

Ideas in Physics and Astronomy by Gene Preston May 28, 2018

As an electrical engineer I've been fascinated by all things electrical including ham radio, electronics, and electromagnetic waves. I began to suspect in the early 1980s the speed of light might be only a measured constant instead of an absolute constant. Note this is not a MOND or modified gravity. I'm looking for past errors in physics.

Observation 1 – How can we know the speed of light is an absolute constant? I set up an experiment assuming light speeds are not constant. The measured speed was observed to always be a constant even when the speed of light is variable.

This formula will cause a bending of light around the sun of 1.75 seconds of arc.

$c(R) = c_{\infty} \left(1 - \frac{2GM}{Rc^2}\right)$ where c is a variable speed of light and M is the sun's mass.

The Pound-Rebka experiment shows how frequency f changes with gravity potential.

$f(R) = f_{\infty} \sqrt{1 - \frac{2GM}{Rc^2}}$ The frequency changes by $\sqrt{c/c_{\infty}}$ if we treat c as a variable.

It's also necessary for lengths to change by $\sqrt{c/c_{\infty}}$ for the speed of light to be a measured constant. Here is a speed of light experiment for illustration purposes.

We set up an experiment to count the cycles N of an oscillator at f cycles per second as a light wave travels over a distance L . The count N is a measure of the speed of light since N is a number of oscillations when f is oscillating at f cycles per second.

$N_{\infty} = f_{\infty} L_{\infty} / c_{\infty} = (\text{cycles/sec}) * (\text{meters}) / (\text{meters/sec}) = \text{number of cycles at } r = \infty.$

The N_{∞} counts are found to be consistent with the known speed of light in m/sec.

Now we move the experiment to an r close to M and take a new reading.

$N = f_{\infty} \sqrt{c/c_{\infty}} L_{\infty} \sqrt{c/c_{\infty}} / c = f_{\infty} L_{\infty} (c/c_{\infty}) / c = f_{\infty} L_{\infty} / c_{\infty} = N_{\infty}$

We get exactly the same N count as before. We conclude that since the measured speed of light is constant from our experiment that the speed of light must be an absolute constant. However this is incorrect because c is actually variable.

I met with John Wheeler, author of the book Gravity, and showed him this experiment. John said he understood what I was saying, but the consensus of physicists is that the speed of light should be treated as an absolute constant.

From this simple example we see that the speed of light is always a measured constant but is not shown to be an absolute constant. We are free to treat c as a variable.

Observation 2 – Wavefronts in a passive lossless medium are always conserved. The conservation of wavefronts should be a physical law right up there with conservation of energy and momentum. If you walk into any engineer's, physicist's, or astronomer's office and ask them if electromagnetic wavefronts are conserved they will say yes, for billions of years as waves travel from distant stars. Then you tell them General Relativity violates the conservation of wavefronts and they look stunned, possibly angry. How do we reconcile the problem. What is the problem?

We know photons are seen to change color (frequency) as we move to different gravity potentials. The question is one of 1) did the photons change frequency in flight, or 2) was the frequency constant and we simply changed as observers? Okun points out the observer is changing instead of the photons <https://arxiv.org/pdf/physics/9907017.pdf> and says to have both us changing and the photons changing is double counting. He thinks photons do not change frequency, only the observer.

A simple experiment can be constructed to illustrate that wave fronts are conserved and the frequency does not change in flight as waves are moving from one gravity potential to another. This is possible to observe directly by any stationary observer.

Set up a radio transmitter on short wave such as 10 MHz (WWV) and have an electronic counter count the number of waves transmitted between each second's tick from the time standard. The counter will count 10 million waves. Now set up receivers at different locations with different gravity potentials. Some receivers observe the WWV time clicks to be shorter than one second. They are at a lower gravity potential so their local time is running slower than the WWV time standard. Some receivers are at a higher gravity potential and they observe the ticks to be longer than one second, with one second being their local clock as a reference. Their local time is running faster than WWV.

At each location a counter is placed to count the number of waves received between ticks and everyone sees the same 10 million number of waves. All radio frequency waves transmitted are being received. No new wavefronts have been created or destroyed. Thus we have a conservation of wavefronts. Through telescopes each observer can see what is happening at the other listening posts and all observers see that all measurement posts are getting the same result. The only conclusion that can be drawn is that the shift in frequencies observed is entirely due to the local clocks changing their speeds locally as a function of gravity potential and there is no changing of the frequency of the waves in transit. If there were, there would be a cumulative building up or loss over time of wavefronts in the pipeline. But this is not observed. Photons do not change frequency while in flight. Only the observer is changing.

Observation 3 – Is a variable speed of light due to a changing permittivity or a changing permeability? A simple LC inductance L and capacitance C circuit can answer this question for us. So what we are going to do is solve the voltages and currents in a lossless LC circuit in very small time steps in a computer program and observe the currents and voltages as the permittivity is slowly changed in one study case and then in a separate case slowly change the permeability.

Start the program with an initial voltage of 1 volt on the capacitor. Then the current in the inductance rises a bit due to the voltage. The incremental current flows through the inductor draining the capacitor. After a few thousand very small time steps the capacitor voltage goes to zero and changes sign. At the moment the voltage on the capacitor changes sign we multiply the permittivity by a very small multiplier such as 1.000001. This slowly increases the capacitance which lowers the frequency simulating lowering the LC circuit down to a lower gravity potential. Remember we are lowering the frequency due to the Pound Rebka experiment. We let the program run for a while and it stops and prints out the following:

V	C	EC	I	EL	SEC	HZ
1.000000	1.000000	0.500000	0.010000	0.000000		
0.999999	1.000000	0.500000	10.000001	0.500000	0.628400	1.591343
:	:	:	:	:	:	:
0.497710	2.535313	0.314018	7.926356	0.314136	1.000200	0.999800
	1.592266					

RATIOS OF ENERGY CHANGE AND FREQUENCY CHANGE
ENERGY RATIO = 1.592267
FREQUENCY RATIO = 1.591661
ENERGY/FREQUENCY = 1.000380

The initial voltage is $V = 1.00000$ volts. The initial capacitance $C = 1.00000$ farads. The initial energy in the capacitor $E_C = 0.5$ joules. The initial inductor $I = 0$ amps, well it must have been the second time step shown above. The initial energy in the inductor is $E_L = 0$. You can see the first full cycle period is 0.6284 seconds giving the frequency of 1.591342 Hz. The program keeps running until the increase in C has caused the peak voltage V to drop to half its initial value. At this point the program stops and prints out the circuit values and energies and frequencies.

We see that the energy and frequency track each other just as in Plank's equation. This is a good sign. The circuit is losing energy as the permittivity increases. This would indicate a gravity attraction for an increasing permittivity. The increasing permittivity lowers the frequency as we expect from Pound Rebka.

Notice that the capacitor C variation is the inverse square of the change in energy and frequency. This means that the capacitance C is tracking the speed of light variation. However, if this capacitance were a sphere of radius R then the capacitance would be

$4\pi R\epsilon$ where ϵ is the permittivity of the space surrounding the capacitor. But our circuit requires the capacitor to vary by the speed of light in capacitance which is the square of the permittivity. The only way to account for this is to have the R also be changing in the capacitor. We already required the metric dimensions to be changing with gravity potential so it's not surprising we would need to have the R and ϵ both be changing as the speed of light is changing around the LC circuit.

What happens when we change the L inductance is surprising. To lower the frequency we must insert an inductance like an iron rod into the L to lower its value. But in doing so the energy of the circuit increases, not decreases. We have to do work to push the iron rod into the coil increasing the inductance of the coil. So the frequency and energy relationship is reversed if the inductance or the permeability changes. In order to get agreement with the observed effects of gravity we can only change the permittivity.

Einstein said there was no difference in an acceleration and the acceleration of gravity. But here we see an electronic difference. If we push on the inductance we make the coil and capacitor move in space and it lowers its frequency and takes on energy. This would be kinetic energy which increases the velocity of the LC circuit and adds energy to it and slows down its frequency.

If are holding a dielectric close to the capacitor it will pull the dielectric into the gap between the capacitor plates. The circuit gives up energy (loses mass) to us and lowers the frequency. This is what is happening with gravity potential. So we see gravity is acting on the capacitor and potential energy whereas acceleration is acting on the inductor and kinetic energy. They are different. Have you considered that an acceleration of mass violates Plank's energy frequency-energy relationship whereas gravity and frequency satisfies Plank's energy-frequency relationship? That is a huge difference between acceleration of mass with a force and acceleration of mass in a gravity field. Kinetic energy of motion is motion of electrons in the coil and is affected as a change in movements. Potential energy in the capacitance is the energy in static electric fields in the capacitor and changes due to a changing external permittivity.

Observation 4 – Einstein hardwired General Relativity to become asymptotic with Newton's gravity formula for great distances. However Newton's force equation does not agree with observed movements of stars in galaxies which are at much higher velocities than predicted by Newton's equation. This is very pronounced in stars in the outer arms of galaxies but is also observed in stars near our sun, where the attraction force needs to be double what Newton's force provides, even for stars only a few light years from our sun. This has led to an exhaustive search for dark matter to make up the difference between theory and observation.

Let's review the simple equations that determine the speed of stars in the outer arms of galaxies. We can use the centrifugal force is balanced by the attraction of gravity. Where M is the galaxy mass, m is the mass of a star in the outer arms, v is the star's velocity, and r is the distance from the galaxy center. Then the forces balance:

$$mv^2/r \text{ centrifugal force} = GMm/r^2 \text{ gravity attraction force}$$

$$v = \sqrt{GM/r} \text{ and we see this formula predicts star velocities will decline by } \sqrt{1/r}.$$

However the actual data shows v is almost constant, not dropping off. There has been an exhaustive effort to find dark matter to cause the increase in stars in the outer arms of galaxies. So far there is no finding of any source of this dark matter. It's now becoming clearer that cold dark matter is not going to salvage this mismatch in theory and observations.

If the original force had been $Gm\sqrt{(M/r^2)}$ then the v due to the second term in the equation:

$$F = GMm/r^2 + Gm\sqrt{(M/r^2)} \text{ which I explore in}$$

<http://www.egpreston.com/GravityMod.pdf>

In the above formulation if $M=10^{40}$ kgm for the M33 galaxy, then the two forces are equal at $r=10^{20}$ km which is about 10,000 light years. Simulation shows the second term needs to be scaled down in force by a factor of about 0.04 to get a flat velocity. A problem is that the $1/r$ term leads to $c \rightarrow \infty$ as $r \rightarrow \infty$ which seems illogical. The stars have speeds of about 200 km/s. Plugging into the above equations will yield a speed of 200 km/s at a distance of 2000 light years from the center of M33. Going out to a very far distance the constant speed drops to $v = \sqrt{(G(\sqrt{M}))} = 82$ km/s which seems to be a bit too slow but is not far off.

We need to study where the second term would come from? It may come from the permittivity gradient rather than the speed of light. Let's talk in terms of a relative permittivity so that vacuum of space at an infinite distance would have a relative permittivity of 1. Then the permittivity increases as we get closer to mass M .

There is one relationship we know for sure and that is $c = c_{\infty}/\sqrt{\epsilon_r}$ where ϵ_r is the relative permittivity. As ϵ_r increases for smaller r , the speed of light slows down. So if we review Newton's formula gravity potential $E = m_{\infty}c_{\infty} (1 - GM/rc^2)$ we can now substitute the equation for c into the formula to get $E = m_{\infty}c_{\infty} (1 - GM \epsilon_r / rc_{\infty}^2)$ and when we take derivatives we will have two force terms. One will be Newton's equation and the second term will be a new force term which is dependent on the formula we choose for ϵ_r as a function of M and r . I have not yet found the magic formula.

Observation 5 – Can a gravity modification contain a \sqrt{M}/r term? The answer is no it cannot because it fails a simple test. Suppose we have a mass M at some point in the galaxy. The formula suggests we take the square root of the M and divide by the distance to get the force from that M for an m at our location. However this cannot be true because splitting the M into smaller masses and calculating the sum of the individual forces produces a different answer. Any modification to Newton's formula that fails this test is an incorrect formulation which is probably all the gravity MONDs. The only formula for gravity potential possible is M/r and that's it. Any new formulation for gravity potential must use at its core the M/r ratio as a starting point.

Here is a historical example of this rule. Aristotle told his students heavier objects fall faster than lighter objects. Let's suppose a bright student was sitting beside some rocks as he listened to his teacher. He thought to himself, if I place a small rock on top of this larger rock and then I drop them, I should see them separate as the heavier rock will fall faster than the smaller rock. So he does this and observes that no gap forms as the two rocks are dropped. He holds up his hand and stands up and says hey everyone, I have a way to test if heavier rocks fall faster. He drops them and everyone observes the larger and smaller rocks fall together. Thus this bright student advances science by a 1000 years. Unfortunately the students were all too willing to accept what they were being told was fact so they never bothered to do the test. Or maybe they were not allowed to question authority was the reason.

Observation 6 – Any new derivation must begin with M/r . There is evidence the permittivity is causing the gravity field. The formula must be $\epsilon_r = 1 + A/r$ where ϵ_r is the relative permittivity from a source A at a point in space. We can sum up the sources of these relative permittivity increases linearly since the A/r term is linear. The A/r satisfies the requirement that masses can be divided and lumped together with little effect on the distant gravity field. By definition the speed of light $c = c_\infty/\sqrt{\epsilon_r}$. Because of Pound-Rebka we also know that $f = f_\infty\sqrt{c/c_\infty}$. Likewise, to be consistent with Newton's gravity force $m = m_\infty\sqrt{c/c_\infty}$. Combining these we have $m = m_\infty(\epsilon_r)^{-.25}$. The A term can be found noting $c = c_\infty/\sqrt{\epsilon_r} = c_\infty(1+A/r)^{-1/2} = c_\infty(1+4GM/(rc_\infty^2))^{-1/2}$. The 4 is due to the square root exponent if we are to get the correct bending of light around the sun of 1.75 seconds or arc. The $-1/2$ exponent is due to the permittivity requirement. Note that this gravity formulation has a denominator increasing with a + sign rather than a numerator decreasing – minus sign. For small changes in the speed of light the + denominator and – numerator give the same bending of light around the sun. However this has major implications for large gravity fields. For example there will be no hard boundary for black holes if the denominator increases to ∞ at $r = 0$.

Now the formula for permittivity is $\epsilon_r = 1 + 4GM/(rc_\infty^2)$. When formulating the gravity field this permittivity field scalar potential should be calculated first and then all the other quantities calculated from this. So there is no gravity potential per se. There is a permittivity field as the descriptor for warped space. This is quite different from space time in general relativity. The advantage of this derivation is the permittivity links directly into Maxwell's equations and if this formulation agrees with galaxy rotations without dark matter then most likely the permittivity will be closer to observations than other theories including general relativity. Using the formula $m = m_\infty(\epsilon_r)^{-.25}$ and converting that to energy $E = m_\infty c_\infty^2 (\epsilon_r)^{-.25} = m_\infty c_\infty^2 [1 + 4GM/(rc_\infty^2)]^{-.25}$ and taking the derivative of E with respect to r to get the force on the mass results in this formula:

$$F = (GMm/r^2) [1 + 4GM/(rc_\infty^2)]^{-1.25} \quad \text{which is a slight modification to Newton's formula.}$$

This is not a MOND. It's a complete new derivation of the gravity force based on gradients in the permittivity using basic physics concepts. So how well does this predict the rotation speed of galaxies?

$$mv^2/r = \text{centrifugal force} = GMm/r^2 = \text{Newton's force which balances for } v = \sqrt{GM/r}.$$

The new formulation has $v = \sqrt{GM/r} [1 + 4GM/(rc^2)]^{-.625}$. Plugging in $M = 10^{40}$ kgm and $r = 10^{21}$ meters (100,000 light years) the velocity of stars on the outer rim of the galaxy is 25.8 km/sec for Newton's formula and

After some further scribbling on notes its clear that the observation 6 derivation is far too weak a field. It's not going to produce a field with enough gradient in the speed of light to cause the lensing that is observed. There is some source of the field that is creating a much larger gradient in the speed of light than what is associated with mass M. I need to start looking for that source....

Observation 7 – Let's go back to our LC circuit and take a closer look at the capacitor C. Electrons moving on and off the plate form a charge $Q = CV$. Q is the charge, C is the capacitance, and V is the voltage across the plates. When you are thinking about V consider it is actually an electric field with a direction. If we take the derivative of Q with respect to time we get a current I in the wire which creates a magnetic field. Maxwell reasoned the magnetic field is continuous across the gap so the $C dV/dt$ also creates a magnetic field. There is also an additional possibility he left off. If the permittivity is increased due to a strong electric field then $V dC/dt$ also makes a magnetic field. So we have

$$I = C dV/dt + V dC/dt \quad \text{if the charge } Q \text{ flows through a wire connecting the } C \text{ plates. All the above terms can create a magnetic field if there is an AC loop current.}$$

The magnetic field created by these terms is important in satisfying Newton's three laws of motion of inertia, acceleration, and reaction in an electrical circuit sense. Suppose we did not have a wire loop for electrons to flow, then the I would be zero. The two terms $C \, dV/dt + V \, dC/dt = 0$ would have to form the induction mechanism inside the capacitor plates.

Imagine we have a set of concentric spheres of increasing permittivity as the radius of the spheres is decreasing. This is a circuit without a wire connecting the plates. It's a sort of one sided capacitor or you could think of the outer plate of the capacitor is very far away. Let this outer shell at a very large distance, such as at infinity, has 0 volts as a reference. Then as the voltage V is increasing as radius r is decreasing while there is an increasing permittivity ϵ . Question – does this increasing ϵ cause charge to be created inside this changing space?