

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

Peter A Jackson. Richard K Nixey. Kent, UK. pj.ukc.edu@physics.org 30.6.2010

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Abstract

We identify an observer frame error which influenced physics at a critical time. Refraction due to relative media motion was considered from the incorrect inertial frame for Stellar Aberration by Lodge (1893) after Michelson's null result, giving a light path 'dragged' from the refractive plane normal by the incident medium.^[1] But in the frame of the new medium (Earth) the light path refracts *back towards* the normal. Jones's (1970) spinning glass disk experiment inherited that wrong observer frame.^[2] We find that using correct *rotating* observer frames is consistent with Special Relativity (SR) and that the error erroneously falsified the Stokes/Fresnel frame 'drag' theory supported by Michelson's finding, producing incorrect assumptions and paradox. We extend Young's experiment and consider the Huygens-Fresnel Principle,^[3] wave/particle coupling, extinction, and shocks, finding quantum vacuum field implications. SR's postulates are confirmed but important domain limits emerge at Maxwell's near/far field transition zone. A quantum mechanism giving mutually exclusive hierarchical inertial systems derives SR. 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

As misapprehensions can distort histories we first provide a brief resume and analysis. The backdrop of the 1800's was the fundamental light paradox. The Newtonian corpuscular 'ballistic' concept was uncomfortable with the increasing evidence that light travelled at a constant speed 'c', apparently through and with respect to (wrt) a 'luminiferous aether' medium in space, as a wave, and 'irrespective of the speed of emitter or observer'.

A major turning point in science followed Michelson & Morley's (M&M) 1887 'null' (small) interferometer result for 'aether flow' when 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 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' in using the 'lateral waves' of solids, for SR, the 'ballistic' theory of light had to also be 'dusted off' and rejuvenated to try to explain Stellar Aberration, so 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 the gap is largely filled, but Roger Penrose identified the fundamental incompatibility^[p14] of time itself, confirming the 'chasm' is still vast and the nature of light central. Though SR still has no physical 'mechanism', no credible alternative exists. We find a likelihood that SR may simply not be entirely complete, and that all apparent paradox and dissent and may be removed by deriving SR with the 'quantum' mechanism of scattering to local c. A more detailed understanding of electromagnetic (EM) wave propagation mechanisms is found to be required, and proposed.

Stellar Aberration is central to understanding light and wave/particle duality, so is considered with wider implications. We use a methodology based on logical and empirical analysis which includes 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, embracing 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.*" We identify and analyse the broad consequences of the correction of this shortfall in complete understanding of the importance of observer inertial frames for aberration, prior to 1900.

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 actual position* on our orbital path (ecliptic polar). The change of position evolves to describe 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. However we now know that the upper atmosphere and plasma/ionosphere particles, while strongly coupled to EM waves, have a refractive index of $n \approx 1$, so H.A. Lorentz's argument *against* ether drag has proven to be false.

The M&M result was not consistent with Fresnel's 'partial' drag theory or with Lorentz's own ether theory, 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.

The poor understanding of refraction kinetics then sent physics off course. Lodge's 1891 Stellar Aberration experiment and 1893 paper^[1] supported Stokes, 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 then the common assumption that an observer in the rotating rest frame would find the same as in the lab frame confounded matters. A 'ray' of light entering dragged ether would be dragged "*..in the direction of motion. A negative or lagging real aberration would therefore occur*" clearly opposite to observed aberration which was positive, or *ahead* of the true position. The error of using the wrong rest frame then **suggested the reverse of the real Stokes effect**, but the mistake went unnoticed.

It seems then that the luminiferous aether had frustrated those seeking a mechanistic description of reality for long enough. It was relegated to a supporting role by a non 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 1905, assuming Stokes model falsified he reverted to 'ballistic' theory. Wave particle duality was further mystified but all 'immobility' of the aether could be removed, seen as required for the equivalence of all bodies in motion in the vacuum. Stokes dynamics, with or without 'aether' would have precluded the need for ballistics. However Eddington's confirmation of curved light path predictions then installed Relativity as the new paradigm. Einstein said; "*Space without aether is unthinkable.*" (1921) when also considering field based General Relativity but he had already removed the last of its properties, 'immobility', for SR. The aether went out of fashion but an 'interstellar medium' re-emerged, 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. The apparent paradoxes then remain.

Stellar aberration had only been partly (and duality not at all) explained. Maxwell's EM equations were field based, as General Relativity, yet for SR background fields and 'matter waves' were banned. Transverse waves had been derived by Young and Fresnel to explain polarised waves and why they didn't interfere, but are now better explained by scattering and spherical harmonics, consistent with the Huygens-Fresnel Principle (HFP)^[4]. Young's transverse waves were also in a medium, only previously existing as vibration in solids or a string but reinvented by Einstein when removing the medium of longitudinal waves. Other problems remained; Transverse waves also seemed to conflict with Schrödinger's three dimensional spherical wave front of plane or matter waves. Such longitudinal variations in magnitude of a quality, requires a background frame, field energy density/potential or 'dark energy' medium. The question 'what then is waving' also remained.

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 is violated when the media are not at rest relatively. Angle of refraction depends on relative density of the new medium (refractive index 'n'), and incidence angle, giving; $n_1 \sin(\theta_1) = n_2 \sin(\theta_2)$. When waves are slowed they refract and wavelength reduces, conserving energy and frequency. The fixed relationship term 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 medium's motion ***so light***

changes speed due to media motion not just 'n'. And now we point out that, unless the observer changes speed K to that of the new medium K' , he is observing from a different inertial frame, so 'frequency' is only *apparently* conserved. Stokes' Full Drag thesis (essentially also consistent with Fresnel and Heaviside) is then consistent with findings of a field (iono/atmosphere) orbiting with the Earth through a background at rest with respect to the sun (or a radial 'solar wind'). The product of frequency f and wavelength λ locally within the new media remains 'c', and 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 as 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 suggest we have then been guilty of a major failure of dynamic comprehension, including of light paths, considered below. To simplify; Relatively moving media (at v) represent different inertial 'fields' or frames. If observing apparent motion in one frame from another we cannot use 'Proper Time'. Relative c will differ and *cannot be validly measured*. Frequency f will *appear* to be constant, and wavelength λ is Doppler shifted. For $v = f \lambda$ to be valid the apparent v ($<c$) will change inversely with λ . But as we cannot observe any such light unless it is scattered, all we would be seeing is a **sequence of scatterings**, 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.

In ballistic theory, incoming photons entering the new medium are 'swept along' in the direction of medium motion (see Fig.3) but this would give aberration in the wrong direction, not as found. Lodge showed this 'ray vector path' in 1893, Fig 13 (p780.)^[1] *as viewed from his lab frame* not the co-moving frame representing planet Earth. His viewpoint was then effectively from *interplanetary space*. The '*vector*' is then false, and only *apparent*. 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 retaining 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 now wrongly cited to 'disprove' Stokes model. Modern optics correctly finds 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*. The reciprocal relationship between a light 'path' and *observed* deflection by refraction can be seen by inserting rod into 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 n_2 which the light is entering. When considering stellar aberration with a dragged field; n_2 is equivalent to the co-moving observer inertial frame on the Earth's surface. 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 . Figure 1 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_2b because the tidal current is flowing at v .

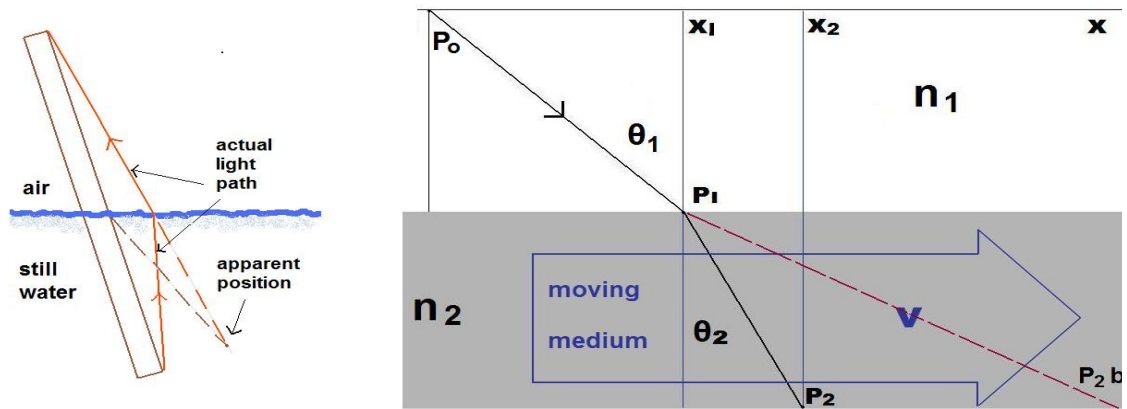
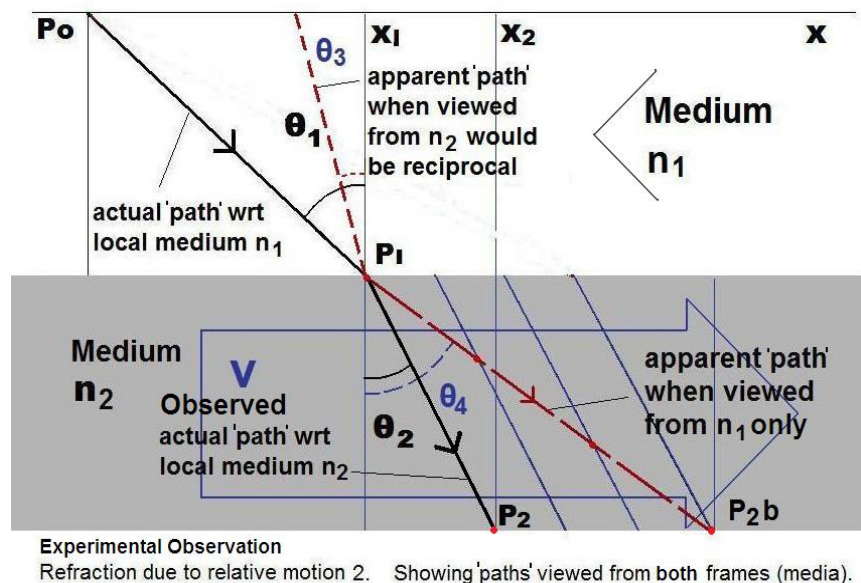


Figure 1: Refraction. Between different media such as air and water actual refraction is inverse to the apparent path change when observed from each medium. For media in relative motion (even of similar refractive index) the same rule applies. Here the observer changes inertial frame with the 'ray' of 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 . See also Appendices; "Kinetic Reverse Refraction" Fig; PJ.

Fermat's Principle and QED emerge as observed light traverses the 'path of stationary time' or least time, occurring when the sines of the angle are proportionate to the propagation velocities. An essence of relativity had not then been grasped; 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. Figure 2. also shows apparent light paths in each inertial frame when observed from the 'other' frame, (shown red).



Experimental Observation Refraction due to relative motion 2. Showing 'paths' viewed from both frames (media).

Figure 2: 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 .

path $P_0-P_1-P_2b$ (as observed from n_1) are tilted in proportion to v when viewed from n_2 . Contrary to previous assumption Stellar Aberration is then accurately derived with a dragged or entrained field effecting a change

in inertial frame some distance 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', then all mystery may be lifted.

The kinetic juxtaposition is difficult to comprehend but is meaningful, demonstrating why we will *always measure light locally at 'c'*. The physical mechanism at the field boundary interface is not yet explained but we've shown that Cartesian co-ordinate systems can represent the limits of *real* physical bodies, and also their 'spatial extension'. We discuss below planetary EM fields and ionospheres, each with a mutually exclusive architecture, dynamically separate, but bounded by a quantum mechanical 'acceleration' process limited by γ .

Rationalising the conception and implications of co-moving frames within frames reveals a new symmetry. Light reaching all observers is then found at 'c' locally. If light moves into a new system 'frame 2', perhaps a moving train, or galaxy, it's properties are *not measurable* by an observer remaining in frame 1. Any remote evidence will show frequency *apparently* conserved, wavelength changed, and *apparent* speed $c + v$ ($c - v$). Any signal informing him of this 'apparent rate of change of position' will however travel locally at 'c'. If the observer 'rides the light beam' and accelerates into frame 2, he will find the *frequency* changed to balance the Doppler shift of wavelength. The product $f \cdot \lambda$ remains 'c' locally, conserving energy E. Correct observer frame choice is then essential. Lorentz had a "reservation" (1913) about the prevention of apparent velocity addition 'limiting' observability as assumed for simultaneity. A 'Discrete Field' model (DFM) shows his concerns well founded. Classical and Quantum Mechanisms for the light speed change 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. Stokes name is familiar for the up and down shifted atomic scattering (Stokes/ Anti-Stokes) which, may be interpreted as supporting the equivalent 'last scattered' basis of his wave based theory. Stokes thought he couldn't explain aberration, but he did. Fizeau helped, proving that 'c' was always with respect to the 'local' medium, as confirmed by Sagnac and others, in closed single frame systems. Further Sagnac and Michelson results from 'open' systems (light passing through a background field) also supported Stokes model. Wang also showed light propagation at 'c' locally in all moving media,^[7]

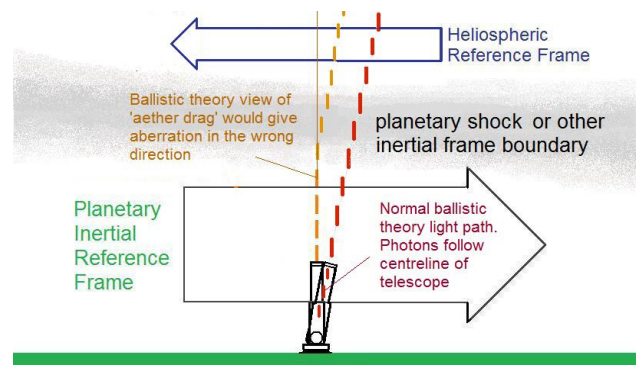


Figure 3: Ballistic Model of Stellar Aberration. Photons pass down the telescope centreline due to its motion.

consistent with Stokes model *and* SR's 2nd postulate. No experimental result exclusively supports a simple ballistic theory. Conserved ballistics also had the issue of 'relative speed' in either plane, and an impossible instant 'vector change' at refraction. All observations are consistent with waves, few with 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. However, 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 consider EM waves and frame morphology more closely below to test our hypothesis. We now know that Earth's EM field, ionosphere and plasmasphere are of far greater optical depth than assumed 100 years ago, as is the solar system heliosheath. Earth's bow shock both deflects the solar wind and couples strongly enough to modulate EM waves, so we may assume the 'near field boundary' between Barycentric (sun) and Geocentric rest frames is at Earth's bow shock. This theory is tested below and the weak field approximation discussed. Penrose found^[17] that if Relativity and QM are to be unified photons cannot be eternally conserved. A pointer to unification may then be identifiable.

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, (to blue) so the canted path travelled by each 'photon' (point) makes less downward progress. This cants the wave

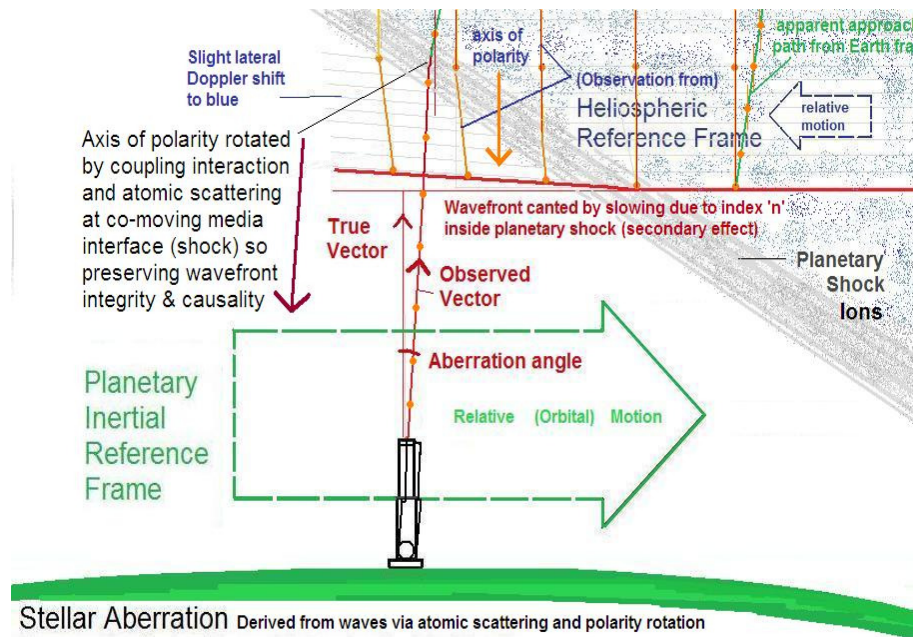


Figure 4: Fig 4. Stellar Aberration; Canting of the wave front. (due to relative motion of media). But see also Fig 7. for Huygens-Fresnel Principle, Fourier Optics and the Frequency Modulation mechanisms.

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 axis we observe is normal to the refracted wavefront. Birefringence infers otherwise. We propose the axis is rotated due to lateral particle co-motion on absorption, resolving the final

and deriving proper observed Stellar Aberration from Stokes 'full drag' theory. The aberration reduces with reduced elevation towards the horizon, and be consistent with Navier-Stokes turbulent shock dynamics, all as observed. The troublesome and inconsistent corrections required for Aberration are identified as 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 further below, and describe 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 feels no solar wind, but is evidenced by the strong oscillating particle activity and accelerations found by *Pioneer* and *Voyager1&2*.^[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 the 'plasmasphere', precisely like the pressure /density wave from the bow



Figure 5: LL Orionis, and Bow Shock. Courtesy of the NASA/ESA HST. The shock configuration (also visible on a more distant star) is similar to NASA's artists impression of the heliopause bow shock being crossed by Voyager 2^[12] The velocity of EM waves within should be 'c' with respect to the star, the same as within our own heliosphere.

wave of a ship. The lack of external solar wind to create the shock that defines the discrete inertial system shows that shocks exists 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. The dynamics derive precisely what Einstein needed to achieve in removing the single absolute background frame, but keeping the local fields of GR.

NASA's Laser Lunar Ranging findings^[13] and GPS^[14] are consistent with a locally bounded inertial system /field^{[15][16]} in which arriving EM oscillations slow or speed up on refraction to pass through *at 'c/n' with respect to the planet*. The Geocentric or Earth Centred Reference Frame (ECRF) is identical to that found at Venus and Saturn. High EM coupling co-efficient of e+/e-/proton plasma particles/ions even when diffuse ensures the near/far field transition K/K' maintaining *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. The Maxwell-Einstein weak field approximation is significantly strengthened even without adding the greater field depth 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 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 aberration prediction 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. The zodiacal 'false dawn' light of Khayyams Rubaiyat is predicted by the model. Ballistic photon theory would not be supported. We test implications and consider the physical

process, starting from the earliest conception of EM waves, refraction and probability theory.

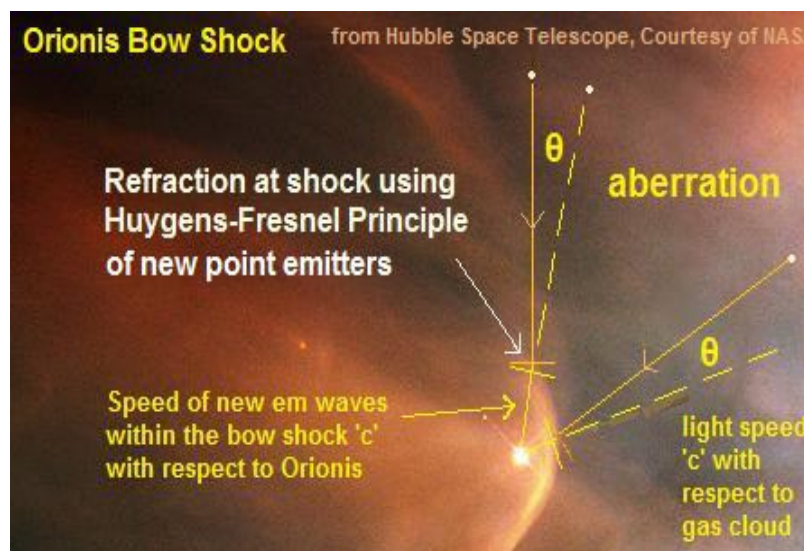


Figure 6: A crescent shaped bow shock produces only positive aberration reducing with elevation, as observed. New Huygens multiple spherical waves will travel at 'c' wrt the star within the shock with the wavelength accordingly transformed by relative velocity (Doppler shifted). (HST).

4. Field Boundary Process

We now consider EM waves more closely, particularly the small visible frequency range, and implications of 'inertial fields'. As we're now considering 'matter waves' we must remove preconceptions and find the new view the hypothesis allows. The father of probability theory, light as EM waves, formulae in physics and much more was Christiaan Huygens, 1629-95. 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 discuss this and FM further below).

Fourier optics shares the dynamic, 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 photo-electron oscillators we see surrounding the particles at <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. Fig. 4 may now

be enlarged to Fig 7 which shows the consistency with HFP optics. The important point is that the new waves from each point propagate at c wrt the inertial field K' rest frame they are moving through irrespective of the relative speed of emitter or of the inertial field K the approaching waves were propagating within. The analogy with sound is also apparent in Wave Field

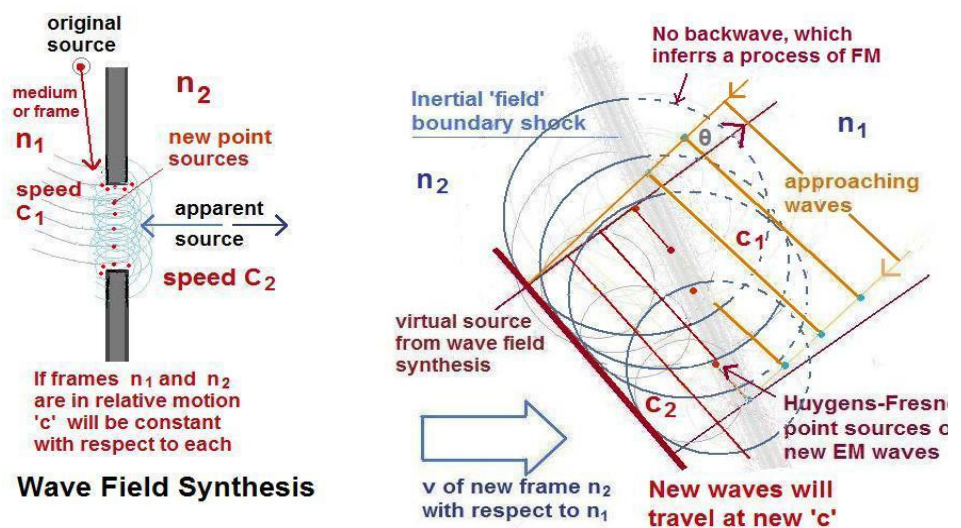


Figure 7: Huygens-Fresnel Principle, Fourier Optics & Wave Field Synthesis deriving a virtual source, inferring that waves from new point sources in new frames travel at 'c' with respect to the new frame. Wavelength changes with vector, conserving frequency and energy.

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 new concept 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. Both SR postulates are obeyed but with the physical 'domain limits' Einstein inferred by never found. 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 consider Doppler shift it remains constant, as an observer is himself *moving between* the frames with the signal, so he may then validly measure using 'Proper Time'. Co-ordinate (relative) $c+v$ speed, like co-ordinate time, is not directly measurable. The refraction process is of wave perturbation at boundaries re-focusing signal energy into oscillation propagating new EM waves at a new wavelength resulting from relative field velocities. Shock pair production, as density found, is proportional to $K-K'$ relative v . Fermat's Principle emerges and Snell's Law of refraction, violated by co-motion, is recovered, using 'Kinetic Reverse Refraction' (see Appdx). Sound waves may also then also be more subtle than colliding billiard balls.

The probabilistic elements of QED and QM emerge from momentum exchange in perturbative particle interactions, which will be derived in a further paper. In the DFM scattering mechanism 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 it's 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).

Our interpretation would imply light to be combined lateral and longitudinal superposed helical fluctuations interacting with condensed short life e^+/e^- oscillators propagated a compressibility limit and to min plasma wavelength γ at optical breakdown density ($10^{23}/\text{cm}^{-3}$), giving the Lorentz factor. Signal information observed is controlled by wavefront angle and scattering polarity, 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 SR to be reunited with probability theory removing paradoxical assumptions. Photons are the more local 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 are conserved within the potential in a non-zero ground state. The measurement problem would be resolved by all instrumentation propagating new waves, so implicitly producing decoherence.

Before moving on we consider a little more detail of HFP, the basis of holography. 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 speed or approach angle of the pebble. This simple analogy appears to fail due to the lack of a back wave at propagation. Fresnel's obliquity factor addressed by problem controversially^[18] but polarity, and spin conservation provides resolution. Reviewing the back wave question in the light of wave particle interaction shows a clear new solution 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.

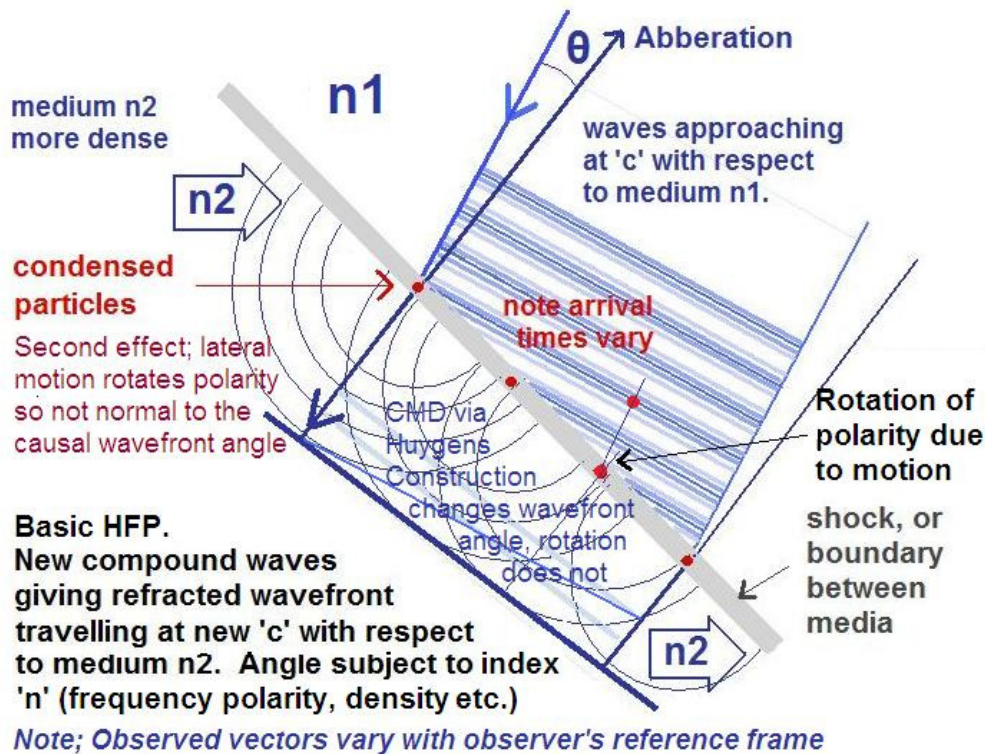


Figure 8: Huygens Fresnel Principle HFP Refraction. (extended). Common refraction is towards the normal (perpendicular) to the refractive plane. For media in relative motion light speed is converted to the new local 'c' (or c/n) and varies subject to the observers frame. In the DFM two related effects 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

and singularities would no longer be required, and the Lorentz transformation curve is explained as the power curve of pair production density required at high relative K-K' velocities, so λ gamma produces the limit c.

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] We consider some of the implications of locality, hypothesizing 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.

An equivalent 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; $F = (kq_1q_2)/r^2$

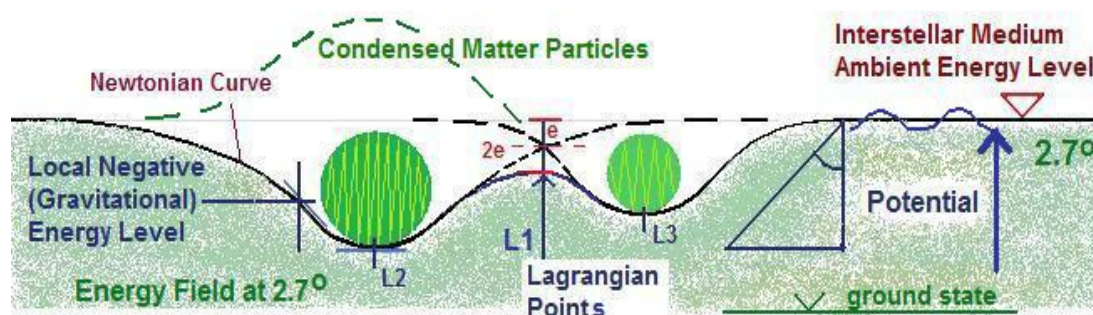


Figure 9: Topological Field Model showing instantaneous communication of potential between charges.

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 a minor and obvious reinforcement of the SR postulates arises, the almost superfluous word 'local'; *EM waves travel through all local EM fields at 'c'.* The HFP would 'change' wave 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 emerge from the mechanism and paradoxes evaporate.

The limits of this '*spatially extended*' mass will partly follow the local EM field limits. We can find most boundary positions from virtual electron clouds to planetary shocks and the stellar shocks of the heliosphere and LL Orionis. The formula for the local spatial limit may directly relate to the total momentum of the system, being based on rest mass x relative speed. The total effective mass will include the mass of the new 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, suggested as the possible link between classical reality and locality. The classical reality via electron density is as proposed by John Bell in 'Speakable and Unspeakable in Quantum Mechanics'.

In Einstein's 'light box' experiment; If the box walls were removed, moving the mirrors laterally in unison would simply leave the light pulse behind to fly off into space. Each mirror would then be it's own local set of co-ordinates (frame) rather than the box being a single system. With the walls *in place* the box has an inertial frame K. *Apparent* $c + v$ is then 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 on entering the moving frame, reverts when red shifted on exiting. The quantum mechanism of atomic scattering replaces the 'assumption of no field' and does not conflict with GR. Indeed the field qualities of GR are adequate to produce limits and boundaries, which would more closely harmonise SR and GR. Argument about the existence of 'aether' 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 SR's postulates also implied that two astronauts in uniform relative motion in space must be entirely equivalent, which meant no 'fixed background' field was possible. Such assumption has given rise to the majority of paradox and dissent. But it is now clear that LOCAL background are allowable, and allow the increasing 'clouds' of oscillators^[23] propagated by accelerating mass^[24] be it single electrons, bunches of protons or stars, each with an inertial state K. 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 giving $c=d/t$. The 'duality' of the model is defined dynamically, somewhat related to De-Broglie's 'pilot wave' theory, rather brushed aside in the 1927 Solvay Einstein/Bohr war, and 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 may have enlightened the discussions, and avoided the division of SR and QM. Ramans work now enables the unifying mechanism. 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' may be remotely observable but not measurable at $v + c$. 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 it's 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. Precisely the same mechanism as a sense glass lens is proposed. First found in a radar signal bounced off Venus spectroscopy now find the delays in Lensing of light around galaxies and clusters to aid estimation of mass. The longer path length implies delays of weeks or even months. DFM inertial fields predict that light passing through the side of a galaxy rotating away from us would be delayed by far longer periods, many *years*, compared to light passing through the 'approaching' side. Lensing at Abell 370 couldn't be matched spectroscopically. Then results over three years apart were compared, and matched! Anomalously high lensing is now common raising questions from respected astronomers (Gates 2010) about the accuracy of the current cosmological model.^[31] The need for invention of extensive 'gravity well' caustics and anomalously dense galaxies is removed when applying the kinetic factor of 'lockstep' rotation.

Shock Clouds. It is predicted that the EM field of all moving mass propagates oscillator pairs, emitting synchrotron radiation and increasing in density and frequency with speed through the vacuum. The pairs have a refractive index of $n=1$, as does the vacuum, so may constitute 'dark' matter. They may hold and conserve acceleration energy as potential energy, and modulate em frequency. Clouds form around particles accelerated in the vacuum, and at cosmic shocks, at densities up to $10^{13}/m^{-3}$ ^[23] 'Photoelectrons' or 'virtual photons', are seen as a parasitic problem to be minimised to assist accelerator efficiency in the search for dark matter. In the DFM they are 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 recycle accreted disc matter. AGN's are Lagrangian, with gravitational equilibrium at the centre, but all matter is re-ionised on ejection. The region is a discrete plasma field which rotates with the AGN equivalent to frame and geodesic drag. The toroid shear planes are Lithium 7 rich, possibly explaining the anomalous shortage. AGN's have intrinsic rotation. Accretion drives quasar jets. Jet collimation shear planes have the same '2-fluid' near/far field dynamic structure as shocks. There is no single "re-ionisation epoch" but H and H_c have been re-ionized in the focussed 'quasar era's'.

CMB Anisotropy. The model predicted that the Cosmic Microwave Background Radiation (CMBR) dipole would contain anisotropies at all scales. Local synchrotronic radiation peaks from lensing, bow shocks and quasar jets may be found to sit in a larger scale helical background with a similar source. The asymmetries detected^[32] are unexplained. But may help inform us of relative motion of massive bodies and fields and providing new data on the Universe. Helicity and asymmetry may support a prediction by the DFM of a

cosmic configuration similar to quasars 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 locally within each.

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. It should be possible to slow the passage of EM waves in the appropriate medium by reducing medium temperature, so propagation energy. Troublesome for current theory, light should instantly accelerate back to ' c ' once released, using field energy, as Lena Hau's lab at Harvard^[34] and others have consistently found. 'Apparent' slow and fast light is possible (via light at $<c$) from arbitrary inertial reference frames

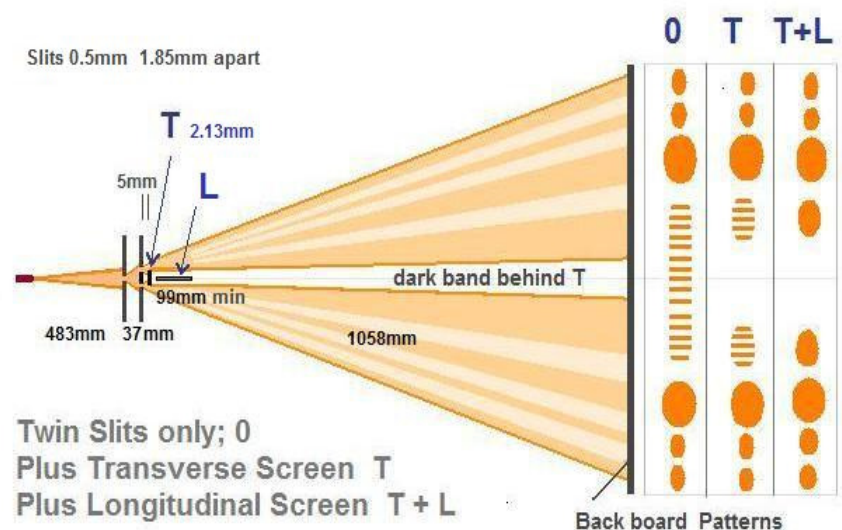
Fast Stars. The 'hypervelocity' stars leaving our galaxy perpendicularly are being injected in the toroidal AGN outflow rest frame within the greater dark matter oblate spheroidal halo.

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, as also confirmed using the Afshar

experiment's wire detectors,^[36] (but refutation of complementarity, giving wave and particle characteristics for the same photon is not agreed.)^[37] With new HFC waves, local particle propagation probability is low where troughs coincide, giving inadequate energy, but at the 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)



Overlapping light paths blocked by transvers screen T. 5mm behind twin slits (with edges in dark bands) Part of interference pattern remains. When lateral screen L is introduced in the dark band behind T the remaining interference pattern is lost.

Figure 10: Double Slit Variation a.) 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. A longitudinal bar in the central zone destroys interference patterns. (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.

We block the direct photon path yet still detect wave interference which we predict is due to locally 'condensed photons' from atomic scattering. Results are consistent with Stern-Gerlach^[38] and has parallels in both pilot waves and complementarity,

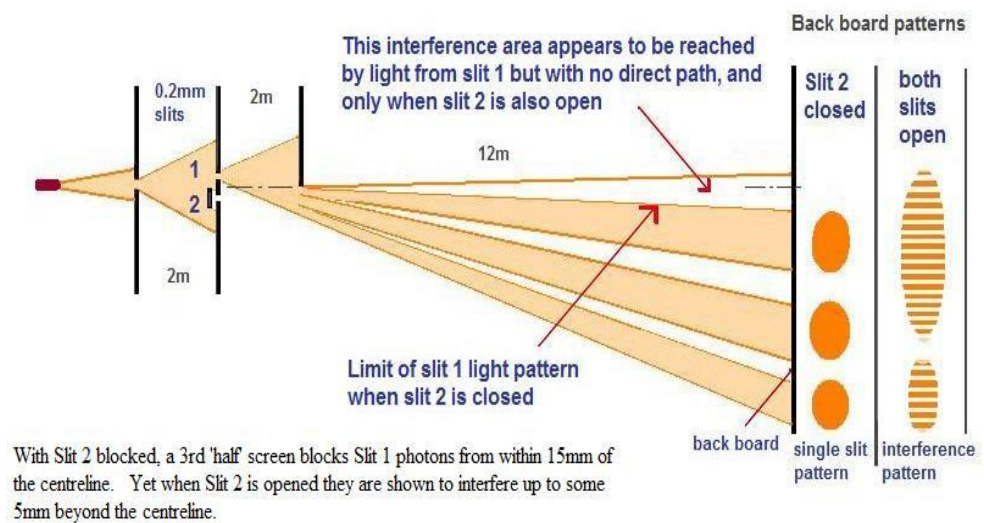


Figure 11: Double Slit Variation b. A third screen edge is positioned on the centreline. Interference still occurs in the central zone inaccessible to photons from slit 1. The finding is only consistent with new waves propagated at the edge of the third screen by HFP/WFS. PJ.

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.10-12). 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 reproduction 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.12). 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.

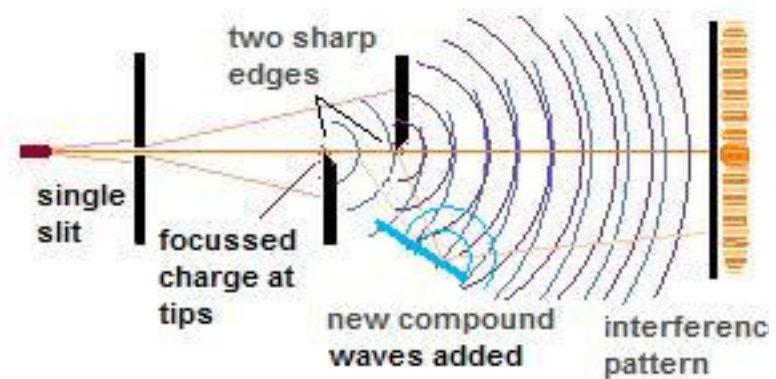
Other quantum and classic physics

suggested that if one of the sharp edges in Fig. 12 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.



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

Figure 12: 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. Fig. PJ.

The results seem to assist in explaining duality and the least intuitive 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 then expended on absorption by (all) measurement.

Superposed helical waves are analogous to 2-dimensional ocean surface waves, compounded at all scales from ripples to tsunami's and on multiple vectors. Particles, including photons emitted from electrons, may 'evaporate' back into the non-zero energy/wave field on 'annihilation' to obey the law of conservation of energy. Similarly the 'virtual electrons' in accelerators are not required to be virtual as they would not breach the conservation law. They may then be treated simply as 'far field' pairs 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 is also 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. If electrons re-emit photons at ' c ' *locally* on refraction, even if not arriving from the previous media at ' c ' relatively, light speed will always be measured at ' c ' locally to any matter, with or without a background field, solving the central conundrum, and along with it resolving all paradox and anomaly.

The SR postulates are confirmed, but a spatial constraint for transformation equations is below infinity, giving Einstein's co-moving and rotating 'spaces within spaces'. A formula to define boundary positions is needed, but the outer extent of the problematic 'ecliptic plane' limit definition can be well approximated as the limit of the particles orbiting with the planet. Latest consistent shock findings will aid this work (i.e. Llama 2010).^[45] Inner domain limits may be within full extinction distances, explaining Raman's atmospheric birefringence.

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. We identify the error as causing most of the paradox and anomalies in physics. We've shown that the 1893 Lodge paper on Stellar Aberration embodied the mistake of the incorrect observer frame and wrongly 'falsified' Sir George Stokes et al's frame drag theory, the only theory supported by the Michelson and Morley findings. We show that the false conclusion led to the assumption that only an 'absolute' background or 'preferred' 3rd reference frame existed so failed to solve the great problem and paradox of constancy of light speed with respect to moving observers. We find Einstein's Postulates of the Special Theory of Relativity proven, along with the Principle of Equivalence. However the 'frame error' forced an assumption or 'stipulation' for simultaneity, that no background field AT ALL can involved in light propagation. An assumption that there can be no apparent $c + v$, even from another inertial frame followed (about which Lorentz expressed reservations in 1913). We show how the need for such assumption is removed, with no need for ether as a carrier' if background frames are non-absolute and a local 'Centre of Mass' rest frame applies to all matter systems. Separate systems around all mass are then allowed to modulate EM wave propagation speed.

We identify the accelerative process at field boundaries implementing co-variance of c , giving SR a quantum mechanism and better explains observation. We find Lorentz's reservation well founded, because we can only ever '*see*' light elsewhere via scattering emissions at c , which involves a new signal velocity with respect to the scattering particles. Remote measurement of such sequences of individual signals from arbitrary inertial frames is then invalid for limits $<c$. 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 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). A bunch of protons in an accelerator, or the solar system inside the heliosheath are all 'discrete systems' with regard to motion, but *only when in motion in the greater background 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 . The discrete system and its shock does not then exist at all if there is no co-motion of the bodies.

We show using Huygens Principle, Fourier Optics, Ewald-Oseen Extinction, scattering and polarity rotation, that *co-motion* promotes pair production, condensing new oscillators which propagate apparent new EM wave 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. The function $c+v -v=c$ emerges from the integro-differential extinction, and the Doppler equations, equivalent to stretched and compressed signals or strings of Q-bits. The Frequency Modulation concept is identified as central, via atomic scattering and polarisation mode dispersion, using particle shock oscillation and coupling, more simply explaining polarity. We identify that more consistent consideration of effects from the correct inertial frame is essential, also 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. Only 'Proper Time' can then be used for valid measurement of ' c '. Measurement from other inertial frames can only use 'co-ordinate' time which may obtain *relative* $c+v$ as a 'closing' speed. We find the DFM dynamics explain the the failure of Snell's Law of refraction and Poynting vector reversal at co-moving media. Motion is invalid as a concept in geometry, limiting the power of algebraic vector space of maths to represent dynamics. Dynamic conceptual visualisation skills are shown as also essential in understanding the logical solution to unification. Once the correct evolution is visualised a more simple intuitive architecture results infinity free but with 'infinitely' many Minkowski-Einstein mutually exclusive 'spaces' around matter in relative motion. We find the dynamic scattering mechanism consistent with Chandrasakhar Raman's 1922 thesis, including locality of c , and Stokes/Anti Stokes up and down shifted 'last' CMBR scattering.

We have shown how the boundary zone of a spatially bounded kinetically discrete system of matter correctly derives stellar aberration and retains ' c ' locally within all systems. We identify that valid systems surround all massive bodies, scale invariant from single particles to clusters and beyond, as Einstein's '*spatially extended*' mass. Boundaries are visible as astrophysical shocks (see LL Orionis) and galaxy haloes. We find anomalous phenomena are allowed, informing duality by not requiring conserved particles, and allowing a topology of space. The Maxwell-Einstein weak field approximation equivalence with interaction via Minkowski's metric, (of Reynolds 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 produces the Unified Field Theory Einstein sought, allowing Reality and Locality without hidden variables.

The limits of Einstein's; '*extended*' mass are found to relate to the momentum of the system because the newly condensed particles add to inertial mass which increases with speed and rest mass, conserving input energy, explaining inertial mass equivalence. This symmetry is additional to those of Refraction/Energy conservation, Doppler shift/ speed/ shock particle density/ oscillation frequency. Acceleration is a 'frame transition' and all frames are equivalent, proving and refining the SR postulates. Contraction and dilation are logically derived via Doppler shift, but, as with the LT, with defined physical 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 the SR postulates and Principles without interpretive assumptions are free of apparent paradox and cause for dissent and consistent with QM. Parallels with Maxwell's EM fields are found in Einstein's 1952 conception that space is really; "*an infinite number of spaces in motion relative to each other.*" now consistently interpreted in terms of bodies of matter. We find co-ordinate systems cannot be 'overlaid' and validly describe limits to real systems in relative motion. But systems can move within each other in operator hierarchies, following the rules of bracketed mathematical functions. A new way of thinking about EM wave propagation in terms of discrete, limited '*Inertial Fields*' of energy potential emerges where matter condenses to implement change. Einstein's conceptual; Space 's' within larger space 'S' in relative motion, and a more original interpretation of Minkowski's Space-Time metric emerge, using 'time' only once *not twice*. 'Vector space' in algebraic maths representing 'motion' in geometry is similarly constrained. Cartesian co-ordinates are "*rigidly attached to a body*" or "*..to the carriage*" ('Space and Time in Classical Mechanics,' Einstein, Ch.3.) which makes each space described mutually exclusive, with boundaries, allowing an ontology free of paradoxes. 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.*"

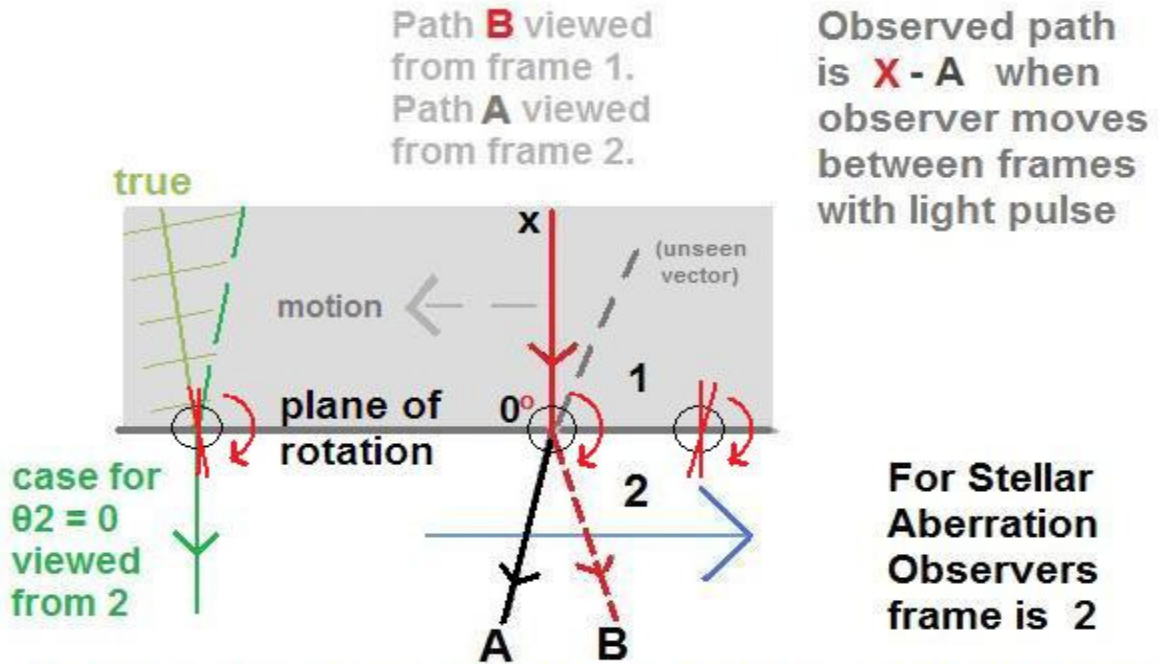
We conclude that demonstrable EM coupling potential and the field qualities of GR are alone adequate to produce the Discrete Field Model boundary shock conditions found both in space and around accelerated particles. Non absolute backgrounds with extinction allow quantum fields with local states K. The vacuum fluctuations may emerge from 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. Non zero Casimir energy is required to produce fermion pairs and maintain the boundary conditions of 'extended mass', and 'regions of space', 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 resolve 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, only locally at c . 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 in the quantum vacuum underestimated by 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/positron/proton' plasma is a most important phase of matter, visible and 'dark'.
10. **The Special Relativity Postulates** are correct, as is equivalence. The LT is an inverse 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 interpreted incorrectly. Non-absolute dynamic locally 'preferred' background frames exist.
14. **Two classes** of inertial field exist. Speed measurement is invalid from *non-local* 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, in a 'quasar' phase.
20. **Galaxies** and universes are scale invariant, evolve secularly and self-recycle (Ave. galaxy cycle ~ 11 Gyr.)
21. **Ether Drag** (Stokes et al) and Chandrasakhara Raman's 1922 diffraction thesis are good approximations.
22. **Minkowski's metric** and Einstein's '*infinitely many spaces*' and '*spatially extended mass*' were correct.
23. **Quantum Mechanics** is quantitatively correct but so was Bell, nature has a largely classical mechanism.
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. **Time.** Two cases of time exist. Proper (Absolute), & Apparent (co-ordinate) as a signal optical illusion.
29. **Speed.** Two cases of speed exist; Propagation' (proper/local), & Relative (co-ordinate, non measurable).
30. **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. As found and termed “Kinetic Reverse Refraction” (see also Appendix. 2).

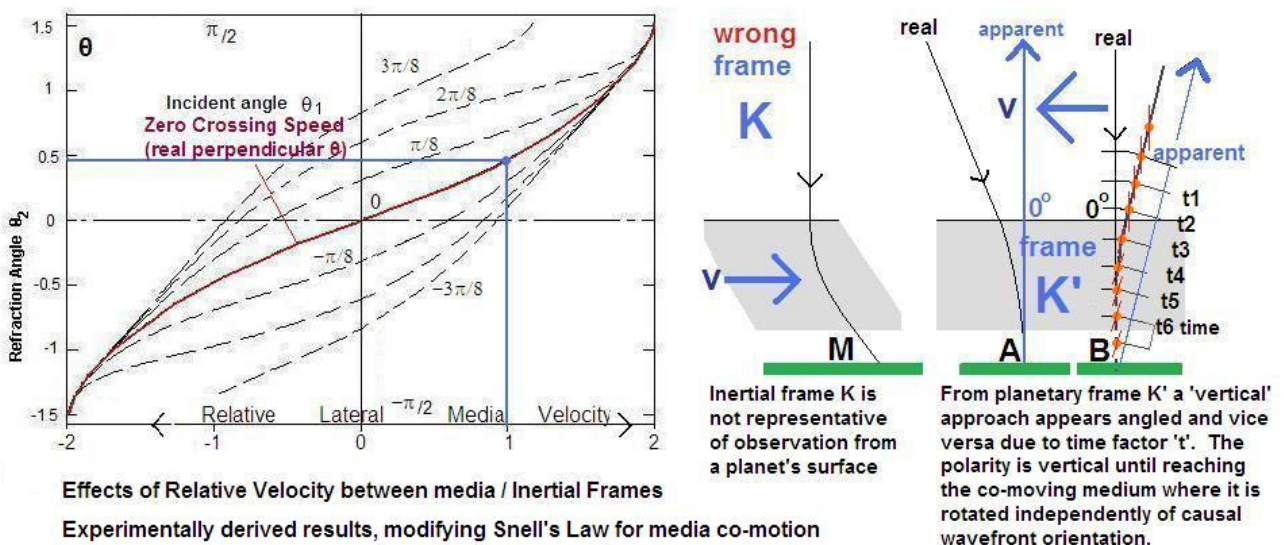
REFRACTION BETWEEN MOVING MEDIA AT $\theta = 0$



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.



References.

- [1] Lodge, Sir Oliver. "Aberration Problems", *Phil. Trans. Roy. Soc.* 184 (1893)
- [2] Jones, R.V. Aberration of light in a Moving Medium. *J Phys. A. Gen. Physics.* Vol. **4**. (1971)
- [3] Lahanas, A. B. et al. WMAPing the Universe: Supersymmetry, Dark Matter, Dark Energy, Proton Decay and Collider Physics. <http://arxiv.org/abs/hep-ph/0308251> (2003)
- [4] Depasse, F. Paesler, M.A. Courjon, D. Vigoureux, J.M. Huygens-Fresnel principle in the near field. *Optics Letters*, Vol. 20, Issue 3, pp. 234-236 (1995) [doi:10.1364/OL.20.000234](https://doi.org/10.1364/OL.20.000234)
<http://www.opticsinfobase.org/ol/abstract.cfm?URI=ol-20-3-234>
- [5] Mackay, T. G. Lakhtakia A. Counterposition and negative refraction due to uniform motion. <http://arxiv.org/abs/physics/0610039v1> (6 Oct 2006).
- [6] Feynman, Richard. QED. The strange theory of light and matter. Princeton University Press 1985
- [7] Wang, R. Zeng, A Yao, A Langley, D. Modified Sagnac experiment for measuring travel-time difference between counter-propagating light beams in a uniformly moving fiber. <http://cdsweb.cern.ch/record/986047> (2006)
- [8] Schwartz, S.J. Hot Flow Anomalies near Earths Bow Shock. *Advances in space research.* Volume **15**, Issues 8-9 pp 107-116. [http://dx.doi.org/10.1016/0273-1177\(94\)00092-F](http://dx.doi.org/10.1016/0273-1177(94)00092-F)
- [9] Bale, S.D. Mozer, F.S. Large parallel and perpendicular electric fields on electron spatial scales in the terrestrial bow shock. <http://arxiv.org/pdf/physics/0703101> <http://cdsweb.cern.ch/record/1023164> (2007)
- [10] Gaensler, B M. Jones, D.H. Stappers, B.W. *The Astrophysical Journal*, 580:L137-L141, An optical Bow Shock around the Nearby Millisecond Pulsar J2124-3358 <http://iopscience.iop.org/154357/580/2/L137/fulltext> (2002)
- [11] *Astronomy*, 1.10.08 Vol. 36. Issue 10. p18. 'Voyager 2 makes a shocking discovery'.
- [12] NASA Voyager Mission pages. http://www.nasa.gov/mission_pages/voyager/
- [13] Gezari, D. Y. NASA Goddard SFC. Lunar Laser ranging test of the invariance of c. <http://arxiv.org/abs/0912.3934> (2009)
- [14] Gezari, D. Y. NASA Goddard SFC. Experimental basis for Special Relativity in the photon sector. <http://arxiv.org/abs/0912.3818v2> (2009)
- [15] Sato, Masanori. <http://arxiv.org/abs/physics/0502007v6> (added 12.2.10). Experimental evidence of the ether-dragging hypothesis in GPS data.
- [16] Van Flandern, T. What GPS tells us about Relativity <http://metaresearch.org/cosmology/gps-relativity.asp>
T. Univ.of Maryland & Meta research.
- [17] Penrose, Roger. Oxford. '*The Road to Reality*', Knopf. July 2004 24/1.
- [18] Jadhaf & Kajali, HFP. <http://www.jadhavresearch.info/docs/AJ.2005.1.ObliquityFactor.pdf>
- [19] Amuasi, H. Maths of Holography <http://resources.aims.ac.za/archive/2003/henryessay2.0.pdf> 2004.
- [20] Popescu. S. *Nature Physics*, Vol. **6**. pp151-153. Dynamical quantum Non-locality. (March 2010)
- [21] Jackson, P. 2009. <http://vixra.org/abs/0912.0041> Lensing & Galactic Mass Anomaly Solution from DFM Shock Model.
- [22] Jackson, P. <http://vixra.org/abs/1001.0010> Relativistic GPS Evidence and Quantum Gravity Architecture of the Discrete Field Model. Jan. 2010.
- [23] Wang, et al. 2002. http://conf-ecloud02.web.cern.ch/conf_ecloud02/papers/allpdf/wang.pdf 3Dsim.
- [24] Harkay, K.C. et al. CERN Simulations of electron cloud build-up and saturation in the APS. <http://conf-ecloud02.web.cern.ch/conf-ecloud02/talks/harkay-ecloud02.pdf> (2002).
- [25] Brunner, N. Scarani, Wegmuller, Legre, Gisin. <http://arxiv.org/abs/quant-ph/0407155v2> Direct measurement of superluminal group velocity and of signal velocity in an optical fiber.

- [26] Jodrell Bank. http://en.wikipedia.org/wiki/Superluminal_motion. 1960's Meting ref. 7 Superluminal Jets.
- [27] Chiao, R. et al. <http://www.newscientist.com/article/mg14619710.100-faster-than-einstein.html>
- [28] Bohringer, H. XMM-Newton observations of M 87 and its X-ray halo A&A 365
DOI: [10.1051/0004-6361:20000092](https://doi.org/10.1051/0004-6361:20000092) (2001)
- [29] Image; Protostar HH34 in Orion. ESO Gas Jet. http://iopscience.iop.org/1538-3881/123/1/362/pdf/1538-3881_123_1_362.pdf http://apod.nasa.gov/apod/image/9911/hh34_vlt_big.jpg
- [30] Wang, et al. Calculation of some properties of the vacuum. Quark Condensate. 2002.
<http://iopscience.iop.org/0954-3899/28/12/309>
- [31] Gates, E. Discover. http://blogs.discovermagazine.com/cosmicvariance/2009/07/13/guest-post-evalyn-gates-on-cosmic-magnification-or-invasion-of-the-giant-blue-space-amoebas/MACS_J1149.5-2223 (2009)
- [32] Diego, J.M. et al. WMAP Anomalous Signal in the Ecliptic Plane. [arXiv:0901.4344v1](https://arxiv.org/abs/0901.4344v1) (2009)
- [33] Juergen-Busack, H. Simulation of the flyby anomaly by means of an empirical asymmetric gravitational field with definite spatial orientation. <http://arxiv.org/abs/0711.2781v2> (2007)
- [34] Hau, L. Harvard. <http://www.seas.harvard.edu/haulab/publications/pdf/HauNaturePhotonics2008.pdf>
Slow Light. Lena Hau. Nature Photonics Aug. 2008_
- [35] Fleagle, B. 2007. <http://sites.google.com/site/phononexperiments/> Variations on Young's Twin Slits. 'Separated Pattern Experiments'.
- [36] Ashfar, S.S. Experimental test of Bohr's Principle of Complimentarity. *New Scientist* cover story /editorial. <http://users.rowan.edu/~afshar/> (July 24 2004).
- [37] Kastner, R.E. Why the Afshar Experiment does not refute complementarity.
<http://arxiv.org/abs/quant-ph/0502021> (2005)
- [38] Franklin, A. Stanford Encyclopaedia of philosophy. Right experiment, wrong theory; The Stern-Gerlach Experiment. <http://plato.stanford.edu/entries/physics-experiment/app5.html> (2009)
- [39] Hecht, Eugene. Zajac, Alfred. '*Optics*'. Addison Wesley. Menlo Park California. (1979).
- [40] Fearn, H. James, D. Milloni, P. 1995. Microscopic approach to reflection, transmission, and the Ewald-Oseen extinction theorem. http://users.aims.ac.za/~jweiner/AJPIAS_64_8_986_1.pdf
- [41] Greenberger, D. Hentschel. Weinert. <http://www.springerlink.com/content/v428n01626428550/> One and two photon interference. Compendium of Quantum Physics 2009 Heidelberg.
- [42] Hamdan, N. Proc. Pakistan Acad. Sci. 43(1): 3N9.- H45a.m 2d0a0n6 LORENTZ TRANSFORMATIONS ARE UNABLE TO DESCRIBE THE RELATIVISTIC DOPPLER EFFECT.
<http://www.paspk.org/downloads/proc43-1/43-1-P39-46.pdf>
- [43] Schwadron, N. A. et al. 2011 ApJ 731 56 doi: [10.1088/0004-637X/731/1/56](https://doi.org/10.1088/0004-637X/731/1/56) Ixex. SEPARATION OF THE INTERSTELLAR BOUNDARY EXPLORER RIBBON FROM GLOBALLY DISTRIBUTED ENERGETIC NEUTRAL ATOM FLUX. <http://iopscience.iop.org/0004-637X/731/1/56>
- [44] Barros, A, Romero C. On the Weak Field Approximation of Brans-Dicke Theory of Gravity. 1997 http://arxiv.org/PS_cache/gr-qc/pdf/9712/9712080v1.pdf
- [45] J. Llama The shocking transit of WASP-12b: modelling the observed early ingress in the near-ultraviolet. Mon. Not. R. Astron. Soc. 416, L41–L44 (2011).doi:10.1111/j.1745-3933.2011.01093.x
<http://arxiv.org/abs/1106.2935>