\right) = k\hbar\omega \qquad (6)$$

Therefore, the energy of dipole waves in spacetime fits the general form of ZPE.
Standing waves are created in the space surrounding all fundamental particles. These standing waves are very important because they are the wave properties of particles that we can detect (de Broglie waves). I have computer modeled these waves in stationary and moving frames of

reference. The following video shows the results so far. It is incomplete and lacks narration, but it still is very interesting.
https://www.youtube.com/watch?v=Qi08DFbJMbo&list=PLGh99BOR2axiAtabtPBLcPJD7m74zzV6P&index=6

There is a single "standing wave" that is rotating, but it has linear and nonlinear components which produce different effects. For analysis, it is good to break these down into different amplitude terms A_e, A_E, A_g, and A_G. This is all explained in the book and Foundation paper. For now, the purpose is only to give important equations which address the claim that "the model does not get any of these out – it just puts them in."

I will start with a pair of equations which I consider to be amazing. These are equations 15 and 16 from the Foundation paper. I started with the force equation $F = kA^2\omega^2 Z a/c$ and inserted the various terms (amplitude, frequency, impedance of spacetime, and area. Equation 15 below used the nonlinear gravitational amplitude terms and equation 16 used the linear amplitude term. Notice in red that the only difference between these two equations is equation 15 has the amplitude terms squared and equation 16 has them not squared. This simple difference makes the gigantic difference between the gravitational force and the electrostatic force.

$$F_G = k\left(\frac{A_{s1}^2 A_{s2}^2}{N_1 N_2}\right)\left(\frac{c^2}{ƛ_{c1}ƛ_{c2}}\right)\left(\frac{c^3}{G}\right)\left(\frac{ƛ_{c1}ƛ_{c2}}{c}\right) = k\frac{Gm_1m_2}{r^2} \quad (15)$$

$$F_E = k\left(\frac{A_{s1} A_{s2}}{N_1 N_2}\right)\left(\frac{c^2}{ƛ_{c1}ƛ_{c2}}\right)\left(\frac{c^3}{G}\right)\left(\frac{ƛ_{c1}ƛ_{c2}}{c}\right) = k\frac{q_p^2}{4\pi\varepsilon_o r^2} \quad (16)$$

Equation 16 generates the force equation between two Planck charges (q_p) from first principles. John W. has criticized this because it generates the force for Planck charge, not charge *e*. The difference is a factor of $\alpha^{1/2} \approx 11.7$. However, I was not attempting to calculate charge *e*. I was attempting to calculate the magnitude of the force generated by the linear component of the standing waves. This is the correct answer because charge *e* has a coupling constant of $\alpha^{½}$ while Planck charge has a coupling constant of 1. No one knows how to calculate α. Planck charge is more fundamental. It is derived from ε_o.

The next set of important equations will be illustrated with crude figures. My model of a fundamental particle is a dipole wave in spacetime rotating as a Planck length distortion of spacetime. The wave has components propagating at the speed of light in a spherical volume one Compton wavelength in circumference. This means that its radius is $ƛ_c$ and its Schwarzschild radius is: $R_s = Gm/c^2$. This lacks the factor of 2 present in a non-rotating Schwarzschild radius because it is maximally rotating. The model predicts that there should be a relationship between a particle's Schwarzschild radius R_s, its Compton radius $ƛ_c$ and Planck length L_p. Indeed, here is the equation:

$$\frac{R_s}{L_p} = \frac{L_p}{ƛ_c}$$

$\underline{R_s \qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad L_p \qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad ƛ_c}$

← Log scale of length →

I find it informative to illustrate this relationship with an example. Suppose that there is a log scale of length illustrated by the above line. On this log scale we designate the Schwarzschild radius (R_s), and the Compton radius ($ƛ_c$). **Exactly** half way between these two lengths is Planck length (L_p).

Next I will illustrate a similar relationship between forces. Suppose that we have two of the same hypothetical particles, both with Planck charge. These two particles have arbitrary separation. We will designate the separation distance (r) using the particle's natural unit of length which is the number (N) of reduced Compton wavelengths $N = r/ƛ_c$. The electrostatic force between these Planck charges will be designated F_E. Also this comparison includes the gravitational force F_g and Planck force $F_p = c^4/G$.

$$\frac{F_g}{F_E N} = \frac{F_E N}{F_p}$$

$\underline{F_g \qquad\qquad\qquad\qquad\qquad\qquad\qquad F_E N \qquad\qquad\qquad\qquad\qquad\qquad F_p}$

← Log scale of force →

This illustration shows a log scale of force. At one end we put the weakest force between the two particles at distance r. At the opposite end of this log scale we put the largest possible force, Planck force F_p. **Exactly** half way between these two forces on a log scale is the product F_eN which is the electrostatic force F_E times the separation distance expressed as the dimensionless number N. If we choose charge e rather than q_p, then this midpoint would be $F_eN/\alpha \approx 137\ F_eN$

The spacetime based model of the universe predicts that the spacetime is a nonlinear medium for wave propagation. There should be a square relationship between the electrostatic force and the gravitational force. This was illustrated by equations 15 and 16 above, but it is also illustrated by the following equations from the Foundation paper.

$\underline{F}_g = \underline{F}_E^2$ (19) Assumes dimensionless Planck units and F_E is between Planck charges

$$\left(\frac{F_g}{F_p} N^2\right) = \left(\frac{F_E}{F_p} N^2\right)^2 \qquad (21)$$

Finally I want to defend my charge conversion constant.

$$\eta \equiv \sqrt{\frac{G}{4\pi\varepsilon_o c^4}} = \frac{L_p}{q_p} \approx 8.61\times10^{-18}\ \text{meter/coulomb} \qquad (26)$$

John W. criticized this as being too simple. He said: "You do not have any base differential equations –linear, quadratic, non-linear or otherwise, and there is no perturbation theory, nothing much beyond proposals such as the one above – which is just a factor to convert what you get from one dimensional relation to another." I challenge anyone to find an error where this conversion constant gives a wrong or unreasonable answer. It is the key to understanding charge, electric fields, magnetic fields, the permeability of space, the permittivity of space and most important the impedance of free space Z_o. Here are two of many possible conversions.

$$\frac{1}{4\pi\varepsilon_o}\left(\frac{1}{\eta^2}\right)=\left(\frac{1}{4\pi\varepsilon_o}\right)\left(\frac{4\pi\varepsilon_o c^4}{G}\right)=\frac{c^4}{G}=F_p \qquad (28)$$

$$Z_o\left(\frac{1}{\eta^2}\right)=\left(\frac{1}{\varepsilon_o c}\right)\left(\frac{4\pi\varepsilon_o c^4}{G}\right)=4\pi\frac{c^3}{G}=4\pi Z_s \qquad (30)$$

Photons experience the same impedance (c^3/G) as gravitational waves. Therefore, photons are quantized waves which propagate in the energetic spacetime field (the new aether).

If the charge conversion constant can be proven correct, then this would be a historic advance in physics. Among other things, it would **prove** that the spacetime field is the new aether. Photons would be understood as quantized waves propagating in the spacetime field.

Equations do not need to be complex to be profound. $E = mc^2$ is simple and profound.

John M.