Much ado about nothing

Prologue.

The backlash from philosophy provoked by Lawrence Krauss's *A Universe from Nothing* [1] exposed an embedded public assumption that space is 'empty'. Both science and philosophy seek truth but only science via experiment. On separation, philosophy retained an 'empty' vacuum while science looked, and found it full of quanta and energy. Krauss finds these '*physical insights*' important,[2] saying old views led to no progress. The philosopher reviewer in the New York Times rejected particles '*popping in and out of existence*'. [3] But as Cosmology itself can't rationalise the implications of the quantum vacuum and dark matter how can we expect others to dig down, find and abandon fundamental belief in empty space? Perhaps we can lead by finding and abandoning some old assumptions of our own.

As seeing is believing we set our stage for those who have not yet seen the content of 'space' (Fig. 1) It's now well evidenced that only ~ 4% of the total mass-energy of the universe is 'matter'. The inter-galactic 'medium' (IGM) quantum vacuum is real. Just a very diffuse medium. The emissions from galaxies and clusters can be seen correlating loosely with magnetic fields.

Figure 1. Space. Different constituents of the Inter-Galactic Medium (IGM) are visible at each waveband. X-ray (left) and visible (right) 'dark matter' around clusters galaxies & stars. The 'clouds' represent a diffuse plasma medium of ions, CO and molecular gas. Each element at all scales is in continuous relative motion as individual particles or n-body systems. Images courtesy of NASA/ESA. Left; ESA XMM Newton, right; Hubble ST.

The International Plasmaspheric-Ionospheric model (SPIM) max. (vertical) total 'electron' content (TEC) is ~ <40 x 10^{16}cm^{-3}. So the empty space nearby is really quite full. There is also no such thing as a 'perfect' vacuum on Earth. Plasma refractive index n = ~1 the same as a vacuum, and it has high EM wave coupling potential. But n =1 means it can't be detected by absorption (so is 'dark'), but may be found kinetically.

One flaw can falsify a theory, and one parameter change can collapse an ontological construction. We 'patch' old theory when new findings emerge but if we always assumed the assumptions first made may be wrong, dug out and challenge them from scratch, perhaps then we may better advance. History agrees.

> *"If we worked on the assumption that what is accepted as true really is true, there would be little hope of advance."* Orville Wright

Accepting the IGM as a real diffuse particle 'medium' has implications fundamentally different to empty space wherever the particles 'came from'. The Relativity of Simultaneity within the Special Theory of Relativity (SR) allows no absolute '*preferred background frame*' in space. Speed can only be relative between bodies. This seemed to limit SR's domain to true vacua with no propagating 'ether' medium. ***Assumption 1, that 'Space is nothing'*** was implicit, but this has now been disproved, both by exploration and at CERN. So confusion and dissent remain.

Einstein did invoke a field for General Relativity (GR) and searched till he died for a Unified Field Theory incorporating Quantum Mechanics (QM). If we assume that the GR field and the dielectric qualities found are valid, then how is the constant speed of light (CSL) logically explained? We use dynamic logic and

consider the macro effects of quantum cause. Having undergone the pain of extraction of assumption 1 from our belief systems and used wide evidence to rebuild ontological foundations we find the quanta and classical physics unified, consistent with the SR Postulates and with Einstein's final conceptual monologue of 1952.[4] The tale unfolds.

Act 1.

Scene 1. Detection. Case 1. Direct. Deep in '*space as a medium'* lies the complex barrier of CSL, faced through the 1800's. If light travels at a speed of distance d divided by time t (d/t = km/sec) then how can it be found always at c (~300,000km/sec) by all moving observers? A simple answer would be that light changed speed *on arrival*. Light would then travel at c= d/t through a background medium, but change to local c when *meeting* an observer. Observation in this case requires ***detection***, needing physical interaction with the lens medium of the detector at the refractive plane *prior* to being 'passed on' for analysis. So if a lens is advancing towards a source, then wavelength (or perhaps 'distance between photons'), is reduced due to the *non-zero time between* wave peak (or photon) arrivals. This is simply the Doppler effect, which is how we find the local speed of light based on time and emitted wavelength **λ**. But **Δλ** then exposes another assumption, about the relationship of frequency f and λ.

Assumption 2. Frequency is real. Frequency f is only a *derivative,* of time and *speed* (a derivative of time and distance), so f can *NOT* change without time or distance changing. We are so used to dealing with f as the 'observable,' for a correct numerical result, that we forget reality. In the Doppler shift case, due to *motion* (in non-zero time) it is ***distance*** that changes. So shifts in f are found *because* effective λ *changes on interaction with a detector.* This adds quantum reality to the simple assumption that observers just meet more waves in less time if closing with them. They must *interact* to be detected, so a second wave peak ends up closer to the first peak (**Δλ**) subject to relative media velocity. So we must now root out and banish the old assumption and arm ourselves with this knowledge, implanting it firmly, as it's needed in the quest for truth. This isn't easy. Frequency is the observable so λ is often ignored. When applying this in other areas the brain will revert to embedded *'default*' assumptions and equations. Doppler equations rarely use **λ** because f is a short cut. But we've now exposed another assumption:

Assumption 3. Speed changes by n to c/n. It may be hard to envisage light speed changing at all on entering a medium from a 'vacuum' yet it does so by Fresnel's Refractive Index n to c/n. Glass n = ~1.55 so light slows from ~300,000 to ~193,500k/sec. then *accelerates by the same amount on leaving.* As our 'space' is now also a 'medium' we can simply say; "*Light speed changes by relative n between media.*" It may shock some that we can only find n experimentally, but more shockingly we point out that;

Light changes speed by TWO factors.

Scene 2. Light passes through glass at ~193,500k/sec irrespective of the speed of any *other* medium around the glass. This is *invariant*; on any train, planet (we guess), Earth or spacecraft. The refractive index of a dielectric medium is invariant to the motion of *other* media. In diffuse media the change simply take more time/distance, giving birefringence as it changes. Extinction distances ('Ewald-Oseen' etc.) for the 'old' signal are commonly ~1 to 200nm< (also λ dependant) but may be on <parsec scale in space. So, for a *direct* interaction case with light we propose that: Entering the new medium frame K' of of index n' (moving at v with respect to the incident mediums frame K), *light changes speed by Δn + Δv.* We consider gamma and it's precise quantum cause and domain below, but note that as glass block K' represents an inertial frame, and the laws of physics and c/n apply invariantly *within* it, this case is consistent with SR's postulates. The ***twin*** speed change factors must be understood and firmly implanted in place of the more simplistic Assumption 3, and use as a cognitive weapon in our quest for a consistent truth. To rehearse our key lines; there are **two speed changes** when light enters a new co-moving medium, not just the *one* assumed. And where the media are in *lateral* co-motion the optical axis of the re-emitted light changes to give '*kinetic reverse refraction*' (KRR), an optical effect with, as yet, no full theoretical basis (See Act 3).

Scene 3. In case of concern we recall that the specified domain of SR is 'Idealized Rigid Bodies.' We are discussing non-rigid relationships or space-time 'events'. In an interaction over non-zero time and with relative media motion the relationship between two photons, wave peaks or 1sec. pulses is not 'rigid'. The *apparent time* between pulses emitted in another, co-moving, medium then entering an observers medium *will change subject to v.* It may have been noticed that when considering 'inertial frames'; we can now simply substitute 'media', because no real (non-zero spatial) 'body' or 'system' can be ***assigned more than one state of motion*** K at any o*ne space-time point*. Cartesian co-ordinate systems then form 'planes', as specified by Einstein, and mutually exclusive volumetric spaces, so cannot overlap. Motion is an invalid concept in geometry, so arguably the validity of motion in vector space, simply based on geometry may also be limited. No provision for evolution of interaction over time is yet included. We discuss the effects of evolution below. We can however now identify another assumption which appears to be wrong;

Assumption 4. Cartesian co-ordinate systems adequately model motion.
Points and lines are not 'real'. All particles and systems have non-zero dimensions and can move, so may be assigned a state of motion. Co-ordinate systems cannot then 'overlap'. The kinetic construction is 'nested' or hierarchical. There may be infinitely many spaces within infinitely many others at all scales. Matter is *'**spatially extended**'* AE 1952 (as Boscovich "*field of influence"*) and new frames are created by motion within any other. '*Kinetic states'* ***cannot*** then overlap (see 'Dynamic Logic'). It may also be noticed that 'dark energy' frames are then 'allowed' if not required. Before discussing Case 2; indirect observation of light pulses 'passing by', our budding star takes the stage, with some dynamic logic to help embed the above, local **kinetic change** to c.

Scene 4. Eddy and the Electrons. Eddy and his pals are poorly understood but free, harmonic and not bound to any protons. They hang around together as a group. Some call them 'plasma', even 'dark matter' (as n=1). Eddy has also been called a vortex, but whatever they are they have just one task, on which they're very *self focussed*; they interact, and pass on the good vibrations, always at 'c', and focussed on arrival axis. As they stick together the bunch has an assignable group state of motion K as an 'n-body' system. They only know one c, which is *their own* c. Whatever their state of motion with respect to anything else, when the vibes hit they're immediately converted to the local c of the K of the group, and are passed on at the same speed, their own c. Vibes approach slower and faster subject to how much speed Eddy has, but are always re-emitted at the **new c**. If the bunch are on the back seats of a train, then any vibes from behind arrive slower, but are none the less speeded up to the new c of the bunch. This **kinetic speed change**, means the vibes end up further apart and shifted to the red. The 'self focussing' quality of plasma[5] also ensure the vibes are re-emitted spot on the arrival axis, unless of course they are moving sideways as they meet. The importance of this will emerge.

Scene 5. Case 2 Indirect Detection.
In SR only one case was assumed for observing 'speed' with constant c. We describe a second case, where c is unaffected but where an '*apparent*' speed c+/-v is also allowed. This is an old optical illusion based on an idea of Hermann Minkowski, but now we reveal the secret, We set up a vast stage in space, with the audience on a spaceship at rest in a diffuse medium of Eddy and the electrons. From stage right light pulses cross at 1sec. intervals, at c. First neither the pulses or electrons can be seen as the light is passed on only on it's incident axis. There no 'atoms' or molecules to scatter it.

On cue the whole massive cast then take the stage. Some want to be stars so join up as CO, Hydrogen, Helium, Lithium, and Neon. Energy binds them, but at rest with the electrons. Now all the bound particles are 'lit up' (charged) by the pulses, so their passing is now evidenced by the all round glow of each particle, one by one in turn. Eddy and his pals then just pass on these new signals, on their **new** axis, straight to the audience. The audience calculate the pulse speed as ~c. So no shocks yet. They also find the light scattered by the particles reaches them doing c. Now that may be a shock. If not then you may wish to visit the bar and think about it carefully until it is.

Interval.

(The audience's ship moves off stage left, turns and heads back at relative 0.2c. The scene is the same.)

Act 2.

Scene 1. A magic trick. The audience and a fixed camera pass the stage parallel to the light pulses (the opposite way) and record relative pulse speed. But the audience is now *not interacting* with the pulses, they are only interacting with light re-emitted, at c, sequentially, by the particles lit up by the pulses. They gasp as they *now* find the apparent pulse speed of 1.2c! (with small fringe shift). Yet nothing, *anywhere,* is *really* moving at c <. The only interaction is between the re-emitted light and the lens (or window glass) of the audience and camera, giving local c (Case 1). The acceleration had removed their ability to use Einstein '*Proper Time'* in the measurement, or in this case; *time in the rest frame of the medium* through which the light pulses are moving. Whatever angle they arrive at the ship windows, on interaction they convert to the local c/n of the windows in the ship frame. This ***second case***, allows '***apparent'*** c+v. The *apparent time* gap between the original pulses also reduces, but this time ***not*** via the Doppler shift mechanism which only applies on *interaction*.

Minkowski and Lorentz spotted this natural illusion. Minkowski used '*imaginary*' for '*apparent*' in his 1908 soliloquy;

> *"...cases with a velocity greater than that of light will henceforth play only some such part as that of figures with imaginary co-ordinates in geometry."*

Lorentz's said;

> "*...the daring assertion that one can never observe velocities larger than the velocity of light contains a hypothetical restriction of what is accessible to us, a restriction which cannot be accepted without some reservation."* (1913).[6]

Einstein considered *Reality* not illusions. His *"space without ether is unthinkable"* (Leiden 1921) could not be ascribed effects on light propagation, but he described the concept perfectly, saying;

> *"...the concept of space detached from any physical content does not exist."* (1950), then in 1952; *" ..there exists no space 'empty of field".*
> and with respect to; Small space 's' moving within larger space 'S';[4]
> *"...these two spaces are in motion with respect to each other."*

Our model simply *is what it is.* It agrees the reservation of Lorentz as well founded. 'Painted' scenery is thus replaced by the kinetic speed change term and hierarchical kinetic 3D 'spaces', and we can now add;

Assumption 5. Apparent speed c + v is not accessible. We discuss this shock further as the medium (not vacuum) case of '*apparent'* or '*imaginary'* c+v without violating CSL must be firmly embedded in place of the old assumption which has screened our view of reality. *Apparent* speed may be considered ~equivalent to the additive '*rapidity*', a concept which may need it's hyperbole reviewed and a real quantum process provided.

Scene 2. Observer frame matters. The importance of an observers frame has emerged, as we can see that each observer will calculate a different speed and find a different signal 'contraction' subject to his own relative motion. Understanding of this remains poor and we identify one case below, in Stellar Aberration, where confusion of frame representation misdirected us. Issues remain. There are more related matters to resolve, but a clearer light is now thrown on the stage so the mists should start to evaporate. Those with deeply embedded assumptions will be feeling the initial discomfort of unfamiliarity of the new views of nature, but should note;

> *"The important thing in science is not so much to obtain new facts as to discover new ways of thinking about them."* Sir Wm. Bragg.

Scene 3. Relativity Safe and Well. We violate no key assumptions of SR by invoking preferred background frames because our frames are *not* the absolute frame which SR falsifies. Matter, and dielectric media, can and do all move, so ours is an option not originally considered. Even Einstein's assumption that speed in a vacuum can't be discerned is verified because we are not considering the

idealised vacuum specified, in which it is indeed not discernible. We show below that no assumption of a perfect vacuum is required or valid for a unified SR/QM via a medium. Our logic effectively derives SR from a quantum mechanism to extend it's domain and compatibility with QM by dropping just our one key assumption, but a whole new dynamic logic and way of thinking is also needed which we discuss below. Unlike us, Einstein was not able to explore space and find it's qualities. As we now know the 'quantum vacuum' is full of activity and 'particles', in all states of motion, we are able to review and fully rationalise the actual findings ontologically.

5b. That absolute speed is indiscernible in space. We add a qualification: Only the local '***next frame up***' (Einstein's '*Space **S***') is relevant to '*smaller space **'s***'' moving within it. Each medium or local 'space' is defined by a kinetic state and *represents it's own 'space-time geometry*'. Motion is an invalid concept *within* a geometry, but all discrete geometries are equivalent and move with respect to each other. Each is then *separated by an acceleration*, caused by a quantum interaction, these 'boundaries' are where electrons propagate in dense crowds. If we look we find them, from TZ's to shocks. Each of these *kinetic states* is the preferred reference for local speed, so local c, and the 'Local Reality' Einstein sought. This ontology uses the interleaved modes of Modal, Quantum or Propositional Dynamic Logic (**PDL**)[7]. In this case each leaf is equivalent, and part of the same 'book', but each is also in a *discrete* kinetic state. Boundary accelerations are from one equivalent frame to another; a Lorentz transformation, (LT) but as a clearer 'power law' from ion flux and activity, with a ~Yukawa based (sharper) cut-off profile to match better defined physical ion shock limits. The key 'acceleration' is causal, due to all electrons re-emitting at c. The relation c= fλ is a constant, complying with the conservation of energy E = fλ. To conserve f and λ both vary. c or λ varies with *apparent* c on acceleration to conserve f in the frame of *a NON- transforming observer* (so no Doppler shift). The new 'dynamic' way of thinking is required to follow that logic. 'Space time events' or 'distance' λ, with time and partial time derivatives are not co-variant, but the wave function itself and c, *are* co-variant. For receding observers; $\lambda_c = \lambda_{c\text{-}v}\,(1 - {}^{v}/c)^{-1}$ and observed light speed then is;

$$f'\lambda' = \{f\,(1 - {}^{v}/c)\}\ \{\lambda(1 - {}^{v}/c)^{-1}\} = f\,\lambda = c \qquad \text{A.}$$

As wave equations are invariant on transformation in Euclidean space the (unobserved) incident and scattered wave are simply;

$$y = y_O \sin 2\pi(f\,t + {}^{1}/_{\lambda}\,x) \qquad \text{and} \qquad y' = y'_O \sin 2\pi(f\,'t' + {}^{1}/_{\lambda'}\,x') \qquad \text{B.}$$

It is a measure of the genius of both Minkowski and Einstein that even with no quantum link they expressed the relationship of 'co-moving spaces' perfectly with similar words, Minkowski's;

> *"Then from here on, we would no longer have space in the world, but endlessly many spaces;"* (1908).

ontologically extended by Einstein in 1952 [4] with;

> *"...infinite number of spaces in motion relatively to each other."*

The quantum mechanism we invoke in all cases; the propagation and modulation of light speed by continuous 'coupling', (absorption and re-emission), uses the 'photon' as conceived at birth by G Lewis (1926);

> "*...it spends only a minute fraction of its existence as a carrier of radiant energy, while the rest of the time it remains as an important structural element within the atom."*

To check how we discern speed in space we introduce more players; Pretty Penny and the protons

(ASIDE; We do know Eddy and Penny are attracted).

This bunch of fast ladies often hit the accelerator through vacuum magnetic fields, ionizing growing clouds of virtual electrons ^{v}e in both frames, sending them so wild they bounce off the walls, emitting synchrotron frequencies up to gamma as c approaches. Bunch speed is then clearly measurable via ^{v}e density, frequency and *resistance*, but only because this vacuum is *not* empty, at 2.72 degrees, with both resistivity and permittivity. In space protons in asteroids may now aspire to be comets purely by hitting local velocities of a few 10's of km/s, without suicide dives through gas into larger bodies.

Act 3.

Scene 1. A Kinetic Universe. Science in the 1800's was confounded by paradoxical findings since Roemer and Bradley of apparent CSL. Two choices were seen; An absolute ether or no ether at all, but neither option resolved CSL in both the emitter and receiver cases. We have resolved the receiver case by invoking the quanta, but what of the mechanism at the emitter? Can a star emit light at c in frame K, and also in frame K' of the medium through which it moves? We now show how, via the 3rd option; dynamic frames, falsifying yet another related assumption;

Assumption 6. Choice of Absolute or NO background frame.
Consider the detector lens discussed, where light changes speed by both relative n and v at the ion shock. Well that process is symmetrical, i.e. the same each way. We know light accelerates from c/n in glass to c in a 'vacuum' medium, and now understand how it also *changes speed by relative medium v.* We here again invoke kinetic reverse refraction (KRR) from optical science,[8] a phenomena ***not*** yet assimilated into physical theory. In KRR the laws of physics, in particular Fresnel Refraction, and Snel's Law of Refraction, break down with relative media motion. Now we identify another new set of connections: In radio emitter ('antenna') science the same thing happens. At the Transition Zone (TZ) between the domains of Maxwell's near and far field, Fresnel Refraction fails and 'Fraunhofer Refraction' takes over, poorly theoretically understood as are the linked surface Kerr effects, Plasmons, and 'non-linear optics' effects. We also invoke Lamb shift and the Dynamic Casimir effect [11] (See end notes, including 'Plasmoids')

Fine structure surface electron density varies with relative motion via photo-ionization. Magneto-hydrodynamic shocks forms as turbulent 'mixing' zones between kinetic states. Frame mixing (turbulent accelerations) are found at the boundary of the suns barycentric (BCI) frame and our non-rotating Earth centred (ECI) frame used for GPS. *Cluster* probe findings from the ionosphere are consistent. The '*next frame up*' in this case is the galaxy arm beyond the Heliosheath. Scott & Smoot [9] analysed the CMBR anisotropic flow of 365km/s from the barycentric frame (NOT the Earth or Galaxy frame) for the 2006 Nobel Prize. This left the same theoretical problem as CMB 'frames last scattered,' appearing to violate SR. Both are rationalised by light changing speed to a *local c* to produce the Doppler shift at each shock boundary between frames, familiar as Raman / Stokes/Anti-Stokes up & down shifted scattering. Probe telemetry from Earth does c in the ECI frame then change to do the local c of the barycentric frame across the solar system. In dynamic logic only one consistent solution exists: that all signals are modulated at ***real*** frame boundaries to the local c. The sun, as all stars emits at c locally, the light re-emitted at the heliopause crosses interstellar space at c = d/t in the galaxy rest frame irrespective of the sun's motion, verifying SR's postulate.

Doubts will always enter the minds of those asked to shed so many assumptions. With scant room for the wide evidence we just point to more recent findings inconsistent with the cosmological model but consistent with unification. The Atacama ACT *SAURON* and ATLAS 3^{D} projects allow kinetic analysis and mapping of galactic rotation. Correlation with extreme 'Lensing' light delays of 3<yrs (Abell) between sides of a rotating system supports a kinetic logic. Light travels through each side of a rotating halo at c with respect to the halo *locally.* An important new kinetic classification was found by Emsellem et al (2007)[10] using; $\lambda_R \equiv (R\,|V\,|)/(R\sqrt{V^2 + \sigma^2})$. Similar findings persist and theoretical consistency is only possible with a relativity based on a *medium*, not 'nothing' in space. The intrinsic rotation of matter in space,[12] CMB jet flow anisotropy [9] and $\Delta\lambda$ all dismiss issues raised by Bell and Haag's theorem.

Scene 2. An Aberration in Aberration. The Stellar Aberration 'Constant' was dropped by the IAU in 2000 as too inconsistent. Major atmospheric refraction is 'guesstimated' (< 34arc min) and added to give accurate predictions.[13] Inconsistency with ballistic models, and *apparently* SR, remains. Related problems with Celestial Planes and BCI/ECI frames are not well aired. The US Naval Observatory (USNO) provide the data for the AA2010 model predictions. Hidden away in USNO Circular 179 is a note; *"The apparently familiar concept of the ecliptic plane has not yet been defined in the context of relativity resolutions. A consistent relativistic theory of Earth rotation is still some years away;"* (2005. p.6) [14]

Assumption 7. 'Ballistic' Stellar Aberration. A hidden implicit sub-assumption is that the barycentric 'medium' does not exist, which confounds theory. If Lodge had recognised the IAU Barycentric frame and also known of KRR, in 1893 he would not have used his lab to represent the ECI frame in 'disproving' Stokes ether drag, a kinetically similar theory. Lodge postulated the 'path' of a 'ray' entering a spinning glass disc as 'dragged' by the glass, so giving aberration in the wrong direction (aberration is *ahead* of our orbital path). However, the rest frame of the ***glass*** represents an observer on Earth, the optical axis is then reversed (KRR) [8] consistent with our dynamic logic and a quantum mechanism behind the SR postulates.

A second 'sub' assumption is the single Earth centred frame. *'Kinetic only'* aberration uses the non-rotating ionospheric ECI frame, but there are TWO! Refraction and additional rotational kinetic term from the atmosphere explain the 'manual' algorithmic additions, greatest at longer optical paths near the horizon. This second frame should resolve the residual errors of laser lunar ranging and aberration. Annihilation in both cases would only be partial, so the birefringence, found by Raman (1921) helps explain scintillation ('twinkling'), ellipticity and consistently low but non-zero interferometer results. Raman's 1930 [15] Nobel Prize speech identified our kinetic speed change, but the implications were not well understood. Importantly he said that if a particle;

> *"...scatters light while it is moving,..* (radiated f is) *...different from... the incident waves"* (C. Raman 1930)

Scene 3. Optical Axis rotation. We now review light '*rays*' and '*paths*' and find limitations. A less familiar player also enters 'stage left', mentioned earlier: An ***'Optical Axis'*** of emissions. A usual assumption made, when needed, is generally;

Assumption 8. Observation on wavefront normal. Similarly to KRR, the divorce of observed 'source position' from the plane normal (perpendicular) is not yet assimilated into theory. Doing so brings great benefit. Fig. 2 shows an 'invisibility optics' finding confirming that rotation of the optical axis of re-emissions with refraction conserves causal wavefronts (first found in 1968 [16]). Considering plane wave-fronts at normal incidence to the refractive plane *in 3D* shows that causality is ***only*** conserved by invoking a local rotation of the optical axis at each particle, either from lateral media co-motion or differential dispersion (See Figs. 3 & 4). To clarify; this is NOT Interstellar Faraday Rotation of polarity which is a related effect. A consistent explanation also emerges for the Kerr magneto/ electro optic effects. The zero time lag (3B) allows experimental verification.

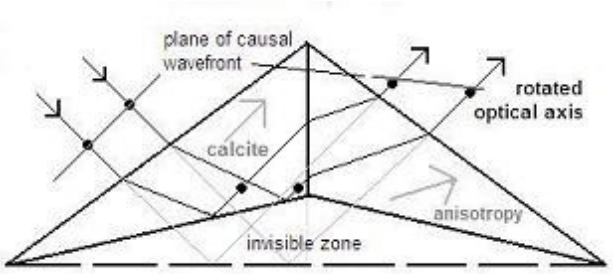

Figure 2. Rotation of 'Optical Axis'. Static example from 'Invisibility Optics' using anisotropic Calcite crystals. Light source position is 'observed' on an axis NOT tied to the causal wavefront normal as normally assumed. The implications are significant but not yet ontologically assimilated into theory as change to theory is required.

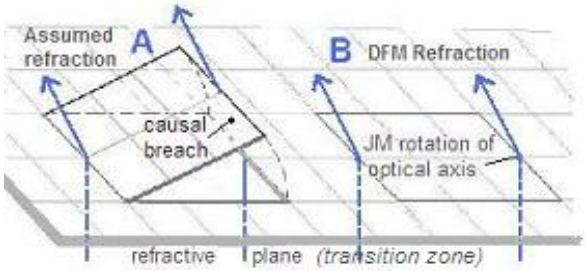

Figure 3. Refraction via rotation of optical axis at each re-emitting particle (B). Shows both a static case and kinetic reverse refraction with refractive plane in relative motion LEFT to RIGHT, caused by asymmetry of charge. The simple assumed mechanism (A) breaches the causal wavefront. Plane thickness may be to megaparsec scales, providing the missing mechanism implementing the effects of 'curved space-time'. Fig. P Jackson

Scene 4. Symmetry. Lined up across the stage the electrons absorb arriving charge and re-emit with perfect symmetry. If the line is in motion to the left, their left side receives more charge, so the re-emission axis rotates to the right to recover symmetry and vice versa. See Figs. 2, 4, and 3B. The rotation gives KRR and aberration at a TZ shock. Harmonics prevail in the static case. The effect is refraction. Transverse Doppler shifts are also constrained, consistent with experimental results.[17]

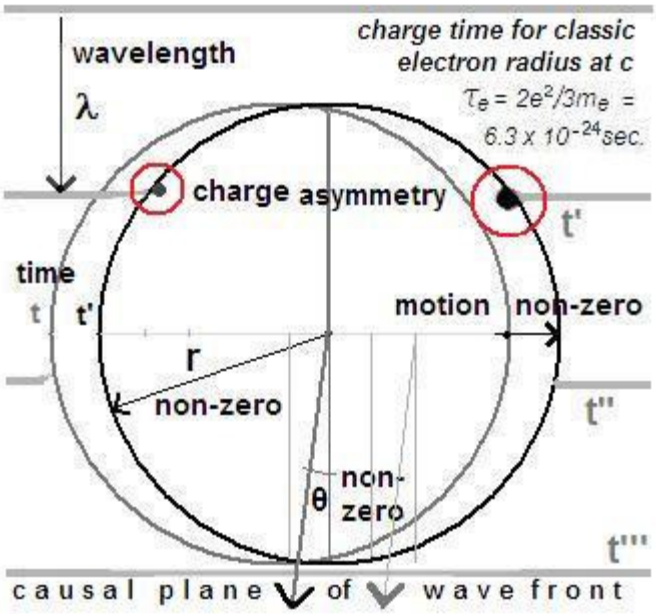

Figure 4. Asymmetry of charge due to lateral motion rotates the optical axis on re-emission. Note additional slight diplacement to right. Angle θ is in same class as refractive index 'n', only found experimentally. Apparent curvature results from medium density and momentum. Multiple variables suggest that 'uncertainly' is equivalent to high complexity. Credit; Jackson / Minkowski.

Finale.
Accepting the reality of space as a medium is not a problem for SR but is of fundamental importance for understanding nature. *Both* ontology and experimentation are required. Old interpretation and assumptions have often not been adequately reviewed or challenged. We must apply 'Proper Time' consistently and assimilate effects from optical sciences. We've here falsified a set of related beliefs, allowing removal of the basic assumption that 'nothing' exists. A new rotation is identified (Figure 4) giving a kinetic basis to Einstein's conceptions and a *Quantum Relativity*, curving space-time in direct correlation with particle density. In deference to Shakespeare (& Dodgson) we summarise this preview in a sonnet;

Our play hath dealt with nothing now we've left nothing behind.
Do 'real' things turn your insides out and overload your head?
Thou may'st prefer familiar ways, with fog that clouds the mind
where matter doth not matter? ...by Mad Hatters then we're led!
Our physics needs ontology, philosophy needs nature.
Too weak those two alone, far greater wholes than sums of parts.
The road forks in the mist, we must decide, anon, not later.
Reject false points and lines, rotate in time, follow your hearts!
So is the soul of every man just built on his assumption?
Can we take arms and challenge them, defeat the sea of troubles?
Dynamic vision needs big change, true bravery and gumption,
new intuition must be learned, with space that's *real*, like Hubble's.
Ne're Haag nor Bell can 'ere stop mankind reaching for our stars.
(and p'raps we might now not lose all those craft we send to Mars!)

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End Notes; *(Alphabetical by subject)*

Assumptions Identified. Main and Related

1. That 'space is nothing'
2. Frequency is real.
3. Speed changes by n to c/n.
4. Cartesian co-ordinate systems adequately model motion.
5. Apparent speed c + v is not accessible. or 5b, discernible.
6. Choice of Absolute or NO background frame.
7. Ballistic' Stellar Aberration.
8. Observation on a wavefront normal.

Algorithms. Other co-variance equations; Rigidity of bodies or systems varies as does wavelength λ of light signals on transformation. Doppler shift is of λ by relative motion during a sequence of *interactions*, only then giving the derivative; *frequency* change. The basic principles are consistent with E H Dowdye's 'Extinction Shift' principle (2005) which used similar terms. First; for an observer, medium or plasma shock (n = 1) in relative motion v approaching source;

Wavelength will be;	$\lambda_c = \lambda_{c+v} (1 + {}^{v}/c)^{-1}$	(1)
or for a receding observer;	$\lambda_c = \lambda_{c-v} (1 - {}^{v}/c)^{-1}$	(2)
The shifted wavelength is then;	$\lambda' = \lambda_O (1 + {}^{v}/c)^{-1}$	(3)
The shifted frequency;	$f' = f_O (1 + {}^{v}/c).$	(4)
Incident wave (unobservable), at c is;	$\psi = \psi_O \sin 2\pi(f t + {}^{1}/_{\lambda} x)$	(5)
Scattered wave (as in text);	$\psi' = \psi'_O \sin 2\pi(f' t' + {}^{1}/_{\lambda'} x')$	(6)
Observed light speeds;		
Observer approaching source;	$f'\lambda' = \{f (1 + {}^{v}/c)\}\{\lambda(1 + {}^{v}/c)^{-1}\} = f \lambda = c$	(7)
Observer receding from source;	$f'\lambda' = \{f (1 - {}^{v}/c)\} \{\lambda(1 - {}^{v}/c)^{-1}\} = f \lambda = c$	(8)

Bars and cyclic cosmology. The intrinsic rotation[12] of matter in space derives the bar of barred galaxies from the inner arms of spent quasar jets (AGN accretion complete) within the virial radius on a new perpendicular axis. The outer arms then trail to form an open, then closed, spiral rotating in lock-step (as a body) with 'dark' halo matter. A scale invariant Discrete Field Model emerges via re-ionozation and jet helicity consistent with the infinite cyclic cosmology first postulated by R H Dicke and P J Peebles.

Bell, Haag's Theorem, CJS. Deterministic Local Reality was constrained by Bells Inequality, Haag's theorem, and Currie-Jordan-Sudarshan (CJS) theorem. Haag disallowed field theory requiring invariance. CJS says; two relative frames can't interact or exchange energy for the LT to be used. We constrain the LT. **CMB anisotropy** (jet flow) is handed and λ varies on detection, lifting theoretical bars, consistent with Christian (2011).[18] No full relativistic basis for Scott & Smoot's [9] analysis or CMB 'frames last scattered' exists. The 'velocity' of our 'local group' is 627kms^{-1} yet the Solar system's is 368kms^{-1} Earth's own speed varies with orbital path. Poor understanding in this area is resolved in our hierarchical kinetic model of nested, real and equivalent local inertial frames, including limited expansion as seen in quasar jet matter.

Co-variance. Our definition: A quality/quantity (Q) unchanged to an observer when at rest in *each* frame (after acceleration between frames). **Invariance;** Where no change occurs as a result of an acceleration, as observed by a single observer B *remaining at rest* in the first frame, (i.e. an idealised rigid body). B may then observe a **co-variant** 'Q' as *apparently* varied because he cannot use **Proper Time** to measure it.

Dielectric media Are considered simply in familiar terms as media of various densities which allow and influence the propagation of light and EM waves. Our dielectric model is then fully **deterministic**.

Discrete Field Model An ontological construction of co-moving frames as real media entities, some more diffuse than we normally consider, *discrete in kinetic terms* and mutually exclusive but spatially 'nested'.

Dynamic Casimir Effect (DCE).[11] The DCE ***creates light by motion*** of a mirror in a vacuum because "*the ideal mirror (*gives*) a boundary condition for the EM field.* In our model the boundary is equivalent to the 'fine' ion surface transition zones of Maxwell's equations and the bow shocks of bodies in space.

Frames. It is unfortunate that the word 'frame' in English can imply a 'wire' framework, for Descartes co-ordinate systems. Einstein specified 'planes' forming rigid bodies and we use similar 3D spaces with discrete inertial states, or 'modes'. Inertial frames cannot thus 'overlap' but need an acceleration to bridge.

Gravity. Gravity emerges from the model of matter condensed from the dark energy/ Higgs field, based on energy or pressure density distribution. The paucity resulting from the focussing of local energy at a 'massive' particle remains in a ~Newtonian distribution around the mass. This is loosely equivalent to a 'Dirac hole' which would be re-filled by the energy on annihilation. Matter condensed by motion of halo mass through the field has gravitational/inertial mass as well as giving axial rotation as the mechanism for both **curved space-time and equivalence**. 'Caustics' are thus limited locally to EM toroidal Black Holes'.

Ions. Different areas of science vary in defining 'ion.' We axiomise ions here as the fundamental particles of matter, mainly as free (unbound) electrons and protons, and apparently also the equivalent negative particles, positrons and neutrons. These are largely considered as at rest as part of n-body **systems.** We use Einstein's '*space is matter spatially extended*' and 'scale invariance' so larger systems, such as the solar system are spatial extensions of the sun for kinetic purposes, i.e. they each may be assigned a ***group state of translational motion*** with respect to a background system (i.e. Galactic arm). The atmosphere and magneto/ iono/ plasmasphere move with Earth. The Heliosphere and it's similar particle shock limits are in the same kinetic state as the sun with respect to the galaxy. Ions are propagated by physical disturbance of a dark energy field due to relative motion. For the purposes of light re-emission ions act as 'stem cells', so only re-emit precisely on the arrival vector except where our defined rotation applies, unlike bound matter.

Lamb shift. A small energy level/shift of an electron (QED/Quantum Optics). A 'condensate' plasma absorbing then re-emitting at c can produce the effects of this vacuum interaction of apparent energy variations. It provides a measure of the fine **structure constant α** which we predict is variable with relative surface plane motion motion. The TZ ion shock of a small mass at rest may however represent a ground state of ~0.073% of it's mass. We find the electro-optic and surface magneto-optic Kerr effect (SMOKE) and photo-ionized TZ as closely related. Lamb shift then essentially arises due to acceleration. **Plasmoids**. This discrete EM toroid is scale invariant with AGN's and Neutron Stars' (see 'Bars' above).

Paradox. All apparent paradoxes of SR are resolved. Signals from each end of a train are simultaneously received by observer A central on a train and B on the embankment *opposite A at the moment of emission*. A and B are no longer opposite when simultaneously received. The twins, ladder and Xeno's paradoxes are similarly resolved by light travel time because all inertial frames are local to all condensed matter.

Relativity. In studying Einstein's extension of Galilean Relativity it is clear that different ways of seeing and interpreting it's various aspects, also the LT and curved space-time, exist. Each is found correct and often slightly better than the others. We cannot discussing here but please be assured that the resolutions offered for *unification, time* and other inconsistencies have been informed by the various interpretations. The credit for the new view goes to A. Einstein who, if nobody can be perfect, was certainly correct in the postulates and 1952[4] conceptions, oft considered illogical. We use Einstein's own ontological approach but much improved information. Controversy and derision will remain, and the mechanism, hiding literally right before our eyes, is so unbelievably simple it will be simply unbelievable. It will also be ignored and forgotten as it is so self evident to those who can think kinetically. If we had to sum up with one simple memorable phrase as an aid memoir, over and above treating *space as a medium* we might suggest;

Velocity Addition is Invalid in Reality. Reality can only be found by using 'Proper Time.'

Peter A Jackson. Orchard House, Whitstable, Canterbury, UK, CT5 3EX peter.jackson53@ymail.com