

Inertial Frame Error Discovery derives Stellar Aberration and Paradox Free Special Relativity via Huygens Principle.

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Abstract

We uncover an observer frame error which influenced physics at a critical time. Refraction due to relative motion was considered from the wrong inertial frame, including by Lodge in his 1893 showing a light path 'dragged' by the new medium^[1] in his Stellar Aberration paper following Michelson's null result. In the frame of the moving medium (Earth) the light path reverses, refracting towards the normal. Jones's (1970) glass disks experiment used Lodge's observer frame.^[2] We show that use of the correct observer frame is essential for Special Relativity (SR), and how the error erroneously disproved Stokes Ether Drag theory, which Michelson supported, engendering incorrect assumption and paradox. We extend Young's experiment, and consider Huygens-Fresnel Principle,^[3] wave/particle coupling, scattering and implications on vacuum fields. Through extinction, bow shocks and FM, SR's postulates are confirmed, but important clarifications emerge at Maxwell's field limits, allowing replacement of an assumption with a quantum mechanism deriving SR, using mutually exclusive systems. We find extra predictive powers, symmetries and the ability to resolve perceived paradox and anomalies. New perspectives on Stokes, Raman and beyond arise from a local reality model using Einstein's 1952 view that 'space' is actually; "*infinitely many spaces in relative motion.*"

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1. Brief Historical Introduction

Histories can be erroneous if misapprehensions prevail so we first provide a brief resume and analysis. The backdrop of the 1800's was the basic light paradox. The Newtonian corpuscular 'ballistic' concept was not comfortable with the increasing evidence that light travelled at a constant speed 'c' through and with respect to (wrt) a 'luminiferous aether' medium in space, as a wave, 'irrespective of the speed of emitter or observer'.

A major turning point in science came when, after Michelson & Morley's (M&M) 1887 null interferometer result for 'aether flow', H A Lorentz incorporated FitzGerald's contraction theory into a transformation equation, taking away many properties of the 'aether'. Lorentz had agreed that Sir George Stokes 'Full Ether Drag' theory, built from Fresnel's partial drag theory, was consistent with the M&M result, but he objected on the basis that flow over a sphere is uneven and would not be zero at it's surface. Max Planck supported Stokes thesis and suggested '*compressible ether*,' more dense at the surface. Lorentz responded; "*..this assumption of an enormously condensed ether, combined, as it must be, with the hypothesis that the velocity of light is not in the least altered by it, is not very satisfactory.*" When Einstein reticently removed the last aether property, 'immobility' by using the 'lateral waves' of solids, for SR, it rejuvenated the 'ballistic' theory of light, dusted off to simply explain Stellar Aberration, but exacerbating the mystery of wave particle duality.

The nature of light and it's propagation is still poorly understood over 100 years after Special Relativity (SR). Einstein believed a better, simpler answer must exist, saying in 1940; "*..we have to admit that we do not possess any general theoretical basis for physics, which can be regarded as its logical foundation.*" And in his letter to Max Born 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.*" He wrestled to find 'local reality' and a unified field theory to fill the gap between Relativity and Quantum Physics until he died. Some believe this is largely filled, but Roger Penrose probably identified the problems comprehensively^[p14] confirming the 'chasm' is still vast, and the nature of light central. No credible falsifiable alternative to SR, the theory with no mechanism, has been proposed, but we considering another possibility, that SR is simply not yet complete, and that dissent and apparent paradox may be removed by it's completion with a quantum mechanism. Gaining a fuller understanding of the electromagnetic (EM) wave propagation mechanism must be essential and will be considered.

Stellar Aberration is central to understanding light and wave/particle duality, so we consider this and it's implications. We use a reality based, logical and largely non technical methodology, and include consideration of dark matter and energy, the assumed equivalence of mass in relative motion in the vacuum, lateral waves and both geometric and quantum optics. We look more closely at some parts of the history bearing in mind Sir William Bragg's view that; "*The important thing in science is not so much to obtain new facts as to discover new ways of thinking about them.*" and identify and analyse the broad consequences of the correction of this pre SR shortfall in complete understanding of the importance of observer inertial frames for aberration.

2. *Stellar Aberration and 'Aether Fields'*

Stellar aberration is the small angle stars appear to be off true position, considered as due to the orbital motion of the Earth around the sun. The cause and what it told us about the nature of light was the subject of major contention for almost 200 years since Oxford Astronomer James Bradley discovered this apparent seasonal change in position in 1725-7 when investigating parallax.

The observed position of a star is always found to be ahead of the assumed actual position on our ecliptic polar, (orbital heading) and the change of position describes a full ellipse in one orbit. The maximum aberration at some 20.47 seconds of arc is found at higher declinations and reduces to zero at the ecliptic plane. Using Draconis, with a declination 75° above the ecliptic plane, Bradley calculated the aberration angle using Earth's orbital velocity $v = (2.98)10^4\text{m/sec.}$ and $'c' = (3)10^8\text{m/sec.}$ as;

$$v/c \sin 75(\text{degrees}) = (9.59)10^{-5} \text{ radians} = 19.8 \text{ seconds of arc.}$$

The angles are small so a relativistic calculation is not considered necessary, $\sin(\alpha) = v$ being virtually indistinguishable from $\tan(\alpha) = v$, or simply (α) . The Newtonian 'ballistic' corpuscular theory of light was used. This suggested speed should be dependant on relative motion of source and receiver, but despite careful work by Arago and others, no variation was found. This supported wave theory of light, where speed may be logically independent of the motion of the source.

But there remained problems. It was assumed there was one aether, through which celestial bodies moved. But two parallel rays of light propagating in an all pervading aether, when focussed to a central point by a telescope moving laterally through it, would take different times to reach the centre. This would require a tilt of the instrument by $\tan \theta = v/c$ to correct, the same as for the corpuscular theory and as observed. However, in a medium with a higher index of refraction there would be far greater aberration. Airey's filling of the telescope with water demonstrated there was not. This result either ruled out aether flow if the wave basis was correct, or ruled out the wave basis if there was lateral aether flow. The wave basis was then the clear winner.

Fresnel first had the inspiration which included first deriving the relativistic velocity addition law used later by Lorentz and Einstein. He proposed that the aether was at least partially dragged along by massive objects, including the Earth, citing the relationship between density and refraction for aberration, tilting the apparent wave front by v/c . He did not further address the link with frequency and the problem that chromatic dispersion, (CD, - splitting of the spectrum), should occur due to it's variable relationship with density, but of course the alternative ballistic theory had the same problems. Fresnel had a basic thesis that light's speed related to each local medium, which was later confirmed by Fizeau's moving water experiment which also evidenced the wave properties of light. This derived Fresnel's Index of Refraction for all dielectric media; 'n', based on $n=1$ in the vacuum. The index can only be found by experiment, and proves the media based speed hypothesis.

But many were still not happy, and chromatic dispersion remained a problem with all theories. Sir George Stokes, Heaviside and others, then derived the 'full aether drag' theory, where the wave normal would undergo full deflection without dispersion as it approached the planet. Max Planck's proposal of a compressible aether, more dense at the surface countered the first Lorentz objection on surface flow speed variability, but his next, that the speed of light would be affected by density was not countered. In the meantime Lorentz was working on a development of Fresnel's theory and equation but also using a new parameter of phase time. We now know that the ions of the upper atmosphere and plasmasphere, while exceptionally strongly coupled to EM waves, have a refractive index of $n \approx 1$, so the Lorentz argument against ether drag has proved baseless.

The M&M result was not consistent with Fresnel's partial drag theory or Lorentz's ether theory derivation, but *was precisely* as predicted by Stokes theory. Michelson wrote to Alexander Bell after his experiment in 1881 saying; "*the ether in the vicinity of the earth is moving with the earth... ..in direct variance with the generally received theory of aberration.*" Einstein knew this, saying in his 1952 paper 'Relativity and the Problem of Space.' "*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*". This left Stokes Full Ether Drag wave based proposal as the main contender. The ballistic theory, although with wide support, had major issues to address, including with refraction and emitters motion. Stokes thesis, consistent with Maxwell's EM fields, gained support, but still needing to address the questions of variable density and Stellar Aberration.

Then physics changed. Oliver Lodges 1891 Stellar Aberration experiment and 1893 paper^[1] first gave Stokes support, saying; "*There is nothing to be said against the aberration effect being producible... ..by motion of parts of the medium as, for instance, by sliding one portion of the ether past another portion.*" But he then confounded this with a common misconception regarding observer reference frames, saying a 'ray' of light entering dragged ether would be dragged "*..in the direction of motion. A negative or lagging real aberration would therefore occur.*" This was clearly opposite to the observed aberration which was positive, or *ahead* of the true position. His error, considering from the wrong inertial frame, reversed the effect, but was unnoticed.

It seems the luminiferous aether had frustrated those seeking a mechanistic description of reality for long enough. It was now relegated to a supporting role by a, less mechanistic, mathematical solution. FitzGerald, a mathematician and close colleague of Lodge, derived an extraordinary thesis of length contraction, which may have gone the way of most speculative theory but for H.A. Lorentz. After the disappointment of M&M this seemed to be the solution for completing the Voigt/Fresnel derived relativistic frame transformation equations, already mooted by Larmor and Poincare. This was to replace the Galilean transformation;

$$x' = x - vt. \quad \text{with the new;} \quad x' = (x-vt) / (1-(v/c)^2)^{1/2}$$

then applying the 2nd order time transformation correction to the first half to give the full new transformation;

$$t' = (t - vx/c^2) / (1-(v/c)^2)^{1/2}$$

Einstein discussed stellar aberration in his 1905 paper, reverting to the simpler kinematic solution, further mystifying wave particle duality but allowing the 'immobility' of the aether to be removed. This allowed perfect equivalence of bodies in motion in the vacuum for Special Relativity. Eddington's later confirmation of curved light path predictions installed Relativity as the new paradigm. Einstein said "*Space without aether is unthinkable.*" (1921) when also considering field based General Relativity but he had effectively removed the last of its real properties, 'immobility', for SR. The aether went out of fashion but an 'interstellar medium' survived, with the Dirac Sea, the Higgs Field, and now a Dark Energy field^[3] representing 73% of the mass/energy of the universe, and the CMBR rest frame, with many known properties, maintaining the paradox.

Stellar aberration was only partly resolved, and duality was not at all. Maxwell's EM equations were, like GR, field based, yet for SR background fields and 'matter waves' could not exist. Transverse waves had been derived by Young and Fresnel to explain polarised waves and why they didn't interfere, but this is now better explained by scattering and harmonics, consistent with the Huygens-Fresnel Principle (HFP)^[4]. Young's transverse waves were in a medium, only previously existing as vibration in solids or a string, but they were reinvented by Einstein when removing the medium of longitudinal waves. There were other problems. Transverse waves did not co-habit with Schrödinger's three dimensional spherical wave front. This used plane or matter waves, a longitudinal variation in magnitude of a quality, which requires a background frame, field energy density/potential or 'dark energy' medium. The question 'what then is waving' in transverse waves has not yet been answered, and they still have no logical analogue in quantum energy propagation.

Calculations of the distance between the emitting stars and the observer is based on the speed of light across the vacuum with respect only to the vacuum itself, or 'absolute' speed, $v = dt$. This remains a paradox in itself as neither 1) the emitter, 2) the vacuum or 3) the receiver can have any influence on its velocity and there is no other entity by which it may be quantified. But the main paradox was the lack of influence the speed of the receiver has on measured speed 'c'. SR's apparent paradoxes have always engendered significant dissent, less so GR where the equations stress-energy field functions include sheer stress, pressure, energy and momentum densities and flux. Lorentz-Fitzgerald contraction has not yet been observed, yet the postulates of Special Relativity themselves are well evidenced, leaving confusion. So we now try to find a better and more logical match to the widely conflicting evidence, firstly by studying the phenomena of velocity derived refraction.

3. Refraction due to relative Velocity

Snell's Law of refraction only directly applies when both media are at rest. The angle of refraction depends on the relative density of the new medium (refractive index - n), and angle of incidence, giving the term; $n_1 \sin(\theta_1) = n_2 \sin(\theta_2)$. When waves are slowed the angle changes (refracts) and wavelength reduces, conserving energy and frequency. The fixed relationship is; $\sin \theta_1 / \sin \theta_2 = v_1 / v_2 = n_1 / n_2$. But the phenomena of refraction is also a function of *relative velocity* between two media, therefore it *also occurs if the media in relative motion have identical refractive indices*. This means that light will travel at c/n with respect to the

new mediums motion *so light changes speed due to media motion* not just n . And now we must remember that, unless we change speed to that of the new medium, we are observing from a different inertial frame, so frequency is only apparent. This is equivalent to Stokes' Full Aether Drag thesis where a dragged field moves with the Earth in its motion through a surrounding medium at rest with respect to the sun. The product of frequency f and wavelength λ locally within the new media remains 'c', and the energy E is also conserved. For $E = f \lambda$ and $c = f \lambda$ both f and λ must change to balance each other on transition, but only when viewed from each medium, i.e. when the observer also changes frame. The angle of refraction θ_2 can be derived from θ_1 and relative frame velocities. We have been guilty of a major failure of dynamic comprehension here, and not only of light paths, which are considered below. To put it simply; as relatively moving media (v) represent different inertial 'fields' or frames, when observing apparent motion in one frame from the other we cannot use 'Proper Time', so relative c will change as it cannot be validly measured. Frequency f will appear to be constant, and wavelength λ will be Doppler shifted. For $v = f \lambda$ to be valid the apparent v (in this case c) will change to match the change to λ . But as we cannot observe any such light unless it is scattered, all we would be seeing is a sequence of scattering, giving an *apparent* speed, not the actual signal speed. We may then see apparent velocity addition $c + v$ from arbitrary invalid inertial frames, with different results entirely subject to observer motion. This meets the SR postulates as **c is constant within** each frame, and each scattered signal from each particle travel to the observer travel at c , or at c/n in a medium.

Now considering vectors, under the ballistic theory, incoming photons entering the new medium are 'swept along' in the direction of medium motion (see Fig.3). For Stokes 'ether drag' theory this would give aberration in the wrong direction. Lodge showed this path in 1893, Fig 13 (p780.)^[1], but this was *as viewed from his lab frame not* from the co-moving frame which would, in this case, represent the planet Earth. His viewpoint was effectively from *interplanetary space*, which gives a *different vector*. This basic error, reversing the result, went unnoticed. An experiment was proposed with light passing through a spinning glass disc. R V Jones carried this out in 1971^[2] confirming the quantitative result but retained the interpretive error, suggesting a 'drag effect', opposite to that actually observed from the second inertial frame, i.e. from Earth. (See Fig.1)

This error of comprehension regarding the correct observer frame has remained unnoticed ever since. Stellar Aberration is still now wrongly assumed by some to 'disprove' aether drag. Modern optics correctly considers it in theory, giving the vector reversal, but the error of application to Stellar Aberration and its fundamental implications changing the route taken by science *have not previously been noticed or corrected*. It may be seen in the reciprocal relationship between refraction and observed deflection of a rod or finger in water. The path change observed from the frame of the first medium n_1 is *not* the actual, refraction angle, or the path that will be observed from the second medium, (or co-moving inertial frame) n_2 which the light is entering. This, n_2 , is the observers frame on the Earth's surface when considering stellar aberration with a dragged field. The observer at rest with respect to medium n_2 will actually see the angle of refraction reduced and the path vector *steepened*, at the point of refraction. The time averaged Poynting vector is counterposed with the refracted wave vector at obtuse incidence angles.^[5] The path, $P_1 - P_2$ in Fig.1. is angled *against* the 'flow' of the

medium as observed from n_1 . The figure shows the relationship of two 'bodies of medium' n_1 and n_2 with relative speed v , but considers each medium from its own inertial frame, where the refractive angle θ_2 is less than angle of incidence θ_1 . In the new medium light will take the fastest path to P_2 . We shall extend Richard Feynman's Quantum Electrodynamics (QED) analogy;^[6] A lifeguard wanting the fastest route from P_0 to P_2 would run to P_1 shortening his (slower) swim to P_2 . But. Though swimming on actual heading (vector) $P_1 - P_2$, by the time he arrives at P_2 When viewed from n_1 he will be in position $P_2 b$ because the tidal current is flowing at v .

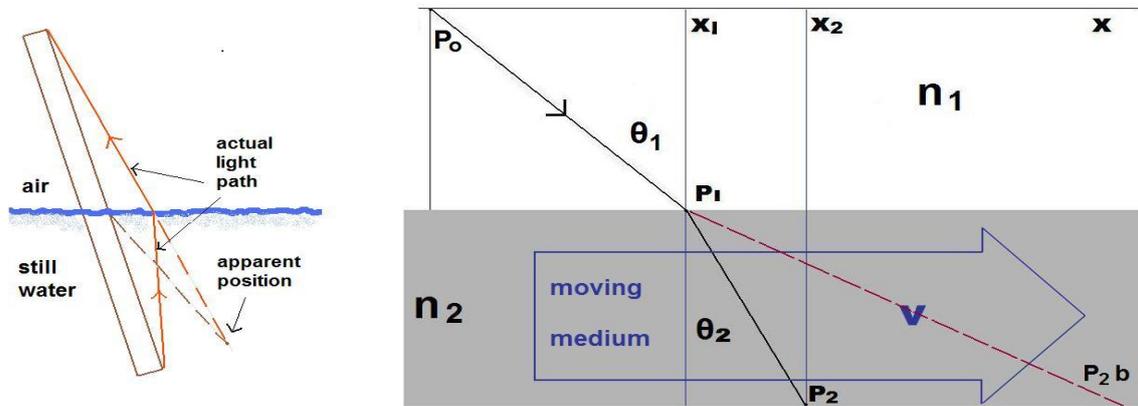


Fig 1. Refraction. Between different media such as air and water actual refraction is inverse to the apparent path change when observed from each medium. For media in relative motion (even of similar refractive index) the same rule applies. Here the observer changes inertial frame with the 'ray' of light. Lodge showed the 'ray' following the red path. Viewed from frame n_2 (as from Earth) it actually refracts in the opposite direction, to P_2

This recognises the implications of Fermat's Principle and QED, that the observed light traverses the 'path of stationary time' or least time, occurring when the sines of the angle are proportionate to the propagation velocities. Lodge, along with most,

had not yet grasped the essence of relativity, still misunderstood now, that each inertial frame *is* its own 'lab frame', with the same laws of physics. An event observed from the frame of a long established lab on Mars or in Andromeda will be different when viewed from Earth. We must always very carefully consider the frame we're observing from in considering the relativity of simultaneity. Fig. 2. below also

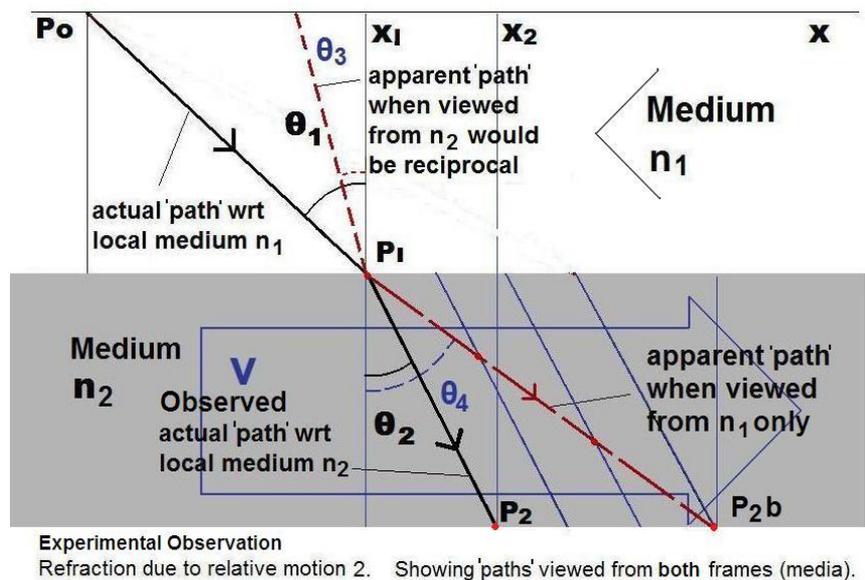


Fig2. Refraction at media in relative motion. Light paths vary viewed from each frame. Earth's 'lab frame' for ether drag or a discrete field is n_2 . It can be seen that the pair of vectors,

path Po-P₁-P₂b (as observed from n₁) are tilted in proportion to v when viewed from n₂. This demonstrates that, contrary to previous assumption, Stellar Aberration is accurately derived with a dragged or entrained field effecting a change in inertial frame above the planets surface. The heart of the resolution is; The *relative* speed of light changes in exactly the same way it does for a greater refractive index, as it must with the shift in wavelength and angle, but this time it does so *to maintain 'c' locally in the new medium*, within the new mutually exclusive moving system. As all lenses are made of matter, so are 'media', the mystery may be lifted.

The juxtaposition is difficult to comprehend but is very meaningful. It demonstrates why we will *always measure light locally at 'c'*. But it does not yet explain the physical mechanism at the field boundary interface. It shows that Cartesian co-ordinate systems can represent the limits of *real* physical bodies, and the 'spatial extension' of mass, we will discuss below, including planetary EM fields and ionospheres, but with a mutually exclusive architecture, dynamically separate, but joined by a quantum mechanical acceleration process.

Once the conception and implications of co-moving frames within frames is reached, a symmetry becomes clear. Light reaching the observer always does so at 'c' locally. If he stays in frame 1 when light moves into frame 2, perhaps a moving train, or galaxy, he would observe frequency apparently conserved but wavelength changed. He will also observe its *apparent* speed as $c + v$ (or $c - v$). The signal informing him of this 'apparent rate of change of position' will however travel locally at 'c'. If however he 'rides the light beam' and accelerates into frame 2, observing from there he will find the frequency changed to balance the Doppler shift of wavelength, their product remaining 'c' locally, and conserving the energy. Use of the correct observers frame is always essential. Lorentz stated his 'reservation' (1913) about the 'limits' to observability assumed for simultaneity preventing apparent velocity addition. The Discrete Field Model (DFM) show his concerns well founded. Both Classical and Quantum Mechanisms for the light speed change exist and are identified below.

The simple 'ballistic photon' aberration model from over 200 years ago is shown in Fig.3, the telescope angled to allow photons to pass down the centreline. For Stokes theory this mechanism would however derive the incorrect aberration direction. Ironically Stokes name is used for the up and down shifted atomic scattering (Stokes/ Anti-Stokes) which, interpreted correctly, supports the equivalent 'last scattered' basis of his wave based theory, but he couldn't explain aberration. We now can. Fizeau helped, proving 'c' was always with respect to the 'local' medium, as confirmed by Sagnac and others. This was in closed single frame systems. Further Sagnac and Michelson results from 'open' systems (light passing through a background field) also supported Stokes model. Wang showed

light propagation at 'c' in all inertial frames,^[7]

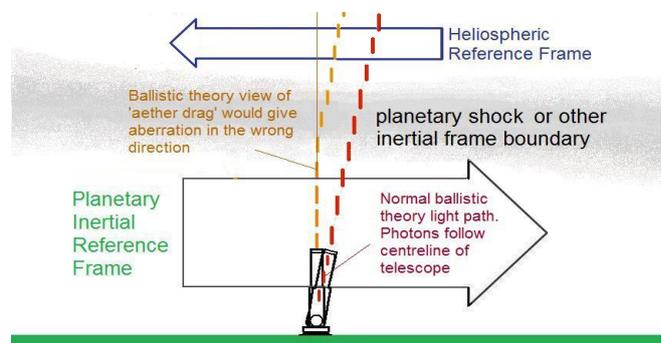
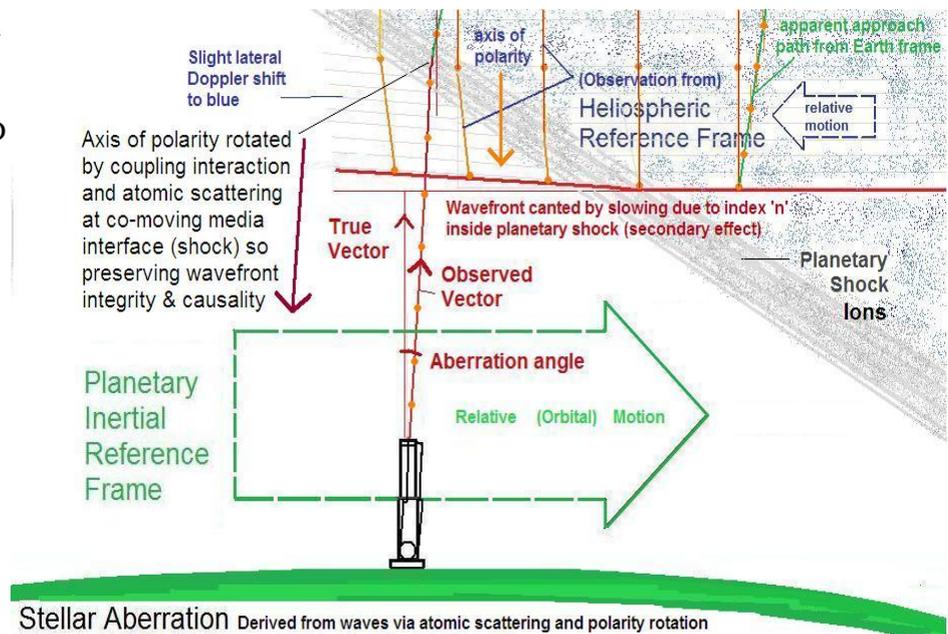


Fig. 3. Ballistic Model of Stellar Aberration. Photons pass down the telescope centreline due to it's motion.

supporting both Stokes model and SR's 2nd postulate. No experimental result *exclusively* supports simple ballistic theory. Conserved ballistics also had the relative speed issues in either plane, and in instant vector change on refraction. All other observation is consistent with waves rather than conserved ballistics. We have not yet observed long term conservation of photons, and from QM and cloud chamber experiments we know that particles condense and evaporate. But. Considering wave refraction with a spherical field model we may only derive aberration in the correct direction for the 'trailing' 50% of the sky. Deflection direction reverses for stars ahead of our path as a positive root is required at above zero crossing speed (normal incidence), and negative root below. (see Fig. 4). We will study EM waves and frame morphology more closely to check this result. We now know that Earth's EM field, ionosphere and plasmasphere are of significantly greater depth than assumed prior to space exploration, as is the heliosheath. The bow shock adequately deflects the solar wind and we will assume coupling as also adequate to interact with EM waves, so initially assume the 'limit of potential' or boundary between frames occurs at our planetary 'collisionless' shock. This theory is tested below and the weak field approximation discussed. Penrose has found^[17] that if Relativity and QM are to be unified photons cannot be eternally conserved so the road to unification should be found if successful.

As assumption can be the greatest enemy of truth we test the assumption of a spherical field. In Poincare's conjecture the plasmasphere may be many shapes, and we know a 'bow shock' is paraboloid. A Schrödinger sphere light wave surface arriving from ahead of our orbital path would interface with a shock boundary as shown in Figure 4. The red

line here shows how the wave front vector would change across the bow shock with CD due to slowing, via HFP. The observed signal is assumed as precisely normal to the wavefront. We will, for ease, consider a photon as a position on the wave front. Those *positions* are deflected in the direction of motion of the new medium, when met, satisfying intuitive logic. The

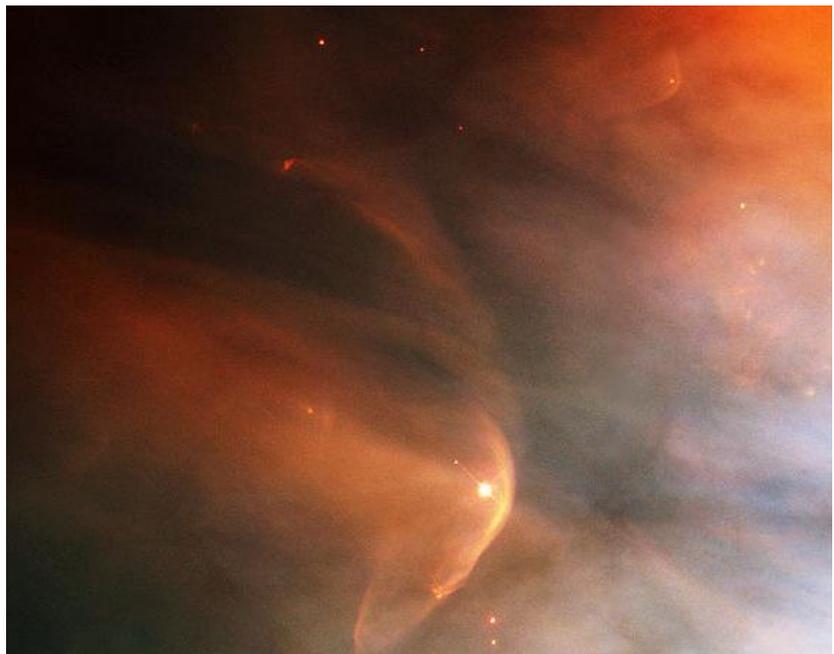


lateral Doppler shift effect reduces wavelength slightly, (blue shift) meaning the canted path travelled by **Fig 4. Stellar Aberration; Canting of the wave front. (due to relative motion of media).**

each 'point' (or photon) *But see also Fig 7. for Huygens-Fresnel Principle, Fourier Optics and FM mechanisms.* makes less downward progress. This cants the wave front in the opposite direction, in proportion to relative velocity, putting the stars 'virtual' position *ahead* of the true position, now as observed. We are now viewing this correctly, from *the Earth's* frame, from where the ballistic 'path' of a point/photon is not required. When considered at perpendicular incidence there is however a problem with wavefront plane angle and causality.

We cannot 'tilt' a plane without destroying causality at its limits (edges) by destroying the continuity of the Schrödinger Sphere and light cone surface. But we have only ever *assumed* that signal polarity we observe is normal to the refracted wavefront. Birefringence shows that this is not necessarily the case, and polarity can be rotated due to lateral particle co-motion on absorption. This resolves the final problem and derives the proper observed Stellar Aberration from Stokes 'full drag' theory. The aberration would reduce with reduced elevation towards the horizon, and be inconsistent with Navier Stokes turbulent shock dynamics, all as observed and giving the troublesome and inconsistent corrections needed for Aberration described originally by the Kimura Term (1902), agreed as refractive by most including Ross, Jones, Chandler, Corvoisier etc (1903-1916) and confirmed and quantified by Hewish/Bragg for EM waves in 1951. (up to 'approx 5km.'). Gherm et al (2011) is consistent and Heymens et al (GEMS Survey 2005) comprehensive in review of the 'poorly understood' and inconsistent corrections we are now so used to applying. Heymens also refers, but carefully, to refraction and the occasional “*strong horizontal diffraction spike.*” seen. But there still appears to be a problem. The aberration direction would still be reversed for an approach angle behind the interface boundary normal (here allowing it's right hand side to meet the interface before it's left hand side). This is not what observation seems to suggest. The negative root below zero crossing speed (vertical in Fig. 2) would disprove a model with a plasmasphere with anything similar to a spherical morphology, giving reversed aberration for low objects behind our path. We consider this more carefully still below, and find a solution.

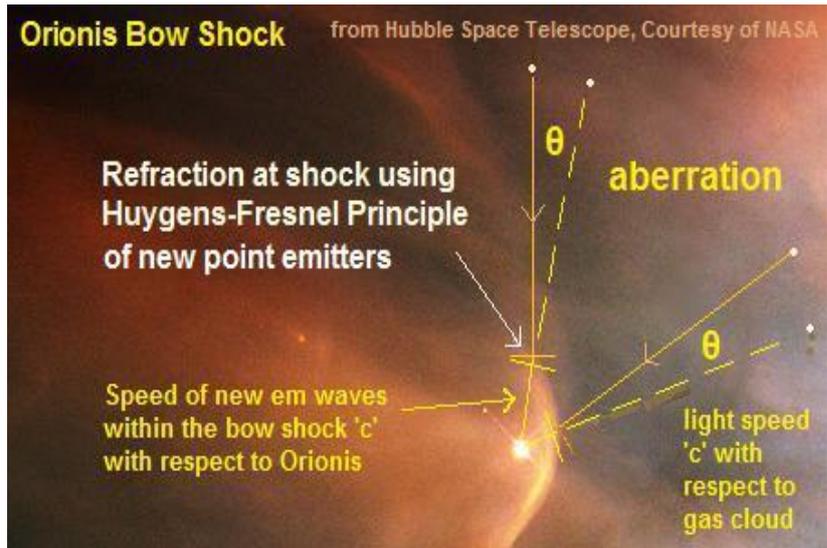
As the Earth's magnetospheric boundary is dominated by the effects of the solar winds it is hard to detect any other phenomena, although there are anomalous shock vectors and 'hot flows'.^{[8][9]} But on seeking evidence of dragged fields to massive objects moving rapidly through the interstellar medium away from such influence a clear pattern of parabolic or 'crescent' shaped bow shocks emerges. Recent studies of pulsar J2124-3358^[10] showed an optical bow shock and reported it moving through an ambient medium at a bulk flow velocity of 15-25km/s⁻¹ and gave a mean density of the medium at 0.8-1.3/cm⁻³. This is also the case at the bow shock of our Heliosheath, the region of what may be the inertial frame interface of the solar system as it moves through the interstellar medium at 45,000mph. This has no sun blasting it, but is evidenced by the anomalous oscillating particle activity and accelerations found by *Pioneer* and *Voyager*^[11] NASA have produced dramatic images^[12] from the data. The termination shock is where the solar



winds and interstellar medium meet. Fig. 5 is a NASA/ESA *HST* image of star LL Orionis and her heliosphere's bow shock, highlighted by the gas clouds of the Orion nebula, hitting her 'plasma sphere', precisely like the pressure /density wave from the bow of a ship. Here there is no external solar wind to create the shock that defines the discrete inertial system, so shocks exist and are maintained due to the system's relative motion through the vacuum field, or a smaller magnetic field through a greater field, which gives the concept of 'local' dynamic background frames embodied in the DFM, achieving precisely what Einstein needed to achieve in removing the single absolute background frame, but keeping local fields.

NASA's Laser Lunar Ranging experiment results^[13] and GPS^[14] find a local background inertial frame/field^{[15][16]} in which arriving light slows or speeds up to pass through at '*c*' with respect to the planet (or *c/n*). This is the Earth Centred Reference Frame (ECRF), identical to that found to Venus and Saturn. High EM coupling for even diffuse plasma ions ensures that it does so, as does observation of local '*c*'. Ions are unbound and Barros-Romero (1997) and Tajmar-de Matos (2011) have shown that they may couple at rates 6 orders greater than anticipated and far higher than molecular gas, significantly strengthening the Maxwell-Einstein weak field approximation even without adding the greater field depth magnitude element, gradually diffracting the old signals. This interpretation offers us a new viewpoint on the massive particle activity of galactic haloes and the flat gravitational curves of our galaxy edges as the galactic field spins and moves through the intergalactic medium, propagating pair production and particle activity in its peripheral star nurseries, all with mass and thus with gravitational potential. We now propose using a new term '*inertial field*' to conceptually unite the concepts of local systems of co-ordinates and dark energy potential with physical reality. How closely these may be related to Maxwell's EM fields, infinite in number, is not yet known, but there seems a certain symmetry to the concept of the speed '*c*' applying to EM waves within EM fields. It is now suggested as a possible reality analogue of Minkowski's 1909 and Einstein's 1952 conceptual description of space when searching for his unified field theory as; "*Infinite number of spaces in motion relatively to each other.*"

If the shocks dense cloud of oscillators is the interface between inertial frames the asymmetric crescent shape would only allow one refraction direction to be observed, resolving the final issue raised with Stokes thesis. Aberration will be ahead of our path and reduce towards the horizon.^[5] See Fig.6. But precise consistency of aberration low and rearwards, on both our orbital path and path through the solar wind frame, is predicted as impossible. Wave velocity would change to remain at 'c' after the shock, with refraction and Doppler shift and



conforming to the postulates of SR. We may even have observed this in the zodiacal 'false dawn' light of

Figure 6. Aberration at a crescent shaped bow shock. Only positive Khayyams Rubaiyat. Ballistic photon aberration would be derived, reducing with elevation, as observed. New theory would not be supported. We HFP waves from the shock will travel at 'c' wrt the star with the wavelength test implications and consider the accordingly transformed (Doppler shifted). physical process, starting from the earliest conception of EM waves, refraction and probability theory.

4. Field Boundary Process

We now consider EM waves more closely, particularly the tiny visible frequency range, and the implications of inertial fields. As we're now considering 'matter waves' we must clear our minds of preconceptions and look through the new doors this may open. The father of probability theory, light as EM waves, formulae in physics and much more was Christiaan Huygens, 1629-1695. The Huygens Principle was extended to the Huygens-Fresnel Principle^[3] (HFP) and confirmed by Kirchoff for wave equations in 1845, using matter waves to show how each point on a wave can become the point source of new waves. Sound waves behave similarly, a sound coming through a window with a source to one side will be heard as a sound from the window. The HFP says a change in medium will act as point sources of new waves, creating a virtual source. This is consistent with probability where, as in QM, a particle may propagate at any position, possibly subject to perturbation or compression. If it does it emits new synchrotron radiation and EM waves at a frequency directly relating to relative velocity, providing the Doppler shift and constant 'c'. Each new wave signal is a superposition of many such waves, but no back waves are generated. We consider this and FM further below.

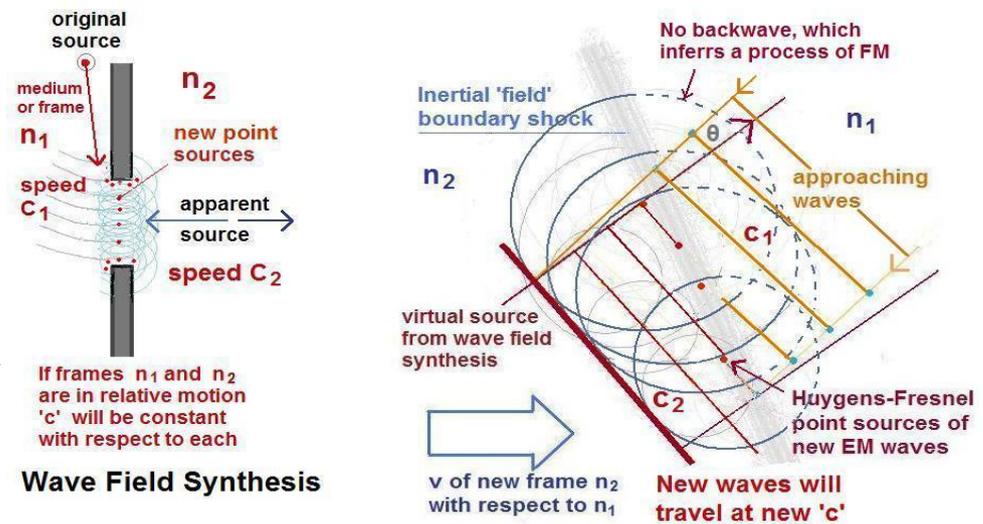
This extends to Fourier optics, where an EM wave front is considered as an infinite number of individual 'wave points' which can move laterally with respect to each other so any variable data (wave) can transform into 'frequency space' and back. This is not possible with conserved ballistic particles, but does suit the short term condensed virtual photon' or photoelectron oscillators we see surrounding the particles at up to very high

densities and frequencies subject to speed in accelerators. This would suggest that, when conceived, QM and EM waves were fully unified, and may now re-unite to explain paradox. Newtons ballistic light particles were certainly a precursor of QM, but neither Young's 1801 confirmation of EM waves or Fresnel's extension seems to have been enough to bring Huygens original principles back under the microscope. Figure 4 may now be enlarged to figure 7

below, showing

consistency with HFP optics. The main point to note is that the

Fig. 7. Huygens-Fresnel Principle, Fourier Optics & Wave Field Synthesis deriving a virtual source, inferring that waves from new point sources in new frames travel at 'c' with respect to the new frame. Wavelength changes with vector, conserving frequency and energy.



new waves from each point will propagate at 'c' wrt the inertial field they are moving through irrespective of the relative speed of the emitter or of the inertial field the original waves were travelling in. The analogy with sound is also shown, in Wave Field Synthesis (WFS). This shows sound waves behaving in the same way as light. The wave front finds a disturbance or new medium, condenses particles along the interface, and new multiple wave emissions give new 'virtual' emission points and observed vector. The most important concept to hold in mind is that with HFP the speed of the new wave is c with respect to the new local inertial frame it's travelling within, as found by Raman in his 1930 Nobel Prize winning paper, and consistent with both SR postulates. This speed must therefore be relatively different to 'c' in the old frame and would physically and mechanically, produce the Doppler shift observed in such cases. If we consider c in the same way we do Doppler shift it remains constant, as the observer is moving between the frames with the signal, so may validly measure using 'Proper Time'. The refraction process would be via wave perturbation at boundaries focusing the signal into oscillating (non 'point') particles, due to compressibility limits, propagating new EM waves at a new wavelength directly related to relative field velocity. We now find Snell's law and Fermat's Principle emerge, but with the former disqualified by co-motion. It also seems that sound waves may be a little more complex than colliding billiard balls. The probabilistic elements of QED may be explained by particles propagating locally by perturbation on interaction with photo-multiplier's.

In the DFM and scattering wave functions do not 'collapse' but the signal and energy are 'recycled' at the inertial frame boundary or, if reflected, also follow the path of stationary time. The virtual sound source of WFS may be created, controlled and positioned by a bank of tuned emitters providing the multiple superposed

wave pattern. This virtual source is analogous to the aberrated star position we observe from within any different local inertial field. With em waves only the edges of a wide opening would be affected, but the reason we find more charged particles at sharper edges of surfaces, such as slits in a baffle, and its role in penumbras, is explained, with the HFP. Connections reach beyond analogy when we discover that high frequency sound waves moving between different semi-conductors can directly generate terahertz em waves. (Fromhold et-al. New Scientist, 5 June 2010 p20).

If this interpretation is correct it would allow light to be longitudinal superposed EM waves of fluctuating (dark) energy potential, with condensed short life oscillators no longer exactly randomly propagated. Signal information observed would be controlled by both wavefront angle and scattering polarity, and so preserving the overall integrity of causal light cone surfaces a little 'battered' by Einstein lensing and PMD. The process uses the postulates of SR but allows it to be reunited with probability to evaporate paradoxical assumptions. It also suggests that photons are the more local short life entities of observational evidence, small waves packets within superposed larger waves, similar to fields within fields. Energy conservation would be more clearly met as the energy of annihilated or 'evaporated' particles would be conserved within the potential in a non zero ground state. It explains the measurement problem by suggesting all instrumentation propagates new waves, and leads to explanation of decoherence.

Before we move on we must consider HFP, the basis of holography, in more detail. Consider ten people throwing pebbles into a pond surface at an angle. Each set of ripples will, at the first order, propagate in a circle and at a speed relative to the water not the pebble. A cascade of superposed waves tells you the points of entry not the angle of approach of the pebble. This simple analogy breaks down due to the lack of a back wave at propagation, addressed by Fresnel's obliquity factor, considered arguable^[18] but resolvable by polarity, and by spin conservation. Reviewing the back wave question with current quantum physics and wave particle interaction a clear new solution is available in frequency modulation (FM) and polarisation mode dispersion (PMD). Signal vector follows polarisation axis, but momentum is conserved. In more dense media, subject to relative frequencies, massive particles absorb more of the old signal. The extended HFP is shown in Fig 8.

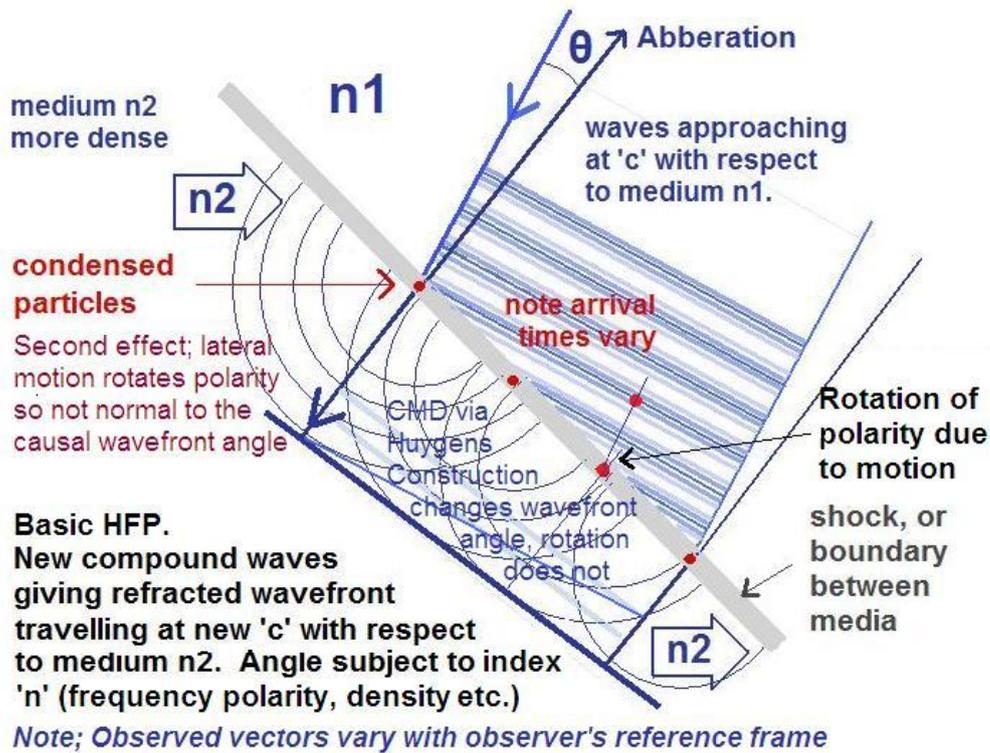


Figure 8. Huygens Fresnel Principle HFP Refraction. (extended). Common refraction is towards the normal (perpendicular) to the refractive plane. For media in relative motion light speed is converted to the new local 'c' (or c/n) and varies subject to the observers frame. In the DFM two related effects are combined; Chromatic Mode Dispersal (CMD) due to propagation speed change, and polarity rotation due to co-motion on charging.

Refraction angles are 'known' by individual oscillators but do not remain perpendicular to the causal wave front on rotation. Fresnel's transverse waves, conceived for polarity reasons and informed by QFT and holography^[19] are not required. Wave energy patterns on oscilloscopes are representational of energy density fluctuations within a compressibility limit, not spatial constructions. Birefringence, or Multiple refraction angles, evidence the process and the importance of polarisation. The coupling of ions and EM waves is also evidenced by the birefringent qualities found in the shock plasma medium, possibly due both to molecular gas formation with varying refractive index, but conceptually due to the gradual vector change process.

Doppler shifts, equivalent to stretched or compressed strings of Q-bits, will occur at the fine structure of the lens of an eye or instrument if in motion relative to the background. Indeed they occur in infinite numbers, not just as mathematical constructs but with a beautiful and symmetrical quantum propagation and polarity based HFP process, balancing vector, frequency and wavelength to conserve energy and speed 'c' locally. Infinities would no longer be required, and the abstract transformation curve is explained by the real quantum mechanism of atomic scattering and the power curve required for charge approaching higher frequencies.

5. Implications of Inertial Fields and Locality

Maxwell used an 'all pervading' aether to simplify his field equations, but these have only local jurisdiction. Any ether may be similarly local, and Schrödinger's equations are indeed only local.^[20] Let's consider some of the implications of locality. There are infinitely many EM fields, with physical reality. Heisenberg said "...electromagnetic fields are a reality of their own and can exist in empty space." Each moving particle has a field potential and charge, small fields within ever larger fields, all in relative motion. Minkowski's 1909 conception was; "...from here on, we would no longer have space in the world, but endlessly many spaces;" In Einstein's quest to unite Locality and Reality in the unified field theory he said, in his 1952 ('54) paper; "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." We suggest that now may be the time for that concept to play such a role.

Similar to that concept is an infinite number of EM fields in relative motion. We must envisage each field as a real physical inertial frame. Einstein again, in '52; "Physical objects are not *in* space, but these **objects are spatially extended**. In this way the concept "empty space" loses its meaning." Mass with extended 'field' potential must be in relative motion to generate charges. If we have non zero background energy potential we can use topology to solve problems with action at a distance. Each massive particle affects local topology and will be instantaneously 'aware' of other mass in the vicinity. Figure 9 below shows an example of a simple 2D topological representation based on a GR gravity model but complying with Coulombs Law; $F = (kq_1q_2)/r^2$

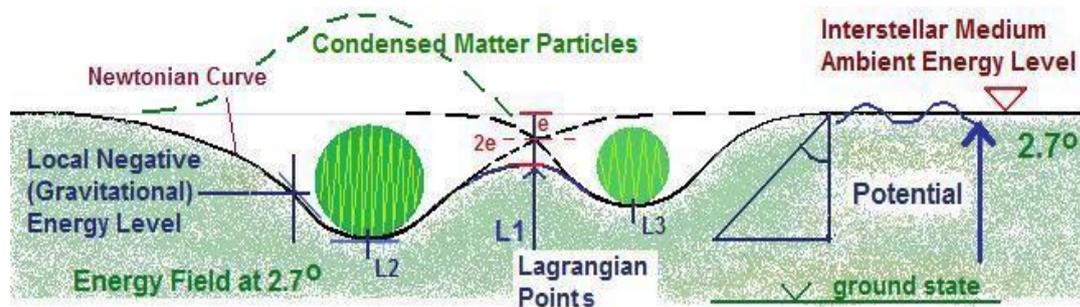


Fig 9. Topological Field Model showing instantaneous communication of potential between charges.

The curvature under each 'object' is affected by the other object subject to relative sizes or charges, and the square of the distance apart. The depressions represent the 'spatial extension' of the objects, and when annihilated they are absorbed and the surface flattens. Complex superposed EM waves would propagate at the fixed speed 'c' through and with respect to the medium. In this case the minor and obvious addition to the postulates of the STR arises, the almost superfluous word 'Local'; *EM waves travel through all local EM fields at 'c'.*" The HFP would 'change' their speed at the dense boundary shocks of oscillating particles, as at a new medium, with consummate Doppler shift and refractive aberration, always propagating at 'c' locally. If the particles are condensed at the perturbation so may be their polarity, but as any field would be allowable so may be any form of wave. All observed properties seem derivable from the mechanism.

The limits of this '*spatially extended*' mass should relate to the limits of the local EM fields. From virtual electron clouds to our planetary shock and the bow shocks of the heliosphere and LL Orionis, we can find the boundary positions. The formula for the local spatial limit will directly relate to the total momentum of the system, being based on rest mass \times relative speed. The total effective mass will include the mass of the condensed particles, physically giving the system that momentum, inertial mass and therefore gravitational mass in yet another symmetrical relationship from which a quantisation of GR appears to emerge. Frequency modulation, the wave-particle interaction used for FM radio, is equivalent to PMD in atomic scattering. The wave particle interaction and its implications are discussed in depth in the Discrete Field Model (DFM)^{[21][22]} which preceded this paper which uses the basic dynamic shock boundary mechanism with a unified field potential, suggesting this as the possible link between reality and locality lost with Bells inequality, now restored with a non hidden but simply unrecognised variable consistent with recent theory (Christian 2011).

In Einstein's 'light box' experiment, moving the mirrors laterally in unison would simply leave the light pulse behind to fly off into space if the box walls were removed. Each mirror would then be it's own local set of coordinates (frame) rather than the box being one large frame. With the walls in place the box is an inertial frame and apparent $c + v$ is allowable as it not a *real* 'speed'. Light passing through a train may also be observed from the embankment at $c + v$, as the train itself represents an inertial field, but the light signal with this information still travels to us and arrives at 'c' (and $c/n = 1.55$ through the glass), consummately Doppler shifted. If we're moving ourselves? our own field boundary fine structure 'surface charge' electrons convert it to our local 'c'. The photoelectric effect is explained in terms of energy conservation, the energy focussed with blue shifted light as a function of the waves compressing entering the moving frame, reverts when red shifted on exiting. The quantum mechanism of atomic scattering replaces the 'assumption of no field', does not conflict with GR, and indeed the field qualities of GR are adequate to produce limits and boundaries, which would more closely harmonise the two. Argument about the existence of 'aether' thereby becomes irrelevant, so the model may help remove dissension and accusation of paradox within SR. We consider how.

Postulate 1. *'The laws of physics are the same for all observers in uniform motion relative to one another.'*

Also termed as the 'Principle of Relativity', this would mean even more than we have realised, that the laws of physics for an observer *within* a spinning disk, train, space station or on Mars are the same as in our lab frame on Earth. Mass in relative motion also has real inertia as well as an EM field, deriving 'momentum of charge'.

Postulate 2; *'The speed of light in a vacuum is the same for all observers, regardless of their relative motion or of the motion of the source of the light.'* We may consider that this has always logically implied that wave propagation speed may *change* to 'c' locally for each moving observers lens. Inertial fields allow this but now with a real quantum mechanism to derive the observed classical effect.

It was assumed that the postulates also meant that two astronauts in uniform relative motion in space must be entirely equivalent, which meant no 'fixed background' field was possible. It has essentially only been this assumption that has propagated the majority of paradox and dissent. It's now clear that this conflicts with the increasing 'clouds' of oscillators^[23] propagated by accelerating mass^[24] be it single electrons, bunches of

protons or stars. We can tell from shock density and frequency the relative velocity of any mass through a vacuum containing an EM field, and all vacua within or in close proximity to the Universe will be likely to contain. Using Huygens Principle with frame transitions, Proper Time and signal rotation creating real inertial fields the unproven and problematic assumption of no background field is no longer necessary. If *all* bunches of particles, or 'systems' in relative motion, large or small, astronaut, planet or galaxy shaped, have their own EM field and boundary shock, anything with mass will always measure light locally at 'c' anyway.

When time is measured against distance in empty space we still find that EM waves have travelled at velocity 'c' with respect to the field of that part of space for $c = dt$. The model retains a duality defined dynamically and is somewhat related to De-Broglie's 'pilot wave' theory, brushed aside in Einstein's battle with Bohr at the 1927 Solvay Conference when it now appears it could have united them, but it is also consistent with the Maxwell-Einstein gravito-magnetic combined 'C field'. Uninvited to Solvay the contents of Chandrasakhara Raman's 1922 paper on atomic scattering would have enlightened the discussions, avoided the division of SR and QM and now enables the DFM mechanism which may re-unite them.

Other implications are considered in the papers on the DFM^{[21][22]} but without the HFP and potentials. We use the conceptual basis inferred in Einstein's comment; "*We can't solve problems using the same kind of thinking we used when we created them.*" incorporating logic and conceptual dynamics with broad data input, but further specialist exploration of the model is invited. Other papers are planned, but we now briefly identify some implications, testable and anomalous predictions and apparent practical issues.

Superluminal Motion. Light observed in another field in relative motion 'v' would be observable at $v + c$. But we would only observe an *apparent rate of change of position*, 'c' is not exceeded locally, and the individual signal sequence from which we calculate the rate of change of position would be received at 'c'. Fields may move rapidly within larger fields, perhaps in the ejected gas jet from the contorted magnetic fields of a fast rotating black hole. New material ejected into the centre of the stream would do 'c' within and wrt the material that went before. We have found superluminal phenomena,^{[25][26][27]} on Earth and in space, typically at Messier 87.^[28] The HH34 jet^[29] is measured at 300km/s^{-1} rapidly slowing as it meets an "*ambient medium.*" This would supplement the 'shallow angle' effect (Rees, Nature 211, 468. 1966) of an emitting pulse travelling at relativistic speeds close to its earlier emissions, which has a limited angular domain. The DFM predicts the same apparent 'Doppler time reversal' effect for light waves as found with sound waves, due to multiply collimated jet field structures.

Micro-structure. We don't speculate on background field structure, but field energy characteristics may include metric scalar, vector and tensor qualities. We have approximate density, (p.10) temperature (2.7°K), permittivity, refractive index, magnetic permeability, impedance, Casimir and quark condensate values^[30]. Like em fields and gravity it's barycentric. It propagates superposed longitudinal waves at 'c', and condenses and evaporates mass at the exchange rate c^2 , is low friction, and becomes locally anisotropic when isotropic compressibility is exceeded, condensing 'mass'. Quantum fluctuations in the CMBR frame apparently falsify the assumption for simultaneity of no absolute background frame. The assumption is shown to be correct but via multiple dynamic backgrounds not zero field.

Lensing delays. Erwin Shapiro found the predicted 200ms light delay due to the path bent by the sun of a signal bounced off Venus. Spectroscopy now find the delays in Einstein Lensing of light around galaxies for estimation of mass. This may give delays of weeks or even months. The problem with inertial fields is that they predicts light crossing a galaxy moving away from us, would be delayed by extraordinary periods, of many *years* compared to light lensed around it. Studying recent lensing at Abell 370 we find spectroscopy wasn't matched until results over three years apart were compared, giving over 3 year delays for anomalously high lensing mass, causing speculation from respected astronomers (Gates 2010) about the accuracy of the current cosmological model.^[31] The need for extensive 'gravity well' caustics and anomalously dense galaxies is thereby removed.

Shock Clouds. It is predicted that the EM field of all moving mass propagates a 'cloud' of oscillators, emitting synchrotronic radiation and increasing in density and frequency with speed through the vacuum, also that these may both constitute and propagate 'dark' matter via pair production when compressibility and density limits are exceeded. They may hold and conserve acceleration energy as potential energy, and modulate em frequency. Clouds do form around particles accelerated in the vacuum, and at cosmic shocks, at densities up to $10^{13}/\text{m}^{-3}$ ^[23] Parasitic 'photoelectrons' or 'virtual photons', are seen as a problem to be minimised to assist accelerator efficiency but in the DFM they are closely related to dark matter.^[24] Galactic edge Haloes and the consequential flat acceleration curves would be due to similar field boundary interaction and fluctuations giving pair production, ions and molecular gas. These do hold momentum, as recently found at supercluster haloes. (Fraser-McKelvie et al 2011)

Black Holes. Active galactic Nuclii (AGN) are toroid, with multiple helical magnetic fields, and behave with the qualities of Hoft Fibration, the relativistic quasar jets recycling the matter. They are in theory Lagrangian, with gravitational equilibrium at the centre, but all matter is ionised on ejection. The region is a discrete plasma field which rotates with the AGN equivalent to frame and geodesic drag. The toroids are Lithium 7 rich, explaining the anomalous shortage. The AGN's have intrinsic rotation and accretion drives quasars.

Microwave Asymmetry. The model predicted that the Cosmic Microwave Background Radiation (CMBR) would be asymmetric due at least partly to local synchrotronic radiation peaks from bow shocks as well as astrophysical quasar jets. The asymmetries detected^[32] are not yet fully explained. They may help inform us of relative motion of massive bodies and fields and providing new data on other aspect of the Universe. A spiral asymmetry would support a cosmological prediction by the DFM of a configuration similar to quasars which may be considered as part of a recycling process. (Further papers are planned). The CMBR is based on local rest frames 'of last scattering', with a speed of propagation c within all.

Accelerations. Anomalous accelerations on planetary probes and craft on flyby's, would be centred on bow shock zones caused both by the additional parabolic shock mass and the change in background medium velocity. Progress would slow forward of bow shocks. Intense particle activity would be detected and

communication problems arise passing through shock interfaces to new inertial frames needing frequency adjustments. Some models of anomalous accelerations accurately indicate the precise effects predicted.^[33]

Slow light. Free of long range ballistic limitations it should be possible to slow the passage of EM waves in the appropriate medium by reducing temperature and energy for propagation. More troublesome still for current theory, they should then instantly accelerate back to 'c' once released, using field energy. We find that Lena Hau's lab at Harvard^[34] and others have consistently achieved this. The 'appearance' of both slow and fast light is possible from arbitrary inertial reference frames invalid for remote measurement.

Fast Stars. The 'hypervelocity' stars leaving our galaxy perpendicularly are being ejected in our toroidal AGN jet's frame within the greater dark matter halo.

Re-ionisation. The re-ionisation 'epoch' would be falsified as the recycling process of the DFM is scale invariant and ionisation of dead stellar and galactic mass by relativistic jets derives the process.

6. Experiments, and Extinction

Variations on Young's twin slit experiments by Fleagle^[35] (unpublished 2007-9 'Separated Pattern') were reproduced and extended. In quantum physics no photons would be found at dark bands on target planes. This is as confirmed by the Afshar experiment's wire detectors,^[36] although it's refutation of complementarity, showing wave and particle

characteristics for the same photon is contested.^[37] With new HFC waves, local particle propagation probability is low where troughs coincide, giving inadequate energy, but at peaks before perturbation planes probability is high.

Additional transverse and lateral screens past the twin slits give interesting results supporting Huygens-Fresnel mechanism and propagation via atomic scattering. (Fig. 10)

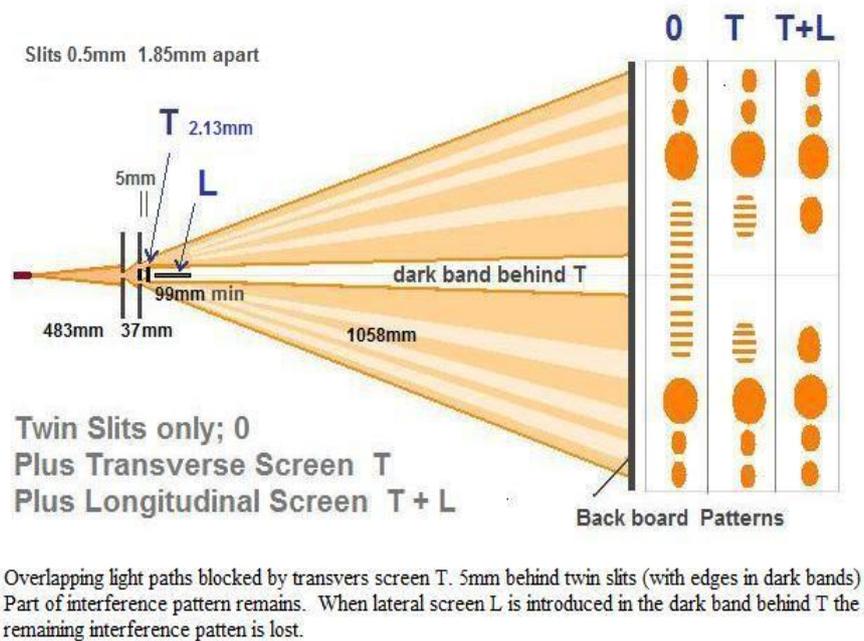


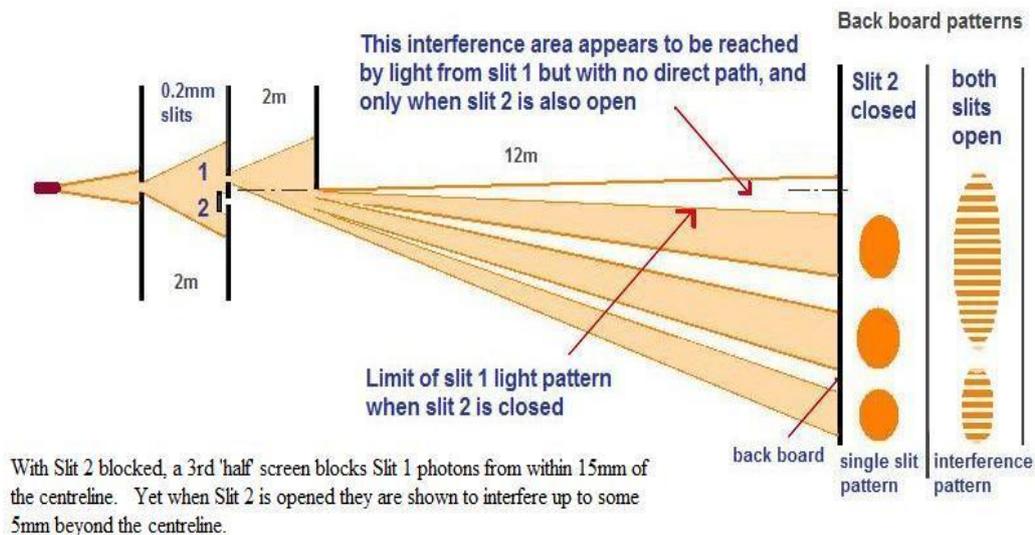
Figure 10a. Double Slit Variation a.) Shows wave energy passing across a shaded zone, where a photons paths passing through the slits are prevented from crossing (T). High refraction via HFP wave generation occurs at each slit. Placing a Longitudinal screen in the central zone destroys the interference pattern. (Fleagle 'Separated Pattern').

We predicted that if another slit were sited in the centre of the dark band it would promote interference with light from a further slit. New oscillators would also be propagated at the sharp topography of each slit edge,

which may also explain focussing of high surface charge towards configurations of high topological change. The experiments confirmed predictions which varied from some quantum and classic wave theory.

Figure 10b. Double Slit Variation b. A third screen edge is positioned on the centreline. Interference still occurs in the central zone inaccessible to photons from slit 1.

This is however consistent with new waves propagated at the edge of the third screen by HFP/WFS.

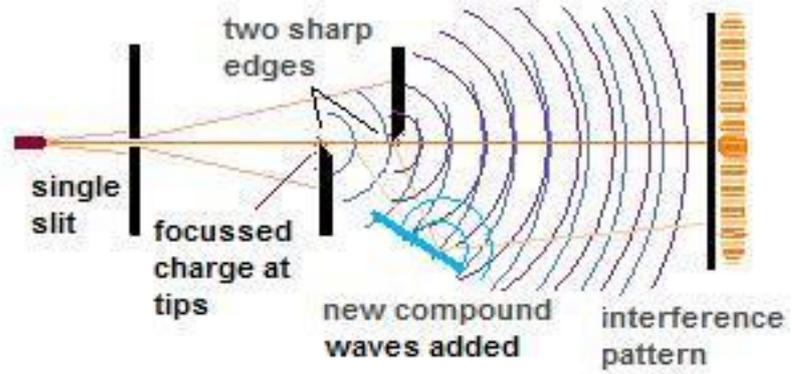


We block a direct photon path yet still detect wave interference which we predict is due

to locally 'condensed photons' from atomic scattering. This is consistent with Stern-Gerlach^[38] and has parallels in both pilot waves and complementarity, where Wilson chamber observed trajectories are allowed, but discontinuously through symmetry breaking. A number of experiments tested for interference from both 'dark band' energy and where the second direct photon path was blocked. (See Fig's.10a-c). These were also consistent with rotation of polarity where basic motion was introduced but a far greater level of precision than was possible with the basic equipment used will be required to reliably confirm the effect.

Other new variations on these experiments were carried out. A variation of a Fleagle result placed one of two additional slits in the dark band of an interference pattern. A new 'two slit' interference pattern was created, confirming signal energy passing through the dark band. Another experiment generated fine 2 slit banding from two separated sharp edges (min 5° bevel) rather than slits positioned within 1mm of beam CL. (Fig.10c). When a mirror was placed behind the first screen an enhanced and magnified pattern was created. This suggested that new waves are generated at the tips, coinciding with the topological area of highest surface charge, and these interfere. Oscillators were found at all surfaces (on perturbation), but these could not be physical particles that passed through the slit. This is consistent with a continuous process of local propagation via symmetry breaking of wave energy as the HFP and the Fourier Transformation^[39] which may be considered as another way of describing electrons absorbing & emitting a quanta of energy. The Ewald-Oseen Extinction Theorem^[40] with EM field boundaries and a strict interpretation of Huygens Principle show that new oscillators and waves may indeed be propagated at any medium or directional change, the wave front being apparently 'cancelled out' throughout the medium by interference effectively reflecting and refracting at the surface. This is consistent with and analogous to Feynman's QED explanation. The simple realization that this process equally applies to co-moving media of the same 'n' tells us that EM waves will change speed do 'c,' or to do c/n where PMD exists, locally everywhere. This quantises and unifies SR and GR with a field.

Figure 10c. Fine interference from tip wave propagation. The lack of a back wave in HFP was suggested as due to conserved 'spin' signal - or polarity.



Interference pattern from a single slit via refraction from two sharp edges with 1mm gap, propagating new waves from tips.

Other quantum and classic physics suggested that if one of the sharp edges in Fig. 10c was moved out of the beam then this would remove the interference pattern. We found that it did not do so. It

seems that the compound wave signal from the first edge is spread, as predicted by the HFP, and a new one is propagated at the second edge, the peaks and troughs of which can still boost those of the first signal to encourage further oscillator propagation at the backboard. Three slits also produced interference, as Born's prediction. All results were consistent with predictions, and with the the importance of polarisation or spin axis. Chiao and others quantum eraser experiments confirmed that neither simple quantum nor classic theory alone can explain the behaviour of light.^[41] Our results bring the quantum and classic together, but cannot conclusively exclude conserved oscillators severely refracted by other means than local propagation, or other possibilities.

The results seem to assist in explaining duality and the most bizarre features of QED by combining field wave energy with quantized particles, as condensed and detected at photo-multipliers, on back boards, and wherever else perturbed. Detecting a quanta of energy at a slit would normally utilise the energy detected. This may complete a circle through Bohm's complementarity back to a more understandable and localised duality. It also has implications for the understanding of non-locality and the Aharonov-Bohm effect.^[20] As a field is allowed we may reconsider matter waves anyway, but we should also consider how limited our eyes and instruments are and how small the visible part of the EM spectrum is. There is much happening that we cannot directly observe, but some of these causes have effects on things we can observe. A reef under the sea is unseen, but, due to relative motion, will propagate waves at the surface, often breaking locally due to superposition where energy levels are sufficient. Both the peak wave and an equivalent measurable quanta may perhaps be seen as a phase transition or even condensation to 'matter' when interacting and expended on absorption by strong measurement.

Superposed waves are analogous to ocean surface waves, compounded at all scales from ripples to tsunamis and on multiple vectors. Particles, including photons emitted from electrons, may 'evaporate' back into the non-zero energy/wave field, rather than be simply 'annihilated' or suffer extinction in contradiction to the law of conservation of energy. Similarly the 'virtual electrons' in accelerators would not be required to be virtual as they would not breach the conservation law. They may then be treated simply as ions resultant from pair production on local field compression, with frequency subject to relative velocity to maximise coupling. In

all cases on reflection the wave function is recreated with a new emitted photon at the backboard and greater amplitude for this exists with rapidly changing topography. The paradox of a reflected wave in a vacuum moving at c with respect to the incident wave rest frame not the moving mirror will also be given a logical explanation by the DFM. It is predicted that with improved instrumentation much finer interference patterns and different 'wave signal' speeds as well as frequencies will be detected. Schrödinger was as convinced as Einstein about the physical reality of his waves and we conclude from the experiments that they do have this reality, strongly supporting non-conserved oscillators propagated by em energy at perturbations. As with conventional electrons emitting photons, these or wave energy is always emitted at ' c ' locally by refraction, even if not arriving from the previous media at ' c ' relatively. This alone means light will be always measured at ' c ' locally to any mass, with or without a background field, solving the central conundrum, and along with it resolving a host of paradox and anomaly.

7. Conclusions.

We find and explain a major error of optical analysis caused by incomplete understanding of inertial frames in the 19th century which had fundamental implications for our understanding of nature, and we find this has caused most of the paradox and anomaly of current physics. We show that the 1893 Lodge paper on Stellar Aberration embodied the mistake of using an incorrect observer frame, and, critically, wrongly refuted Sir George Stokes et al's ether drag theory, which was the only theory supported by the Michelson and Morley experiments. We find that the erroneous conclusion led to the assumption of only an 'absolute' background or 'preferred' 3rd reference frame, which did not resolve the major problem and paradox of constancy of light speed with respect to receivers in motion. We find Einstein's Postulates of the Special Theory of Relativity proven, along with the Principle of Equivalence, but that the error also forced an assumption or 'stipulation' for simultaneity, that no background field is involved in propagating light. This also required the assumption that we cannot observe apparent $c + v$ from another inertial frame, and we find Lorentz expressed reservations about this in 1913. We show how the need for this assumption is removed if background frames are non-absolute and an equivalent to the Earth Centred Reference Frame applies to all matter. This gives us separate systems around all mass for the purposes of EM wave propagation speed. We identify the accelerative process at field boundaries which implementing co-variance of c , which gives SR a quantum mechanism and better explains observation. We find Lorentz's reservation well founded, because we can only ever '*see*' light via scattering, which involves a new signal velocity with respect to the scattering particles, means that remote measurement of such sequences of individual signals from arbitrary inertial frames is invalid. Timing would be timing of a sequence of individual emissions from a moving medium not of any real velocity. It has also been shown mathematically and not yet refuted that a relativistic Doppler shift cannot be derived via the LT.^[42] As scattered light is all emitted at c , an observer in another frame would only have an 'illusion' of speed at added velocities $c + v$. We term this view the discrete field model (DFM). We find that a bunch of protons in an accelerator and the solar system inside the heliosheath are all discrete systems with regard to motion, but only when in motion in the background vacuum field. This new dynamic architecture proves consistent with the shock particle activity findings of IBEX and Voyager.^[43] In accordance with the principle

of least action the plasma ions, though with high coupling, have a refractive index n of ~ 1 , and the discrete system and its shock does not even exist if there is no co-motion of the bodies.

We show using Huygens Principle, Fourier Optics, Ewald-Oseen Extinction, scattering and and polarity rotation, that *co-motion* promotes pair production, condensing new oscillators which propagate apparent new EM waves vectors on a rotated polarity axis, at c with respect to the motion (frame) of the new medium. Also that this is consistent with QED, and applies to boundary electrons absorbing and emitting photons at the new ' c ' of the new inertial field, giving the simple function $c + v - v = c$ from the integro-differential Extinction, and the Doppler equations, which we find equivalent to stretched and compressed signals or strings of Q-bits. The concept of Frequency Modulation is identified as central, via atomic scattering and polarisation mode dispersion, using particle shock oscillation and coupling, which also gives a simpler explanation of polarity. We show that consistent consideration of effects from the correct inertial frame is essential, and how ' c ' and energy are conserved in $c = f \lambda$, by the balancing of frequency wavelength within the new frame, deriving Doppler shifts to match relative frames velocities. We find that 'Proper Time' must be used for any valid measurement of ' c ', which means measurement from other inertial frames does not use Proper Time explaining why they may obtain *apparent* $c + v$. We find that the DFM dynamics explains the logic of the failure of Snell's Law of refraction and Poynting vector reversal at co-moving media, as motion's invalidity as a concept in geometry also limits the power vector space of algebraic maths in translating dynamics. Dynamic conceptual visualisation skills are thus shown as also essential in understanding the logical solution to unification, but, once the correct mental picture is achieved, an more simple intuitive architecture results, with no infinities, but with 'infinitely' many Minkowski-Einstein mutually exclusive 'spaces' around all matter in relative motion. We find the dynamic scattering mechanism closely analogous to Chandrasakhar Raman's 1922 thesis, including locality of c , and Stokes/Anti Stokes up and down shifted 'last' CMBR scattering.

We show precisely how a dynamic discrete field boundary shock process correctly derives stellar aberration, retaining ' c ' locally within all fields. We identify implications, and predictions that the space surrounding mass is scale invariant, from single particles to clusters and beyond, as Einstein's '*spatially extended*' mass, as visible at LL Orionis, and the edges of galactic discs, and discuss how some present anomalous phenomena may thus be allowed, assisting with duality, via non conserved particles, and action at a distance via topology. The Maxwell-Einstein weak field approximation equivalence with interaction via Minkowski's metric, (and Reynolds for accuracy at higher frequencies), is shown to be qualitatively and potentially quantitatively able to explain observation, via coupling potential,^[44] which logically quantizes both SR and GR. We find the result is the Unified Field Theory Einstein sought, allowing Reality and Locality without hidden variables. The limits of Einstein's; '*extended*' mass are found to be equivalent to the momentum of the system, as the condensed particles add to inertial mass which increases with both speed and rest mass and conserves the energy, explaining inertial mass equivalence. This brings yet another simple symmetry to the system to add to the Refraction/Energy conservation and Doppler shift/ speed/ shock particle density/ oscillation frequency symmetries identified. Acceleration is always 'frame transition' and all frames are equivalent, proving the SR

postulates but defining more precisely. Contraction and dilation are logically derived via Doppler shifting, but, as with the Lorentz transformation, with better defined limits to domains. Einstein's thought Gedankens are re-considered giving logical intuitive results, and a number of anomaly resolutions are identified.

We show that using the SR postulates and Principles with unnecessary assumptions removed also removes apparent paradox and cause for dissent, to better unite physics. We explore parallels with Maxwell's EM fields as embodied in Einstein's 1952 conception that space is really; "*an infinite number of spaces in motion relative to each other.*" which is now more fully and clearly interpreted in terms of real bodies. Using co-ordinate systems to describe limits to real spaces in relative motion we find that maths cannot 'overlap' spaces, but that the bodies can move within each other, which demands a new way of thinking about all EM wave propagation in terms of discrete, limited '*Inertial Fields*' of energy potential, where matter forms to implement change. This is consistent with Einstein's conceptual; Space 's' within larger space 'S' in relative motion, and a more original interpretation of Minkowski's Space-Time metric, only using time once not twice. This extends the non validity of motion in geometry to the vector space of algebraic maths, so Cartesian co-ordinates are "*rigidly attached to a body*" or "*..to the carriage*" (Einstein, Ch. 3. 'Space and Time in Classical Mechanics,') which makes the space described mutually exclusive, with boundaries, and allows an ontological basis, to lift paradoxes. So only the 2nd 'time' factor not the first (in Cartesian 'motion') is used. 'Time stepping' maths and real number systems may then better meet the conceptual requirements to accurately describe nature. The results are consistent with closed system interferometer evidence, and we arrive at the suggested clarification or Extra term for SR; "*EM waves travel at 'c' within all **local** inertial fields.*"

We conclude that the limits of EM coupling potential and the field qualities of GR are adequate to provide the Discrete Field Model boundary shock conditions as observed both in space and around accelerated particles. Quantum energy fields are allowed by the non absolute backgrounds, and Ewald-Oseen extinction and vacuum fluctuations may witness a non zero ground state which would resolve the fuller range of questions. The interstellar medium, or condensate, originally considered mainly in terms of propagation of light, may now be of more interest in a broader sense, including as the origin of dark energy and matter, what is required to produce pairs and maintain the boundary conditions of Einstein's extended mass, and 'regions of space', and what dictates and controls its limits.

We show that a model of mutually exclusive barycentric systems around mass in motion, as dynamic discrete fields, meets observation, can resolves anomalies and remove paradox, is highly predictive, logical, intuitive once fully understood, and complies with Occam's razor, so would possibly be able to guide physical science back onto a more logic tracks following a long hidden error of comprehension about relativity. As the DFM has implications across all of nature there are many key components, but some basics derived are as follows;

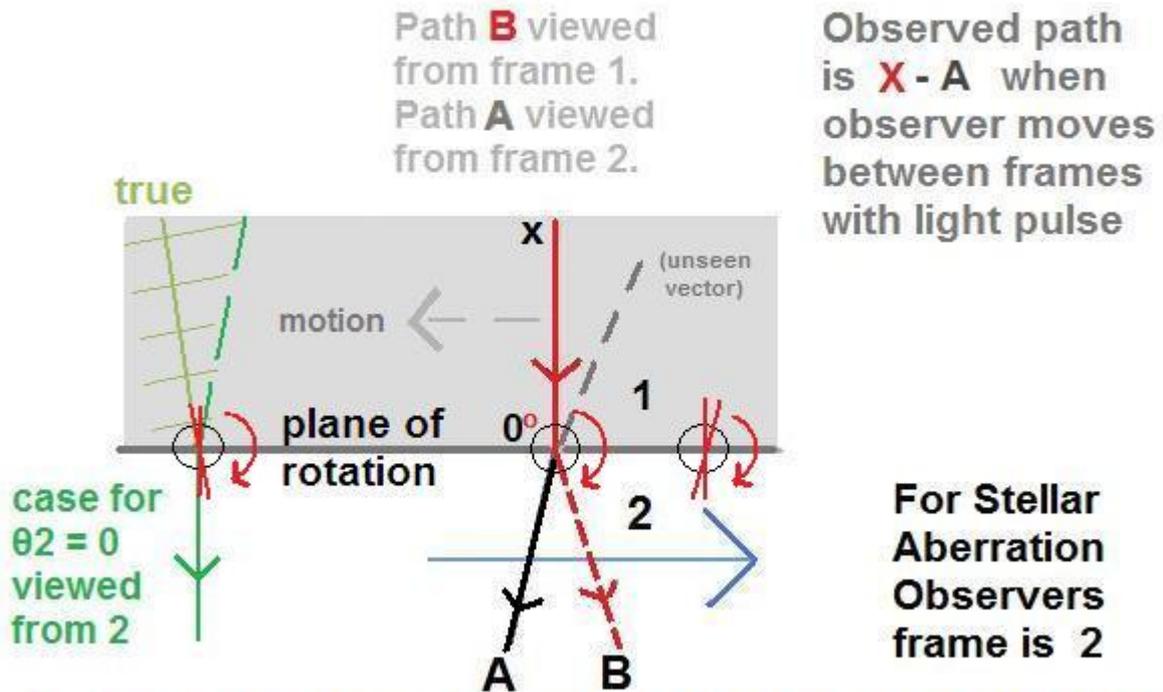
1. **Matter** is condensed as a phase of energy to implement change to preserve c and energy at co-motion.

2. **Shocks** of plasma ions bound all EM fields. The 'frame' of matter in motion is a 'system' or 'inertial field'.
3. **Light** is propagated via atomic scattering, at c in local fields. Field scale may be equivalent to momentum.
4. **Inertial Fields** around matter are mutually exclusive systems but may be within, and include, other fields.
5. **Momentum** is equivalent to inertia, and condensed matter provides real inertial and gravitational mass.
6. **Interaction** and quantum scattering involves frequency harmonics and polarisation, giving diffraction.
7. **Coupling** potential has been underestimated in terms of the Maxwell-Einstein 'Weak Field Equivalence.'
8. **Space-Time** curvature is implemented by quantised diffraction, at $n = \sim 1$ but via high coupling and scale.
9. **Plasma** - 'free electron/proton' ions are fundamental, and the most common, phase of matter, light and dark.
10. **The Special Relativity Postulates** are correct, as is Equivalence. The LT is an inverted resistance curve.
11. **Contraction and Dilation** is the Doppler shift of signals on transition by compression and expansion.
12. **Lensing delays** are from coupling, diffraction and relative system motion advancing or delaying signals.
13. **Simultaneity** is incorrect. Non absolute dynamic preferred local background frames exist
14. **Two classes** of inertial field exist. Speed measurement is invalid from different systems, fields or frames.
15. **Duality** is scale invariant. Particles form by interaction to implement change. Photons are not conserved.
16. **The CMBR rest frame** is the local background 'frame last scattered', and light does c in all such frames.
17. **The ECRF** belongs only to Earth. All bodies have their own EM fields which form similar local systems.
18. **Light changes speed twice** on transition to preserve c locally, 1) for medium index n , 2) for co-motion.
19. **AGN 'black holes'** are toroid closed loop EM fields which re-ionise and eject matter, as 'quasar' phase.
20. **Galaxies** and the universe are scale invariant, evolve secularly and self-recycle (Ave. galaxy life ~ 10 Gyr.)
21. **Ether Drag** (Sir George Stokes) and Chandrasakhara Raman's 1922 diffraction thesis were accurate.
22. **Minkowski's metric** and Einstein's '*infinitely many spaces*' and '*spatially extended mass*' were correct.
23. **Quantum Mechanics** is largely correct but nature has a logical dynamic structure, with intuition possible.
24. **The fine structure constant** describes the shock 'surface' flux 'ground state' of matter not in co-motion.
25. **Intrinsic Rotation** also turns polar (signal) axis away from wavefront normals due to media co-motion.
26. **Stellar Aberration** Is derived for the perpendicular co-motion case by rotation of the polarisation axis.
27. **Causality.** Light cone surface is curved by dispersion and lensing but unaffected by signal axis rotation.
28. **Occam's razor** was correct. Nature is logical and organised, with complexity beyond our understanding.

Appendix 1

Refraction between laterally co-moving media at perpendicular incidence. Ignoring Chromatic Dispersion.

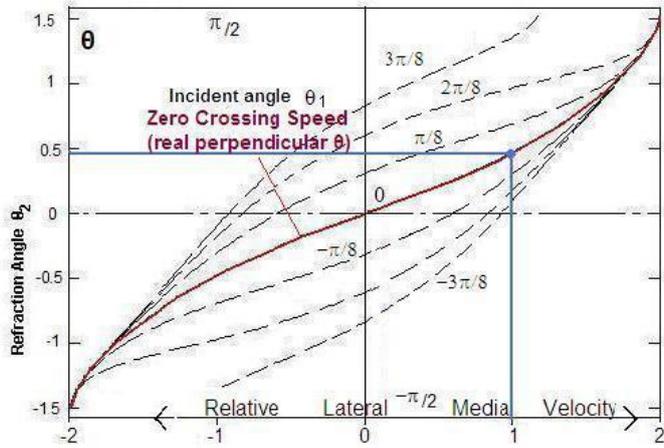
REFRACTION BETWEEN MOVING MEDIA AT $\theta = 0$



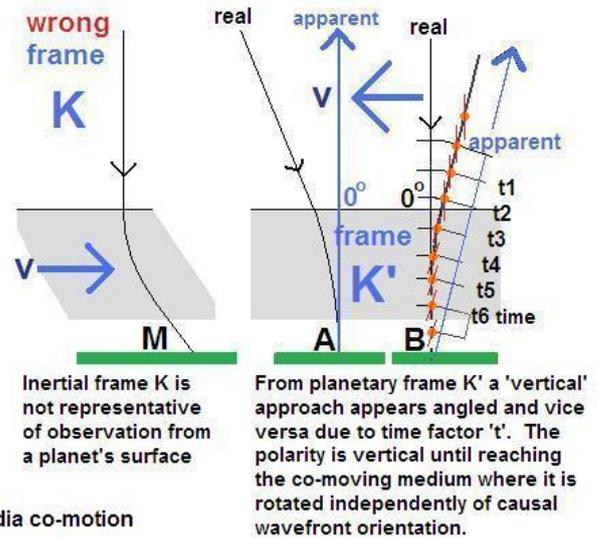
Appendix 1. Fig. A. Shown different apparent paths from different observer frames, plus polarity charge (signal) rotation due to lateral particle motion.

Appendix 2.

Typical experimentally derived results for media co-motion, and application to Stellar Aberration. Observed signal (polarisation axis) is NOT normal to the causal (time based) wavefront, preserving light cone surfaces.



Effects of Relative Velocity between media / Inertial Frames
Experimentally derived results, modifying Snell's Law for media co-motion



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