

LENSING AND GALACTIC MASS ANOMALY SOLUTION FROM DFM SHOCK MODEL

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Abstract

Lensing at cluster MACSJ1149.5+2223 extends previous anomalous lensing delays to over three years, indicating gravitational mass concentrations significantly higher than expectation. This continued problem has lead a leading astronomer 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 plasmaspheric bow shock, the heliosheath and the galactic halo is postulated and tested, considering effects on Pioneer and Voyager, and within particle accelerators. A conceptual quantum mechanical resolution for this via Doppler shifting of EM waves by scattering is proposed, with implications for Dark Matter, consistent with Maxwell-Einstein's weak field equivalence. This also derives a fuller explanation of apparent superluminal motion within astrophysical jets using the postulates of Special Relativity. The historical background to this '*Discrete Field*' model (DFM) is identified, further predictions are derived, and wider implications considered.

1. Introduction.

Our cosmological model frequently proves inadequate in accurately predicting observation, engendering ever wider theoretical speculation. Lensing delays are greater than predicted, explainable only with 'gravity wells'. We review some key anomalies, carry out a thought experiment and discuss aspects of Einstein's Special Theory of Relativity (STR), drawn up to resolve the most serious problem of 19th century physics, the apparent constancy of the speed of light in a vacuum irrespective of the motion of emitter or observer. Relevant phenomena from different areas of physics and assumptions are studied and tested, key issues are identified and a fresh conceptual background approach is used to derive and test a more consistent model using bounded or discrete fields in relative motion, equivalent to local inertial frames and consistent with the cosmic microwave background radiation (CMBR) rest frame.

We consider that electromagnetic (EM) waves or photons passing by an observer in a vacuum are not visible, and thus the proposition; '*light is only visible when scattered, including at lenses.*' The historical basis of the

current and proposed models is reviewed, including its fit with recent discovery. Axioms are established, the 'discrete field' model (DFM) processes is described in real physical terms and its resolution of anomalies tested. A need for improved dynamic conceptualisation skills is suggested, particularly considering the invalidity of the concept of motion in geometry and thus maths vector space. The conclusions give overview and consider consequential matters and remaining issues.

2. Outline of Major Anomalies.

Shapiro/Einstein lensing delays

The delay of part of the light in lensing is attributed to the curved light path and gravitational time dilation of light passing 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, consistent with Eddington's earlier confirmation, at least approximately, of Einstein's prediction. It is the primary tool for estimation of gravitational mass of lensing objects. Spectroscopy allows delays to be accurately measured. The first anomaly arose with the measurement of Jupiter, where adjustments had to be made to the calculations to reach a consistent result, causing controversy^[2].

The anomalous results 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 extraordinarily anomalous results for lensing mass magnitude. Gravity 'wells' were proposed in explanation, severe local 'caustics' in gravity fields. 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."* Gravity wells have not been credibly explained except in general terms of black holes, but neither has any other option.

2.2 Superluminal motion.

Astrophysical Jets are now known to be common, particularly to Quasars or Active Galactic Nuclii (AGN) with jets evident in over 1.5% of galaxies (SDSS). The model predicts this will prove significantly higher. 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 6-7 times 'c'. This is partially explainable as due to shallow angle towards us, predicted by Martin Rees, but full quantification is missing and this cannot fully explain the speeds commonly observed, at over 8c, or jets more perpendicularly orientated. It is assumed the 2nd postulate of the STR would be violated if observed from any frame at apparently more than 'c', so its velocity within its own galactic frame is estimated at just below 'c'. M87 is close, and exceptional, but by 1983 seven other examples of motion greater than 'c' had been observed^[4] and numbers have snowballed to well over 100. We consider this in 5.3 below, and suggest there is a second effect. 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.*' The STR also assumes isotropy and homogeneity. The postulate does however say '*measured in*' not '*from*' an inertial frame, so does not 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 suggest that if light is only visible when scattered by a string of medium particles we must distinguish between the apparent position of the particles and the speed of the light signal charging them. We now 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

Observer O is at rest in space observing spaceships A and B passing in opposite directions at say at $0.4c$. According to the STR it makes no difference if the velocities are relativised with a Lorentz Transformation (LT) as the 'closing' velocity as observed from our 3rd frame must be the addition of the two^[19]. But we will assume the $0.4c$ is the relativised velocity of both. Their apparent relative velocity will clearly be $0.8c$, both when approaching and once receding. According to the STR 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. Observation from the frame of A and B of course varies. Each ship is now fitted with a strobe light on the rear tip of its tail, and 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).

Consider Option 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? If so, one or both ends must appear to become detached. This is our present understanding of the STR, which leaves an apparent paradox.

Now consider Option 2. Observer O sees a closing pulse velocity of $(0.4c + 0.65c) \times 2 = 2.1c$. The velocity of the light scattered from each pulse when it reaches O is however measured at 'c'. So, all light only does $<c$. The postulates are not broken and causality is not affected as no information is passed at greater than 'c'. We do not require the LT to prevent anything moving at over 'c'. As viewed from Earth's rotating and orbiting frame the scattered signal sequence from many distant phenomena may similarly give the impression they are exceeding 'c' yet they are not doing so within their own local frame or field, as defined by scattering.

The signal from the strobe at the tail is emitted at the same time as the pulse in the cable. This travels at 'c' with respect to O "irrespective of the velocity of the emitter". The pulse in the cable therefore arrives at the front of the spaceship *before* the light from the strobe, and without breaching the postulate.

If we consider two galaxies passing by O, light may move through the interstellar medium of each galaxy at 'c' with respect to (wrt) each galaxies barycentre. This meets observation. If O 'sees' any of this light, it is because it is scattered by matter in the galaxy. He sees a sequence of individual scatterings, and receives all light at 'c'. If he accelerates, on any vector, this will be additionally modulated by the glass of his helmet or instrument lens ($n = 1.55$) or of his eye lens ($n = 1.38$) to account for the motion.

Two things are shown. The first is that paradoxes remain under relativisation which appear unresolvable by contraction or dilation. The second is that the observation of *apparent* superluminal motion from a 3rd frame is possible without breaching the STR postulates or causality. Observing a 'sequence of bulbs' light up in another inertial frame is not a valid way to measure the speed of light in that frame. Apparent, 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. This then allows local reality without hidden variables, and *apparent* superluminal motion, but a major test of the discrete field model will be whether or not it can resolve the anomalies and paradoxes.

2.4 Shocks; Voyager, Pioneer and Flyby anomalies

Unexpected accelerations have been experienced^[8] at both the Heliosheath and at cosmological shocks, including in the area of Earth's plasmasphere. 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 and commonly referred to as the point where the 'solar winds' meet the interstellar medium. Looking at it another way it's the boundary of the solar system as a discrete unit, moving within the galaxy at 45,000mph in the same way as the heliospheres of stars such as LL Orionis move through the Orion nebula gas, giving a visible parabolic shock. Our quasi-perpendicular planetary bow shock similarly leads our magneto-sphere/ ionosphere/ plasmasphere 'frame' in it's motion through the local CMBR rest frame interplanetary medium around the sun, though largely inundated by the significantly higher velocity (x20) and flux of the 'solar winds'. It consists of an active accelerated particle field, the inner part in the Earth's frame, interacting with Stokes-Navier dynamics on a slightly asymmetric vector with the solar wind particles and magnetic fields. The Voyager and Galileo probes found the same around Jupiter, enclosing a region of space within the planets inertial frame and, like the planet, far greater in size than Earth's despite lower orbital velocity. This suggests that the considerable shock particle evidence now available may need to be reviewed from a slightly different angle.

Voyager 2 provided data^[5] on unexpectedly high and frenetic particle activity during it's long trip though the heliosheath at 1 million km/day. We have little direct knowledge 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 vector issues of Pioneer and Voyager are consistent with a change in media 'direction' and velocity each side of the shock as the solar system moves through space, - as first discovered by Hershel. Velocity wrt a medium of space itself is however assumed inconsistent with the STR so is dismissed. We show that it is not inconsistent. This also

also gives rise to the possibility that there is sufficient pair production, ion population and density of massive particles in the Halo and shocks to account for the additional accelerations, which is considered below.

The model predicted a Doppler frequency shift of Pioneer and Voyager signals through the shock, directly proportional to heliospheric velocity. This was expected from experience with our own planetary shock and was no great surprise. We know EM signals 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* of zero medium tacked on to the STR postulates is correct. Since we became aware of the CMBR rest frame the assumption of no '3rd frame' in space in the STR should have been reassessed. But the STR requirement is only for no '*Absolute*' 3rd frame. There is another logical option; Local background frames that are not 'absolute', but relative, and with their own background frames. This is conceptually the; "*infinite number of spaces in motion relatively to each other*" specified by Minkowski 1909 and Einstein in 1952.^[16] In reality, and in our model, the shocks and frequency modulation by scattering is the simple quantum mechanism by which the Doppler shift is effected at the boundary zone between the discrete inertial 'fields' we are considering. Maths can describe and measure the frequency shift but cannot make it physically occur in nature. The model is logically consistent but also requires evidence of adequate wave/ particle interaction at field boundaries. The diffractive effects of free plasma ions have been found to be 6 magnitudes more effective than bound particles, and considering the many variables, including that that significant densities of some $10^{13}/\text{m}^{-3}$ are found, may strengthen the weak field equivalence diffractive potential ^[6a] to quantitative candidature not only for transformation via scattering but as the mechanism for the space/time curvature of lensing.

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 are equally justified in saying he is at rest and the other is in motion. This is why there could be no third 'background' frame to measure any speed

against, which itself gave rise to paradoxes. (Oxford Dictionary; "*seemingly absurd though perhaps really well founded statement*"). The light paradox was always central; velocity always 'c' regardless of motion of emitter and receiver. The incompatibilities between the STR and quantum physics started here. Despite the problems no challenges to the STR have succeeded, due to lack of a credible alternative, and to solid evidence for the postulates. But note that most evidence is indeed for the postulates, not necessarily for any associated assumptions. This is an important point to remember. The perfect solution, if there is one, may be something that just *refines* STR, and;

- a) Uses the 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 of SR and QM.
- e) Assists our understanding of dark matter and energy.

This may seem an impossible order for one discovery, but a significant step in one key area often tends to throw new light on 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 also 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*'. He and Bragg similarly suggested a new way of thinking or looking at what we already know is needed rather than more discoveries. This anticipated that the answer may be right here under our noses, and perhaps too simple to recognise. This is the basis of the model we test.

Minkowski and Einstein's conceptual fundamentals of '*infinite spaces in relative motion*', are consistent with Einstein's; "*The particle can only appear as a limited region in space in which the field strength or the energy density are particularly high,*" and "*objects are not IN space but are spatially extended*". We consider this '*spatial extension*' as including the heliosheath, plasmasphere, and indeed the fine structure '*cloud*' or halo around all '*matter*', (see 3. below), all of which are at rest in the frame of the object. In considering a small space *s* within a larger space *S* in 1952 Einstein used the common conception that small *s* is '*part of*' *S*. But he also realised it was "*logically unavoidable*" that; "*When s is in motion with respect to S, however, the concept is less simple.. ..it then becomes necessary to apportion to each box it's particular space.. ..in motion with respect to each other.*" We point out that this is the same difference that causes the failure of the Law of Refraction between co-moving '*blocks*' of media, so is a real phenomena.

Even Richard Feynman said; "I believe that the theory that space is continuous is wrong" (The M.I.T. Press, 1990). For space not to be continuous it must be a medium. The question is, can it influence the passage of light? Due to $v = dt$, logic says it must, which brings us back to the original problem, and our check to see if a slightly different formulation may remove the paradoxes and anomalies.

3. Methodology and Relevant Phenomena

3.1 Conceptual methodology

Our quantum neurology is considered as we must understand the potential and limitations of tools we use. Einstein was convinced; *"We can't solve problems using the same kind of thinking we used when we created them."* also saying; *"We shall require a substantially new manner of thinking if mankind is to survive."* Feynman agreed that if maths 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 and branch method of going through a completely different learning process and career path was used in the long training of an architect in environmental sciences and conceptualisation while researching other areas of science and astrophysics. Three dimensional conception, visualisation and complex analytical techniques used in architecture were developed into a structured form termed 'triple helix morphology.' The training particularly gives a natural insightful approach and skills of structured overview across many specialities. This is further discussed in another paper. History of science was learnt as history, not all as current science, as still often taught, and new work in most fields was kept under review. Work in the energy field among many others benefited.

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 maths 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! There remain issues in the STR involving maths, no less the fact that $e = mc^2$ is not equivalent to $m = e/c^2$ due to the fact that the first is 'rest mass' but the second 'inertial mass', which can be very different. The issue of invalidity of motion in Vector Space was even recognised by Feynman, saying; *"I rather suspect that the simple ideas of geometry, extended down into infinitely small space, are wrong"* and *"Another way of describing this difficulty is to say that perhaps the idea that two points can be infinitely close together is wrong - the assumption that we can use geometry down to the last notch is false"* QED (Princeton University Press, New Jersey, 1985), p. 129.

Our model is of nature, of reality, it is not a mathematical abstraction or 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 Newton, Maxwell, Schrödinger, Minkowsky, Fresnel, Einstein, and Christian Doppler.

3.2 Photo-electron Clouds.

Proton bunches accelerated in a collider progressively build up a surrounding cloud of frenetically oscillating free action particles^[9] termed photo- or 'virtual' electrons. These contain the mass/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 synchrotronic radiation emission flux and frequency are largely proportional to velocity. These have been termed 'parasitic' particles, and much of the work at the LHC and Tevatron 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. We predict these particles, which exist in both the frames of the magnets fields and the proton bunches, are equivalent to the ions produced by motion of massive bodies and their fields through the background space. The particles are propagated for a purpose, to always modulate the local speed of light to 'c'. Astronauts have detected an 'aura' to both the Moon and the Apollo spacecraft en route. The model predict this aura is equivalent to Earth's plasmasphere, will be found around all mass, and has a refractive index of $1 <$ subject partly to motion.

3.3 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. The model predicts that propagation of spin particles at shocks is proportional to velocity through the quantum 'dark energy' field in a similar way to proton bunches.

We know 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 Harvard's Hau lab and immediately assume 'c' when released, it seems they may draw energy from the quantum dark energy field, equivalent to what used to be known as the 'ether', and they may be absorbed and propagated by perturbation in the same way we create them for experimentation. Einstein did not dismiss fields as such, saying in 1921 "*space without ether is unthinkable,*" 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 propagated at high flux in dense clouds in the shock and halo boundary regions. If dark energy background fields of an 'ether' type condensate exist as a fluid 'vacuum', their contribution to the propagation of EM wave perturbation in Schrödinger spheres must be considered. The model neither requires or, more importantly, precludes this '*logically unavoidable*' spatial medium, but it would allow a topological approach to quantum fields, with scattering and entanglement itself reducing uncertainty. With such a role, sub atomic particles, ions and the photon, the zero mass 'wave bundle', could come and go with perturbation in the same way as photoelectrons and most other particles we observe, implementing transitions between spaces in relative motion as Minkowski's non symmetric energy-momentum tensor.

3.4 EM Waves

If we're using the visible EM wave spectrum in a model we should consider and define it with regard to duality. Lensing delays dictate 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 a 'conserved particle' that can travel for billions of years at constant velocity under it's 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 completely substituted lateral wave forms 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, joining that of incompatible 'time'.

Particle propagation from the field is by perturbation so EM wave fluctuations as perturbations through the field would have a relationship with particles, condensed locally to implement change, including between fields. 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 immediately join to form molecules 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 but that particles emit signals as waves in non particle form, equivalent to the Maxwell-Einstein combined C field. As surface waves on the sea the field 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'.

3.5 Doppler Shift

We know we have accurate formulae but science yet has no quantum mechanism for frequency or wavelength shifts of EM waves. Waves as longitudinal pressure variations propagating through an energy field would however enable this. This may be the background field with the 74% of the mass/energy of the universe estimated by WAMP, with the properties attributed by Maxwell and more. 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. We know from shocks that space is not fully homogeneous and changes of uniformity and flux 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 for any inertial observer, so some form of process, with a quantum mechanism, *must* logically exist to implement this change.

Now we are deep in the heart of the model and much of physics. Our task is to find the way out so we can take another overview. When we study and test quantum mechanisms for compatibility the best route found is very familiar from 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 via wave particle interaction. Indeed the aerial itself works in this way, via atomic scattering. The signal changes propagation speed to a constant with respect to the new medium, whatever it's state of motion. The waves reach each particle at whatever 'rate', relative velocity and frequency, the relative field motion dictates, but the new field particles oscillation rate is fixed and it can only pass on the signal, or wave form, at 'c'. The dense clouds of spin particles propagated by the perturbation at the bow shock of fields in relative motion are simply oscillators, doing the same job of wave/particle interaction. The process is well understood in fibre optics, producing the delay of polarisation mode dispersion (PMD) as the particles are charged and emit the signal. Where different polarisations exist within a medium different curved light paths may be produced, giving the well known effect of birefringence. Now we can see that our model of discreet fields happily incorporates both Special Relativity and Quantum Mechanics. It's not yet fully built, but most of the elements are in place. The signal telemetry from deep space probes will be consistent with these Doppler shifts of wavelength, which the model derives as equivalent to length contraction and time dilation on transformation between inertial fields.

4. Equivalence and History

History is important for learning from others mistakes, for finding if and how the wheel was already 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 the STR, but it seems clear that we're currently a little 'head in the sand' about the quantum field of space, the CMBR rest frame 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). The Equivalence of gravity and acceleration seems obvious, but the equivalence of two astronauts floating in space in relative motion was always problematical and wouldn't appear to work with the third, background, frame of an 'absolute' space. This was one of his main concerns when he referred to the "*evil quanta*". We have had to assume the dark energy field has no 'direction' relevant to motion, so no privileged 'frame' of it's own, simply leaving us with different apparent paradoxes. Dilation and length contraction, first originated from the distortion of an EM field, have been relied upon but can't resolve the conditions in the thought experiment above. Relativistic velocity addition is an issue 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'. Einstein was clear about the shortcomings of the STR, saying in 1940:

"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". in 1944; *"I hope that someone will discover a more realistic way, or rather a more tangible basis than it has been my lot to find."* and in 1952 of QM; *"So far also relativity theory has proved ineffectual in relation to this most profound physical problem of the present time."*

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 retained the ether. The history is given in more detail in an earlier paper^[12] dealing more with high energy physics, but, essentially, a misconception regarding Stella Aberration, (since pointed out),^[13] discredited the Stokes/Heaviside 'Full Ether Drag' theory. Inadequate understanding of relativity and the importance of using the correct observer frame appear to be to blame. Stokes theory was the only one supported by 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. Stokes theory, developed from Fresnel's partial drag hypothesis, couldn't be tested in space and 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 and science could perhaps have been very different. Almost ironically it is Stokes and 'anti-Stokes' up and down-shifted scattering that implements the change in PMD.

5. The Discreet Field Model

5.1 *Conceptual Outline.* Now we have the components, constraints and methodology we can complete the model. Our axioms are the postulates of the STR, as written but without further assumption, with 'c' as an absolute constant for EM wave propagation, and considered as such within "all and any" inertial frames or 'local fields'. We also now have defined boundaries between these fields, condensed ion or 'plasma' fine structure shocks, clouds and halo's, implementing change by atomic scattering, and perhaps also allowed the quantum field of space it's natural 'immobility', or existence as a third 'background' reference frame. These characteristics of plasma are consistent with Nobel Laureate Hannes Alfvén's work. 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.

The core conceptual mechanism we have missed is that light is subjected to TWO changes of speed when entering a different medium. When light enters glass it's speed is changed to c/n . If the glass is moving at v with respect to the field the light speed will also change by v . This is why the Law of Refraction fails. Consideration of observer frame is crucial, and the law E or $C = \text{frequency} \times \text{wavelength}$ applies to all observer frames. As light reaches our planet wavelength is shifted at the shock to change speed to the new local 'c' for those on the surface. The heliosphere therefore has it's 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 it's own moving through deep space.

All mass behaves like accelerated protons, propagating 'shock' clouds of free action oscillating particles, A 'fine structure' cloud of density and activity proportional to velocity through a surrounding field. This includes the vacuum of an accelerator pipe and for 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 energy is the mechanism compressing or stretching varying pressure wave-lengths as needed and seen^[14]. It seem therefore that the 'photoelectrons', generated at the rate of some $10^6/\text{cm}^{-3}$ in colliders^[9], are of the same family as the dark matter of halo's and shocks. The logic of the photo-electric 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 shocks and heliospheres. More detailed spectroscopic line analysis should 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 galaxies 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 in the absence of gravity wells, and significantly greater delays are expected.

5.3 Resolution of apparent Superluminal Motion

Common apparent Superluminal motion of Astrophysical Jets may be more fully explained as additionally due to the view from a 'privileged' 3rd reference frame. Jets ^[4] may move across the Hubble's frame of reference at over $7 - 8 'c'$, without having to be within a tight range of shallow approaching vector angles but still not violate the postulates of SR or causality. As Martin Rees predicted, if inclined towards the observer the apparent speed will be increased by the earlier emitted light 'gaining less ground' on the later emissions. The compensatory smaller lateral distance (arc) apparently covered works against this and gives a limit, of well below real local jet speeds at real speeds of significantly below c . (At $0.5c = \text{approx } 0.23c$ at 15°). Only when approaching ' c ' and at fine angles does the effect become significant. The large numbers found also do not sit well with the limited critical angles needed. Some have been found at rather greater angles and it has been suggested the effect may be a temporary one as jets vectors 'wobble'. (Schillizi - De Bruyn 1983).

But the highly collimated or graduated 'incentric' motion means that locally, within the medium the central pulse is moving in, the pulse is doing less than ' c ', but that medium is itself in motion within the earlier ejected medium, also in motion. It is suggested that the jets are produced by magnetic fields of super-massive black holes, possibly toroid, dragged, contorted and concentrated to give twin contra-axial jets of accreted matter. The jet head moves at $<c'$ and particles are ionised and shot into a stream at almost ' c ' with respect to the stream centre, so will do ' c ' with respect to that field. More are blasted in and go increasingly fast, like ever smaller moving pavements being built on moving pavements. The same effect is observed from a river bank, where no water molecule is passing another at more than 0.1knot, but the stream centre may be doing 8 knots from the frame of the bank. The signals in all cases are scattered to the local ' c ' and reach us at

'c'. They are Doppler shifted towards Gamma, but may have been scattered or shifted back and forth many times on the way, to maintain 'c' through each field crossed. The core pulses within the jet are observed from the arbitrary frame of Hubble as doing $8c$ or more, but all such arbitrary non-local frames are not valid for measuring phenomena in other frames. The limit 'c' is only valid locally and cannot be validly measured 'remotely' as only scattering can be observed remotely.

The duality of light is also informed, light energy being held in both large waves *and* symmetry broken into shorter life small oscillating corpuscles. The 'light box/clock' experiment of STR may be readily adjusted to remove the light speed paradox. Simply; The box is an enclosed field and the signals observed are from individual scattering particles, so the pulse may validly *appear* to be moving at $c <$, yet we receive all signals at c/n . If the *sides of the box are removed* and the top and bottom mirrors well separated, the pulse vector will remain vertical, not move sideways with the mirrors (except for a small 3rd order effect locally) , and when the mirrors move, will fly off into space, allowing the intuitive solution. 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. The implications of superposition, and phase and group velocities greater than wave front (cause) velocity, were not then well understood and it is predicted similar effects will continue to be found.

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] Dark matter starts as condensed atomic particles and ions and is focussed at boundaries of discrete fields moving relatively at $< c$. Mass densities at halo's would be proportional to those around accelerated protons^[17] subject to mass size and relative v , and would explain galactic fringe stability found without requiring MOND and also the unexplained 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. It is predicted that the planned Venus express probe will find a similar shock, in the planets reference frame, but mitigated in flux by the planets mass and em field. The model fits the complex patterns found in the earth's shock, and once studied further from this viewpoint more useful data on the shock and field characteristics should be obtainable, including from the mixing patterns and deceleration profile. It may also be the case that if ions are commonly propagated by pair production no re-ionisation 'epoch' may be needed.

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 fine structure boundary zones, and lenses, through which light can

only propagate at 'c'. If they are at rest in the local field their boundary layer will have a constant fine structure of $1/137$ and wavelengths received will be unchanged. As Einstein anticipated, they will not represent a new inertial field unless in motion relative to the field they are otherwise in. If in motion they will have a comparatively denser quantum cloud, which modulates the frequency and keeps wave speed at 'c' locally. 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 conceptual model test result matches observation in all situations while removing the chasm between the two halves of physics. It required adjustment only 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 condensate, finally explaining how particles 'pop up', any further comment on characteristics, or mathematical abstraction, would be speculation and assumption, which carries the dangers we are avoiding. Einstein's concept of multiple regions of space was based on 'systems of co-ordinates' which were allowed to resolve to Cartesian x,y,z, axis despite his conception specifying '*planes*' and '*rigidly attached to a body*.' rather than point and line abstractions, which have not been 'renormalised'. He did however almost describe the full basis of the Discrete Field Model in his 1952; *"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 as well as deriving the energy momentum tensor. But only now, with data from space exploration and particle accelerators, can this and Einstein's conception and postulates play their 'considerable role.. in scientific thought'.

Dissent about Relativity persists, but this model shows how it can be given an Extra dimension to satisfy critics. Some feel it is sacrosanct, but Einstein did not He 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."* He also 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."*

6. Conclusions

We have described how the Discrete Field Model represents a relativistic field theory as discrete regions or 'blocks' of space, as Minkowski and Einstein's conceptions, associated with mass at all scales, formed when in

motion relative to each other, and possessing a quantum boundary mechanism. EM waves move through each field at 'c', and change speed at those boundaries to maintain 'c' locally. This allows resolution of Lensing, Superluminal motion and other anomalies due to wave propagation being *only apparently* sped up or delayed when viewed from another frame, subject to relative frame velocity. Space is allowed 'absolute' field properties by using a real quantum mechanism to achieve Doppler shifts at field boundary 'shocks'. We show how this co-joins SR with QM by stepping back a little from maths to think in real physical terms, the original basis of physics, giving Locality and Reality using dynamic logical conceptuality.

We describe how the elements of the model are both inductively and observationally supported, including with the existing evidence of the Special Theory of Relativity (STR), but with an adjustment of assumption to remove all paradox. We give examples of its predictive power and how it may be falsified by experiment. This includes suggesting 'Dark' particle halos and shocks will prove more dense^[17] and dynamic^[18] than anticipated, assisting our understanding of halo stability, and that shocks are propagated by perturbation at the boundaries of these discrete quantum 'dark energy' fields in relative motion, equivalent to bow shocks. We identify the quantum mechanism of Doppler shifting of signals at the particle shocks to ensure the constancy of 'c', and identify fields up to galaxy cluster or larger, around all mass in motion including a single particle.^[20] Shock density, oscillation and Doppler shift are predicted as 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. We show how the DFM is intuitive symmetrical, and meets Occam's razor, seeming to provide a fundamental solution to astronomical anomalies which also resolves other fundamental issues in physics. An associated paper,^[12] is referred giving further details, consequences and predictions. We briefly identify that DFM does inform gravitational theory, but this is beyond our scope here and a further paper is intended. We identify that the magnetosphere does seem to correlate closely with the planetary shock of what may be an EM wave modulation medium, but this well known relationship is still not clear. Targets (a) – (e), page 5) are set and met by the model.

We show that at the heart of the model is the fact that light speed in a medium is c/n with respect to the medium, so when it is in motion with respect to the previous medium the light was in there are TWO elements to speed change, one being 'n', the other being the relative 'v', which fact resolves the paradoxes of the STR and explaining why the law of refraction fails in co-moving media. We identify how the invalidity of motion as a concept in geometry and therefore vector space and algebra, has kept the problem hidden.

We only know any phenomena in nature by its characteristics and we suggest that once we've looked a little harder and analysed everything we know about the quantum field we suggest we may find it becomes far more natural and familiar than we realised. 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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