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Can One Transmit Energy Faster Than Light

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ABSTRACT

Considerations on the mechanism of why EM fields in the near-field of an antenna, and particles tunnelling through a potential barrier are both superluminal, that if this could be understood, then there may be the possibility of sending energy faster than light. Possible explanations of this mechanism are considered, the nature of tunnelling and EM fields in general and considered explaining such behaviour through Emmy Noether's theorem (1918) and the principle of least action, and applying this to the principle of work and energy, with considerations of Wheeler - Feynman Absorber theory of advanced waves echoing back to the source, as an explanation of the principle of least action, then speculating that this can be applied to superluminal effects in tunnelling and EM fields in the near-field. That the solutions of Maxwell's equations for advanced and retarded potentials shows a symmetry to time, reflecting the fact that there must be two-time flows, one into the past and the other, into the future. From this it is considered that the reducing of the refractive index of the vacuum, ZPF field is what causes light to be faster than light, giving an explanation of the mechanism of tunnelling and EM fields in the near-field being superluminal, and considering the engineering of the vacuum, to send energy faster than light.

Keywords: advanced waves; retarded waves; near-field; tunneling; refractive index

INTRODUCTION

I start this paper with the question, what is the mechanism for particles tunnelling through a potential barrier and EM fields in the near-field from a transmitter, to be both superluminal. One then naturally asks if one could understand the mechanism of this, that one might be able to send energy faster than the speed of light. With these considerations it has been shown by Gunter Nimtz [1][2] that tunnelling through a potential barrier are superluminal in the barrier, and that Walker [3] showed that EM fields are superluminal in the near-field of an transmitter and reduce to the speed of light in the far field. Talaaki Musha [4] in a number of experiments, shows in his paper that photons travel at superluminal speeds in the electromagnetic near-field of the source. E. Recami claimed that tunnelling Photons can move with superluminal speed [5]. Chu and S. Wang at BT Bell labs measured superluminal velocities for light [6]. Steinberg, Kwait and Chiao did an experiment, measured the tunnelling time of light with and optical filter, confirmed superluminal speed [7].

The work of Wang, Kuzmuch A, Dogariu A, who did optical experiments at Princeton NEC have verified superluminal propagation in transparent media [8]. And Walker WD has shown that fields generated by an electric or magnetic dipole propagate superluminally in the near-field of the source and reduce to the speed of light as they move into the far-field. That he found information signal can be propagated superluminally, that it can be reflected by a moving frame and arrive at the source before the information was transmitted, enabling causality to be violated [9].

I introduce each characteristic findings of the paper of Nimtz [1][2] and Walker [3] and there is consideration of the work of Bajlo [10] where he detected for the first-time advanced waves, where such advanced potentials are considered to be reflecting the symmetry exhibited by time, in the advanced and retarded solutions of Maxwell's equations, that reflect two flows of time, and that this is related to the German Mathematician (1918) Emmy Noethe's theorem, due to conservation laws and the principle of least action, which is also applied to laws of refraction in the tunnelling medium to superluminal speeds through an potential barrier and the superluminal EM fields in the near-field. One then considers what the mechanism is, of why energy behaves this way to be superluminal, and if one can understand this mechanism, that one could send energy faster than light.

I offer one explanation, that this can be understood when we apply the principle of least action to such superluminal effects in the near-field and in tunnelling. One further considers the principle of least action applied to the nature of energy and work, in an attempt to understand possible explanation of why energy is superluminal in tunnelling and EM fields in the near-field. Then one finds a possible explanation for the mechanism of why one superluminal speeds in tunnelling and EM fields in the near-field, that in the reducing the refractive index of the vacuum, ZPF field being reduced, allows light to be superluminal and consider the engineering of the vacuum, to send energy faster than light.

TUNNELLING

I begin in listing the effects found Gunter Nimtz in his paper [1]. In Nimtz's paper, it's found that tunnelling of particles in the barrier are nonlocal, instantly spread out with the same amplitude over the whole barrier space. One could then ask, are not than all nonlocal effects superluminal in the vacuum energy or ZPF field, that such virtual particles in this field are nonlocal?

For $C_{signal} \rightarrow \infty$ there is absolute time, of Galilei-Newton world in tunnelling barriers, where as in finite signal velocities are representative of local interaction. The energy of tunnelling particles in the barrier are negative and travel faster than light. So, the particles energy is negative. This fits in with anything travelling faster than light.

The particles in the barrier appear from the past to the future, is a similar effect of the behaviour of advanced waves. Nimtz in his paper calls this primitive causality and says, this is evidence that causality is preserved. But here I think Nimtz is confused. The particles in the tunnelling appears in the past and travels to the future, is the same effect for advanced waves after Bajlo's [10] experiment that proved the existence of advanced waves. The tunnelling signal being in the past, but travelling into the future, this is what Bajlo found for advanced waves, but Bajlo argues, that a confused human being who's psychological experience of time has a preferred direction, misinterprets the advanced wave as incoming waves, (from the past) that emerge from infinity without causation and converge to a point at the location of the antenna, exactly at the moment of emission.

Such behaviour for particles tunnelling from A to B in a potential barrier may seem paradoxical. But I believe there are two-time flows, one into the past and one into the future, it explains what is happening. From our experience the time flow into the future, we misinterpret and see the advanced waves converge from infinity, effect before cause, converging from the past to the present. But from the time flow into the past, an observer would see the advanced waves as outgoing waves, not travelling from the past to us in the present, but leaving us and travelling into the past. And I belief this is what is happening in particles tunnelling through a potential barrier.

EM FIELDS IN THE NEAR-FIELDS

In a paper by Walker [3], he explains that time dilation and space contraction depend on whether near-field or far-field propagating fields used in their analysis are illusion created by the propagating EM fields used in their measurement. Instead space and time is proposed to not be flexible as indicated by Galilean relativity. Considering this, how does this stand with theories of time? In walkers paper you get Einstein relativity time transform in the far field, and get Galilean relativity time transform in the near-field. Therefore, for speeds greater than light, (superluminal EM fields in the near-field) relativity does not apply.

Length contraction. That observers using a near-field propagating magnetic field will see no length contraction, since in Walkers calculation $\gamma = 1$ in the near-field, whereas observers using a far-field propagating magnetic field will see the usual Lorentz contraction. So, for speeds greater than light, no length contraction of relativity, according to Walker.

Time dilation. That observers using a near-field propagating magnetic field will see no time dilation, since in Walkers calculation $\gamma = 1$ in the near-field, whereas observers using a far-field propagating magnetic field will see the usual relativistic time dilation. Therefore, for speeds faster than light, there is no time dilation. Walker shows that the space and time coordinate transform reduce to the Galilean relativity. Here I show Walkers calculations of γ from his paper [3] pages 7and 8.

$$\gamma = \frac{1}{\sqrt{\left(1+\frac{\frac{v}{c}}{1+\frac{1}{(kr)2}}\right)\left(1+\frac{\frac{v}{c}}{1+\frac{1}{(kr)2\left[1-\frac{v}{c}\right]}}\right)}}$$

= 1 reduces to one in the near-field

$$\frac{1}{\sqrt{\left(1+\left(\frac{v}{c}\right)2\right)}}$$

= reduces to Einstein relativity gamma function in far -field. Where K is the moving reference frame.

It has been shown by Walker in his paper, that the space and time coordinate transform reduce to the Galilean relativity transformations in the near-field and in the far-field they reduce to the Einstein relativity transformations. Intuitively this can be understood because in the near-field the propagation speed of EM fields is approximately infinite.

And Walker says further, that it is apparent from all the previous analysis, that the space and time transformations seem to depend on whether near-field or far-field propagating fields are used. But according to Einstein's special relativity the effects of space contraction and time dilation should be used and independent of near-field behaviour of propagating EM fields. To resolve this dilemma, it is proposed that the Einstein relativity transformations are and illusion caused by the propagation delays of EM fields used in the measurements of time and space.

And Walker goes on, instead it is proposed that the real space and time transformations are Galilean and only appear to be different when propagating far-field EM fields are used in their measurement. If near-field propagating EM fields are used, then the propagating EM fields are used, then the propagating time delays are near-zero and do not effect the transformations. It has been shown that Einstein's relativity is only valid in the far-field and reduces to Galilean relativity in the near-field, very near the source.

The constant of the speed of light. Einstein relativity assumes that the speed of light is constant. Walker says from his paper, that since this assumption has been shown to not be valid in the near-field, relativity theory has been reanalyzed and has been shown to reduce to Galilean relativity in the near-field and to approximately Einstein relativity in the far-field. But if physical systems are measured with the far-field EM fields, then the Lorentz transform can be used to calculate the altered space-time illusion, but it must be stressed that these effects are not real, time and space are not to be interpreted as being flexible.

So, it seems that for energy going faster than light in the near-field, that Einstein relativity brakes down. So according to Walker, for something travelling faster than light, relativistic effects don't take place, only Galilean relativity applies. Considering this I wondered if moving faster than light, going backwards in time is an illusion. But then I realized in the experiment of Bajlo [10][11] the first person to detect advanced waves, that detection was done with a $\lambda/20$ monopole antenna in the advanced time window at a time $2r/c$ before the arrival of the centre of the retarded pulse, that the effect arises before the cause, that causality is violated, and Tolmans paradox equation explains this behaviour perfectly:

For sending a signal faster than light $\Delta t = t - t^{\circ} = \frac{B-A}{a}$ The arrival at B is given by velocity a, and event A is the cause of B. This inertial frame moving with relative velocity v, the time of arrival at B is given according to the Lorentz transformation:

$$\Delta t' = t' - t^{\circ} = \frac{t^{\circ} - vB/c^2}{\sqrt{1 - v^2/c^2}} - \frac{t^{\circ} - vA/c^2}{\sqrt{1 - v^2/c^2}}$$

$$= \Delta t' = \frac{1 - av^2/c^2}{\sqrt{1 - v^2/c^2}}\Delta t$$

If $a > c$ then certain values of v, can make $\Delta t'$ negative, in other words the effect arises before the cause in this frame. This is what relativity says about objects or energy moving faster than light. And for Bajlo's discovery of advanced waves, this seems to hold true to the above equations of Tolmans paradox. Even then Bajlo calls this an illusion [10][11] and says that advanced waves are not incoming waves but outgoing waves travelling into the past. I believe there are two time flows after Talaaki Musha [12] derived this. One-time flow into the future, one into the past. That energy travels each time flow, and this explains the behaviour of energy flowing into the past and into the future.

That from the point of view from the time flow into the future, (retarded) that advanced waves travel from the past, its observed that the advanced waves appear from infinity and converge to a point on the antenna. (But the advanced waves here travel from the past to the future, and would have had to have been already sent from the past here, where they would have been sent into the past anyway). While according to Bajlo the advanced waves are outgoing and travel into the past, and so from the point of view of the time flow into the past, the energy of the advanced waves travels into the past.

But considering Walkers paper [3], one asks how can time dilation be an illusion, its well known that particles called muons have a very short life, would not normally reach the ground, because time is slowed for particles travelling near light speed. And with atomic clocks on the Earth and high up in a plane, the atomic clocks on the Earth is slower, according to relativity. Is this an illusion as Walker claims? Perhaps at relativistic speeds relativity works, but at speeds faster than light Einstein's relativity does not apply and brakes down.

Regarding the work of Bajlo, one can consider Maxwell's solutions for advanced and retarded potentials. We can define the retarded time,

$$t_r - t - \mathrm{I}r - r'\mathrm{I}/c$$

as the latest time at which a light signal emitted from position r' would reach position r before time t. We have also shown that a solution to Maxwell's equations can be written in terms of retarded potentials,

$$\phi(r,t) = \frac{1}{4\pi\epsilon_\circ}\int \frac{\rho(r',t_r)}{\mathrm{I}r - r'\mathrm{I}} d^3r'$$

But we can also define the advanced time,

$$t_a - t + \mathrm{I}r - r'\mathrm{I}/c$$

This is the time a light signal emitted at time t from position r would reach position r'. It turns out that we can also write a solution to Maxwell's equations in terms of advanced potentials,

$$\phi(r,t) = \frac{1}{4\pi\epsilon_\circ}\int \frac{\rho(r,t_a)}{\mathrm{I}r - r'\mathrm{I}} d^3r'$$

Let's examine the Greens function,

$$\phi(r,t) = \frac{\rho(r',t')}{4\pi\epsilon_\circ}\frac{\delta(t - t' + \mathrm{I}r - r'\mathrm{I})/c}{\mathrm{I}r - r'\mathrm{I}}$$

This says that charge density present at position r' and time t' emits a spherical wave in the scalar potential which propagates backwards in time. Here is the wave equation for the Scalar potential:

$$\left(\nabla^2 - \frac{1}{c^2}\frac{\partial^2}{\partial t^2}\right)\phi = -\frac{\rho}{t_\circ}$$

This equation is manifestly symmetric in time (i.e. it is invariant under the transformation $t \to -t$) Thus, backward travelling waves are just a good a solution to this equation as forward travelling waves. The equation is also symmetric in space (ie it is invariant under $x \to -x$) use the symmetric Greens function:

$$\phi(r,t) = \frac{\rho(r',t')}{4\pi\epsilon_\circ}\frac{1}{2}\left(\frac{\delta(t - t' - \mathrm{I}r - r'\mathrm{I}/c}{\mathrm{I}r - r'\mathrm{I}} + \frac{\delta(t - t' + \mathrm{I}r - r'\mathrm{I}/c)}{\mathrm{I}r - r'\mathrm{I}}\right)$$

In other words, a charge emits half of its wave running forwards in time (retarded wave) and the other half running backwards in time (advanced wave). This in fact was found by Bajlo who first detected advanced waves. The dipole antenna emits both advanced and retarded waves, after the Wheeler-Feynman absorber theory. The reason advanced waves are not normally noticed is that the advanced waves cancel out, only leaving retarded waves. But Bajlo got round this by making the receiver (the absorber) smaller than the emitter (transmitter) and so detected advanced waves. They don't cancel out.

We see here then the two solutions of Maxwell's equations are symmetric in time, most physicists teaching this subject ignore the advanced solutions, and concentrate only on the retarded waves, because advanced waves are not observed. But advanced waves are observed and proved to exist by Bajlo's experiments [10], where the advanced waves appear from infinity (the past) and converge to a point at the antenna (absorber) before the arrival of the retarded wave.

Therefore, Maxwell's solutions of advanced and retarded waves are proved to be symmetrical in time, where causality is violated, where the effect arises before the cause. This shows that Maxwell's equations do give a truth of the symmetry of time and that the advanced solutions of his equations cannot now be ignored.

CONSIDERATIONS

In regard to Nimtz [1][2] and Walker [3], in both there papers, on tunnelling particles and EM fields in the near field from a dipole antenna, that go faster than light, what is the mechanism for energy to behave in this way?

And in tunnelling, what is the mechanism that particles go faster than light in the energy barrier, while no energy is expended by particles tunnelling through the barrier? I belief that the mechanism of why energy goes faster than light without the expenditure of energy in tunnelling and EM fields in the near-field, that if it can be understood, the mechanism of it, then we might be on the way to send energy/matter faster than light, which may propagate into the past?

Walker explains in his paper [3] p22 on the mechanism for EM fields being superluminal, that very near the dipole source the phase of the longitudinal electric field is zero, causing both the phase speed and group speed to be infinite. This must be a property of all transmitters and show perhaps a time symmetry according to Maxwell's equations of advanced and retarded potential's (it does certainly for Bajlo detecting advanced waves, that are also in the far-field). And this fact proved by walker can be shown against the prevailing view that only retarded potential's apply in assuming there is an asymmetry to time. Bajlo in detecting advanced waves and EM fields being superluminal proves against such assumptions and proves a symmetry of time.

One could do the same experiment of Bajlo of transmitting advanced waves into the past, and sending information or a TV image, and when that advanced information comes from the past, converges to a point at the on the receiver (absorber), what would the information look like?

One could experiment with different frequencies to transmit as advanced energy, e.g. microwaves or gamma rays, and see how this energy behaves?

In 1918, the German mathematician Emmy Noether proved the following fundamental connection, that every continuous symmetry of a physical system corresponds to a conservation law. Can one say this of the symmetry of time, in advanced and retarded potentials, reflected in both solutions of Maxwell's equations, and having two-time flows, one into the past, and one into the future? Emmy Noether's theorem is connected to the principle of inertia. The proof of Noether's theorem is in the principle of least action. I think all of this applies to conservation laws, to EM fields in the near-field, and the principle of least action can apply to why we have EM fields in the near-field being superluminal and then reducing to the speed of light in the far-field. It might be due to the principle of least action.

Gunter Nimtz [1] says in his paper on tunnelling that the refractive index plays a role of the potential for electromagnetic evanescent modes in wave mechanical tunnelling. This is the same with the principle of least action, where light takes the shortest path in a medium in refraction through glass for example. But in tunnelling through a potential barrier the particles in taking the shortest path go at speeds faster than light. This is the same as Fermats principle, that light saves as much time as it can, but in Gunter Nimtz paper [1] the speed of tunnelling is faster than light. It might be that the principle of least action applies to photons going faster than light in tunnelling. The law of reflection and refraction is directly compatible with Fermats principle, because at a constant speed of light, the fastest way is also the shortest way. This may also apply and explain why particles or photons tunnelling through a barrier go faster than light, the particles chooses the fastest path between two point. But it must be remember from Gunter Nimtz's paper [1] that particles in the potential barrier are non-local, there energy is negative, and they become virtual particles.

There energy is negative because they are superluminal in the barrier. This might also be connected to the conservation of energy. Light takes every possible path, in tunnelling experiments have shown that evanescent modes are present at the same time all over the barrier, at the front and at the back interface of the barrier.

We can also consider that the spherical wave front of each elementary wave as itself a source for many new elementary waves, in this sense we can say that the wave takes every possible path. So light not only takes the fastest (or slowest) way, but also explores all other ways. And only if we take them all into account will Fermat's principle be derivable as a consequence of interference. This is the way energy behaves, even to the extent of faster than light speeds in tunnelling through a barrier.

And this principle of least action also applies to Newtonian mechanics, say if throwing a ball up . For each motion from A to B, we can see this action. It says to a certain extent how ‘effective' or 'favourable' the corresponding motion is. The greater the potential energy v of the body and the lower its kinetic energy T on average, the more favourably the motion will be. In any real situation the body will 'choose' the most favourable motion i.e. the one with the least action.

According to the principle of least action, the object tries to move between the two points, A and B in such a way that on average its kinetic energy T becomes as small as possible and the potential energy v as large as possible. The object must arrive on time at location B, at the fixed time t_2.

Dose this not explain the nature of tunnelling and EM fields in the near-field with speeds faster than light, can one transmit energy faster than light, where the energy or a object must arrive on time at a location at the fixed time? But how does the object know how to arrive at B at the fixed time t_2? Is it informed by its own advanced echoes of its future state, that it knows it must arrive on time at location B, at the fixed time. Why is energy behaving this way? The transactional interpretation [13] could explain this by saying that all quantum paradoxes are explainable, that advanced signals or waves are sent back in time to their source. For example, how does a particle know in quantum physics to go through both holes in diffraction experiments, or weather to choose to be a particle or wave, if one of the holes is blocked or not. Feynman and Wheeler [14] imagined that the first electron would vibrate briefly, in this way at time zero, sending out advanced and retarded waves, this would explain the inertia of an object, and how the object knows it has to arrive at B at the fixed time t_2, because it has echo's of its future state.

This might be an explanation of how EM fields in the near-field are advanced, superluminal and in the far-field retarded, at the speed of light, due to the dipole transmitter. But in the example of Bajlo's experiment you get advanced waves in the far-field. I have not as yet compared both these different examples? I have not got a model of a medium where the EM fields in the near-field go faster than light due to some refractive index, as I did for tunnelling? But the above arguments of electrons producing advanced and retarded waves, might be a better explanation. Could one get advanced EM fields in the far-field, but Bajlo achieved this. Having two-time flows may be due to Emmy Noether's theorem of the principle of conservation laws, (of least action) might be reflected in the two solutions of Maxwell's equations, of advanced and retarded waves, and having two-time flows may explain why an electron emits both advanced and retarded waves. We can also consider the nature of energy and work, in relation to the concept of the principle of least action. Work is a scalar quantity, it has magnitude and no direction, work transfers energy from one place to another, or in one form to another, $W = F$. This is work W is equal to the applied force. Force is a vector, it can apply also to kinetic energy, $W = -\Delta E_p$. Consider the equation,

$W = \int_c Fds$ where c is trajectory from $x(t_1)$ to $x(t_2)$ and s is displacement along a line. This trajectory from $x(t_1)$ to $x(t_2)$ should be governed by the principle of least action. But why dose energy behave this way? One consideration of this, is the transactional interpretation [13] that the energy is getting an echo from its future state $x(t_2)$ while at $x(t_1)$ from advanced potentials, and knows it has to get to $x(t_2)$ and arrive at the location at a fixed time. This can also be considered as inertia, and I wrote of such behaviour in a paper [15] 'Notes: Is Abraham Damping Constant and Inertia in matter a Consequent Echo of its Future State'? Where according to Wheeler-Feynman Absorber theory [14] particles emit advanced waves to produce a kind of electrical inertia and that the Abraham-Lorentz force where they get in their calculations of signals from the future. From my paper I state, that for a particle in an external force $Fext$, we have,

$$mv = Frad + Fext = mt^{\circ}v + Fext$$

Where $Frad$ is radiation, and where $t^{\circ} = \frac{\cup^{\circ} q\hat{}2}{6\pi mc}$
Where $\cup^{\circ}$ is Permeability of free space.

This equation can be integrated once to obtain:

$$mv = \frac{1}{t^{\circ}} \int_{t}^{\infty} ext\left(-\frac{t'-t}{t^{\circ}}\right) Fext(t^{\circ}) dt'$$

The integral extends from the present to infinitely far in the future. Thus, future values of the force affect the acceleration of the particle in the present the future values are weighted by the factor:
$\left(-\frac{t'-t}{t^{\circ}}\right)$ Which falls off rapidly for times greater than $t°$, in the future. Therefore, signals from an interval approximately t°, into the future affect the acceleration in the present. For an electron it is $10^{24} sec$. With Lienards relativistic generalization of Larmar formula in the co-moving frame, one can show this to be valid force by manipulating the time average equation for power:
$P = \frac{\cup^{\circ} q\hat{}2a\hat{}2y\hat{}2}{6\pi c}$ Where P = power and $\cup^{\circ}$, is permeability of free space.

Dose this not show that energy in relation to power follows the principle of least action in these echo's from a objects future state. One can write the equation of work,

$$W = \int_{c} F.dx = \int_{t_1}^{t_2} Fvdt$$

$dx(t)$ defines the trajectory c and v is velocity also this trajectory. The time derivative of the integral for work yields the instantaneous power,

$$\frac{dW}{dt} = P(t) = F.v$$

Therefore, one can write,

$$\frac{dW}{dt} = P(t) = \frac{\cup^{\circ} q\hat{}2a\hat{}2y\hat{}2}{6\pi c} = F.v$$

FURTHER CONSIDERATIONS

In a teleportation physics study, by Eric W. Davis [16], it's been found that lowering the refractive index of the vacuum, can lead to the speed of light moving faster than light, and that this may explain why EM fields in the near-field are superluminal. I quote from this paper from pages 12 and 14:

'We begin our look into this concept by examining the propagation of light through space. We know from quantum field theory that light propagating through space interacts with the vacuum fields (fluctuations). The observable properties of light, including the speed of light, are determined by these interactions. Vacuum quantum interactions with light lead to an effect on the speed of light that is due to the absorption of photons (by the vacuum) of the photon. The virtual particle pairs are very short lived because of the large mismatch between the energy of a photon and the rest mass-energy of the particle pair. A key point is that this process makes a contribution to the observed vacuum permittivity ε_0 (and permeability μ_0) constant and therefore, to the speed of light $c[c = (\varepsilon_0 \mu_0)]^{1/2}$ '.

They further say, 'The role of virtual particle pairs in determining the $\varepsilon_0(\mu_0)$ of the vacuum is analogous to that of atoms/molecules in determining the relative permittivity ε $(and\ \mu)$ of a dielectric material. We know that the absorption/re-emission of photons by atoms/molecules in a transparent medium is responsible for the refractive index of the medium, which results in the reduction of the speed of light for photons propagating through the medium. This absorption/re-emission process is also known in physics as a scattering process. We know from experiment that a change in the medium leads to a change in $\varepsilon(\mu)$, thus resuting in a change of the refractive index. The key point arising from this analogy is that a modification of the vacuum produces a change in $\varepsilon_0(\mu_0)$ resulting in a subsequent change in c, and hence, a corresponding change in the vacuum refraction index. Scharnhorst (1990) and Latorre et al (1995) have since proved that the suppression of light scattering by virtual particle pairs (coherent light-by-light scattering) in the vacuum causes and increase in the speed of light accompanied by a decrease in the vacuum refraction index'.

This could explain why EM fields in the near-field are superluminal, where one assumes here that in the near-field one must get a decrease in the vacuum refraction index close to the transmitter, and leads to speeds faster than light of the EM fields.

For light (photons) propagating in a Friedmann-Robertson-Ealker Vacuum we have,

$$\frac{c^*}{c_0} = \left(1 + \frac{11}{45} \alpha G \frac{\rho_r + p}{m_e^2}\right) > 1 \qquad (\hbar = c_0 = \varepsilon_0 = \mu_0 = 1)$$

Where c^* is the modified vacuum speed of light, G is Newton's constant, and ρ_r is the energy density and p is the pressure of a radiation-dominated universe. Here the speed of light is increased.

This may explain why EM fields in the near-field are faster than light, that the refractive index of the vacuum is reduced for EM fields in the near-field, and hence travel faster than light. But still no one has yet checked if the vacuum refraction index is decreased in the near-field of transmitters. This should be checked?

This may also be true of particles tunnelling through a potential well, if so one could manipulate the refractive index of the vacuum, (Casimer plates effect) to send energy faster than light. As Walker says in his paper [9] page 22, of EM fields in the near-field, 'These results show that very near the dipole source the phase of the longitudinal electric fields is zero, causing both the phase speed and group speed to be infinite'. This is one explanation of the mechanism of why EM fields in the near-field are superluminal. But the effect described where the speed of light goes faster than light, due to the refractive index of the vacuum being reduced is also called the Scharnhorst effect [17]. Recall that based on quantum field theory, virtual particles and antiparticles are born and annihilate in the vacuum. This means that in the vacuum there is a pressure of virtual photons, which slows down a real photon, consequently if pressure is reduced, then the speed of light in the new vacuum (the Casimir vacuum) will be greater than the speed of light in the ordinary vacuum. This phenomenon is called the Scharnhorst effect, it is not confirmed experimentally, but predicted theoretically. The Casimir effect was experimentally fixed, from which the Scharnhorst effect logically follows.

But as I said at the beginning of this paper, that if the mechanism of how such superluminal behaviour in tunnelling and EM fields in the near-field can be understood, then perhaps one can engineer the vacuum to send energy faster than light. One way of engineering the vacuum would be in-between the plates of the Casimer effect, because the wavelengths of the virtual energy of the vacuum is shorter between the plates, than outside the plates, meaning there is negative energy there, and a lower

refractive index, and the plates get pushed together. And there may be other ways to engineer the vacuum, to lower its refractive index, so that one can send energy faster than light.

In the paper by Davis [16] Teleportation physics study, they say; 'There already is extensive theoretical and more importantly, experimental research proving that the vacuum can be engineered (or physically modified) so that the vacuum ZPE can be exploited (via the Casimir effect, for example) to extract electrical energy or actuate microelectromechanical devices. (e.g Ambjorn and Wolfram, 1983; Forward, 1984, 199, 1996; Puthoff, 1990, 1993; Cole and Puthoff, 1993; Milonni 1994; Mead and Nachamkin, 1996; Lamoreaux, 1997; Chan et al., 2001)

So, there may be ways to engineer the vacuum to lower its refractive index, so that one can send energy faster than light.

CONCLUSIONS

I speculate that if the mechanism of why superluminal behaviour of EM fields in the near-field superluminal tunnelling by particles through a potential barrier could be understood, then perhaps there is the possibility of sending energy faster than light, as both in the near-field and in tunnelling is demonstrated in these experiments. One has tried to find an interpretation of explaining this behaviour through Emmy Noether's theorem and the principle of least action, of why in tunnelling and in the near-field energy behaves this way, and one applied the same principle to work and energy and explained the nature of the principle of least action by the Wheeler-Feynman Absorber theory of advanced waves echoing back to its source. Of why light knows how to take the shortest path in refraction, and how in Newtonian Machanics of why a ball thrown into the air knows it has to be at $x(t_2)$ at the exact right time. I explained this by the principle of least action due to advanced waves showing that the solutions of Maxwell's equations of both advanced and retarded potentials shows a fundamental symmetry to time, and in referring to this fact, that there must be two time flows into the past and future and that this is what the two solutions to Maxwell's equations are demonstrating.
I showed that the transactional interpretation supports the notion of two-time flows and of advanced signals getting back to their source, explaining many of the paradoxes of quantum theory. But I think the best explanation of tunnelling and EM fields in the near-field travelling superluminal speed is the fact that it has been found, that a reduction of the refractive index of the vacuum or ZPF field leads to speeds of light being faster than light. And that this can be also explained by the Scharnhorst effect which is basically saying the same thing. This can explain such superluminal behaviour and hopefully mean that one could engineer the vacuum to send energy faster than light, as it seems one might have found a possible mechanism, of why there are superluminal speeds in tunnelling and in the near-field of EM fields. And experiment should be designed to lower the refractive index of the vacuum measure if light or particles are superluminal in this state, and then the possibility of engineering the vacuum to send energy faster than light.

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