

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 that influenced 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 Ether Drag theory, supported by M&M, and lead to Lorentz's contraction and time functions. We test variations on Young's experiment, and consider, non-technically, implications on and relationship with SR, the interstellar medium and EM field potential. Through the Huygens-Fresnel Principle^[3] interplanetary shocks and FM a clarification of SR emerges requiring no more field than GR, replacing an assumption with a known quantum mechanism, but confirming SR's postulates. We test it's unprecedented additional predictive power and 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° 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 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 Planck's 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 Lodge's 1891 Stellar Aberration experiment and 1893 paper^[1] first gave Stokes support, saying; *"There is nothing to be said against the aberration effect being producible.. ..by motion of parts of the medium as, for instance, by sliding one portion of the ether past another portion."* But 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 its 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 a background field and 'matter waves' couldn't exist. Transverse waves were first suggested by Fresnel on finding polarised waves didn't interfere, but may have simply been evidence of conservation of spin axis, and seemed to be superceded by the Huygens-Fresnel Principle^[4]. They were re-introduced by Einstein in removing any medium for longitudinal waves. Familiar as two dimensional representations on oscilloscopes they had only existed as vibration in solids. They don't co-habit comfortably with Schroedinger's three dimensional spherical wave front which intuitively uses matter waves, the longitudinal variations in magnitude of a quality or characteristic, which require a background frame, field energy density/potential or ethereal 'dark energy' medium.

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. Angle of refraction depends on relative density of media, giving refractive index (n), and angle of incidence, (to the rest frame) giving the term; $n_1 \sin(\theta_1) = n_2 \sin(\theta_2)$. When the waves are slowed (phase velocity reduced) wave length reduces to retain constant frequency (and energy), and the angle changes. The fixed relationship is; $\sin \theta_1 / \sin \theta_2 = v_1 / v_2 = n_1 / n_2$ Refraction is also a function of relative transverse velocity between the media, therefore also observed if the media in relative motion are identical. This is as Stokes' Full Aether Drag thesis where a dragged field around the Earth is in motion with respect to the surrounding medium, itself at rest with respect to the sun. The fixed relationships between speed and wavelength within media remain. This meets the law of conservation of energy. Angle of refraction θ_2 can be derived from θ_1 and relative frame velocity.

What we find may still be counter intuitive to many. Under the ballistic theory, incoming photons entering the new medium are swept along in its direction of travel (see fig.3 below) giving observed aberration in the wrong direction. This is the path change Oliver Lodge showed (Fig 13. p780.)^[1] which 'confirmed' Fresnel's prediction of $v(1-1/\mu^2)$, but with the key error going unnoticed. He suggested an experiment with light passing through a spinning glass disc. R V Jones eventually carried this out in 1971^[2] but retained the error. This confirmed the drag effect, viewed from his lab frame, as opposite to observed aberration.

This error of comprehension has remained unnoticed until now. Aberration is still erroneously assumed to disprove aether drag. Current optical analysis treats it correctly but the error and its fundamental implications have been missed. It's an extension of the simple 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, co-moving inertial frame, of medium n_2 which the light is entering. This, n_2 , is the observers frame on the Earth's surface when considering stellar aberration with a dragged field. The observer at rest with respect to medium n_2 will actually see the angle of refraction reduced, 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 . This 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 P_0 to P_2 would run to P_1 shortening his (slower) swim to P_2 . But. Though swimming on actual heading (vector) $P_1 - P_2$, by the time he arrives at P_2 When viewed from n_1 he will be in position $P_2 b$ because the tidal current is flowing at v .

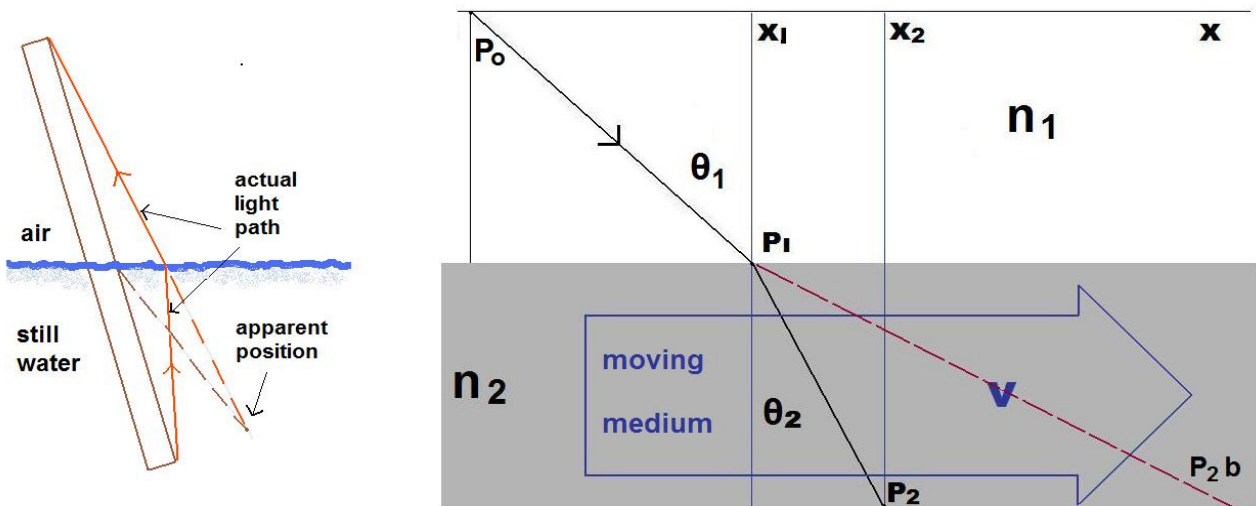
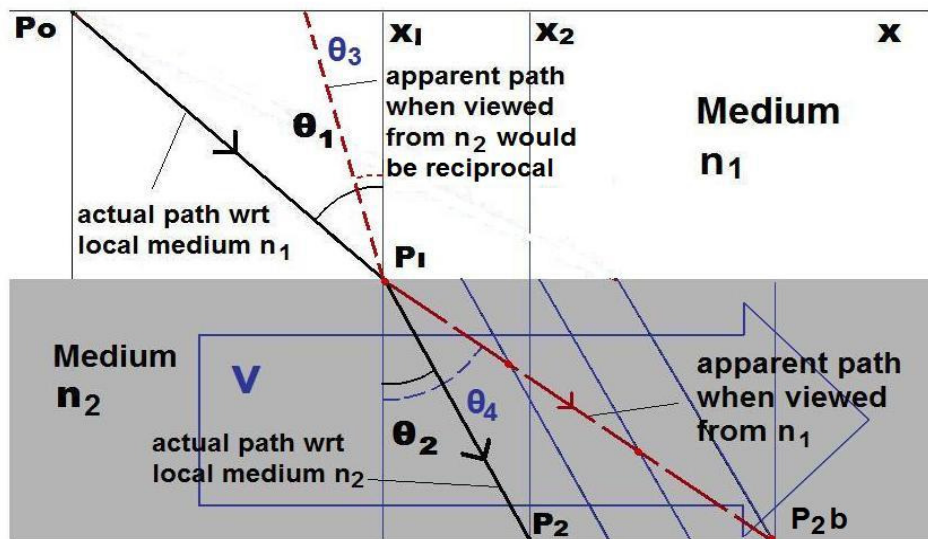


Fig 1. Refraction. Between different media such as air and water actual refraction is inverse to apparent path change observed from each medium. For media in relative motion (even of similar refractive index) the same applies. Here the observer *changes inertial frame* with the 'ray' of light. Lodge showed the 'ray' following the red path, giving the wrong actual aberration, which is as observed from P_2 in frame n_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 often misunderstood now, that each inertial frame is it's own lab frame. i.e. 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 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 Earth's '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 $P_0-P_1-P_2b$ observed from n_1 are tilted in proportion to v when viewed from n_2 . This proves 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 is more meaningful than it may first appear, and simply demonstrates why we must always measure light locally at 'c'. But without yet explaining the physical mechanism at the frame/field interface. What it has also done is compellingly drawn to our attention that a 'set of co-ordinates' can represent a real physical body, of medium, potential energy, or simply of mass and/or 'extended' mass.

This discrete entrained field model is inconsistent with the kinetic-ballistic side of duality using long term conserved 'photon' particles, but this did always struggle with the change of path of refraction. The simple ballistic aberration model is shown in Figure 3 below, with the telescope angled to allow photons to enter on

the centreline vector. This assumes light as a very different entity with no relevance of wavefront normal to observation and no easy explanation of the constancy of 'c' *'without regard to motion of observer or receiver.'* If photons did not change speed the lateral vector components of the photons when focussed to a central point would vary from 'c' due to the telescopes motion. Fizeau's proof of lights constancy wrt its local medium, as confirmed by Sagnac and others for closed systems, threw light on Airey's water filled telescope experiment. Confusion over the Sagnac/Michelson Gale 'open' systems should have been removed by Wang's confirmation of longitudinal propagation at 'c' within all inertial frames,^[7] (2003-2006), which confirms SR's 2nd postulate.

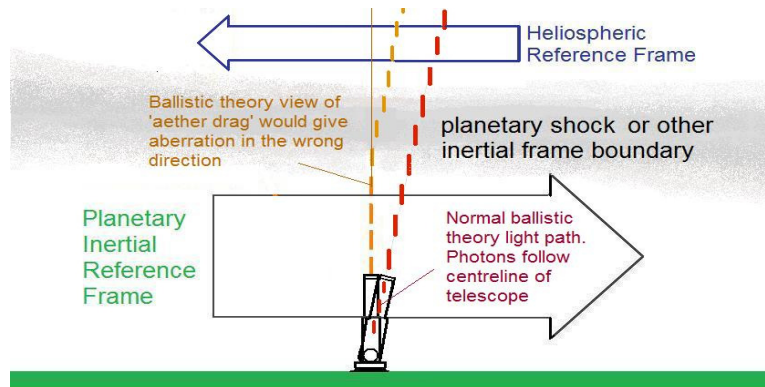


Fig. 3. Ballistic Model of Stellar Aberration. The red broken line shows the standard *no aether* light path, the aberration angle based on c/v where v is orbital speed. With a dragged field the ballistic theory would not work, the photons (yellow broken line) would be refracted and observed behind the Earth's orbital path.

Conserved ballistics still seem to struggle with the relative speed issues in either plane and chromatic dispersion, but we do now find everything consistent with non-conserved ballistics. We have not 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 both sides of duality have issues to resolve. The field model would only seem 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 Earth's 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; Planck's suggestion of a compressible field is valid. We know light speed is reduced proportionally by increasing density in the atmosphere so the Lorentz objection is not. EM signal conductors may indeed be more dense than insulators, and gravitational time dilation would also render it invalid. The Fizeau result is sometimes wrongly quoted as conflicting with Stokes theory but does not, confirming velocity is always with respect to the local medium. We have limited information on characteristics of any medium or energy potential, discussed below, but we do have to consider what real physical boundary mechanism could derive stellar aberration as observed using EM wave theory.

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 Earth's 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.

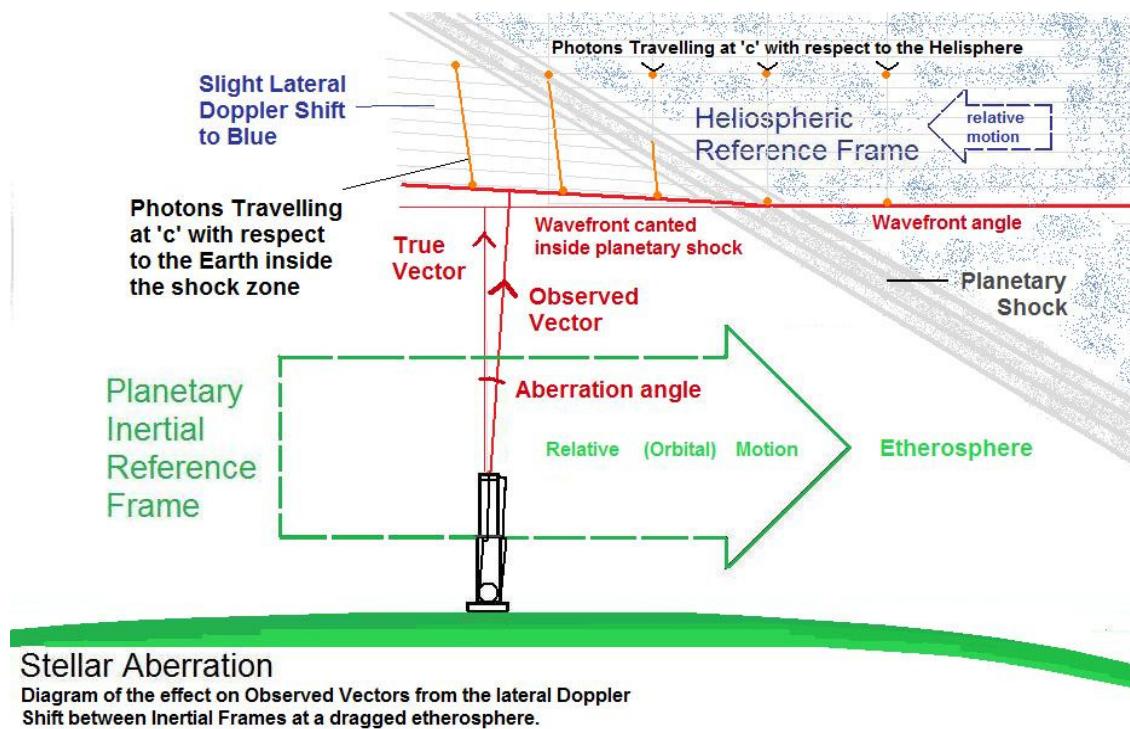


Fig 4. *Stellar Aberration; Canting of the wave front. (due to relative motion of the media).
But see also Fig 7. for Huygens-Fresnel Principle, Fourier Optics and FM mechanisms.*

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 ethersphere with anything similar to the spherical field interface we might postulate. This is further investigated below.

The Earth's 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 $15\text{-}25\text{km/s}^{-1}$ and gave a mean density of the medium at $0.8\text{-}1.3/\text{cm}^{-3}$. 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 'ethersphere', 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.

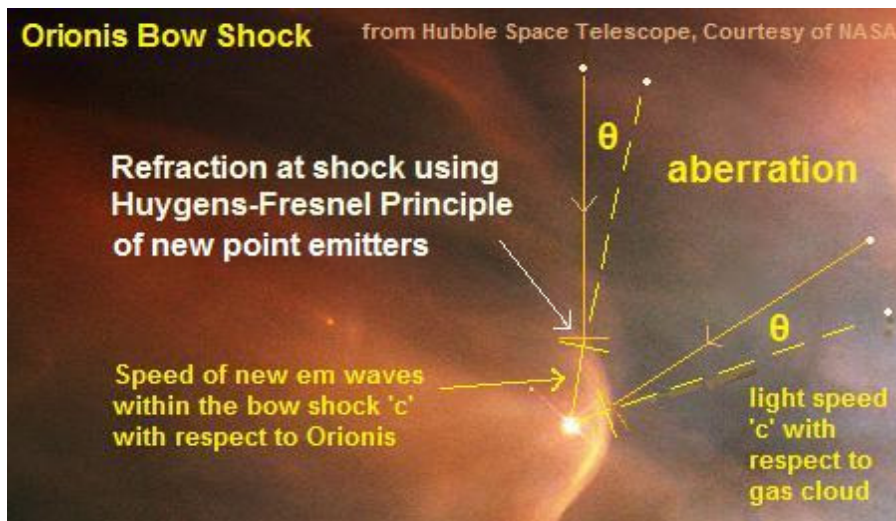


Figure 6. Aberration at a crescent shaped bow shock. Only positive aberration would be derived, reducing with elevation, as observed. New HFP waves from the shock will travel at 'c' wrt the star with the wavelength accordingly transformed (Doppler shifted) in accordance with Snell and Fermat.

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.

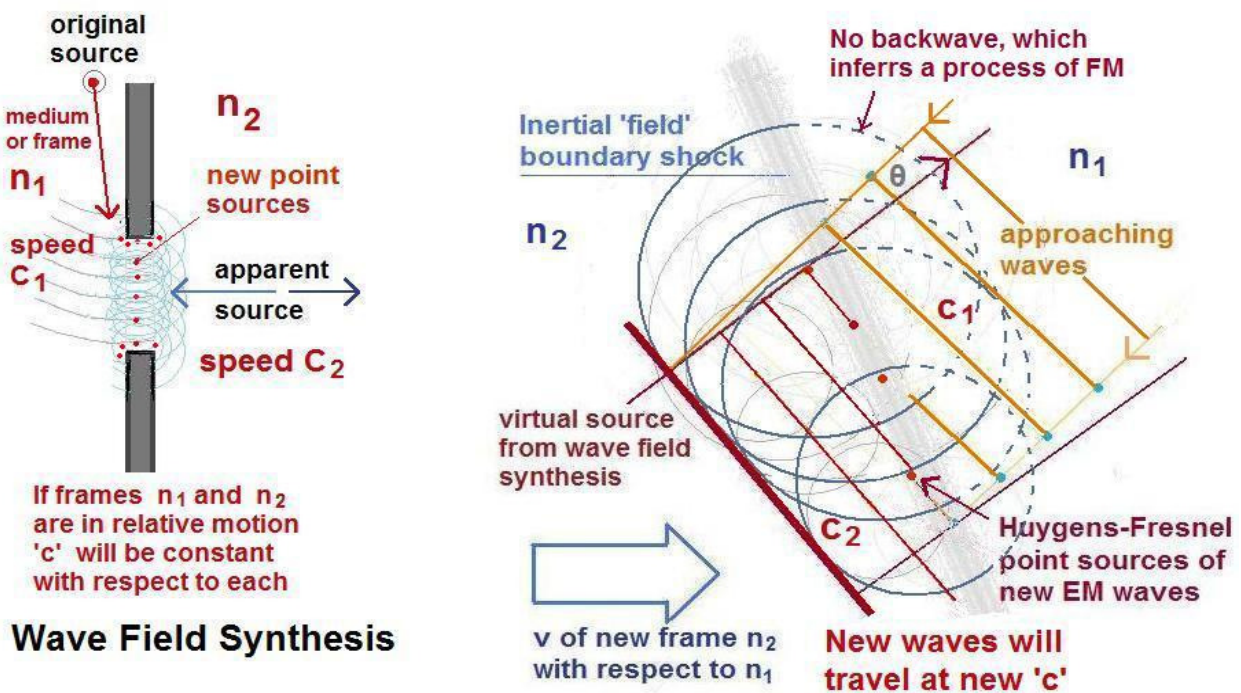


Figure 7. Huygens-Fresnel Principle, Fourier Optics and Wave Field Synthesis deriving a virtual source, inferring that waves from new point sources in new frames will travel at 'c' with respect to the new frame. Note the new wavelength has changed with vector, conserving frequency and energy.

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 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).

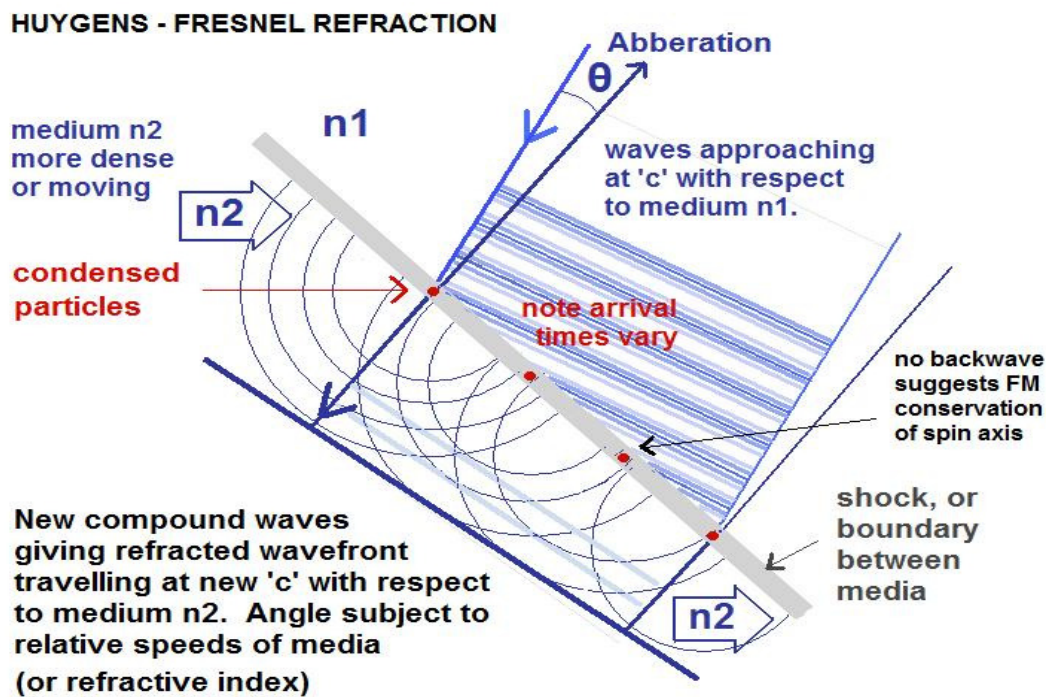


Figure 8. HFP Refraction. (Reconsidered). The time averaged Poynting vector gives refraction towards the normal. For media in relative motion this sequence is as observed from within each inertial frame/medium. Light speed is converted to the new local 'c'.

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 spacial 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 and wavelength to always conserve energy and speed 'c' locally.

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.

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. Doubts about Einsteins continued view on the completeness of SR may be dispelled by his words; *"For the time being, we have to admit that we do not possess any general theoretical basis for physics, which can be regarded as its logical foundation."* ('Science' 1940).

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 $10^{13}/\text{m}^{-3}$ ^[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.

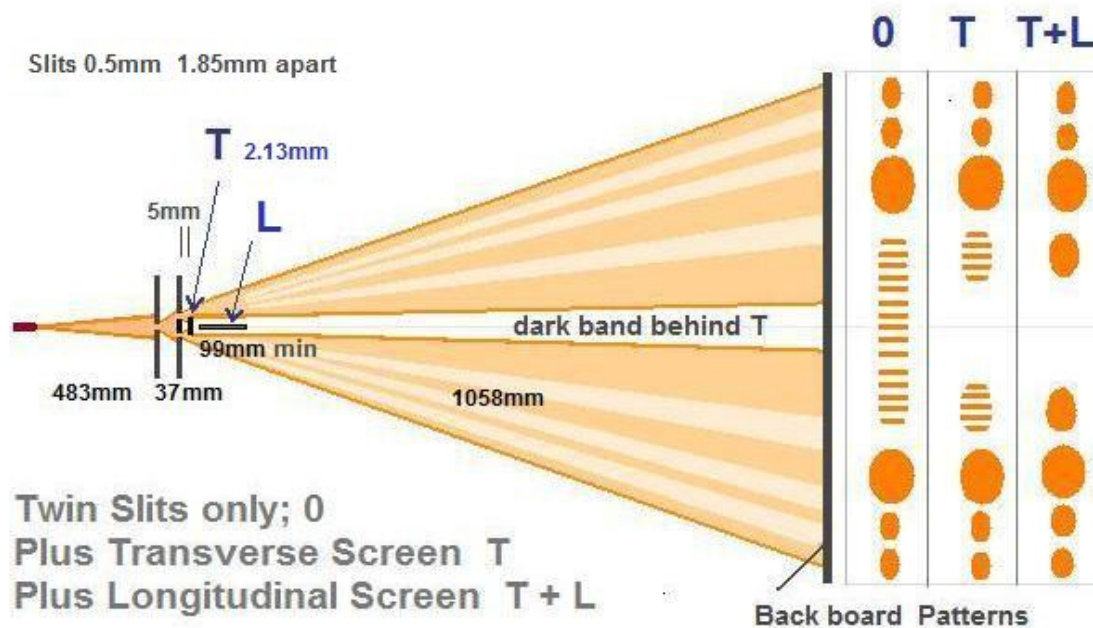
Microwave Asymmetry. The model predicted the Cosmic Microwave Background would be asymmetric due to local synchrotronic radiation peaks from bow shocks. The asymmetry detected^[32] is not yet explained. It may help inform us of relative motion of massive bodies and fields, providing new data on the Universe.

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

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').

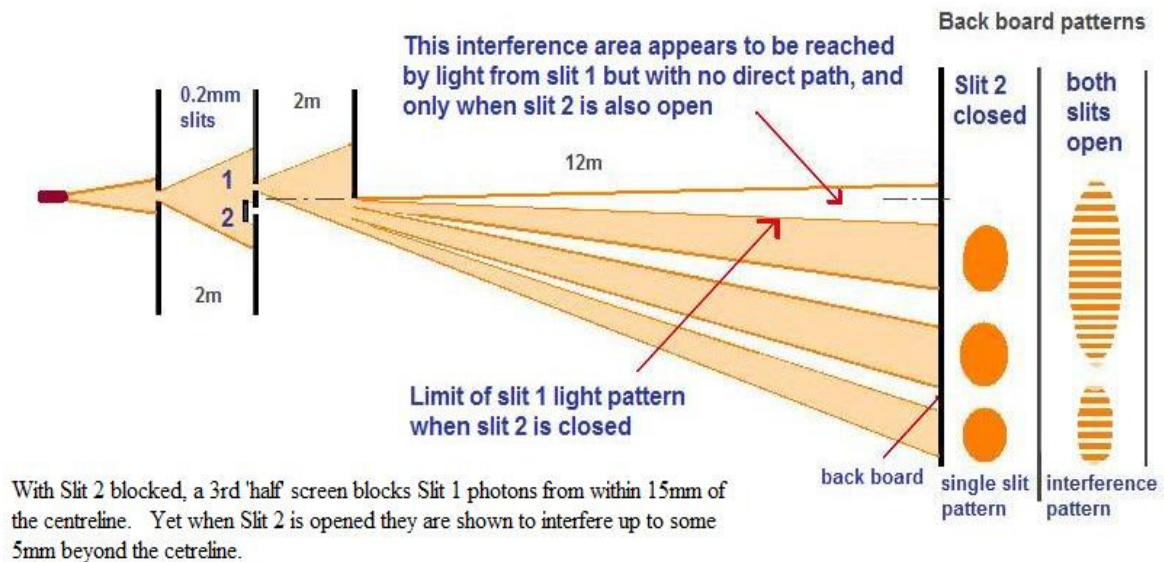
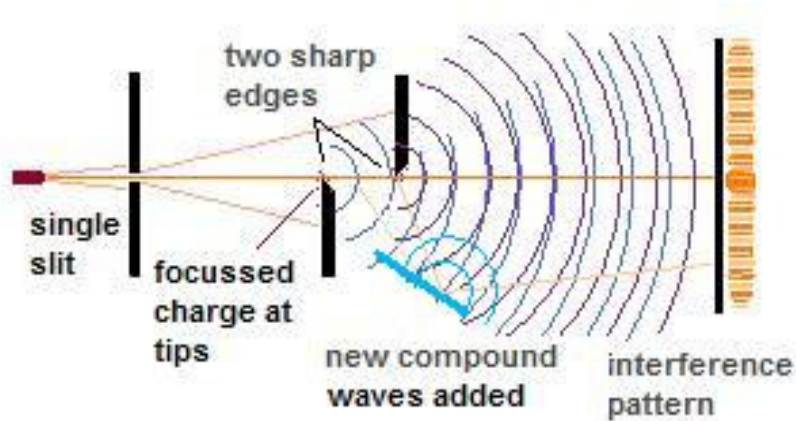


Figure 10b. Double Slit Variation b. A third screen edge is positioned on the centreline. Interference still occurs in the central area inaccessible to photons from slit 1 without an exceptional refraction angle. This is however consistent with new oscillators or waves propagated at the edge of the third 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 simply from two separated sharp edges (min. 5° bevel) rather than slits positioned within 1mm of beam centre. (Fig.10c). When a mirror was placed behind the first screen an enhanced and magnified pattern was created. This clearly indicated waves were being generated at the tips, coinciding with the topological area of highest surface charge, and interfering. Again oscillators were found locally at all surfaces on perturbation, but these could not all be the same physical particles that passed through the slit. This would be consistent with a continuous process of local propagation via symmetry breaking of wave energy as the HFP and the Fourier Transformation which may simply be another way of describing electrons absorbing and emitting a quanta of energy.

Both 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. 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 fully explain the behaviour of light.^[39] Our own results bring these 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 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 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 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 'melt' into the energy wave field rather than be simply 'annihilated'. 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 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, 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. Also that this error 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 essential 'stipulation' that no background field can be involved in propagating light, and the assumption that we may not observe apparent superluminal motion from another inertial frame. We showed how such assumption may be replaced with a quantum process to unify SR with QM.

We've demonstrated using Huygens Principle, that em waves at new *or moving* media may condense new oscillators and propagate new waves of EM potential, it's density fluctuating from a non zero ground state, on the refracted wavefront vector, at 'c' wrt the new medium. This may equally apply to boundary electrons absorbing and ejecting photons. Frequency and energy are conserved and wavelength would be Doppler shifted, matching relative velocity between frames. Snell's Law and Fermat's Principle emerge.

We show how a discrete field correctly derives stellar aberration, retaining 'c' within our planets fields. The real mechanism of FM is identified, using particle shock oscillation with conserved spin polarity and wave /particle interaction. We identify implications, and predictions that the space surrounding all mass, from particles to clusters, as Einsteins 'extended mass', includes high densities of boundary oscillators focussed on ecliptic polars and the edges of galactic discs, discussing how some present anomalous phenomena may thus be allowed, assisting with duality, via non conserved particles, and action at a distance, via topology.

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 all 'sets of co-ordinates' to describe 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 no additional physical presence such as the old aether is essential, simple EM potential 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. Any quantum field may however be allowable. If the question about the ether or interstellar medium was originally about properties relevant to propagation of light, it may now be more about what is required to propagate and maintain the boundary conditions of Einsteins extended mass, and what controls its limits.

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