Ideas in Physics and Astronomy by Gene Preston May 8, 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.
$N_\infty = f_\infty L_\infty / c_\infty$ = (cycles/sec)*(meters)/(meters/sec) = 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 permittivity? 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

4πRε 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 the 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 centrifugal force $= GMm/r^2$ gravity attraction force

$v = \sqrt{GM/r}$ 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 = $GMm/r^2 + Gm\sqrt{(M/r^2)}$ 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 $c \to \infty$ as $r \to \infty$ 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 $c = c_\infty/\sqrt{\varepsilon_r}$ 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 $E = m_\infty c_\infty (1 - GM\,\varepsilon_r/rc_\infty^2)$ 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.