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

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Abstract

We uncover a relativistic error influencing physics at a critical moment. Refraction due to relative motion was considered from the wrong inertial frame by Lodge for his influential 1893 Stellar Aberration paper following Michelson&Morley's null result, the light path shown 'dragged' by the new medium.[1] Within the frame of a moving medium the lights path refracts back towards the normal, as in more dense media at rest. Jones's 1970 glass disks experiment repeated the error.[2] We show how in Special Relativity (SR) using the correct observer frame is essential, and how this erroneously 'disproved' Stokes M&M supported Ether Drag theory, engendering Lorentz's contraction and time functions. We test variations on Young's experiment, and consider the Huygens-Fresnel Principle[3] and implications on the interstellar medium and EM field potential. Through the Ewald-Oseen Extinction Theorem, interplanetary shocks and FM the SR postulates are confirmed, but a clarification emerges at Maxwell's field limits, allowing replacement of an assumption with a quantum mechanism. We find extra predictive powers, symmetries and improved ability to resolve anomalies and perceived paradox. New perspectives on Snell and Fermat arise from the model using Einsteins 1952 view that 'space' is actually; "*infinitely many spaces in relative motion.*"

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1. Brief Historical Introduction

History can be re-written if misapprehension propagates so we first provide a brief resume and analysis. The backdrop of the 1800's was the basic light paradox. The Newtonian corpuscular 'ballistic' concept was not comfortable with the increase in evidence that light travelled at a constant speed 'c' through and with respect to (wrt) a 'luminiferous aether' medium irrespective of the speed of the emitter or observer.

A major turning point in science came when, after Michelson & Morley's (M&M) 1887 null interferometer result for 'aether flow' past the earth, Lorentz decided to incorporate FitzGerald's new contraction theory into his transformation equations, taking many properties from the 'aether'. Contrary to some opinion he had accepted that the Fresnel/Stokes etc. 'Full Ether Drag' option complied with M&M. His objection was 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 removed the last of the aethers properties, 'immobility' by using 'lateral waves', as found in solids, in SR, it still left only the ballistic theory of light to explain stellar aberration, adding to the mystery of wave particle duality.

The nature of light is still subject to contention 100 years after Special Relativity. 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 with the gap between relativity and quantum Physics until he died. Some believe this is largely filled, but Roger Penrose probably identified the problems most comprehensively[p14] pointing out the chasm is still vast, and the nature of light central. No credible falsifiable alternative to SR has ever been proposed, but it may be worth considering another possibility, that it is simply not yet fully complete, and apparent paradox and dissent may be removed by doing so with a link to quantum physics. Gaining a proper understanding of light should help.

Stellar Aberration is central to understanding light and wave/particle duality, so we review this and the implications of it's correction using as non technical a methodology as possible, including dark energy, leading to considering of the assumed equivalence of mass in relative motion in the vacuum, lateral waves, and optics. We look more closely at some parts of the history below, considering Sir William Bragg's famous quotation; "*The important thing in science is not so much to obtain new facts as to discover new ways of thinking about them.*" and identify and analyse the major consequences of correction of a pre SR error of understanding of observer inertial frame for aberration.

2. Stellar Aberration and Aether Fields

The cause of stellar aberration 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 seasonal apparent change in position of stars in 1725-7 when investigating parallax. It is the small angle a star will appear to be off its assumed position due to the orbital motion of the Earth around the sun.

The observed position of a star is always found to be ahead of the assumed actual position on our ecliptic polar, (orbital heading) and the change of position describes a full ellipse in one orbit. The maximum aberration as some 20 seconds of arc is found at higher declinations and reduces to zero at the ecliptic plane. Using Draconis, with a declination 75^{o} above the ecliptic plane, Bradley calculated the aberration angle using Earths orbital velocity $v = (2.98)10^{4}$m/sec. and 'c' = $(3)10^{8}$m/sec. as;

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

The angles are small so a relativistic calculation is not needed, $\sin(\alpha) = v$ is virtually indistinguishable from $\tan(\alpha) = v$, or simply (α). Newtonian 'ballistic' corpuscular theory was used, suggesting 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 the non ballistic wave theory of light, with speed 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 would, 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 the wave basis if there was lateral aether flow.

Fresnel, master of the optical, first had the inspiration which included first deriving the relativistic velocity addition law used later by Lorentz and Einstein. He proposed 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, (splitting of the spectrum), should occur due to it's variable relationship with density, but the alternative ballistic theory had the same problems. Fresnel's basic thesis that light's speed related to each local medium was later confirmed by Fizeau's moving water experiment which also evidenced the wave properties of light.

But many were still not happy, and chromatic dispersion remained a problem with all theories. 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 Plancks proposal of a compressible aether, more dense at the surface countered Lorentz's first objection on the grounds of 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.

The M&M result was not consistent with Fresnel's partial drag theory or Lorentz's ether theory derivation, but was as predicted by Stokes. Indeed Michelson wrote to Alexander Bell after his 1881 experiment 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 the ballistic theory, with issues to address, or Stokes Full Ether Drag wave based proposal. This had some parallels with Maxwell's EM fields and was gaining support, only needing to address the variable density question.

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

It seems the luminiferous aether had frustrated those seeking a mechanistic description of reality for long enough. It was now relegated to a supporting role by a, less mechanistic, mathematical solution. FitzGerald, a close colleague of ether supporter Lodge, derived a thesis of length contraction quite extraordinary at the time and might have gone the way of most speculative theory but for H.A.Lorentz. After the disappointment of M&M it was the ideal solution for completion of the Fresnel derived relativistic frame transformation equation, already mooted by Larmor. This was to replace the Galilean transformation;

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

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

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

Einstein discussed stellar aberration in his 1905 paper, reverting to the simpler kinematic solution, further mystifying wave particle duality but allowing the 'immobility' of the aether to be removed. This allowed perfect equivalence of bodies in motion in the vacuum for his Special theory of Relativity (SR). Eddington's confirmation of predictions installed Relativity as the new paradigm. Although Einstein said "*Space without*

aether is unthinkable." when also considering field based General Relativity in 1921 he had removed the last of it's real properties, 'immobility', for SR and the aether went out of fashion. But an 'interstellar medium' never entirely died, we've had the Dirac Sea, the Higgs Field, and now a Dark Energy field[3] representing 73% of the mass/energy of the universe.

But Stellar aberration was only partly resolved, and duality was not. Maxwell's EM equations were, like GR, field based, yet for SR background fields and 'matter waves' couldn't exist. Transverse waves were suggested by Young and Fresnel to explain polarised waves and why they didn't interfere, but it seems this may simply be evidence of the conserved spin axis we've found, consistent with the Huygens-Fresnel Principle[4]. Young's transverse waves were of a medium, only previously existing as vibration in solids or a string, but they were reinvented by Einstein when removing a medium for longitudinal waves. These didn't co-habit well with Schroedinger's three dimensional spherical wave front. This used plane or matter waves, a longitudinal variation in magnitude of a quality, which requires a background frame, field energy density/potential or 'dark energy' medium. The question 'what then is waving' in transverse waves has never yet been fully answered.

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. This remains an apparent paradox in itself as neither the emitter, the vacuum or the receiver can have any influence on its velocity and there is no other entity by which it could be quantified. The growing sister paradox was the apparent lack of influence the speed of the receiver has on measured speed 'c'. SR has always engendered dissent, unlike GR where the equations stress-energy field functions include sheer stress, pressure, energy and momentum densities and flux. SR's Lorentz-FitzGerald contraction has also not yet been observed. We try to find a better understanding of evidence, first more closely studying the phenomena of velocity derived refraction.

3. Refraction due to relative Velocity

Snell's Law of refraction only directly applies if both media are at rest. The angle of refraction depends on the relative density of the new medium (refractive index - n), and angle of incidence, giving the term; $n_1 \sin(\theta_1) = n_2 \sin(\theta_2)$. When waves are slowed the angle changes (refracts) and wavelength reduces, conserving energy and frequency. The fixed relationship is; $\sin \theta_1 / \sin \theta_2 = v_1/v_2 = n_1/ n_2$ But refraction is also a function of relative velocity between two media, therefore also observed if the media in relative motion are identical. But now we must remember that, unless we change speed to that of the new medium, we are observing from a different inertial frame, so frequency is only apparent. This is as Stokes' Full Aether Drag thesis where a dragged field moves with the Earth in it's motion through a surrounding medium at rest with respect to the sun. The product of frequency and wavelength locally within the new media remains 'c', and the energy. The angle of refraction θ_2 can be derived from θ_1 and relative frame velocities.

Under the ballistic theory, incoming photons entering the new medium are 'swept along' in its direction of travel (see fig.3). For Stokes 'ether drag' theory this would give aberration in the wrong direction. Lodge showed this path in 1893, Fig 13 (p780.)[1] , but it was as viewed from his lab frame *not* the co-moving frame which would represent the Earth. This key error, reversing the result, went unnoticed. An experiment was proposed with light passing through a spinning glass disc. R V Jones eventually carried this out in 1971[2] but retaining the error, suggesting a 'drag effect', opposite to that actually observed in the 2nd inertial frame.

This error of comprehension regarding the correct observer frame has remained unnoticed. Stellar Aberration is still now wrongly assumed to disprove aether drag. Current optics considers it correctly but the application error and its fundamental implications have been missed. It is an extension of the reciprocal relationship between refraction and observed deflection of a rod or finger placed in water. The path change observed from the frame of the first medium n_1 is ***not*** the actual, refraction angle, or path that will be observed from the second, (or co-moving) inertial frame, of medium n_2 which the light is entering. This, n_2, is the observers frame on the Earths surface when considering stellar aberration with a dragged field. The observer at rest with respect to medium n_2 will actually see the angle of refraction reduced, the path vector *steepened,* at the point of refraction. The time averaged Poynting vector is counterposed with the refracted wave vector at obtuse incidence angles.[5] The path, P_1 - P_2 in Fig.1. is angled *against* the 'flow' of the medium as observed from n_1. The figure shows the relationship of two 'bodies of medium' n_1 and n_2 with relative speed v, but considers each medium from its own inertial frame, where the refractive angle θ_2 is less than angle of incidence θ_1. In the new medium light will take the fastest path to P_2. We'll extend Richard Feynman's Quantum Electrodynamics (QED) analogy[6]. A lifeguard wanting the fastest route from Po to P_2 would run to P_1 shortening his (slower) swim to P_2. But. Though swimming on actual heading (vector) P_1 - P_2, by the time he arrives at P_2 When viewed from n_1 he will be in position P_2 b because the tidal current is flowing at v.

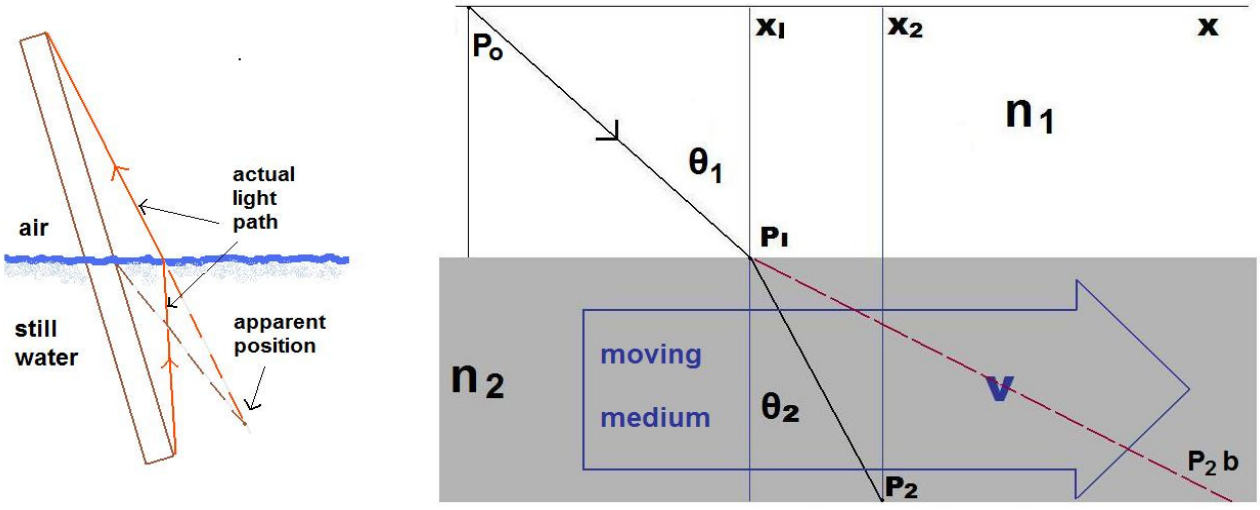
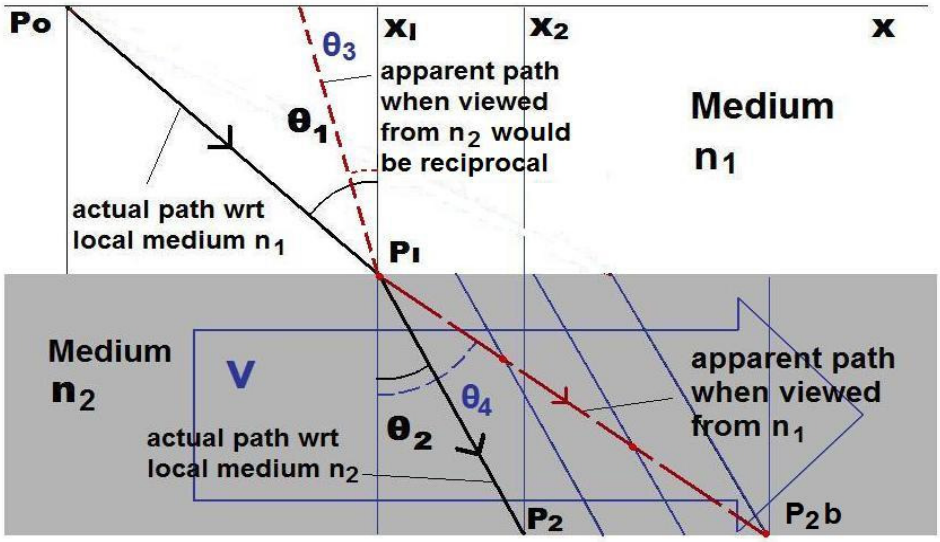


Fig 1. *Refraction*. Between different media such as air and water actual refraction is inverse to apparent path change observed from each medium. For media in relative motion (even of similar refractive index) the same applies. Here the observer *changes inertial frame* with the 'ray' of light. Lodge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

This recognises the implications of Fermat's Principle and QED, that the observed light traverses the 'path of stationary time' or least time, occurring when the sines of the angle are proportionate to the propagation velocities. Lodge, along with most, had not yet grasped the essence of relativity, still misunderstood now, that each inertial frame ***is*** it's 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 if viewed from Earth. We must always carefully consider which frame we're observing from to obey the relativity of simultaneity. Fig. 2 below also shows the apparent light paths in each inertial frame when viewed from the other frame, (in red).



Refraction due to relative motion 2. Showing paths viewed from other frames (media).

Fig 2. *Refraction between media in relative motion.* Both light paths are different if viewed from the other frame. The Earths 'lab frame' for Stokes ether drag or a discrete energy field should be n_2.

It can be seen that the pair of vectors, path Po-P_1-P_2b (as observed from n_1) are tilted in proportion to v when viewed from n_2. This demonstrates that, contrary to previous assumption, Stellar Aberration is accurately derived with a dragged or entrained field effecting a change in inertial frame above the planets surface. The heart of this is; The *relative* speed of light changes in exactly the same way it does for a denser medium, as it must with the shift in wavelength and angle, but this time it does so *to maintain 'c' locally in the new medium*.

This juxtaposition is both difficult to comprehend and more meaningful than it seems, demonstrating why we will always measure light locally at 'c'. But it does not yet explain the physical mechanism at the frame/field boundary interface. It compellingly demonstrates that expanded full 'sets of co-ordinates' can represent the limits of real physical bodies, of 'spatial extensions' around mass, or of a 'dark energy potential' medium.

Once the conception of co-moving frames is reached the perfect symmetry emerges. Light reaching the observer always does so at 'c'. If the he stays in frame 1 when light moves into frame 2, perhaps a moving train, or galaxy, he would observe frequency apparently conserved but wavelength changed. He will also

observe it's *apparent* speed as c+v (or c-v). The signal informing him of this 'apparent rate of change of position' will however do so at 'c'. If however he 'rides the light beam' and accelerates into frame 2, observing from there he will find the frequency changed to balance the Doppler shift of wavelength, their product remaining 'c' locally, conserving the energy. Use of the correct observers frame is always essential. Both classic and quantum mechanisms for the light speed change already exist and are identified below.

The ballistic aberration model is shown in Fig.3, the telescope angled to allow photons to pass down the centreline. This simplistic view derives the incorrect aberration for ether drag. Fizeau proved 'c' was always with respect to the 'local' medium, as confirmed by Sagnac and others. This was for 'closed' single frame systems. Further Sagnac and Michelson Gale results from 'open' systems, with light passing through a back-ground field, also supported Stokes model. Wang confirmed propagation at 'c' within all inertial frames,[7] (2003-6), which confirms this model and SR's 2nd postulate, but not ballistic theory or current interpretation.

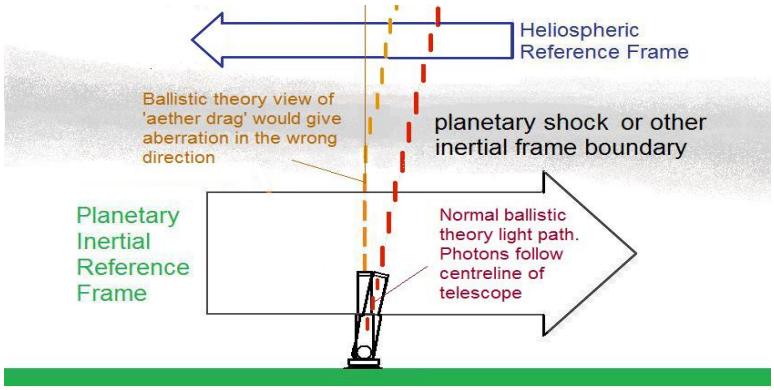


Fig. 3. *Ballistic Model of Stellar Aberration.*

Conserved ballistics also struggled with the relative speed issues in either plane and chromatic dispersion, but we find all observation consistent with non-conserved ballistics. We haven't observed long term conservation, and from QM, cloud and bubble chamber experiments we know particles can condense and evaporate, so it seems a solution may lie here. But the field model only seems to derive aberration in the correct direction for just over 50% of the sky. We consider below that for a spherical field deflection direction would reverse for stars ahead of our path, a positive root required at above zero crossing speed (normal incidence), and negative root below. We will study EM waves and frame morphology more closely for evidence, We know how the Earths EM field is effective at deflecting dramatic solar ejections we've initially assumed the 'limit of potential' or boundary between frames may occur at our planetary 'collisionless' shock. This is tested below.

Of Lorentz's objections; Plancks compressible field is valid, we now know light speed is indeed reduced by increasing density in the atmosphere, EM signal conductors may also be more dense than insulators, and gravitational time dilation would also render his objection invalid. We have limited information on qualities of any medium or energy potential but we do have to consider what real physical boundary mechanism could derive stellar aberration and change to light speed to conserve 'c' and it's relationship with duality.

Figure 4. shows how the wave front vector change would occur across an inertial frame 'shock' interface. The signal we observe in focus is precisely normal to the wavefront. We will, for ease, consider a photon as simply a position on the wave front. Those positions would be deflected in the direction of motion of the new medium, when entered, satisfying intuitive logic. The Doppler shift of the waves, including lateral Doppler shift effect, will reduce the wavelength slightly (blue shift) which means the canted path travelled by each point (or photon) makes less downward progress. This would cant the wave front in the opposite direction, in proportion to relative velocity, putting the stars 'virtual' position ahead of the true position, as observed. We are viewing from the Earths frame. We see the ballistic 'path' of the point/photon is irrelevant. The signal we observe is normal to the refracted wavefront but may be contorted by gravitational lensing and caustics.

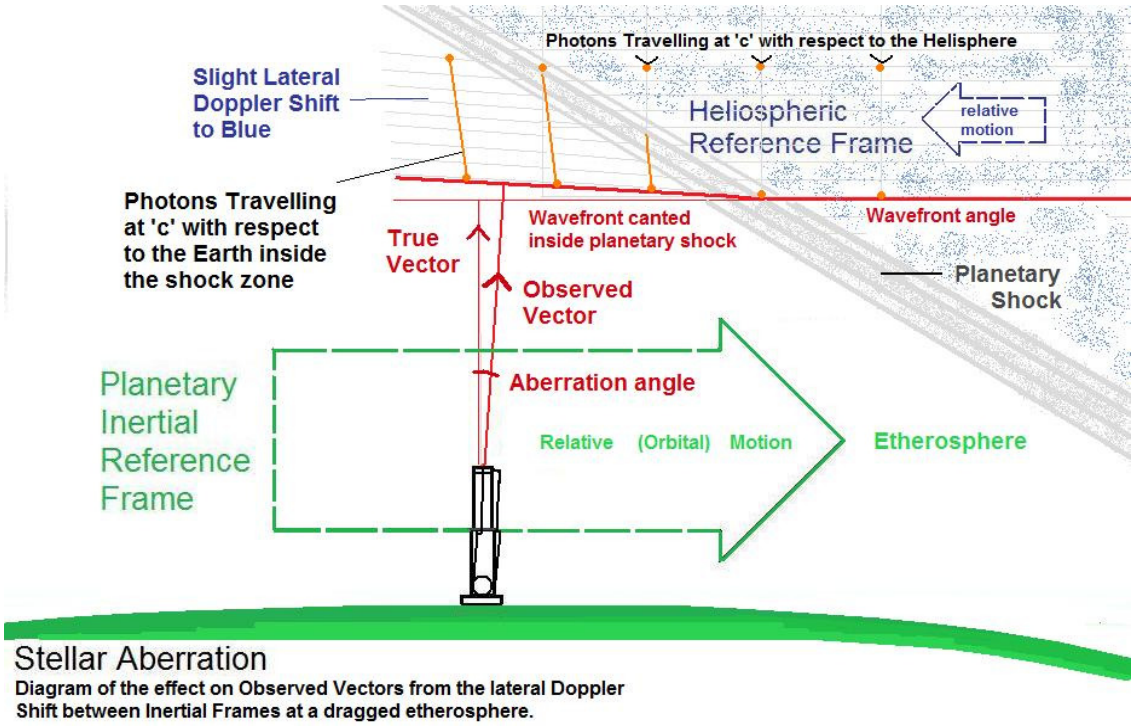


Fig 4. *Stellar Aberration; Canting of the wave front. (due to relative motion of the media). But see also Fig 7. for Huygens-Fresnel Principle, Fourier Optics and FM mechanisms.*

The aberration would reduce with reduced elevation towards the horizon, as observed. But, as discussed, there appears to be a problem. The aberration direction would be reversed if the wave approach angle was beyond the interface boundary normal (here allowing it's right hand side to meet the interface before it's left hand side). This does not meet observation. The negative root below zero crossing speed (vertical on Fig. 2) would disprove a model with an etherosphere with anything similar to the spherical field interface we might postulate. This is further investigated below.

The Earths magnetosphere is so dominated by the effects of the solar winds it would be hard to detect any other phenomena, although there are some anomalous shock vectors and 'hot flows'.[8][9] But when we search

for evidence of dragged fields around massive objects moving rapidly through the interstellar medium away from such influence a clear pattern of 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 would be the inertial frame interface of the solar system as it moves through the galactic interstellar medium at 45,000mph. This has no sun blasting it, but it is well evidenced by the anomalous oscillating particle activity and accelerations found by the Pioneer and Voyager missions[11] and NASA have produced dramatic images from the data.[12] The 'termination shock' inside the bow shock is termed the place the solar winds hit the interstellar medium. Most dramatically, Figure 5 below shows a Hubble space telescope photograph of the solar system of the star Orionis and her own heliosphere's bow shock, highlighted by the gas clouds of the Orion nebula impacting her 'etherosphere', exactly like the pressure/density wave from a bulbous ship bow. If the Earths has such a dragged field our non-visible crescent shaped bow pressure wave would be centred on the ecliptic polar of our 100,000mph orbital path.

Fig. 5. *Orionis, and Bow Shock. Photo courtesy of NASA. Hubble Space Telescope*. The shock configuration (also visible on a distant star top left) is similar to NASA's artists impression of the heliopause bow shock, being crossed by Voyager 2.[12] The velocity of EM waves propagating within the shock should be 'c' wrt the star, the same as within our own heliosphere.

NASA's Laser Lunar Ranging experiment results[13] and GPS[14] are consistent with such a local background inertial frame frame/field.[15][16] This interpretation may intriguingly also offer us to a new viewpoint on the massive particle activity of galactic halos and the flat gravitational curves of our galaxy edges as the galactic field spins and moves through the intergalactic medium, propagating particle activity in its peripheral star nurseries. We now propose using a new term '*inertial field*' to conceptually unite the concepts of local systems of co-ordinates and dark energy potential with physical reality. How closely these may be related to

Maxwell's EM fields, infinite in number, is not yet known, but there seems a certain symmetry to the concept of the speed 'c' applying to EM waves within EM fields. It is now suggested as a possible reality analogue of Einsteins 1952 description of space as; "*Infinite number of spaces in motion relatively to each other.*"

If it is the shocks dense cloud of oscillators that acts as interface between inertial frames the asymmetric crescent shape would only allow one refraction direction to be observed. This the correct aberration direction, and reducing towards the horizon. See Fig.6. Wave velocity would change to remain at 'c' after the shock, with the proportional refraction and Doppler shift conforming with Snell's Law. This is now all as observed[5], reinforcing SR's postulates. We may perhaps even observe it in the zodiacal 'false dawn' light of Khayyams Rubaiyat. It wouldn't allow ballistic light with the correct aberration. We test implications and considered the physical process, starting from the earliest conception of EM waves, refraction and probability theory.

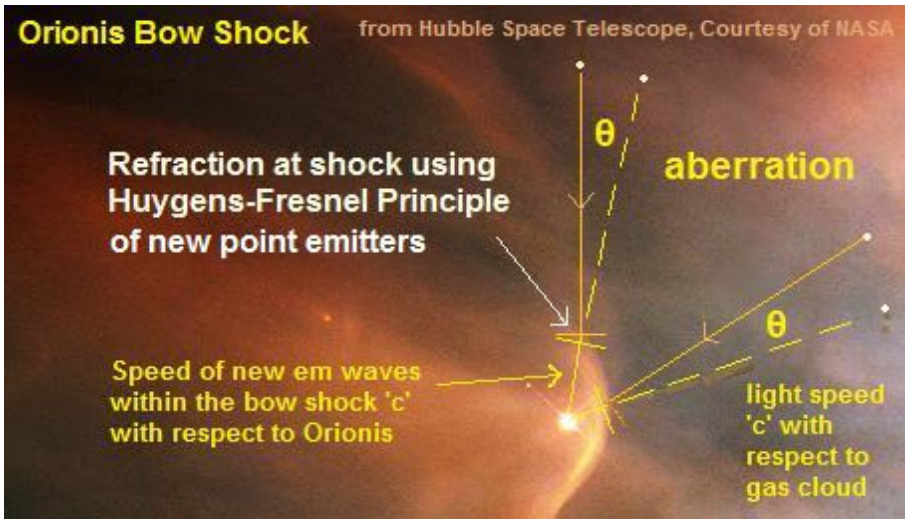


Figure 6. *Aberration at a crescent shaped bow shock.* Only positive aberration would be derived, reducing with elevation, as observed. New HFP waves from the shock will travel at 'c' wrt the star with the wavelength accordingly transformed (Doppler shifted) in accordance with Snell and Fermat.

4. Field Boundary Process

We now consider EM waves more closely, particularly the tiny visible frequency range, and the implications of inertial fields. As we're now considering 'matter waves' we must clear our minds of preconceptions and look through the new doors this may open. The father of probability theory, light as EM waves, formulae in physics and much more was Christiaan Huygens, 1629-1695. The Huygens Principle was extended to the Huygens-Fresnel Principle[3] (HFP) and confirmed by Kirchoff for wave equations in 1845, using matter waves to show how each point on a wave can become the point source of new waves. Sound waves behave similarly, a sound coming through a window with a source to one side will be heard as a sound from the window. The HFP says a change in medium will act as point sources of new waves, creating a virtual source. This is consistent with probability where, as in QM, a particle may propagate at any position, possibly subject to perturbation or compression. If it does it emits new synchrotron radiation and EM waves at a frequency

directly relating to relative velocity, providing the Doppler shift and constant 'c'. Each new wave signal is a superposition of many such waves, but no back waves are generated. We consider this and FM further below.

This extends to Fourier optics, where an EM wave front is considered as an infinite number of individual 'wave points' which can move laterally with respect to each other so any variable data (wave) can transform into 'frequency space' and back. This is not possible with conserved ballistic particles, but does suit the short term condensed virtual photon' or photoelectron oscillators we see surrounding the particles at up to very high densities and frequencies subject to speed in accelerators. This would suggest that, when conceived, QM and EM waves were fully unified, and may now re-unite to explain paradox. Newtons ballistic light particles were certainly a precursor of QM, but neither Young's 1801 confirmation of EM waves or Fresnel's extension seems to have been enough to bring Huygens original principles back under the microscope.

Figure 4 may now be enlarged to figure 7 below, showing consistency with HFP optics. The most important point to note that the new waves emitted at each point will propagate at 'c' wrt the inertial field they are moving through irrespective of the relative speed of the emitter or of the inertial field the original waves were travelling in. It also shows the analogy with sound, in Wave Field Synthesis (WFS), considered below.

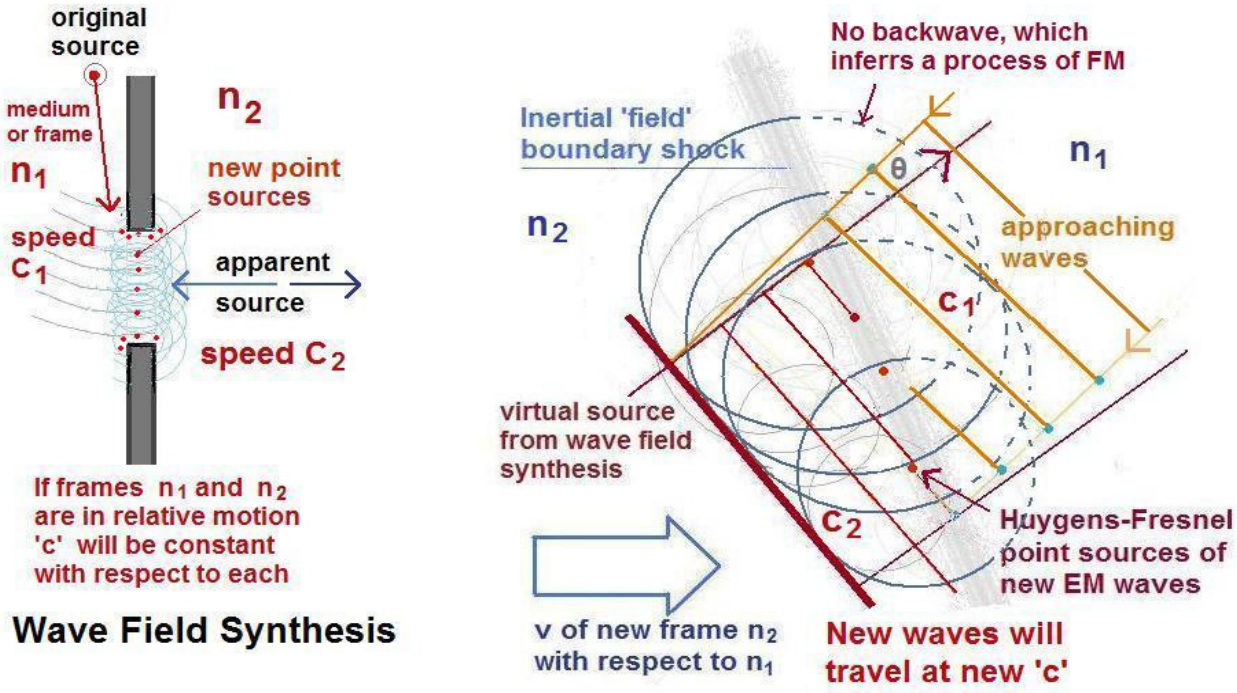


Figure 7. *Huygens-Fresnel Principle, Fourier Optics and Wave Field Synthesis deriving a virtual source, inferring that waves from new point sources in new frames will travel at 'c' with respect to the new frame. Note the new wavelength has changed with vector, conserving frequency and energy.*

Wave Field Synthesis (WFS), 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 the new multi point wave emissions

create a new 'virtual' emission point and wavefront vector. The most important concept to hold in mind is that with HFP the speed of the new wave will be 'c' with respect to the new local inertial frame it's travelling within. This must be relatively different to 'c' in the old frame and would physically, mechanically, produce the Doppler shift observed in such cases. The refraction process would be; wave perturbation at boundaries focuses the signal into oscillating (non 'point') particles, due to compressibility limits, propagating new EM waves at a new wavelength directly related to relative field velocity. We now find Snell's law and Fermat's Principle emerge, and also that sound waves are a little more complex than colliding billiard balls. The Probabilistic elements of QED are fully explained by particles propagating *at* photomultiplier's. Wave functions do not collapse but are recycled at the inertial frame boundary or on reflection, also following 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 aberred 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).

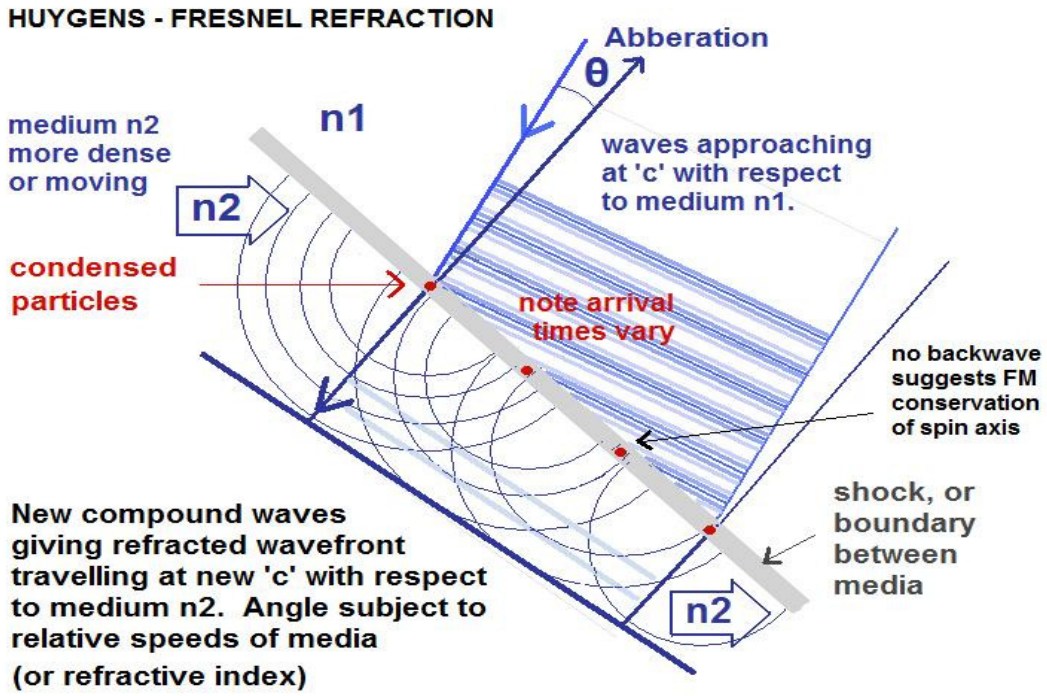


Figure 8. *HFP Refraction*. (Reconsidered). The time averaged Poynting vector gives refraction towards the normal. For media in relative motion this sequence is as observed from within each inertial frame/medium. Light speed is converted to the new local 'c'.

If this interpretation is correct it would allow light to be longitudinal superposed EM waves of fluctuating dark energy potential, with condensed short life point oscillators no longer exactly randomly propagated.

Signal information observed would be precisely normal to the wave front, complying with causality. This uses the postulates of SR but allows it to be reunited with probability to evaporate paradoxical assumptions. Roger Penrose believes particles cannot be conserved if we are to join relativity and quantum physics.[17]. This also suggests that photons are the more local short life entities we have observation evidence for, small waves packets within superposed larger waves, similar to fields within fields. Energy conservation would be more clearly met as the energy of annihilated or 'evaporated' particles would be conserved within the potential in a non zero ground state. It explains the measurement problem by suggesting all instrumentation propagates new waves, and leads to explanation of decoherence and even proof that Schroedinger's cat is not dead and alive.

Before we move on we must consider the HFP, the basis of holography, in more detail. Consider ten people throwing pebbles into a pond surface at an angle. Each set of ripples will, at the first order, propagate in a circle and at a speed relative to the water not the pebble. A cascade of superposed waves tells you the points of entry not the angle of approach of the pebble. This analogy breaks down due to the lack of a back wave at propagation. This was addressed by Fresnel's obliquity factor, but his solution was arguable[18]. Reviewing it with current quantum physics and wave particle interaction a new solution emerges in frequency modulation (FM). The energy signal would be vectoral and spin axis conserved Where the medium is more dense massive particles absorb some of the signal. Refraction angles wouldn't be known by individual oscillators but held with causality in the new compound wavefront. Fresnel's transverse waves, conceived for polarity reasons, would have been informed by QFT and holography.[19] Wave energy patterns on oscilloscopes are representational of energy density fluctuations within a compressibility limit, not spatial constructions.

Doppler shifts would indeed 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, and not simply as a mathematical construct but with a beautiful and symmetrical quantum propagation and spin based HFP process, balancing vector, frequency & wavelength to conserve energy and speed 'c' locally, but the required infinity of transformation is removed.

5. Implications of Inertial Fields and Locality

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

Similar to Einsteins concept is an infinite number of EM fields in relative motion. We must envisage each EM field as a real physically 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."* Physical objects with extended 'field' potentials have to be in relative motion to generate charges. Smaller ones within larger local fields. If we have a non zero background energy potential we can use a topological model to overcome problems with action at a distance. Each massive particle affects the local topology and will be instantaneously 'aware' of any other mass in the vicinity. Figure 8 below shows an example of a simple 2D topological representation based on a GR gravity model but complying with Coulombs Law; $F = (kq_1q_2)/r^2$

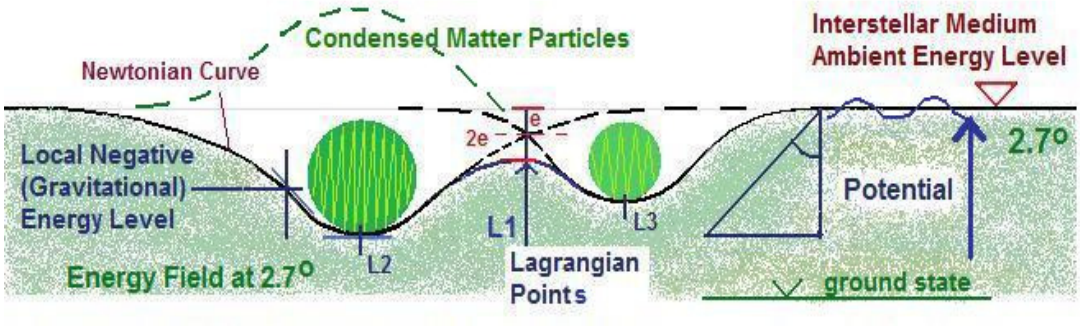


Fig 9. *Topological Field Model showing instantaneous communication of potential between charges.*

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

The limits of this '*spatially extended*' mass may relate to the limits of the local EM fields. From virtual electron clouds to our planetary shock and the bow shocks of the heliosphere and LL Orionis, we can find the boundary positions. The formula for the local spatial limit will directly relate to the total momentum of the system, being based on rest mass x relative speed. The total effective mass will includes the mass of the condensed particles, physically giving the system that momentum in yet another symmetrical relationship.

The most simple candidate as a quantum process for this is Frequency Modulation, the wave-particle interaction we use for FM radio. This concept and its implications are discussed in depth in the Discrete Field Model (DFM)[21][22] which preceded this paper but with a field potential based model, suggesting this as the possible link between reality and locality lost with Bells inequality.

Either model shows that moving Einsteins 'light box' experiments mirrors would simply leave the light pulse behind to fly off into space if the box walls were removed before moving the mirrors. Each mirror would then be it's own local set of co-ordinates (frame) rather than the box being one large one. Light passing through a train may indeed 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' (consummately Doppler shifted). If we're moving ourselves? our own field boundary fine structure converts it to our local 'c'. The photoelectric effect may be explained in terms of energy conservation, the energy focussed with blue shifted light as a function of each wave, reverts when red shifted. The mechanism, replacing the assumption, wouldn't seem to affect GR, Indeed the field qualities of GR are adequate to produce limits and boundaries, which would more closely harmonise the two. Argument about the existence of 'aether' thereby becomes irrelevant, so the model may help remove dissension and accusation of paradox within SR. We consider how.

Postulate 1. '*The laws of physics are the same for all observers in uniform motion relative to one another.'* Often called the 'Principle of Relativity', this would mean even more than we believed, that the laws of physics for an observer within a spinning disk, a train, the space station or on Mars are the same as in our lab frame on earth. That all mass has and is a real inertial as well as EM field if in relative motion with any other. **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.'* This has always implied that it's speed changes to 'c' locally for each moving observer. Inertial fields would actually allow this with a quantum mechanism.

It was assumed it also meant two astronauts in uniform relative motion in space must be entirely equivalent, meaning no 'fixed background' field was possible. It's only this assumption that propagated paradox and dissent. It's now clear it conflicts with the increasing 'clouds' of oscillators[23] propagated by accelerating mass[24] be it single electrons, bunches of protons or stars. Using Huygens Principle alongside frame transitions this unproven assumption becomes unnecessary. If *all* bunches of particles, large or small, astronaut or planet shaped, have their own field and boundary shock we'll always measure light at 'c'.

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. Transformation and Doppler shifting would be a real, physical not just mathematical process. Relativistic transformation equations would still be needed to describe energy input required to accelerate any mass to 'c', but their regime would be more limited. The model is closely related to De-Broglie's 'pilot wave' theory, brushed aside in Einsteins battle with Bohr at the 1927 Solvay Conference when it now appears it could have united them.

Many 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 Einsteins comment; *"We can't solve problems using the same kind of thinking we used when we created them."* further specialist exploration is invited, We now briefly identify some implications, testable and anomalous predictions and apparent practical issues.

Superluminal Motion. Light observed in another field in relative motion 'v' would be observable at v + c. But we would only observe an *apparent rate of change of position,* 'c' is not exceeded locally, and the signals 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 poles of a 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*."

Micro-structure. We don't speculate on structure any more than GR does, 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'.

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

Shock Clouds. It is predicted all moving mass propagates a 'cloud' of oscillators, emitting synchrotronic radiation and increasing in density and frequency with speed through the vacuum, and that these may both constitute and propagate dark matter, as non-point particles, when compressibility and density limits are exceeded. They may hold and conserve the energy of acceleration, as potential energy, and modulate em frequency. Clouds do form around accelerated particles and at cosmic shocks, at densities up to $10^{13}/m^{-3}$[23] Parasitic 'photoelectrons' or 'virtual photons', are minimised to assist accelerator efficiency but may be closely related to dark matter.[24] Galactic edge Halo's and consequential flat acceleration curves would be due to similar field boundary phenomena.

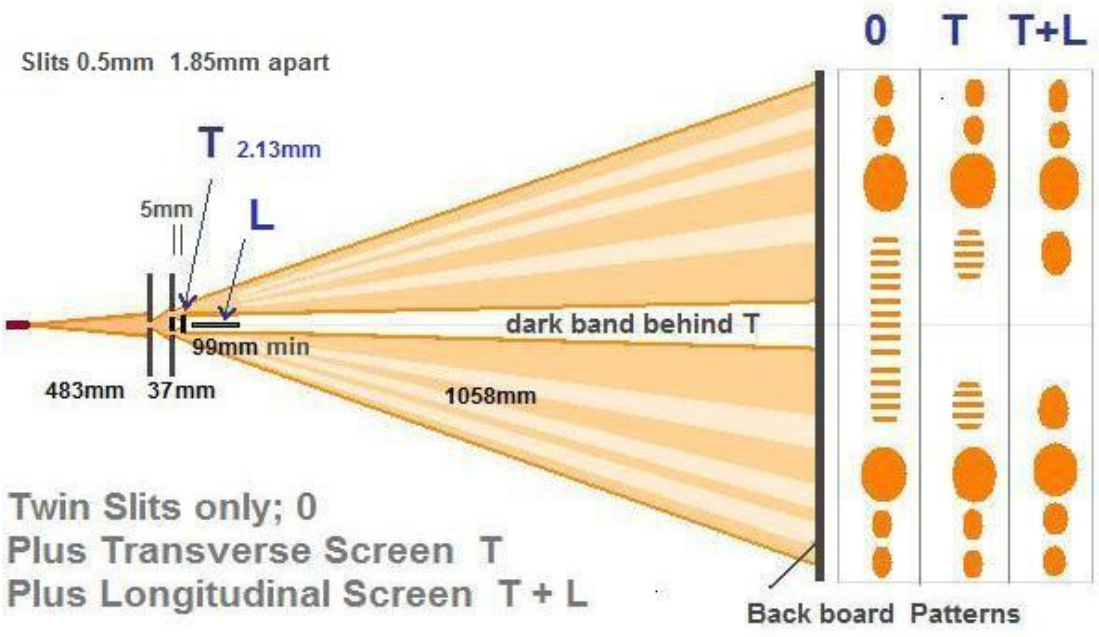
Microwave Asymmetry. The model predicted the Cosmic Microwave Background would be asymmetric due to local synchrotronic radiation peaks from bow shocks. The asymmetry detected[32] is not yet explained. It may help inform us of relative motion of massive bodies and fields, providing new data on the Universe.

Accelerations. Anomalous accelerations on planetary probes and craft on flyby's, would be centred on bow shock zones on orbital paths, caused both by additional 'crescent' 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 anticipated.[33]

Slow light. Free of long range ballistics it should be possible to slow the passage of EM waves in the right medium by reducing temperature and energy for propagation. More troublesome still, they should instantly accelerate back to 'c' once released, using field energy. Lena Hau's lab at Harvard[34] has achieved this.

6. Experiments, and Ewald-Oseen

Variations on Young's twin slit experiments by Fleagle[35] (unpublished 2007-9 'Separated Pattern') were reproduced and further extended. These are basic and propound a slightly different thesis, but are in the best traditions of experimentation. In quantum physics no photons would be found at dark bands on target planes. This is as confirmed by the Afshar experiment's wire detectors,[36] though it's refutation of complimentarity, showing wave and particle characteristics for the same photon is contested.[37] With new HFC waves, local particle propagation probability is low where troughs coincide, giving inadequate energy, but at peaks just before the perturbation plane probability is high. We suggest that if another slit were placed in the centre of the dark band it would cause interference with light from a further slit. New oscillators would also be propagated at the sharp topography of each slit edge, possibly also explaining the focus of surface charge there. The experiments test predictions varying from most quantum and classic wave theory, blocking a direct photon path yet still detecting condensed photons and wave interference. This is consistent with Stern-Gerlach[38] and has parallels in both pilot waves and complementarity, where Wilson chamber observed trajectories are allowed, but discontinuously via symmetry breaking. A number of experiments tested for interference from both 'dark band' energy and where the second direct photon path was blocked. (Fig.10a-c).



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 patten is lost.

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

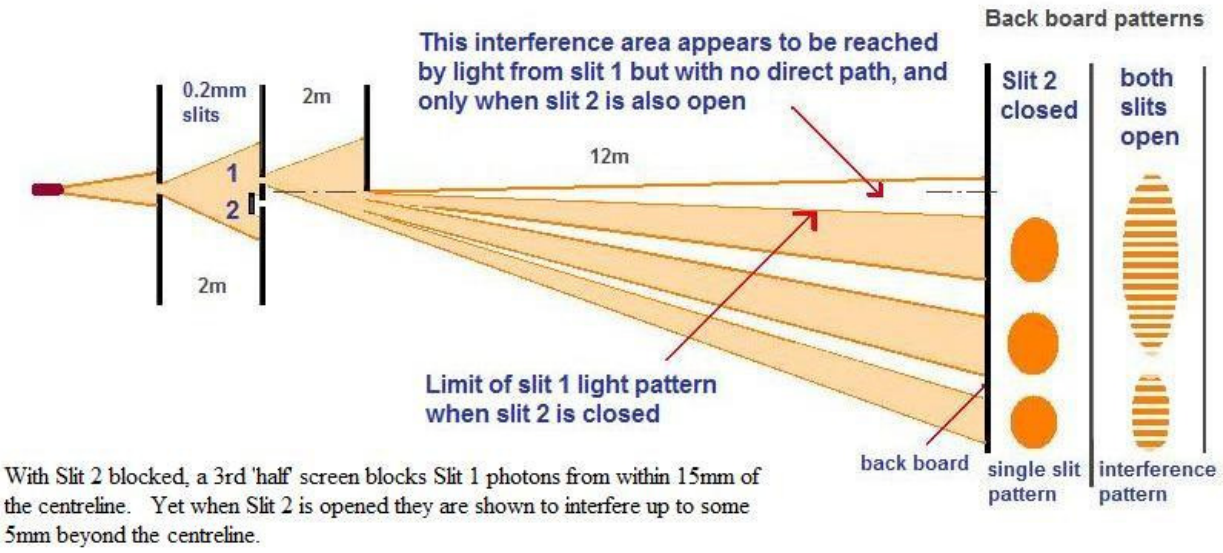


Figure 10b. *Double Slit Variation b.* A third screen edge is positioned on the centreline. Interference still occurs in the central area inaccessible to photons from slit 1 without an exceptional refraction angle. This is however consistent with new oscillators or waves propagated at the edge of the third screen by HFP and WFS. (Fleagle 'Separated Pattern').

Other new variations on these experiments were carried out. A variation of a Fleagle result placed one of two additional slits in the dark band of an interference pattern. A new 'two slit' interference pattern was created, confirming signal energy passing through the dark band. Another experiment generated fine 2 slit banding from two separated sharp edges (min 5º bevel) rather than slits positioned within 1mm of beam CL. (Fig.10c). When a mirror was placed behind the first screen an enhanced & magnified pattern was created. This clearly suggested new waves generated at the tips, coinciding with the topological area of highest surface charge, and interfering. 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 proves that new oscillators and waves are indeed propagated at any medium change, the old wave being cancelled out throughout the medium effectively reflecting and refracting at the surface, leaving just the new compound wave at the new 'c' of the new medium. This is also as 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 always change speed do 'c' locally everywhere. This removes any need for Lorentz-Fitzgerald contraction and unifies SR with QFT.

Other quantum and classic physics suggests that moving one of the edges out of the beam would remove the interference pattern. It did not. The compound wave signal from the 1st edge is spread, as predicted by the HFP, and a new one is propagated at the 2nd 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 Borns prediction. All results were consistent with predictions, and as a hint of the importance of spin type

polarisation, Chiao and others quantum eraser experiments confirmed that neither simple quantum nor classic theory alone cannot explain the behaviour of light.[41] Our results bring these together, but can't conclusively exclude conserved oscillators severely refracted by other means than local propagation, or other possibilities.

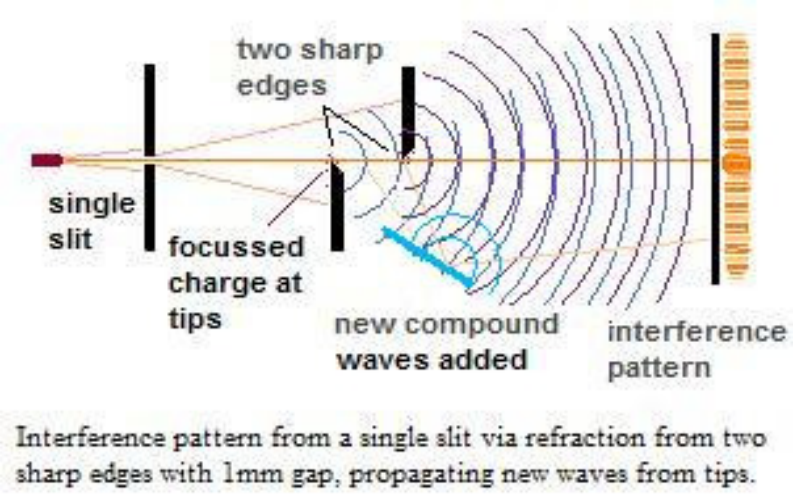


Figure 10c. *Fine interference from tip wave propagation*. The lack of back waves in HFP is suggested as due to conserved 'spin' signal.

The results may help to explain duality and the most bizarre features of QED by combining field wave energy with local quantized particles, condensed and detected at photomultipliers, on back boards, or wherever perturbed. Detecting a quanta of energy at a slit would normally utilise the energy detected. This may complete a circle through Bohm's complimentarity 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 tiny our visible slit of the EM spectrum is. There is much going on we can't directly observe, and some of this has 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 breaker and a measurable quanta may perhaps be seen as a phase transition.

Superposed waves have much analogy with ocean surface waves, compounded at all scales from ripples to tsunami's. Particles, including photons emitted from electrons, may 'evaporate' back into the non-zero energy/ wave field, rather than be simply 'annihilated' or suffer extinction. In 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. It is also predicted that with improved instrumentation much finer interference patterns will be detected. Schrödinger was as convinced as Einstein about the physical reality of his waves and we conclude from the experiments that they do have this reality, strongly supporting non-conserved oscillators propagated by em energy at perturbations. As with conventional electrons emitting photons, these or wave energy is always emitted at 'c' locally, even if not arriving from the previous media at 'c'. This alone means light will be always measured at 'c' locally to any mass, with or without a background field.

7. Conclusions.

We have uncovered a major optical analysis error caused by poor understanding of inertial frames from the 19th century and shown that the 1893 Lodge Stellar Aberration paper embodying the mistake came at a critical moment, wrongly refuting Stokes discrete ether fields, the only ether theory supported by the M&M experiments. Also that the mistake encouraged Lorentz to combine Larmor's time function with FitzGerald's contraction, imposing strict limitations on Einsteins SR. An assumption attached to SR to explain Lorentz invariance is; that all bodies in motion in the vacuum are equivalent, leading to the 'stipulation' that no background field can be involved in propagating light, and the further assumption that we may not observe apparent superluminal motion from another inertial frame. We showed how this assumption may be replaced with a quantum process to unify SR with QM and better explain observation and constancy between frames.

We've demonstrated using Huygens Principle and the Ewald-Oseen Extinction theorem, that em waves at new *or co-moving* media condense new oscillators and propagate new waves of EM potential, density fluctuating from a non zero ground state, on the refracted wavefront vector, at 'c' wrt the new medium. Also that this is consistent with QED, and equally applies to boundary electrons absorbing and ejecting photons at the new 'c' of the new inertial field, giving the simple function c+v -v = c from the integrodifferential Ewald-Oseen Extinction, and non relativistic Doppler equations. The mechanism of FM is also identified, using particle shock oscillation with spin axis conservation and wave /particle interaction, which also allows a simpler explanation of polarity. We show that consideration from the correct inertial frame is essential, and how 'c' and energy are conserved by balancing frequency with Doppler shifted wavelength within the new frame, matching relative velocity between frames and consistent with Snell's Law and Fermat's Principle.

We show how a discrete field boundary correctly derives stellar aberration, retaining 'c' locally within all fields. We identify implications, and predictions that the space surrounding all mass, from particles to clusters, as Einsteins 'spatially extended' mass, includes high densities of boundary oscillators focussed on ecliptic polars and the edges of galactic discs, and discuss how some present anomalous phenomena may thus be allowed, assisting with duality, via non conserved particles, and action at a distance, via topology.

The limits of Einsteins; '*spatially extended*' mass are found to be equivalent to the momentum of the system. The condensed particles add to inertial mass which increases with both speed and rest mass, conserving the energy. This brings yet another simple symmetry to the system to add to the Refraction/Energy conservation and Doppler shift/ speed/ shock particle density/ oscillation frequency symmetries identified. Acceleration is always frame transition and all frames are equivalent, explaining the SR postulates more precisely.

We show that using the SR postulates with the additional assumptions removed, would allow removal of apparent paradox and therefore dissent over SR, to better unite physics. We explore parallels with Maxwell's EM fields as embodied in Einsteins 1952 vision that space is really; *"an infinite number of spaces in motion*

relative to each other." Using full 3D 'sets of co-ordinates' to describe limits to real spaces in relative motion we propose a new way of thinking about light and all EM waves which may be termed discrete, limited '*Inertial Fields'* of energy potential and, consistent with closed system Sagnac evidence, we arrive at the suggested clarification or Extra term for SR; "*EM waves travel at 'c' within all local EM fields."*

We conclude that no physical presence such as the old aether is essential, simple EM potential limits and the field qualities of GR being more than adequate to provide the boundary shock conditions adequate for the model and as observed in space and around accelerated particles. Quantum fields are however allowed and Ewald-Oseen extinction may witness a non zero ground state. Questions about the ether or interstellar medium, originally about properties relevant to propagation of light, may now be more about what is required to propagate and maintain the boundary conditions of Einsteins extended mass, and 'regions of space' and what dictates and controls its limits.

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