

LENSING AND GALACTIC MASS ANOMALY SOLUTION FROM DFM SHOCK MODEL

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Abstract

Lensing of cluster MACSJ1149.5+2223 repeats anomalies found in other clusters. Extended Shapiro delays indicate central gravitational mass concentrations significantly higher than prediction. The continued problem lead Evalyn Gates to comment^[1]; "*This implies that we're either missing some physics in our simulations, or we may need to modify our cosmological model.*" A conceptual model of wave particle interaction at the Earth's bow shock and galactic halo's is tested using data from particle accelerators, and the Voyagers interactions with the heliopause termination shock. The potential, implications and possible quantum mechanical spin derived solution for Doppler shifting of EM waves by FM is explored, and identified as key to resolving the anomalies, also shedding new light on Dark Matter. The model also derives an explanation of apparent superluminal motion within the postulates of STR. Historical background to the '*Discrete Field Model*' (DFM) proposed here is identified, predictions are derived, and wider implications considered.

1. Introduction.

We first review the main anomalies, carry out a key thought experiment and consider aspects of relativity. Relevant phenomena from different areas of physics are then considered, along with the conceptual background approach. Assumptions are studied and tested and key issues identified. The historical basis of the current and proposed models is reviewed. Axioms are established and The Discrete Field Model is then assembled, its processes described in real physical terms and its resolution of the anomalies is tested. The conclusions give overview, consider consequential matters and remaining issues.

2. Outline of Anomalies.

Shapiro lensing delays

The relative delay of part of the light in Einstein lensing is attributed to the curved light path and gravitational time dilation of light lensed by massive objects, often galaxies and clusters. Irwin Shapiro first used radar to successfully test a 200 microsecond delay prediction for Venus lensed by the Sun in 1964. It is the primary tool for the estimation of gravitational mass of lensing galaxies and clusters. Spectroscopy allows delays to be accurately measured. The first anomalies arose with the second measurement, this one of Jupiter, where adjustments had to be made to the calculations to reach a consistent result, which caused controversy^[2].

Anomalous results have continued with delays often far greater than prediction, giving gravitational mass results similarly high. Delays in the order of weeks were explainable but some of over two years were found^[3] giving some extraordinary and anomalous results for lensing mass. Recent Hubble lensing images of cluster MACS J1149.5+2223 show multiple images with delays of over three years. This led UC Chicago astronomer Evalyn Gates to comment;^[1] *"The mass concentration in the center of the cluster is higher than predicted, a result that has also been found for other massive clusters studied with gravitational lensing. This implies that we're either missing some physics in our simulations, or we may need to modify our cosmological model."*

2.2 Superluminal motion.

Gas jets in Galaxy M87 in Virgo, were first measured as moving significantly faster than 'c' from our frame in 1918 and most recently by Hubble at 5-6 times 'c'. This has been 'explained' in various ways as due to space distortions, relativistic motion and movement vectors towards us. It is assumed it would violate the 2nd postulate of STR if able to be observed from any frame at more than 'c'. Its velocity within its own galactic frame is estimated at just below 'c'. M87 is exceptional, but by 1983 seven less extreme examples of motion greater than 'c' had been observed^[4]. The 2nd postulate of the STR has been put in various ways by Einstein and others but the accepted English version, is; *'As measured in an inertial frame of reference, light is always propagated in empty space with a definite velocity 'c' that is independent of the state of motion of the emitting body.'* STR also assumes isotropy and homogeneity. The postulate does however say *'measured in'* not *'from'*, so does not specifically preclude observation of motion at a distance *from* a third frame, as long as the light is always propagated at 'c' where within any local frame. This has not been the common assumption from STR, but assumptions require testing and we will do this here. (Note that velocity also remains a 'local' notion in GR). We will do a thought experiment, here including consideration of dilation, contraction and relativistic velocity addition. (also referred under section 4 below).

2.3 Third Frame thought experiment

We're floating in space observing a spaceship pass at say at $0.4c$. At the same time another passes in the opposite direction also at $0.4c$. According to SR it makes no difference if the velocities are relativised as the 'closing' velocity as observed from our 3rd frame has to be the addition of the two^[19]. But for accuracy let's assume the $0.4c$ is the relativised velocity of both. Their apparent relative velocity will clearly be $0.8c$. Their relative receding velocity is the same once they've crossed. According to SR they will both be contracted slightly in length. If their relativised velocities are each $0.6c$ their apparent relative velocity from our frame is $1.2c$ and the contraction is greater. The observation from the frame of each ship is of course different.

Now each ship is fitted with a strobe light on the rear tip of its tail, and also with a fibre optic cable running its length. As they pass us the strobe flashes, and also a pulse of light is sent along the cable instantaneously. Light travels through a fibre optic cable at approx $0.7c$ (at whatever velocity or vector the cable is travelling, i.e. in its own frame).

Now consider; 1. As we observe the pulse in the cable, at $0.7c$ (relativised to say $0.65c$) plus the ships $0.4c$ velocity, i.e. $1.05c$, will the cable contract more than the spaceship? or it's time dilates more? If so, one or both ends must become detached. This leaves a paradox not resolvable by transformation.

Now consider; 2. Viewed from our frame as they pass the closing velocities of the pulses as observed is $(0.4c+0.65c) \times 2 = 2.1c$. The velocity of the light from each when it reaches our frame is however still 'c' and the postulates are not broken and causality is not affected as no information is passed at greater than 'c'. As viewed from Earth's rotating frame many distant phenomena may similarly appear to exceed 'c' yet do not do so within their own local frame or field.

Now consider; 3. The wave front from the strobe at the tail is emitted at the same time as the pulse in the cable. We will always observe the Schrödinger sphere expand at 'c' with respect to our frame "irrespective of the velocity of the emitter". We would therefore observe the pulse in the cable arriving at the front of the spaceship *before* the wave front, even though the wave front has a higher velocity wrt the spaceship. This leaves another paradox related to the basic 'light paradox' of the STR. We will also of course observe the wave fronts from the ships strobe flashes crossing at a relative velocity of $2c$.

Now consider; 4. If we replace one of the ships with a galaxy the same must happen as they pass. If they were on a collision course we would, from our third frame, observe the ship approach and enter the galaxy, and assumedly, unless it changes velocity within its own frame, travel through it, at the relative superluminal velocity. From the frames of the ship and the galaxy this is not possible, giving another paradox.

Two things are demonstrated. The first is that the observation of apparent superluminal motion from a distant 3rd frame is possible, and indeed common, without necessarily breaching SR, GR or causality. Group and phase velocities don't carry information, and there is no limit to 'proper velocity' as it's not measured in one inertial frame. The second is that paradoxes remain which appear unresolvable by relativisation, contraction, dilation or frame transformations. The major test of the model is whether or not it can resolve the paradoxes.

2.4 Shocks; Voyager, Pioneer and Flyby anomalies

We will not discuss in great detail, but unpredicted accelerations have been experienced^[8] in the areas of both the heliospheres and planet Earth's cosmological shocks. A bow shock is the perturbed area at the 'front' of all massive objects moving through a vacuum. The heliosphere's 'termination' shock is 'inside' this, commonly referred to as the point where the 'solar winds' meet galactic space, the boundary of the solar system as a discrete unit, moving within the galaxy at $45,000\text{mph}$. Our planetary bow shock similarly leads our magnetosphere in its motion through the heliosphere around the sun, it consists of an active accelerated particle field interacting on an asymmetric vector with the solar wind particles and magnetic fields.

Voyager 2 has provided data^[5] on unexpectedly high and frenetic particle activity during its long trip through the heliosheath at 1 million km/day . We have little experience of galactic halos apart from EM cosmic ray

activity^[6] measurement, Hubble images of other galaxies and gravitational estimates of halo mass. These spacecraft acceleration anomalies would require significantly higher shock and Halo mass than the predicted levels which gave rise to 'Modified Newtonian Dynamics' (MOND). The possibility that there are sufficient massive particles in the Halo and shocks to account for the additional accelerations is considered below.

The model predicted a Doppler frequency shift of Voyagers signals through the shock, directly proportional to heliospheric velocity. This was expected from experience with our own planetary shock and was no surprise. We know EM waves propagate through galactic space, within the galaxy, at 'c', and also propagate through the heliosphere at 'c'. As the heliosphere is in relative motion through the galaxy the waves must 'change speed' at the shock (from an imaginary distant viewpoint) to maintain 'c' when the Doppler frequency shift occurs. This of course cannot happen if the *assumption* tacked on to the STR postulates is correct. In reality, and in our model, it is the only quantum mechanical way the Doppler shift could be effected at the boundary zone between the two discrete examples of "*an infinite number of spaces in motion relatively to each other*" (AE;1952^[16]) we are considering. Maths can describe and measure the frequency shift but cannot make it physically occur in nature. The concept requires evidence of wave/particle interaction at field boundaries.

Considerable evidence of wave particle interaction at the planetary bow shock exists.^[7] More solid evidence of discrete fields comes from the time the 13 day solar polarity change 'wave' takes to pass the Voyager craft. This extended to over 100 days on Voyager 1's reported termination shock crossing in late 2005 despite the reported slowing of progress as she reportedly encountered reversed 'solar wind' vectors!^[8] The implications of EM waves changing relative speed through shocks have not yet been fully recognised. Doppler shifts at the earth's own bow shock also evidence this. As EM waves travel at 'c' both before and after the bow shock the frequency change *must physically occur within the shock*. There has been no recognised need for a Quantum Mechanical process for Doppler shifting while we've accepted Relativity being at loggerheads with QM. The model explores the option of the two working more as a team, and shows how this could work.

2.5 The Special Theory of Relativity

Einstein reticently removed the last quality of 'immobility' that Lorentz and Poincare had left the 'aether' with, for the STR equivalence. Each of two astronauts passing in space is as justified in saying he is at rest and the other is in motion. There can be no third 'background' frame. This itself gives rise to paradoxes. (Oxford Dictionary; "*seemingly absurd though perhaps really well founded statement*"). The light paradox is central; velocity always 'c' regardless of motion of emitter and receiver. The incompatibilities between the STR and quantum physics started here. The dark shadow of the 'dark energy' quantum field grows ever longer but all challenges to the STR have failed, due to lack of any credible alternative, and to solid evidence for the postulates. The perfect solution, if there is one, may be something that just *refines* STR, and;

- a) Uses the two postulates of SR, including an invariant 'c'.
- b) Allows observed equivalence without anomaly and paradox.

- c) Simplifies physics with an intuitive solution.
- d) Allows a local and realistic unification solution to SR and QM.
- e) Assists our understanding of dark matter and energy.

This seems an impossible order for one discovery, but a significant step in one key area tends to throw new light on many others. Einstein said; "we *should be able to explain physics to a barmaid*", and Richard Feynman said; '*nature will always find a simpler way than we can imagine.*' so perhaps it should meet with Occam's Razor. Einstein also said; "*We still don't know one thousandth of 1% of what nature has revealed to us*". Not '*has to reveal*' but '*has revealed*'. So perhaps the answer is right here, under our noses.

3. Relevant Phenomena and Peripheral Matters

3.1 Photoelectron Clouds.

Proton bunches accelerated in a collider progressively build up a surrounding cloud of frenetically oscillating free action particles^[9] termed photoelectrons. These contain the energy which would otherwise appear to be lost in breach of the law of conservation of energy as proton bunches are accelerated towards each other, both at close to light speed (giving twice the closing speed). Cloud density and activity is largely proportional to velocity. These have been termed 'parasitic' particles, and much of the work at the LHC and Tevtron has included trying to strip them using differing magnetic fields patterns to clean up the stream^{[9][20]} aiding the search for dark matter. How and why these oscillating particles are propagated has been unclear but densities can be up to 10^{13}m^{-3} ^{[9][20]} Considering that light may be expected to travel at 'c' through and with respect to these clouds, Doppler shifted accordingly, explains the derivation of a central element of the model.

3.2 Particle Spin.

All particles have 'spin', including rotational and oscillatory. The Standard Model contains a number of spin types, as yet little understood but are consistent for each particle type. Spin is kinetic energy, and it's power is intuitively well known from gyroscopes, including oscillatory gyroscopes used in spacecraft as their high inertia overrides outside influences. It appears that propagation of spin particles at shocks is proportional to velocity through the quantum 'dark energy' field in a similar way to individual particles.

We've known for many decades that standard model particles with their range of spin types can propagate or 'condense' from the field with perturbation, and be annihilated, or absorbed back into it. We also now know from Plasmonics that light can be manipulated by particle spin^[10]. The links between EM wave oscillation and particle oscillation are therefore substantial, but some implications may not be recognised. This also raises the possibility of another unproven assumption being tested. One of the issues related to unification is that most particles cannot be conserved in the long term^[11]. If Photons can be stopped in BEC in Lena Hau's lab and immediately assume 'c' when released, it seems they may draw energy from the quantum dark energy field, what used to be known as the 'ether', and may be absorbed and propagated by perturbation in the same

way we create them. Einstein did not dismiss fields as such, saying in 1952; *"There is no such thing as an empty space, i.e. a space without field."* and; *"Space-time does not claim existence on its own, but only as a structural quality of the field"* But only; *"..as long as physical reality is seen exclusively in ponderable bodies."* The Discrete Field Model described here relates all fields to mass; both to the original 'ponderable body' creating the field and the massive particles generated in clouds at the shock and halo boundaries.

If dark energy background fields of 'ether' exist as a fluid 'vacuum', their likely contribution to the propagation of EM wave perturbation in Schrödinger spheres must be considered. If they have such a role, the photon, the zero mass 'wave bundle', could perhaps come and go with perturbation in the same way as photoelectrons and most other particles we observe. This must be tested, and we must further consider waves.

3.3 EM Waves

If we're using the visible EM wave spectrum in a model we should consider and define it with regard to duality. We know from lensing delays that Schrödinger wave front spheres and thus light cones, do not have smooth surfaces. We have considered the zero mass Photon, with therefore perhaps zero energy, as perhaps not 'conserved particles' that can travel for billions of years at absolutely constant velocity under their own steam. Our conceptual model allows wave propagation to draw on the dark energy field for motive power. Studying the wave form more closely we find another assumption. When having to dispense with the aether Einstein substituted a 'lateral wave' form for the concept of longitudinal pressure waves. There is no quantum mechanistic correlation for 'lateral' wave translation through space, only as energetic oscillation of 'mass' in motion through time. This is another issue between SR and QM. A lateral wave with no medium, as opposed to variations of a real physical property such as pressure, may in reality be purely a graphic representation on an oscilloscope and mathematical construct. From GR we know that gravity distorts the whole of space/time, which, as we have a quantum field, must include the field itself, so we do not necessarily need to stay chained to the concept of a massless photon 'particle' being attracted by gravity for EM waves to curve. 'Wave bundle' photons will remain as they always were, but without the assumption that they must last forever.

Particle propagation from the field is by perturbation so EM wave fluctuations as perturbations through the field would have a relationship with particles. This also perhaps applies to propagation itself if the photon is as common a phenomena as we believe. This is a logical and also seductive mechanism to allow as we know unification needs non conservation of those particles^[11] that do not join to form elements and massive objects.

A last point here is the double slit experiment wave. This has always told us more than most have recognised about scale, as has De Broglie. The tiny dots which slowly build up the pattern on the backboard are the 'wave bundle' photons, but the interference wave pattern built up from these dots is a macro form by comparison. If we look at the planetary Bow Shock there are macro scale 'standing' waves at the boundary with the

heliospheric field^{[7][21]}. Theories of 'carrier waves' are proposed to allow natural explanation of quantum uncertainty. It seems wave born information is not limited to oscillation within particles. As surface waves on the sea it includes superposed multiple compound waves interacting and interfering. Any model which precludes such cannot reflect nature. The limit is only that information transfer velocity is 'c'.

3.4 Conceptual methodology

Our quantum neurology was studied as we must understand the potential and limitations of tools we use. Einstein said; *"We can't solve problems using the same kind of thinking we used when we created them."* and; *"We shall require a substantially new manner of thinking if mankind is to survive."* Feynman agreed if math couldn't solve our unanswered questions "a new way of thinking" would be needed. So how can this be done? And how would we know if it has? It's easy to convince ourselves our thought processes are as refined as possible. The root & branch method of going through a new learning process and career path was chosen, using the long training of an Architect to masters level while researching other areas from astrophysics down. The 3 dimensional conception, visualisation and complex analysis techniques used in architecture were developed into a structured form termed 'triple helix morphology.' This is further discussed in another paper.

Our basic neural patterns are developed at an early stage, and no methodology assessments exist, so quite *how* 'different' this is can't be judged. Comparison with the science professions showed differences, one of the most notable being the way math is used. It's an essential tool in designing structures and environments, and no large buildings today could be constructed without massive computational power, but it is used as part of matrix of essential components, never alone. Maths can become detached from nature itself. This gives freedom for exploration, but serious dangers, inherent in our expectations of it, not always recognised. Einstein said; *"as far as the propositions of mathematics refer to reality, they are not certain; and as far as they are certain, they do not refer to reality."* Maths cannot float in real physical space and create things on it's own, it is brilliant at testing, describing and exploring possibility but it is a tool, not nature itself. In some ways our expectation of maths may be our undoing. Einstein said *"Since the mathematicians have invaded the theory of relativity, I don't understand it myself any more."* Perhaps only partly in jest!

Our model is of nature, of reality, it is not a mathematical construct. Maths can be utilised to help test it to destruction once constructed. The only essential maths the model needs so far is the established equations of such as Maxwell, Schrödinger, Fresnel as extended by Einstein, and, centrally, of Christian Doppler.

3.5 Doppler Shift

We know we have accurate and relativistic formulae but no quantum mechanism for frequency shifts of EM waves. Waves as longitudinal pressure variations propagating through a dark energy field would enable this. We can perhaps readily imagine the waves compressing for blue shift as they enter a different field, or 'region

of space', moving towards the emitter. And imagine the red shift as waves 'extend' to maintain 'c' as the new field moves away. Our model assumes EM waves propagate through, and draw the energy for their precisely constant speed from a background field, perhaps of the 74% of the mass/energy of the universe estimated by WAMP, with the properties attributed by Maxwell and more. We also know from shocks that space is not fully homogeneous and changes of uniformity exist. The space/time of GR as defined removed uniformity. If the constancy of 'c' is to be retained in the transformation between fields '*in motion relatively to each other*', the perceived *relative velocity of waves* must change, so a quantum process must exist to facilitate the change.

Now we are deep in the heart of not only the model but a lot of physics. Our next task is to find the way out so we can take another overview. The best route found is very familiar in our manipulation of radio waves; Frequency Modulation, or FM. A single oscillator, acting on a similar inertial principle to an oscillating gyroscope, can change the frequency of EM waves. The dense clouds of spin particles propagated by the perturbation at the bow shock of fields in relative motion are little more than oscillators. The waves reach each particle at whatever relative velocity and frequency the field motion dictates, but the particles oscillation rate is fixed and consistent and it can only pass the wave form on at 'c'. Now we can see our model happily incorporating both Relativity and Quantum Physics. It's not yet built, but most of the elements are in place.

4. Equivalence and History

History is important for learning from others mistakes, for discovering if and how the wheel was invented, and to re-evaluate to past decisions by applying our more complete knowledge. For instance, we now have over 100years of discovery and data since STR, but it seems clear that we're currently a little 'head in the sand' about the quantum field of space and its relationship to to relativity. Einstein was not. He said of relativistic space; *"It plays a determining role in all processes, without in its turn being influenced by them. Though such a theory is logically possible, it is on the other hand rather unsatisfactory."* ("The Meaning of Relativity", Appendix II 1950/1955). Equivalence of gravity and acceleration seems unquestionable, but he was convinced that the equivalence of two astronauts floating in space in relative motion couldn't work with the third 'background' frame. This was one of his main concerns when he referred to the "*evil quanta*". Our solutions have been to ignore it, or designate the dark energy field as having no 'direction' relevant to motion, so no privileged 'frame' as such. We've had no other answer, leaving us with the basic light paradox of STR, and others. Dilation and length contraction, first originated from the distortion of an EM field, are relied upon as a panacea, but cannot resolve the conditions in the thought experiment above. There can be no concerns about relativistic velocity addition equation as its well established that that the relative velocity of two objects approaching each other from different directions will be observed from a third frame as the sum of their velocities, relativised or otherwise,^[19] even if both are close to 'c'. For any who believe dilation & contraction may still somehow resolve the paradoxes let's accept they might, but also compare other options.

The DFM mechanism is able to combine equivalence and the quanta so simply it's difficult to believe it hasn't been considered before. It turns out it had, with common anticipatory plagiarism. The basic Lorentz logic; "*speed cannot change therefore time and distance must*", had prevailed over other theories in the 1800's and Einstein developed it, although Lorentz and Poincare insisted on retaining the ether. The history is given in more detail in an earlier paper^[12] dealing more with high energy physics, but, essentially, a misunderstanding of Stella Aberration, since corrected,^[13] discredited the Fresnel/Heaviside/Stokes etc. 'Full Ether Drag' theory despite support from the M&M null result, of which Einstein said in 1952; "*Concerning the experiment of Michelson and Morley, H. A. Lorentz showed that the result obtained at least does not contradict the theory of an aether at rest.*" The theory suggested a greater 'atmosphere' of ether moving with the planet through space. This would generate the 'bow shock' at our magnetosphere^[7] not then known to exist. As light entered the planets 'field' the shift occurred so it kept at 'c' through the new field, the shift being proportional to the velocity difference. The boundary zone would be the area in which the shift occurred; the 'magneto sheath'. The peak blue shift would be in the bow shock area. Light passing through the 'sheath', past the planet itself and out the other side would be red shifted back to it's original wavelength on exiting. The theory couldn't be tested in space so was lost when STR became the ruling paradigm with the stipulation of a 'non existent' ether tacked on. If spacecraft had come 60 years earlier history could have been very different. But two possibilities now exist; 1) A quantum field with no properties to prevent equivalence, or 2) A field that allows equivalence another way. If either could fit with QM it would seem it must be the right solution. We know that 1) so far cannot, and that's our current problem. DFM provides a testable option 2).

5. The Discreet Field Model

Now we have the components, constraints and methodology we can build our model. Our axioms are the postulates of the STR, as written but not necessarily with further assumption, with 'c' as an absolute constant for EM wave propagation, but considered as such within "*all and any*" fields. We have also now allowed the quantum field of space it's natural '*immobility*', or existence as a third 'background' reference frame. We're using the known characteristics of particles and waves, but oscillatory particles may propagate from the field by perturbation and do not need to be indefinitely conserved. Waves can therefore be physical variations in properties over time, not just equations or imaginary lateral curves. Fields may be localised discrete entities around mass in a similar way to 'full ether drag', but at all scales, and in motion relatively to each other.

Our conceptual 'formalism' initially requires a mental picture. Imagine floating at rest in deep space. You are observing our galaxy going past nearby, moving from right to left. A spherical wave front approaches from the left, the burst of a supernova. The galaxy is moving towards the expanding sphere, and when the wave front reaches the dense galactic halo of frenetically active spin particles the waves are compressed, shifting the light to the blue and transforming them to maintain 'c' within the galaxies frame. This creates a 'dent' in the Schrödinger sphere as the light passing *outside* the galaxy remains at 'c' in the observers frame.

If the galaxy were moving left to right, in the same direction as the wave front, the light would be *red* shifted at the halo and drawn *ahead* of the surrounding light to move at 'c' through the galaxy, forming a 'bulge' in the sphere, and appearing to the observer to move at $c+v$ (where v = the galactic velocity). The light reaching the observer, indeed any observer at rest anywhere, would always remain at 'c'. If we look inside the galaxy we see the wave front light entering our solar system is shifted again at the heliosheath to stay at 'c' within the heliosphere, with the commensurate frequency shift. As the light reaches our planet wavelength is again shifted at the shock to stay at 'c' for those on the surface. The heliosphere therefore has its own discreet field, or 'region of space' moving through the discrete galactic field, itself moving through the intergalactic field of our cluster, a discreet region of space of its own moving through deep space.

At a smaller scale, planets have their own fields, behaving like accelerated protons, propagating 'shock' clouds of free action oscillating particles. All mass has this 'fine structure' cloud of density and activity proportional to velocity through a surrounding field. This includes astronauts floating in space. We watch the supernova, if we move towards it, inertially or otherwise, our own thin surrounding cloud grows and, as light can only pass through it at 'c', Doppler shifts it to the blue. If we move away from it our own field will shift it to the red. A companion nearby at rest will see it white, and we will both always measure it at 'c'.

The cloud activity is proportional both to the Doppler shift required and relative velocity, giving the whole system perfect symmetry. When connected to wave propagation the inertial energy of spin 'particles', oscillating concentrations of energy, is the mechanism compressing or stretching varying pressure wavelengths as needed and seen^[14]. It seems therefore that the 'photoelectrons', generated at the rate of some $10 / 7\text{TeV}$ in colliders^[9], are of the same family as the dark matter of halos and shocks. The logic of the photoelectric effect is now also seen, waves may be squeezed and stretched, but, being a real variation of a property over time and not a 'lateral wave' mathematical construct, they will always retain the same energy per wave.

5.2 Resolution of Delay Anomalies

The frequency of EM waves passing through a galaxy may have been shifted many times through different heliospheres. More detailed spectroscopic line analysis may be able to identify these. It is also predicted that there must be other anomalies in lens structures as light passing *through* galaxies may either arrive before or after light lensed around them. The scale of lensing delay anomaly will be subject to galactic velocity and vector. For a galactic field 10 light years thick with a recessional velocity of $0.2c$ an anomalous delay element would be some 2.5yrs, but as the lensed light would also be Shapiro delayed we'd observe a reversed lens with less total delay. Clusters such as MACS J1149.5+2223^[1] provide multiple images commensurate with each galaxy's motion. As sensitivity increases additional heliospheric delays should be detectable. Hubble has detected and imaged dark matter halos to giant clusters, such as Cl 0024+17. The calculation process to unravel the history of EM waves may involve a long string of Doppler equations, one for each field it's passed through from nebulae and clusters down to planets. The phenomena observed are no longer anomalous.

5.3 Resolution of apparent Superluminal Motion

Superluminal motion is logically explained as the view from the 'privileged' 3rd reference frame. The gas jets of M87^[4] are indeed moving across the Hubble's frame of reference at 5 - 6 'c', without violating the postulate of SR or causality. The EM waves reach us at 'c', and Doppler shifted as emitted, but may have been shifted back and forth many times on the way to maintain 'c' at each field crossed. M87 is exceptional. It is proposed that a fast spinning super massive black hole is dragging its magnetic field to a 'tube' at each pole. Ionised particles are shot into a stream at almost 'c', building the jet. New particles are blasted into the stream already moving at 'c', so will do 'c' with respect to that field already doing 'c' with respect to the black hole. More are blasted in and go increasingly fast, like ever smaller moving pavements being built on moving pavements. None are doing more than 'c' in their own field but some may do 10 times that speed with respect to the black hole. As they're slowed at the tip of the jet they are observed by Hubble as doing 6c or more from our frame.

The duality of light is also informed, light energy held in both large waves *and* symmetry broken into shorter life small oscillating corpuscles. The 'light box/clock' experiment of STR is simply adjusted to remove the light speed paradox, remembering that the pulse can only be part of a sphere. Simply; The box is an enclosed field so the pulse moves at $c+v$. If the *sides of the box are removed*, and the top and bottom mirrors well separated, the pulse vector will remain vertical and not move sideways with the mirrors. The pulse cannot move laterally with parallel mirrors. At very close distances the field will be 'dragged' with the plates.

(Note; The heliosheath is at 100 AU's and the Earth's bow shock many Earth radii away, 60 -117 downstream).

The late 1990's creation of apparent superluminal motion in tunnelling by Nimtz^[22], and the follow up work Chiao^[23] et al at Berkeley were poorly received and largely dismissed by the mainstream as the implications of superposition, and phase and group velocities greater than wave front (cause) velocity, were not well understood. The real physical solution to equivalence, discrete fields, are only now being rediscovered after the misguided dismissal of ether drag in the 1900's, and are only now falsifiable.

5.4 Resolution of other Anomalies

The model of the cosmos described by the DFM includes the currently proposed large 'dark' elements of matter & energy.^[15] The dark elements are focussed at boundaries of discrete fields, moving at any relative velocity up to 'c'. Mass densities at halo's proportional to those around accelerated protons^[17] would explain galactic fringe stability without MOND and the anomalous asymmetric accelerations experienced with the Pioneer, Voyager and Flyby anomalies. The 'reversed solar winds' and assumed additional solar gravitational affect encountered by Voyager^{[5][8]} causing her progress to slow may also be explained by the move from the heliospheric to the galactic field of space, adding the additional relative velocity of 45,000mph through the field. Useful data on the shock and field characteristics should be obtainable from the deceleration profile.

5.4 Resolving Equivalence.

the model resolves the equivalence problem of two astronauts floating in space within a background field. The Doppler shifts occur at their own local boundary zones, through which light can only propagate at 'c'. If they are at rest in the field their boundary layer will have a constant fine structure of $1/137$ and wavelengths received will be unchanged. If they are in motion relative to the field they will have a consummately denser quantum cloud, changing the frequency to keep wave propagation at 'c' within it. The earlier paper^[12] explains how the fine structure varies with velocity, meaning the speed of light is locally space/time dependant and must change to maintain 'c' at the 'dark matter' fine particle zones between local fields.

This test result matches observation in all situations while removing barriers between the two halves of physics. It only required adjustment of some unproven assumptions regarding the quantum field, particle conservation and maths. While we may conceptually agree a form of dynamic scalar field of dark energy, any maths or further comment on characteristics would be speculation and assumption, which has dangers we are avoiding. Einsteins concept of multiple regions of space was always based on 'systems of co-ordinates' but, as his postulates, allowed and indeed almost described the principle of the Discrete Field Model;

*"..space appears as an unbounded medium or container in which material objects swim around. **But it must now be remembered that there is an infinite number of spaces, which are in motion with respect to each other.** The concept of space as something existing objectively and independent of things belongs to pre-scientific thought, but not so the idea of the existence of an infinite number of spaces in motion relatively to each other. **This latter idea is indeed logically unavoidable, but is far from having played a considerable rôle even in scientific thought.**" ^[16] .*

Minkowski had referred to 'endlessly many spaces' at Cologne in 1909. Only now, with data from space exploration and particle accelerators, can it play its 'considerable role.. in scientific thought'.

6. Conclusions

The Discrete Field Model is one of discrete regions of space associated with mass at all scales, in motion relative to each other. EM waves move through each field at 'c', and change speed at boundaries to maintain 'c'. This gives resolution of Lensing and Superluminal speed anomalies as wave propagation can be sped up or delayed (from our frame) subject to the relative velocity of other frames. Space is allowed 'absolute' field properties by using a real quantum mechanism to achieve Doppler shifts at field boundary 'shocks'. It joins SR with QM by stepping back a little from maths to think in real physical terms, the original basis of physics. Mathematics can now fully test it and, if proven correct, move ahead to new areas on solid foundations.

The elements of the model are both inductively and observationally evidenced, largely with the evidence of the STR, but without paradox. It can also be falsified by experiment. It suggests 'Dark' particle halos and

shocks may prove significantly more dense^[17] and dynamic^[18] than anticipated, assisting our understanding of halo stability. Shocks are propagated by perturbation at the boundaries of discrete quantum 'dark energy' fields in relative motion. The quantum mechanism of Doppler shifts at the particle shocks ensures the constancy of 'c'. Fields may be galaxy cluster or larger, and exist around all mass in motion including a single particle.^[20] Shock density, oscillation and Doppler shift are all proportional to relative motion of the fields. Frequency Modulation of the EM waves^[14] is effected by the vast mass of high energy 'wave bundle' particles, at densities possibly up to 10^{13}m^{-3} ^[20] as with FM radio, where single crystal oscillators can synthesize, control and alter frequency using the 'gearbox' principle and angular velocity. DFM is symmetrical, intuitive, and meets Occam's razor. It seems to provide a fundamental solution to astronomical anomalies which also, as it was likely to do, resolves other fundamental issues in physics. It allows, and indeed dependant upon, both Realism and Locality. Further details, consequences and predictions are considered in the associated paper,^[12]

Some felt that the STR was already reconciled and unified with QM and only gravity remained an issue, or there were no major issues to resolve. Einstein commented, initially on physics philosophy in 1936^[24];

"...the physicist believes he has at his disposal a rigid system of fundamental concepts and.....laws which are so well established that waves of doubt cannot reach them; but, it cannot be right at a time when the very foundations of physics itself have become problematic as they are now".

And 4 years later; *"For the time being, we have to admit that we do not possess any general theoretical basis for physics, which can be regarded as its logical foundation."*

The magnetosphere does, as may be expected, seem to correlate closely with the planetary shock of what may be an EM wave modulation medium, but the relationship is not clear. It also seems that while time dilation may be allowed it may not be necessary for the model. In this case a closer study of the GPS adjustment would be necessary. The targets a) - e) of page 5 are met by the model, but it has little comment on attractive energy. DFM does however inform this and other matters and a further paper is intended. Einstein said of GR in 1949; *"The general theory of relativity is as yet incomplete insofar as it has been able to apply the general principle of relativity satisfactorily only to gravitational fields, but not to the total field."* Three years later he wrote; ***"one should not desist from pursuing to the end the path of the relativistic field theory."***

A better understanding of the field should help achieve this. We only know any phenomena in nature by its characteristics and, once we've fully dispensed with mythology and analysed everything we *do* know about the quantum field, we may find it becomes far more natural and familiar than we realised. We've been using brilliant science, but science conceived long ago, from well before all the information we now have from space and particle accelerators. We've known for some time that something was wrong and a review was needed. Perhaps we'd better understand what we're seeing if it wasn't so well veiled by what we're seeking.

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