

# Relativistic GPS Evidence and Quantum Gravity Architecture of the Discrete Field Model

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## Abstract

Adjustment of GPS satellite clocks for relativistic effects is often cited as important evidence for Relativity. In 1952 Einstein said it is "*logically unavoidable*" that space is made up of; "*an infinite number of spaces in motion relatively to each other.*" The Discrete Field Model (DFM) is derived from this, and testing it in the same way should show if this applies simply to 'systems of co-ordinates' or to real physical phenomena as the model predicts. Previous papers <http://vixra.org/abs/0909.0047> and <http://vixra.org/abs/0912.0041> describe a model complying with SR postulates. They uncover consistent evidence suggesting a change in just one assumption pursuant to SR may resolve anomalies and paradoxes. This is reviewed conceptually and QG implications are considered. The GPS evidence, identified in the 2nd paper as potential falsification of the DFM, is considered and logically analysed with other data. Evidence is found that the co-ordinate system also has a real physical basis, able to be described by quantum field phenomena. The root cause and implications are discussed.

## 1. Introduction.

In 1851 Hippolyte Fizeau proved Fresnel's drag co-efficient and prediction that the speed of light through a medium, in that case moving water, was subject to the velocity of the water. The coefficient being  $1-1/n^2$  where 'n' is the refractive index. The observed velocity was therefore  $c/n + v(1-1/n^2)$ . In the inertial frame of the moving water the velocity is 'c'. This prompted Lorentz to introduce the concept of 'Local Time' which was later simplified to the velocity addition formula for relativistic velocities. This supported Fresnel's 'Full Ether Drag' theory, later supported by Stokes, Handiside and others, and by Michelson and Morley's development of Fizeau's early 'interferometer'.

Einstein commented on the M&M null result in 1952; "*H. A. Lorentz showed that the result obtained at least does not contradict the theory of an aether at rest.*" He had dispensed with the need for an 'ether' with 'immobility' for the Equivalence principle of SR but still recognised, in 1952, that space had in fact to consist of; "*an infinite number of spaces in motion relatively to each other.*" How a region of something that could not exist with any measurable quality could be in motion in relation to another area of the same non-existent thing is not explained. This remained the root of the paradox of SR and incompatibility with QM and QFT. The velocity addition equation seemed compatible with QM only in so far as mass could not exceed the universal constant 'c'. Advances in quantum physics have only increased the divide. The overwhelming

evidence of a quantum field of dark matter, and dark energy making up 73% of the energy/mass of the universe, casts another growing dark shadow. Astronomy also retains serious anomalies to be addressed<sup>[1]</sup> resulting from the cosmological model generated by current physics and keeping Cosmology a lively and widely disparate guessing game. But, although most eminent physicists are clear they believe something is fundamentally wrong, no falsifiable alternative theories to Relativity have come along, and solid evidence of relativistic adjustments needed for GPS, the Global Positioning System, arrived to reinforce its position as the unchallenged ruling paradigm. Proposed by Freidwardt Winterberg in 1955 as a test of Relativity the satellites atomic clocks did indeed prove to need adjustment, by 38 milliseconds/day, for relativistic effects.

So is a third solution possible? An answer allowing both relativity and quantum physics. Allowing the unification of physics. Including both equivalence and a quantum field, and perhaps leading to an answer to quantum gravity. A new candidate compliant with the postulates of SR has arisen for testing, the Discrete Field Model (DFM) possibly providing the essential real physical mechanism for Einstein's 'spaces in relative motion'. It uses wide evidence from particle accelerators, astronomy and condensed matter physics, retains an absolute constant of 'c', and is demonstrably able to resolve paradox and anomaly,<sup>[2][3]</sup>. It is also falsifiable.

It is implicit that no new theory combining the two halves of physics could completely agree with the current view of both. Any who believe that all current physics is entirely correct will disagree with whatever solution proves to be correct. Popper insisted ruling paradigms must be challengeable for the survival of mankind, and Einstein said "*we must never stop questioning.*" and; "*one should not desist from pursuing to the end the path of the relativistic field theory.*" Any supporter of Einstein must agree to this pursuit and the testing of all testable models. A major test is whether or not it is compatible with the GPS system evidence. The model's fundamental characteristics are outlined below and the GPS evidence studied and considered.

## **2. Discrete Field Model**

In outline, the DFM was derived from a similar thought experiment on equivalence to Einstein's original but with the rich new evidence of space exploration and particle accelerator physics. It considered the quantum cloud of frenetically oscillating particles that grows in size, density and activity around accelerated Protons, Particle Physics, Neville Mott and others 'Cloud Chamber' experiments, Spectroscopy, Superposition, and Astronomy. It reconsidered the basic light paradox of SR and studied anomalies and paradoxes in all areas of physics. Fuller description and discussion of evidence is given elsewhere<sup>[2][3]</sup>. Some simple questions arose;

- q 2.1. Does the fine structure around **all** accelerated mass everywhere behave in a similar way to protons?
- q 2.2. As the velocity addition formula applies to closing speeds<sup>[6]</sup> will light be observed approaching the quantum cloud filling the tube around the accelerated protons at 'c' from the opposite direction?
- q 2.3. From our detached observational frame, would the EM waves pass through the 1st bunch in the same way, i.e. at the same 'relative' speed of almost 2c, as any protons in the 2nd bunch that did not collide?
- q 2.4. What would be the implications if light could only travel through the 'cloud' medium at 'c'?

*a 2.1.* The fine structure of electrons behaves in a similar way to that of protons when accelerated through the vacuum<sup>[4]</sup> and no evidence can be found that other massive particles behaves significantly differently, whether they are accelerated individually or in groups. It appears that the fine structure constant of 1/137th may only be a constant at rest in the field and increases with velocity. This may be essential for the law of conservation of energy, the energy used to accelerate the particle increasing the effective mass and oscillation rate, to reach infinity as 'c' is approached, with particle density at a "saturation" level<sup>[7]</sup> of some  $10^{13}/\text{m}^3$ .

*a 2.2.* The Lorentz transformation or velocity addition equation does not apply to the relative velocity of objects (or EM wave fronts) approaching, or indeed receding from, each other, or more properly, the equation can be applied to both velocities but their *relative* velocity remains similar, which will be less or more than 'c', as in this case the velocities are simply added or subtracted. This provides the 'special case' in SR, of the view from a detached frame, which is "not the same" as adding two velocities with the same component vector<sup>[6][8]</sup>.

*a 2.3.* Assuming the laws of physics don't change when objects pass close together, the assessed collider impact magnitude is correct and photography records the events correctly, the 2nd bunch, and EM waves, pass into the first at just below 'c' in the frame of the vacuum tube, and relatively at just below  $2c$ . As EM waves cannot however travel at over 'c' anywhere it could reasonably be assumed that the waves are slowed and blue shifted to travel through the cloud at 'c', then shifted back on exit to resume 'c' in the vacuum, as at the Hau lab at Harvard<sup>[5]</sup>. It would therefore be necessary for present physics that, when observed from our detached third frame, the wave velocity changes as it passes into and out of the cloud. This would clearly need a physical process not just the mechanical construct of the Doppler equation, which can only describe it. The dense oscillating particles themselves are the natural candidates, acting as frequency modulators. The density and oscillation rate is proportional to the frequency shift, which gives a system in perfect symmetry.

*a 2.4.* Implications. One set of assumptions seems to put us in a strange 'Alice in Wonderland' universe, the other a simpler version. Let's first assume that there is no privileged 3rd frame from which EM waves can be observed to change velocity, or to have a velocity relative to anything else of more than 'c'. This assumption is witnessed by the constancy of 'c' when measured and explains equivalence. It does however leave complex paradoxes to be resolved, requires length contraction, is not evidenced by much observation and gives rise to many significant anomalies of space.<sup>[3]</sup> It also cannot be unified with quantum physics.

Luckily the other assumption, as described in *a2.3.* above, does not have these issues. Frequency shifts occur to allow 'c' to be maintained through the smallest of quantum fields, including the fine structure 'halo' of the human eye, and all mass up to and beyond galaxies. This is also witnessed by the absolute constancy of 'c' and explains equivalence. But the constancy of 'c' it allows includes constancy *in any and every quantum field*, which allows both equivalence *and* unification with Quantum Field Theory. It's also a little simpler as it doesn't have any of the paradoxes of the other assumption, it can explain Dark Matter, throw light on Dark Energy, resolve the major astronomical anomalies analysed<sup>[2]</sup> and simplify the basic cosmological model. It combines the key but conflicting concepts of Locality and Reality, and follows the postulates of SR to the letter, it simply reviews the assumption of 'no privileged 3rd frame field' on the basis of better information.

The well known experiments of Sagnac, Michelson and Ives (see pt3. below) all supported Lorentz's original relativity (LR) with a basic 'immobile' background 'ether' 3rd frame, but no solution for equivalence. The STR formulated the solution by allowing time and dimensions to change, but had no option but to remove the last qualities of the background field, which gave rise to complex paradox. Now there is an option, provided by the physical process of the DFM. It brings together the two variants of relativity in the same way it brings relativity together with QM, with the smallest of adjustments informed by advances in physics and astronomy.

Causality is not an issue as 'c' remains invariant for transmission of information. Currently anomalous lensing delays of over 3 years<sup>[1]</sup> mean light cone surfaces are far from smooth. The delay solution lies in the intuitive mechanism of light travelling through galaxies at 'c' whatever the speed of the galaxy through space, so light lensed around the galaxy arrives earlier or later. The dense galactic halo dark matter particles simply do the job we use crystal oscillators for in FM radio, Doppler shifting the waves, then shift them back again on exit. The same is done at the Hau lab, light passing by the Bose Einstein Condensate may be bent with a lens and arrive significantly earlier than the light slowed within it.

If you run at 10mph and jump on one end of a train, run it's length, then jump off at the other end, where you end up depends on the vector of the train. The train is like the Galaxy, Heliosphere and Planet, with the dense particle 'shocks' at their boundaries, a 'discrete field' moving within a background field. It is simply one of the "...spaces in motion relatively to each other." referred above, not just a 'system of co-ordinates', but a genuine physical reality. In any field we measure light at 'c' when at rest, and when we move we become a 'region of space in motion' ourselves and simply shift its frequency so it remains at 'c'. The simple frequency change needed for space craft communication as they pass through the shocks is the most irrefutable evidence of this.

### **3. Model Testing.**

Science has spent much time in its current paradigm so the DFM, however compliant with SR and QM, may need infinite testing to be considered. As well the Fizeau, Michelson Morley, and Sagnac experiments it's evidenced by De Sitter ('c' dependant on, so relative to, something other than speed of source), and the Ives-Stilwell proof that ion radiation is dependent on motion through a field. The Keating experiment with atomic clocks on planes was expected to show no difference between the east and west bound clocks, but did not. (see below). All explained by the model with a quantum field. The model is simple, intuitive, falsifiable and inductive, with significant predictive power. Its implications are very broad so testing can be comprehensive.

As the GPS system is cited as conclusive evidence of SR the DFM may be disproved if not equally evidenced by it. Although it follows the SR postulates it is not yet clear how much other assumption within SR would need to be adjusted. We therefore consider the phenomena of time dilation due to both gravity and velocity, and of length contraction, before we consider GPS itself.

*Contraction.* The core concept of SR is; 'As the speed of light can't vary, time and distance must'. This is at the root of the clash with QFT. The DFM agrees the constancy of 'c' but does not require length contraction.

This accompanies dilation in SR, but only to achieve equivalence, which the DFM derives differently. It is not yet clear if this means contraction is just not needed or actually prohibited in the DFM. It has not yet been evidenced and may not be likely to be so for some time so we must, for now, leave this question at large.

*Time Dilation.* Gravitational dilation does not conflict with the DFM. It is not a strict requirement of the new equivalence mechanism at 1st approximation but is likely to be so with the consequential physics of QG. Time dilation, due to velocity based transfer between inertial frames is a slightly different case. This is more closely related to contraction in the standard light clock illustration. It uses the assumption that there can be no third frame where relative motion can be observed at more than 'c', which we now know is not entirely correct<sup>[6]</sup>. It also varies significantly from gravitational time dilation as acceleration is not maintained.

The first DFM paper shows how the light box works with discrete fields, not requiring contraction,<sup>[2]</sup> also more logically resolving the twins paradox. A light pulse can only travel orthogonally to the mirrors, so without a discrete field in motion with the mirrors they would simply move away and leave the pulse behind. Within a discrete field, moving with the closed box, the pulse remains orthogonal to the mirrors and at 'c' in that field/frame, so it's apparent velocity *may* be observed from a 3rd frame as greater than 'c'. The light the observer sees is emitted orthogonally to the pulses direction of travel, towards the observer, and *travels at 'c'*. The observer sees a *continuous changing of position* of the pulse, which does not reflect the velocity of the pulse in its direction of travel in its own frame. No EM waves have to travel at greater than 'c' through any field for this to be observable. The edge of a shadow may similarly appear to 'move' at almost infinite speed along an infinitely changing curve such as that of the Lorentz transformation. Time dilation between inertial frames is therefore not a strict requirement of the DFM adjustment to the STR, but is not disallowed.

*Sagnac Effect.* After Fizeau proved light propagates at 'c' in its *local* medium, (arriving at a different time to that in any background medium in relative motion), Sagnac's 1st open ring interferometer proved the same, the speed of light remained constant to a background field *not* the moving apparatus, but changed frequency. Two astronauts in relative motion in the vacuum are equivalent in their measurement of the speed of light, (but *not* in their motion through the field or scale of their fine structure halos). If one travels behind the other, but faster, he'll receive radio signals earlier. The leader will be further away by the time the signals reach him so they take longer. The signals travel through space at 'c' *with respect to the background field*. The Sagnac effect on GPS signals in air shows this, giving solid evidence for the DFM. When a 'closed' ring (i.e. fibre optic, as a ring laser gyro) interferometer rotates, the waves are stretched or compressed by the motion as they remain at 'c' in the medium. It has not been recognised until recently that the waves are therefore *apparently* travelling at more or less than 'c' to the observer. The medium *is* a discrete field, which proves the model.

#### **4. Quantum Gravity.**

The core concept of equivalence remains that gravitational acceleration is entirely the same as inertia. We may have been a little distracted from this key evidence of QG by confusion with the concept of equivalence of relative motion in a vacuum. The consequential prohibition of a quantum field also made 'dark energy'

more mysterious. That prohibition is lifted by the model. If we consider energy conceptually simply as heat, which is motion, and absolute zero can never be reached, the dark energy field between massive particles must be a medium with a small scale structure in motion giving its  $2.7^\circ$  temperature. We use the conceptual simplification of heat as we may never discover if this residual 'energy retaining' structure is particulate, stringy to avoid infinities, loopy, foamy, a membrane or collection of dozens of other micro dimensions. It is likely to be far smaller than the massive particles we're still now getting to know. If massive particles are concentrations of this energy, each local area where it has been focussed to create or 'condense' a particle is likely to be a zone of less energy. This zone remains inescapably linked to that concentration of energy. When the particle is 'annihilated' its energy evaporates back into the field. The zone, perhaps akin to a 'Dirac Hole', is filled. Where the local energy, or temperature, is below the surrounding field, a relative 'charge' is created which may perhaps be conceived simply as heat or current flowing to colder areas.

The spin (rotational or oscillatory) of each particle has massive gyroscopic energy giving it inertia. It also has the other forces of rapid rotation. Each 'concentration' of equal energy may be drawn equally towards each other by the relatively equal negative energy zone surrounding it (Einstein's static field equations depend on energy density & pressure). The positive focussed energy which gives each particle its gyroscopic inertia, is exactly equal to the negative element, and must equal the inertial energy of another identical particle.

If we group 6 particles together they will jointly exercise 6 times both the energy and inertia of a single particle. The single particle will therefore be moved 6 times as much. A group of 3 particles will have taken three times the energy from the surrounding field so will attract the group of 6 three times as much, but also have 3 times the inertia, exactly cancelling that out. It will therefore be accelerated at exactly the same rate as any group containing any number of particles. So acceleration is exactly equal to inertia? Yes, except that the motion imparted is not exactly equivalent. The larger the particle the less it will move. This is a relativistic adjustment. If an astronaut separately drops a hammer and a feather on the moon and accurately measures their accelerations half way down with respect to his mother ship in space, he will find they did *not* accelerate at the same rate. This is because a hammer has more mass. Consider a larger hammer, perhaps half the mass of the moon. Its additional inertia will mean its actual accelerated motion is reduced. The moon however will be equivalently greater so the hammer and moon will close together and meet in the same amount of time as the feather and the moon. This is increasingly non trivial towards similar masses. The acceleration experienced however remains equivalent as the total acceleration between the masses is a constant of the total mass subject to Newton's 2nd Law regarding distance.

In the DFM the particle oscillation modulates and passes on the EM energy wave fluctuations at 'c'. Local perturbation may produce 'photon' corpuscles but these are not conserved. The varying density of energy in the field is the varying space time fabric of GR, but think of the fabric as having a thickness corresponding to its energy, its top surface being a landscape with hills and depressions, as the Dirac Sea with surface swells and superposed waves. A 'straight' line in this medium is a line of equal energy, as no other reference frame exists in the field. It's only with respect to our own different 'mass based' frames that light appears bent and

time appears dilated. Time must also use this reference frame rather than our own. It is entirely constant for any 'straight line' of equal pressure. This also makes it entirely consistent with the speed of light. In the deepest of the depressions, where virtually no field energy exists as a massive structure has absorbed it all, time will virtually stand still. If there were no energy at all time would stop, or cease to exist, as would light.

*Other Evidence.* Two other important facts inform QG and evidence discrete fields. It was established in the Cyclotron that only speed not acceleration affects the rate of clocks. Clocks were accelerated at up to  $12^{19}g$  with running rate unaffected,<sup>[9]</sup> but slowed in it's new rest frame. This is a blow to SR equivalence, as we know from GR that the 'equivalent', gravitational acceleration *does* slow clocks. This also undermined the mathematical logic of the simplest 'twins paradox' solution. The increased motion *can only* then be relative to a 3rd frame, or the earth may be accelerated away with the same effect. In 1972 Richard Keating sent two atomic clocks around the planet on aeroplanes, one east, one west, and left one at home<sup>[10]</sup>. In SR slowing would depend entirely on the relative velocity of the clocks. It did not. Both clocks slowed, but the rate was dependent on their *absolute velocity* through space, i.e. the speed of the aeroplane plus or minus the speed of rotation of the planet. The initial conclusion was not consistent with SR so it was given a new 'slant'. But it was fully consistent with a quantum field 'cloud' entrained and moving with the planet within its shock zone. Wolf & Petit's famous 1996 'proof'<sup>[11]</sup> of SR could only find isotropic compliance by using GPS data adjusted for the key Sagnac effect, a fatal flaw not logically justified. Further testing was proposed in the previous papers and it is predicted that no evidence for SR without the field and DFM mechanism will be found.

The model also resolves wave particle duality, explaining how the 'photon' waves from Lena Hau's Harvard lab accelerate instantly back to 'c' using zero energy. Again both are correct. Now we have a background medium, pressure fluctuation waves can travel through it, disturbances condensing and reabsorbing 'photon' concentrations of energy. A muon detected near the surface of the earth need not, indeed cannot, be the same muon that was found near the top of the mountain. Only the rate of propagation can vary.

The ability of the DFM to harmonise with gravitational dilation is important when considering GPS evidence. Dark energy may have gravitational acceleration itself. Certainly dark matter particles at the high densities generated by relative motion of fields and other particles<sup>[7]</sup> will generate significant force over wide areas to contort the application of the 2nd law. Particles may be condensed as symmetry breaking with excess energy density. Mass moving through the field will achieve this, as a proton in an accelerator an astronaut or planet through space, building up a bow shock 'cloud' or halo. The shock spin particles at the boundary zone would propagate other particles through perturbation as they move through the background field. Like a ship, the bow shock wave compresses the medium. The relief for the energy is to condense into particles, relieving the field of its excess energy at the rate of some  $e=mc^2$ . The whole system, based on a fixed oscillation rate for the relevant particles, modulates the frequency and therefore maintains the velocity of EM waves at all times. This beautiful symmetry generates the oscillators required for frequency modulation (FM) of the EM waves in exactly the measure needed for the frequency change. GPS uses exactly the same single particle oscillator system, but with crystals, to correct signal wavelength changes due to the relative motion between systems.

A consequence may relate to how energy could be extracted from the quantum field. Heat pump technology is not new, and can use very low level heat sources. It's at the heart of condensed matter, and its processes may indeed inform our understanding of the field, in that energy can be released in phase transition and symmetry breaking. The high density of energy concentrations, or 'photoelectron' particles, in the area around accelerated massive particles gives witness to the vast energy existing in the bow shock of our planet. This comes from the Earth's kinetic energy, moving at 29.8km/sec, or over 100,000km/hr. through the Heliosphere. It may have been possible to lose a couple of early probes of planets such as Mars due to the severe change in field velocity and frequency at the shock giving the impression of anomalous 'winds'.

In this, 3rd DFM paper we try not to repeat references to previous science and evidence, but in QG we must mention Lagrangian points. A future paper will deal further with a proposition that at the centre of massive objects such as moons and planets, as at the centres of mass of multiple massive objects, there are 'flat' areas, of zero acceleration such as the five, in equilibrium, that populate the earth/sun/moon system. Implications include those to inertial frames and time, the possible removal of the problem of mathematically awkward infinities, and possibly singularities. This may also allow a different light to be shed on black hole physics.

The above is only conceptual, but from a long term experiment based on Einstein's view that "*We can't solve problems using the same kind of thinking we used when we created them.*" It uses abstract but inductively based intuition, derived from known natural phenomena and includes 'Alice' project data from the LHC (rather than that of the best selling book on mathematics based on her adventures elsewhere). The maths needed is limited to the existing stock formulas used by Einstein for SR, as derived from Fresnel, and the relativistic Doppler equations. It simply links these back to physical quantum reality. But it will now need good mathematics, consistent with reality and natural physical phenomena not just itself, and working hand in hand with other representational formalisms. This may be of great import in proving the model and in further exploring, describing and quantitatively assessing the many aspects, implications and consequences.

### **5. Global Positioning System.**

The GPS system is based on around 30 satellites at a 'medium' orbit 20,200km. high, giving orbital radii of 26,600km, earth centric. They are not geostationary but have an orbital velocity of 14,000km/hr. (4km/sec), giving a 12 hour orbit. Each of 6 orbital planes, with some 4 satellites each, cover the same ground track each day. A minimum of 3-4 satellites, and normally more, should be accessible at any time from any point on the planet. Accuracy of positioning depends on a large number of variables but is normally within some 10-12m. Ionospherics give deviations of some 5m. other 'standard deviations' collectively contributing 6-6.7m.

*Deviations.* A number of other effects are allowed for in the design of the system, both relativistic and non relativistic. Doppler shifts due to relative motion of the emitter and receiver exist, changing frequency but not velocity of signal, all as expected. The Sagnac effect referred above is also allowed for. Even at 'c', time is critical. The fact that light propagates at 'c' *without* regard to the velocity of the emitter gave rise to the logical question; *propagates at 'c' with respect to who or what?* Eventually it may reach a receiver, and will



be travelling at 'c' in his frame, but couldn't tell beforehand at what speed he'd be travelling. With no background field, to propagate at 'c' *with respect to*, the logical inconsistency remained. The Lorentz infinity multiplier function reverted additions to no greater than 'c' but that did not address the inconsistency. Indeed he retained the 'ether' for his initial relativity (LR). With a background field largely 'dragged' by the planet, like the atmosphere, the EM waves travel at 'c' with respect to (wrt) the planet that they will eventually reach, not wrt the satellite. The Sagnac effect, as the interferometer, can also then only work *with* a field, or 'ether', including the time adjustment needed due to the receivers motion rotating with the Earth's surface.

*Relativistic Effects.* GPS time scale is defined in the satellites inertial system but observations are processed in a 'co-rotating Earth centred/Earth fixed' (ECEF) system in which it is termed 'simultaneity is not uniquely defined'. Opposite signs are used in the calculation for the east and west celestial hemispheres and a Lorentz transformation is applied to convert from the inertial system to the receivers ECEF system, giving a time dilation which would require the clocks to be set to run 0.3 microseconds/hr. faster. For the relative orbital velocity and height involved however the opposing gravitational time dilation, which can only be estimated approximately using Newton's 2nd law, is significantly greater. The system uses daily corrective adjustments but the overall offset which works best in practice is around 1.583 microseconds/hr. Adding back the Lorentz variation allowance of 0.3 microseconds gives a gross average gravitational dilation of 1.9 microseconds/hr. It's often wrongly quoted that the relativistic speed transformation is responsible for correcting what would be a 10km/day error. In fact variable and non-calculable ionospheric, atmospheric and other inconsistencies have a considerably greater effect, and the gravitational effect is also higher, by a factor of over 5. The clocks are generally set to run at the reduced frequency of 10.2999999543MHz against 10.23MHz.

In terms of accurate evidence for time dilation the system is therefore less satisfactory than we may have imagined. The amount and scale of other, only estimated, variations is such that the relativistic variation is largely used as a minor constant, entered 'by hand', to help derive the other elements. The quantum field of space also has impedance as well as other measurable qualities. For reasons 'not yet understood'<sup>[9]</sup> the atomic clocks change frequencies unpredictably by small random amounts. We must also consider orbit variations, the moon's gravitation and the unexplained additional accelerations of the 'Flyby Anomalies'. Space probes have been flown close to earth to accelerate them on continued missions, but gravitational effects have not matched prediction. The anomalous accelerations are inconsistent but can be significant. The acceleration of dense particles in the bow shock zone may account for some of this in the same way those of the galactic halo may negate the need for MOND. If the shock particles did obey the laws of gravity they would also have the effect of reducing the Earth's resultant acceleration on satellites, the same effect as relativistic dilation.

No calculation is offered for shock acceleration here as too little is known, but we may estimate a density of less than a third of the  $10^{13}/\text{m}^3$  over an approximate volume of twice that of the earth, spread out but focussed ahead of the Earth's direction of travel and fanned and distorted by the solar winds. At a distance of perhaps 6-8 earth radii, the gravitational effect will be small compared to that of the moon but certainly non trivial.

Testing SR by satellite was proposed by Friedwardt Winterberg in 1955. It has proven a little more difficult in practice than theory due to so many other, larger, variables. Estimates of dilation from the Apollo and other missions suffered from the same formula led approach and the fact that gravity and speed dilations largely cancel each other out on a moon mission. There is no other firm evidence of this or indeed of any other of the few predicted visible effect. Using GPS to inform and test the DFM has succeeded with respect to the, more significant, gravitational dilation, and importantly to the Sagnac effect, where its resolution of the central light paradox of equivalence allows a more logical explanation. It may only do so with relative velocity dilation using less reliable assumptions but we will none the less conceptually test the physical implications.

We need to revert to the inertial frame of the field itself, a concept not in common use with the previous mechanism used in this part of SR. We said under 4. above; *A 'straight' line is a line of equal energy, as there is no other reference frame in the field, and it seems time must therefore also use this reference frame.* Increased velocity of a particle or group of particles through the field must change the local energy profile of the field. With gravity, time is slowed the greater and closer the concentration of energy we term mass. If a massive particle moving through the medium compresses it and propagate other particles, which we know it does,<sup>[7]</sup> following the law of conservation of energy (as input to the LHC protons) that concentration of energy must slow time in exactly the same way. But not quite exactly. In this case, while accelerating there is no 'surplus' accelerative energy available to be measurable as gravity. This explains the Cyclotron data.

The concept of a 'wall of oscillators' stems from Max Planck's original derivation of the quanta from his black body solution. He saw his most important work as finding this real physical process the formula represented. We're still looking for that process for the STR, and indeed, with QG, for its generalisation. Einstein went one step on from Planck to quantize light. The Discrete Field Model goes just one small step further, but by discovering the real physical process which allows the quanta to work with relativity and observation.

## **6. Conclusions**

Consideration of QG within the DFM shows that time dilation due to gravity and relative velocity is not only accommodated but almost certainly required. It goes further in affording a conceptual physical explanation, suggesting how and why gravity is so precisely balance with inertia, at the quantum level. It also explains the DFM's much simplified light clock solution, resolving it without the need for length contraction so avoiding other anomalies. Non-relativistic effects are allowed, including Ionospheric fluctuations. Doppler shifting is explained, not just by the formula but with the well understood physical process of Frequency Modulation.

*The Sagnac effect.* Close analysis shows there are two related effects. The best recognised is the motion of the receiver (as the earth rotates) giving additional or reduced distance travelled by the wave. This simple case is however only relevant where the 'medium' between is also in motion with the receiver, (motion of the emitter is always irrelevant except to frequency). This includes the Earth's atmosphere, as light propagates through it at 'c' wrt its inertial frame, and is also evidenced by fibre optic ring interferometers. GPS timing is based on this. Different results are gained when the system is 'open', as in the Sagnac interferometer and the

M&M experiment. The EM waves propagate at 'c' wrt the background field, and observer. Frequency (but not velocity) is dependent on the motion of the emitter and receiver. In this case the 'delay' effect is greater because, and in so far as, the 'field' is not being dragged by the apparatus. The longer time the waves take to arrive is in direct proportion to the velocity of the receiver through the field. Both cases evidence the DFM. With the 'length contraction' alternative, when a fibre optic ring interferometer spins it remains the same size when observed from our 3rd frame, but when the pulse is sent through it we must see instant contraction, and/or instant slowing of rotation. This is not observed. But it is currently an integral part of our ruling paradigm due to the previous lack of an alternative, and indeed is at the root of most problems with current physics.

*Dilation.* A further surprise came from close consideration of the velocity time dilation element within GPS. This is less than 1 part in 5 of the relativistic affects, opposing the gravitational element, and some 15% of estimated total deviation, including fluctuating effects. Gravitational dilation is estimated using Newton's 2nd Law and can make no allowance for anomalous acceleration of flybys, or dark matter shocks. Constancy of 'c' is said to be confirmed to within 24m/sec. and prediction for speed dilation to within about 3%<sup>[9]</sup> but as this is added by hand to the calculations, and at only 7.2microseconds/day, if other inaccuracies are as high as 10% the certainty of the evidence would be significantly reduced, questioning the quantum basis of the DFM.

*QG.* Consideration of quantum gravity here is only a discussion of possible mechanisms. The DFM, is a well defined conceptual model, more falsifiable than any recent theory. It's most bizarre predictions are all proven; superluminal phenomena<sup>[8]</sup>, long lensing delays, anomalous accelerations, Voyager<sup>[12]</sup> and other anomalies. Further predictions were made in an earlier paper<sup>[2]</sup> requiring experimentation. The reason the similar 'Ether Drag' theory was discarded in the mid 1800's was Stellar Aberration, which proved to be poorly understood and wrongly cited<sup>[13]</sup>. We also now have much better information, from space and accelerators. It was an accident of history that another idea for this particular small but key part of the model of SR was adopted, leading to it's unsatisfactory relationship with QM, and Einstein's 1940 comment; "*we have to admit that we do not possess any general theoretical basis for physics, which can be regarded as its logical foundation.*" Einstein and Bohr may both have been correct in the argument between classic and quantum physics in 1927. We may now have a new logical foundation for an architecture of physics more closely grounded in nature.

*Epilogue.* During proofing of this paper in Dec 2009, results from the NASA lunar laser ranging test were published.<sup>[14][15]</sup> The thorough analysis given shows that the predictions of the Discrete Field Model are met. Lorentz invariance of 'c' is broken by some 200ms, equating to the Sagnac effect from the 'speed of the observatory along the line of sight due to rotation during measurement'. It is made clear that the result is not consistent with SR as formulated, but must have a preferred frame, but the physical system the frame was tied to could not be identified. The physical system seems entirely consistent with, and is predicted here to be, a combination of the dragged shock zone of the heliosphere as a background field and the local fields within the Earth and Moons shock zones. This is the first real and accurate evidence, not in fact of the invariance of 'c' but of the adjustment of the cosmological model needed to retain invariance and resolve anomalies.

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