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Superluminal Propagation of Electromagnetic Fields in The Near-Field and Far-Field

Anthony Maccini

Flat 9, Fairhall Court, 114 - 124 Kingcharles Road, Surbiton, KT5 8QL, England

*Corresponding author details: Anthony Maccini; anthonymaccini@hotmail.com

ABSTRACT

One examines 3 experiments: Bajlo, who first detected advanced waves that were in the far-field. Walker, in his experiment, detected advanced electromagnetic waves in the near-field, as well as transmitting information faster than light, and Steffen Kuhn, who experimentally detected in the far-field radio waves with Plasma antennas that were superluminal. Here, one tries to distinguish the fact that electromagnetic waves in both the near-field and far-field are faster than light. One gives an interpretation of this, that it's due to matter being sufficiently slow to perceive advanced radiation faster than light in the rest frame of an observer, which allows us to distinguish between the future and past, distinguishing the fact that electromagnetic waves are really faster than light. One further argues that the equivalence paradox of an charge that does not radiate under uniform acceleration with an observer travelling with it, is that the radiation is outside the observers light cone, that using the same argument of the equivalence paradox, that the reason one is not aware of advanced radiation from space is because its outside our light cone, but is observed with plasma antennas in the rest frame of the receiver.

Keywords: near-field; far-field; plasma antennas; superluminal; radio waves; equivalence paradox

INTRODUCTION

It was found in an experiment by Steffen Kuhn [1] using plasma antennas, in a paper: 'Experimental detection of superluminal far-field radio waves with transverse plasma antennas', where the signal is received before it was sent. Bajlo [2] was the first person to detect advanced electromagnetic waves with dipole antennas, also in the far field, travelling into the past. And Walker [4], who detected superluminal radio waves in the near-field.

Realizing that in all 3 experiments of superluminal electromagnetic waves, both in the near-field and far-field, presents a problem, because it is believed that electromagnetic energy is only retarded in the far-field. That this needs to be explained. One questions the nature of time symmetry of retarded and advanced solutions of Maxwell's equations, and the Klein-Gordon equation. These symmetries in the light of electromagnetic radiation in the far-field and near-field have a bearing on the nature of time. From Steffen Kuhn [1] hypothesis is that the reason such advanced electromagnetic radiation is not detected from distant sources in space, reaching the Earth, is due to matter perceiving only that part of the electromagnetic radiation that is slow in the rest frame. One introduces the equivalence paradox of why a uniform accelerated charge does not radiate from a co-accelerating observer, and concludes through the work of David G. Boulware [14] and Camila de Almeida [16] that the reason we don't detect the radiation of an accelerating charge is that it's not in our light cone, and concludes further that the reason one can't observe advanced electromagnetic waves from space is that it's not in our light cone, and that special relativity is violated.

SUPERLUMINAL PROPAGATION OF ELECTROMAGNETIC WAVES IN THE NEAR-FIELD AND FAR-FIELD

Have we all been deceived into thinking that only retarded waves exist, even though there's been evidence that retarded waves are in fact advanced and that this has been detected [1]. I will present experimental evidence that retarded far-field radiation is really advanced and superluminal, despite appearances, and that a total revision of physics is necessary. And as a way of a sort of introduction, I present the abstract of the paper by Steffen Kuhn [1], 'Experimental detection of superluminal far-field radio waves with transverse plasma antennas:

The predictions of Maxwell's equations depend on the reference frame in which they are solved. If one solves Maxwell's equations in the rest frame of the transmitter, which is the common approach, one obtains Lorentz-Einstein electrodynamics by adding the special theory of relativity. Here, for formal reasons, no information velocities greater than the speed of light in vacuum are possible. If, however, one solves Maxwell's equations rigorously in the rest frame of the receiver, one comes to a field-theoretical generalization of Weber electrodynamics, which differs from Lorentz-Einstein electrodynamics.

Although Einstein's postulates are also fulfilled in these Weber-Maxwell electrodynamics, in a specifically designed experimental setup of two mutually stationary and very distant antennas, electromagnetic waves may travel at velocities that exceed the speed of light in vacuum. This effect, previously predicted only theoretically, has now been experimentally investigated and confirmed. This finding indicates that Lorentz-Einstein electrodynamics is incorrect and that Maxwell's equations should instead be interpreted in terms of Weber electrodynamics. As a subsidiary result, these findings can enable remarkable new technologies, such as a highly compact method for radio direction finding (RDF).

Darko Bajlo was the first person to detect advanced waves [2] 'Measurement of advanced electromagnetic radiation'. He says in his abstract: For the purpose of detecting advanced electromagnetic radiation predicted by Wheeler-Feynman absorber theory for the case of incomplete absorption of retarded electromagnetic radiation, pulses in duration of 6 ns to 24 ns, wavelength from 91 cm to 200 cm, were supplied to three different transmitting antennas. Detection was done with a $\lambda/20$ monopole antenna in the advanced time window at 2r/c before the arrival of the centre of the retarded pulse. At distances ranging from 430 cm to 18 m, advanced signals were measured in the SNR ($\mu\sigma$) range from 15.4 to 30.9.

In another paper by Bajlo [3], "The hidden arrow of electromagnetic radiation: unmasking advanced waves". He says in his abstract: Advanced potentials are generally discarded on causal or statistical grounds, as a consequence of misinterpreting advanced waves as incoming waves. Perceiving advanced waves as incoming waves is an illusion created by an anthropocentric view of time. Seen from 'nowhen', outside a block of space-time, advanced waves are also outgoing waves, the cause and source of which is a transmitting antenna, just as is the case for retarded waves. The transmitting antenna radiates advanced electromagnetic waves into free space, in line with Hoghart's calculations in the Wheeler-Feynman absorber theory for an open, ever-expanding universe. The reason advanced radiation is not observed is due to the act of the observation itself, in which lies a hidden mechanism that masks advanced waves. By introducing a receiving antenna, we introduce an absorber where its advanced waves cancel out the advanced waves of the transmitting antenna. However, advanced radiation may still be detectable if the impact of the measuring instrument on the phenomenon being measured is minimized, as recent experiments with radio waves have indicated.

Bajlo says further: Perhaps one of the most important decisions with far-reaching consequences for modern physics was made based on common sense rather than relying on mathematics. Textbooks covering classical electrodynamics state that the advanced potentials are an equally valid solution to Maxwell's equations as well as the retarded potentials. However, the advanced potentials are discarded as unphysical on causal grounds. When mathematics contradicted his expectations of how nature should behave, Griffiths chose to believe in common sense and reject valid solutions from fundamental equations of physics as unphysical.

And on page 2, he says: The common sense belief that electromagnetic influence propagates forward, not backward, in time comes from experience gained by living in the macroscopic world of a large number of particles interacting, in which all the processes that humans can perceive take place in the direction in which entropy increases. However, this does not mean that fundamental processes in nature must take place in the same way. If we trust mathematics rather than common sense, and accept that electromagnetic influence can propagate backward in time, then advanced waves are not sourceless and non-causal. From the human perspective, the cause of advanced waves lies in the future - the effect precedes the cause, but that is just a matter of perspective. Humans are creatures that move along the time dimension in one direction, so the view of the time-symmetrical process is necessarily distorted when viewed from the human perspective. The only way to avoid such distortions is, as Prince suggested, to move away and see things from a non-anthropocentric perspective, from 'nowhen' outside the block of space-time, in which all dimensions and directions are equal.

Now I want to go back to Steffen Kuhn's paper [1] 'Experimental detection of superluminal far-field radio waves with transverse antennas'. He says in his paper: Since their origin approximately 150 years ago, Maxwell's equations have almost always been solved in the rest frame of the transmitter because, at that time and still today, this is thought to be the natural approach due to its simplicity and the similarity to electro- and magnetostatics. With this approach, however, the problem arises that electromagnetic waves travel at the speed of light c only with respect to the transmitter. Yet, it is known from numerous experiments that this does not agree with reality. Few are aware that Maxwell's equations can also be solved in the receiver's rest frame. In this case, the property of being in motion is transferred from the receiver to the transmitter. This approach produces additional current density terms, which must be considered when solving Maxwell's equations. At the same time, the magnetic field B loses its meaning, as the receiving antenna is now at rest, and thus, the velocity $v \times B$ in the Lorentz force is obsolete.

He says further: Mathematically, solving Maxwell's equations in the receiver's rest frame is highly challenging due to the additional velocity-dependent current densities. For a single point charge, this solution is called the Lienard-Wiechert potential. Remarkably, for small relative velocities, this solution is a rather simple equation called the Weber force.

He gives explanations of transverse plasma antennas: The antenna consists of two essential components: a tube containing an ionizable gas and an electrode. For mechanical reasons, it is useful to mount the tube and electrode on a printed circuit board. If a high DC voltage is applied across the tube, the contained gas is ionized. This creates an electrically conductive plasma, and a current flow occurs in which electrons move in one direction and ions in the other. The drift velocities of the electrons can be very high; for example, they can be close to 1% of the speed of light in a vacuum. In contrast, the ions move much more slowly because they are considerably heavier. The principle of operation of a transverse plasma antenna can be visualized by imagining that the tube is penetrated by a transverse electromagnetic wave moving along the tube.

If we further assume that the transverse wave is polarized in the vertical direction, it becomes clear that the electrons in the tube experience a force in the downward vertical direction of the tube due to the electromagnetic force. In turn, a space charge zone is formed, and electrons come out of the electrode underneath, provided that the antenna is connected to the reference ground via a resistor. If the direction of polarization of the incident electromagnetic wave changes, then the direction of the current in the measuring resistor also changes. Thus, a transverse plasma antenna is, at least in principle, suitable for the reception of electromagnetic waves.

He says further: The force exerted on the electron causes it to move in a vertical direction. Because the distance to the electrode is very small, a reaction is triggered almost instantaneously. Thus, it can be concluded that one should be able to receive the transmitted signal earlier with a transverse plasma antenna than with an ordinary antenna. This result is in gross contradiction to our expectations based on special relativity, because both the transmitter and the transverse plasma antenna are at rest. Superluminal signal transmission - especially between antennas at rest with respect to each other - should not be possible. Nevertheless, this result is achieved by solving Maxwell's equations without additional ad hoc assumptions in the receiver's rest frame. In other words, when applied in their pure form, Maxwell's equations lead exactly to this result. Because this theoretical prediction of Maxwell's equations is diametrically inconsistent with Lorentz-Einstein electrodynamics, an experimental investigation was urgently needed.

On page 4, he goes on about the experiment: The basic idea of the experiment is to select a (Radio broadcast) station, align the antenna module in a cardinal direction, and measure the time shift between two demodulated audio signals. If special relativity is correct, there should be no significant measurable time shift between the signals as a function of the cardinal direction. However, if Weber-Maxwell electrodynamics is correct, it should be possible to determine the direction of the radio tower site by rotating the antenna module. During the experiment, it quickly became clear that the latter is true.

He says in his conclusions: We have demonstrated, both experimentally and by interpretation of the solution of Maxwell's equations for a moving Hertzian dipole, that it is possible to construct receiving antennas in such a way that electromagnetic waves in the far field are received earlier than should be possible due to the upper speed limit of *c*. Moreover, it was made clear that these antennas and the experimental results do not contradict Maxwell's equations and Einstein's postulates. However, the results are in contradiction to special relativity as well as ether theories, which are often brought into the discussion by critics of special relativity. Fortunately, a satisfyingly logical and physically clear mechanism can be found that is compatible with Maxwell's equations, fits the test experiments of Einstein's postulates, and predicts the experimental results documented here.

He goes on: As explained, the basic hypothesis of this mechanism is based on the assumption that matter can perceive only that part of the electromagnetic field that is sufficiently slow in the corresponding rest frame. In turn, this assumption implies that the Earth is continuously penetrated by electromagnetic waves faster than *c* with respect to our planet. This may sound implausible, but it is the only logical explanation.

Bajlo [2] tried to receive advanced radiation from the universe, of objects that lie far outside the light cone of the experiment, on the strength of an advanced signal. Steffen Kuhn, in his use of plasma antennas, suggested on page 9 of his paper [1] in the conclusions, that the Earth is continuously penetrated by electromagnetic waves moving faster than *c* with respect to our planet. Perhaps then one can receive such advanced radiation from the cosmos using plasma antennas, which lie outside of the experiment's light cone, as Bajlo tried to do.

As noted in this paper, they detected superluminal radio waves in the far-field, which, according to Steffen Kuhn, if one solves Maxwell's equations rigorously in the rest frame of the receiver, one comes to electromagnetic waves that may travel at velocities that exceed the speed of light. Comparing this to Bajlo's experiment [2][3] in detecting advanced waves, which were also detected in the rest frame of a receiver, and were also advanced waves in the far-field.

Does this mean that Steffen Kuhn [1] experiment with plasma antennas also received advanced waves? This might be true. Notice that the plasma antennas were smaller than the transmitting station. Is this in agreement with Bajlo's experiment, where the receiver was 20 times smaller than the transmitter, where advanced waves do not cancel out? Would this explain the particular experimental results of using plasma antennas?

Also, in the experiment with plasma antennas, information is being sent faster than light. This also violates special relativity. Also is the fact that the conclusion of Steffen Kuhn, that radiation from space is really superluminal. The reason one argues this is such cosmic sources are treated in the rest frame of the transmitter or cosmic source from space, not in the rest frame of the Earth. If this is so, then such advanced sources are not detected.

So far, all of this, Bajlo's experiment, and Steffen Kuhn's experimental results, all suggest that electromagnetic radiation in the far field is superluminal. But it's also found that electromagnetic radiation in the near field is also superluminal, so that the near and far fields are all superluminal. Here I want to introduce the experimental work of Walker [4]: 'Superluminal electromagnetic and Gravitational fields generated in the nearfield of dipole sources'. Walker says in his abstract: In this paper, the fields generated by electric and dipole and a gravitational quadrapole are shown to propagate superluminally in the nearfield of the source and reduce to the speed of light as the fields propagate into the farfield. A theoretical derivation of the generated fields using Maxwell's equations is presented, followed by a theoretical analysis of the phase and group speed of the propagating fields. This theoretical prediction is then verified by a numerical simulation, which demonstrates the superluminal propagation of modulated signals in the nearfield of their sources.

An experiment using simple dipole antennas is also presented, which verifies the theoretically expected superluminal propagation of transverse electromagnetic fields in the nearfield of the source. The phase speed, group speed, and information speed of these systems are compared and shown to differ. Provided the noise of a signal is small and the modulation method is known, it is shown that the information speed can be approximately the same as the superluminal group speed. According to the relativity theory, it is known that between moving reference frames, superluminal signals can propagate backwards in time, enabling violations of causality. Several explanations are presented that may resolve this dilemma.

This shows that not only are electromagnetic fields superluminal in the near field, but that information can be sent faster than light, violating special relativity. But in the experiments of Steffen Kuhn with plasma antennas, he shows that electromagnetic fields or radio waves in the far field also carry information superluminally, because they used in their experiment to receive from Berlin radio and TV broadcast stations signals before they were sent, which is also a violation of special relativity. So, what is one to make of this? It would imply that electromagnetic waves in the near field and far field are both really superluminal. And that is the reason electromagnetic waves in the far field have not been noticed is that matter can perceive only that part of the electromagnetic field that is sufficiently slow in the corresponding rest frame, but the Earth is continuously penetrated by electromagnetic waves moving faster than the speed of light.

This is a challenge to conventional physics, which, if more experiments are done in this area, might overturn all current physics, with a new view on the universe. Other scientists have discovered the superluminal propagation of electromagnetic waves: It has been shown by Gunter Nimtz [5][6] that tunnelling through a potential barrier is superluminal in the barrier, and that Walker [7] showed that EM fields are superluminal in the near-field of a transmitter and reduce to the speed of light in the far field. Takaaki Musha [8], 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 [9]. Chu and S. Wang at BT Bell Labs measured superluminal velocities for light [10]. Steinberg, Kwait, and Chiao did an experiment that measured the tunnelling time of light with an optical filter, confirming superluminal speed [11]. The work of Wang, Kuzmuch A, Dogariu A, who did optical experiments at Princeton NEC, has verified superluminal propagation in transparent media [12].

There is also a paper [13] by Ulisse Di Corpo' and Antonella Vannini; 'Advanced waves and Quantum Mechanics'. They say in their abstract: Advanced waves are predicted by the negative solution of Klein-Gordon's equation. This equation is compatible with the major mysteries of quantum mechanics, making them compatible with special relativity. However, advanced waves move backwards in time and require a new definition of causality. In this short paper, the duality wave particle, quantization, and nonlocality are described as manifestations of advanced waves and of the dual solution of the Klein-Gordon equation. These anomalous properties of quantum mechanics could be considered as evidence that supports the existence of advanced waves.

They say in their paper: The equation $E = mc^2$, commonly associated with the work of Albert Einstein, was first published in 1890 by Oliver Heaviside and then refined by Henri Poincare in 1900 and Olinto De Pretto in 1903, and it then became famous with Einstein's special relativity, where it was integrated with the momentum in the energy/ momentum/mass equation, called the Klein-Gordon equation:

$$E^2 = m^2c^4 + p^2c^2$$

Where the total energy (E) is the result of the sum of the momentum (P) and mass (m), multiplied by the speed of light (c). Being a second-order equation, it is necessary to take a square root, which always produces two solutions, one positive and one negative. This simple property of square roots implies that the solution of energy is always dual: positive $(+E)$ and negative $(-E)$. According to Einstein's special relativity: the positive energy solution $(+E)$ describes energy that diverges from causes located in the past and which propagates towards the future (retarded potentials); the negative energy solution $(-E)$ describes energy which diverges from causes located in the future and which propagates backwards in time from the future towards the past (advanced potentials).

What are we to make of the Klein-Gordon equation with both positive energy solution $(+E)$ and the negative energy solution $(-E)$, if the positive energy solution is faster than light, also advanced if, according to this paper of both the near field and far field are advanced and superluminal, as shown by the experiments mentioned in this paper. Going back to the paper again on page 75, they say further: However, when the Schrodinger (ψ) wave equation is turned into a relativistically invariant equation, the Klein-Gordon's relativistically invariant wave equation:

$$E\psi = \sqrt{p^2 + m^2\psi}$$

Both solutions of the equation need to be considered as a possibility, even a non-physical negative energy has to be considered as a possibility. According to Klein-Gordon's equation: the positive solution $(+E\psi)$ describes waves which diverge from causes located in the past and which propagate towards the future (retarded waves); the negative solution $(-E\psi)$ describes waves which diverge from causes located in the future and which propagate backwards in time from the future towards the past (advanced waves).

The same issue is found here with the Klein-Gordon's relativistically invariant wave equation. If, according to this paper, one has shown from experiments, Bajlo, Walker, and Steffen Kuhn with plasma antennas, that both the near field and far field are advanced, and the far field is not really retarded, how are we to interpret this in the light of the Klein-Gordon's relativistically invariant wave equation?

Part of the answer is to regard $(+E)$ and $(+E\psi)$ on the assumption that the positive solution, that matter can only perceive only that part that is sufficiently slow in the corresponding rest frame, that the positive solutions are really advanced and superluminal, just like the advanced negative solutions $(-E), (-E\psi)$. This also implies that the experimental discovery with plasma antennas leads to the notion that there really is no distinction between the positive and negative solutions. But is this really correct? The Klein-Gordon equations are quite clear in what they mean? That there all advanced, that time is not only symmetrical as Maxwell's equations show with two solutions, one advanced and one retarded, that there is no difference really here, that there all advanced, and that the positive solutions of Maxwell's equations are really advanced, that its this distinction between advanced and retarded solutions is an illusion, created by the fact that matter can perceive only that part of the electromagnetic field that is only sufficiently slow in the corresponding rest frame, that really the positive and negative solutions of Maxwell's equations are all advanced, that there is no real distinction.

But a careful reader may notice that the Klein-Gordon equations are not compatible with Maxwell's equations. To explain how they might be considering a paper [17] by Frank Arntzenius and Hilary Greaves: 'Time reversal in classical electromagnetism'. They say in their abstract: Richard Feynman has claimed that anti-particles are nothing but particles 'propagating backwards in time'; that time reversing a particle state always turns it into the corresponding ant-particle state. According to standard quantum field theory textbooks, this is not so: time reversal does not turn particles into anti-particles. Feynman's view is interesting because, in particular, it suggests a nonstandard and possibly illuminating interpretation of the CPT theorem. This paper explores a classical analog of Feynman's view, in the context of the recent debate between David Albert and David Malament over time reversal in classical electromagnetism. On page 7, they do a time reversal transformation of Maxwell's equations:

$$\begin{array}{ccc} v & \to & -v \\ j & \to & -j \\ E & \to & E \\ B & \to & -B \\ \rho & \to & \rho \\ \nabla & \to & \nabla \\ t & \to & -t \end{array}$$

They say: It follows from this time reversal transformation, as straightforward inspection of Maxwell's equations and the Lorentz force law can verify, that time reversal turns solutions into solutions and non-solutions into non-solutions.

Regarding time reversal, the transformation of Maxwell's equations in the textbook example above has energy E positive, not $-E$ negative. But John G. Cramer (known for his transactional interpretation) has regarded advanced waves of Bajlo [2] that propagate into the past (electromagnetic waves) as possessing negative energy $-E$. Which is different from the above textbook example with energy E being positive. In the time reversal of Maxwell's equations, would not we have $-E$ negative energy in the transformation instead of E?

The Klein-Gordan equation:

$$E^2 = m^2c^4 + p^2c^2$$

Has two solutions E and $-E$ for retarded and advanced energy, one forward in time, and one backward in time. Does this apply to Maxwell's equations? If it does, then the solution of the time reversal transformation for energy should be $-E$. I checked - No, Maxwell's equations do not apply to the Klein-Gordan equation. Therefore, the textbook time reversal transformation on energy is E is positive. But they say instead they are coupled to it, to form the Maxwell-Klein-Gordan equation (MKG equation), which describes the motion of charged particles, interacting with an electromagnetic field.

In a paper I wrote in a Journal, 'Mass shift, coupled to electromagnetic field mass and temporal superposition' [19], writing from another paper [18] 'The Mass of the Gravitational field' by Charles T. Sebens says in this paper: Fields clearly possess energy, and by mass-energy equivalence $m = E/c^2$, also possess a mass that is proportional to their energy. In General Relativity, the mass of the electromagnetic field acts as a source of gravitation in just the same way that the mass of matter does. In fact, the electromagnetic field is considered to be ''matter'' in the broad way the term is often used in the context of General relativity. In fact, gravitational fields have been measured from light [20]. According to mass-energy equivalence, if something has energy E it has mass $m = E/c^2$. The electromagnetic field thus possesses a mass proportional to its energy; therefore, the Klein-Gordan equation $E^2 = m^2c^4 + p^2c^2$ might apply to Maxwell's equations in time reversal transformations, and especially having the negative energy solution $-E$, for backward in time. Therefore, the answer would be:

$$E \rightarrow -E$$

Being Backward in Time

According to the paper [18] by Charles T. Sebens, 'The mass of the gravitational field' says on page 5: The electromagnetic field possesses a mass proportional to its energy. Upon first encountering the idea that the electromagnetic field has mass, one might think that this must be a very different sort of mass than the mass of an ordinary material body. It is not.

Let me pause to preempt a potential confusion. When particle physicists discuss the mass of a given field, they are usually talking about a certain quantity that appears in the dynamical equations for the field and corresponds to the proper mass of the particle associated with that field. In this sense, the electromagnetic field is massless because the photon has no proper mass. That is not the sense of field 'mass' which I am examining here. When I talk about the mass of a field, I am talking about the relativistic mass of the field, proportional to the field's energy. Even though the photon has no proper mass, the electromagnetic field still has a relativistic mass density equal to its energy density divided by c^2.

The laws of electromagnetism are Maxwell's equations and the Lorentz force law. From these laws, one can derive an equation for the conservation of energy (Poynting theorem):

$$\frac{\partial}{\partial t}\left[\frac{1}{8\pi}(E^2 + B^2)\right] + \nabla \cdot S_f = -f_f \cdot v_m^q$$

The first term gives the rate at which the energy of the electromagnetic field is changing:

$$\rho_f^{\varepsilon} = \frac{1}{8\pi}(E^2 + B^2)$$

The ε superscript on ρ_f^{ε} indicates that this is the density of energy, and f subscript indicates that it is a property of the electromagnetic field.

I would say that this is equal to its electromagnetic mass density, therefore:

$$\rho_f^{\varepsilon} = E^2 = m^2c^4 + p^2c^2$$

It is equal to the Klein-Gordon equation, which has two solutions, one positive $+E$ and one negative $-E$, and backward in time. Therefore, the electromagnetic mass density can have a solution that propagates into the past and would be in the time reversal transformation: $E \rightarrow -E$.

In this way, one has shown how Maxwell's equations can be equal to the Klein-Gordon equation. So, the assumptions I was making earlier about Maxwell's equations and the Klein-Gordon equation might make sense, having two solutions, one backward in time, and forward in time, and the fact that the experiments I outlined earlier in this paper are advanced both in the near field and far field.

It's also shown that Maxwell's equations are equal to the Klein-Gordon equation, and that photons have momentum as shown in the Klein-Gordon equation, $E^2 = p^2c^2 + m^2c^4$

m drops out because light has no mass, and we are left with $E^2 = p^2c^2$ So we were left with momentum. But also, there are still two solutions, advanced and retarded light, momentum into the past, and momentum into the future of a photon.

That time is not only symmetrical, but that for energy that seems retarded is really advanced? Also, regarding the Wheeler-Feynman absorber theory, that there are propagated advanced and retarded potentials emitted when a particle is excited, must now be regarded as an illusory difference, the same as the advanced waves detected by Bajlo's experiment.

The dual solution of the Klein-Gordon equation has two solutions, 1-forward in time, 2-backward in time. If there is no distinction between the near field and far field, then both are advanced. How does one regard 1 and 2? Would there not just be 2, that is, time moving backwards? But we don't experience this? Either 1 is illusion and there is no distinction between 1 and 2, or is it the fact that there are two time flows, one forward and one backwards, that this symmetry of time is due to the fact that in the case of 1, that ordinary matter is sufficiently slow in perceiving advanced energy associated with time moving backwards, that we can only perceive time moving forward, were this creates the distinction of two flows of time, and of a distinction of the past and future.

When Steffen Kuhn in his paper [1] says in his conclusion on Plasma antennas, the basic hypothesis is based on the assumption that matter can perceive only that part of the electromagnetic field that is sufficiently slow in the corresponding rest frame, where this implies that the Earth is continuously penetrated by electromagnetic waves moving faster than c with respect to our planet - creates the distinction for us of a retarded and advanced flow of time, or creating for us the retarded view of time in our universe of the forward flow of time. Distinguishing the fact that us not perceiving the backward flow of time.

Also, in the experiment with plasma antennas, they said in their paper that Weber electromagnetism leads to obtaining violations of special relativity, and is applied to their experiment where they received transmissions before it was sent.

So, the advanced waves are hidden from us, which are from the future. This reminds one of the equivalence paradox [21] from the book by Moray B. King, 'Tapping the zero-point energy': Here, a uniformly accelerated charge is recognized to radiate. However, a charge suspended at rest in a uniform gravitational field does not. According to general relativity, a uniformly accelerating system in free space should be equivalent to one at rest in a uniform gravitational field. Thus, in this case, the principle of equivalence seems to be violated. This problem has been discussed in the literature at the classical level without adequate resolution. For example, Rolrhich, Atwater, and Ginzburg conclude that radiation is a function of the acceleration of the observer in relation to the source charge. But as Ginzburg asks, what are photons, and what propagates at the velocity of light if it can be made to appear or disappear depending on the acceleration of the observer? Boulware similarly suggests that ''the way out of the paradox is to deny that the concept of radiation is the same in the accelerated and unaccelerated frames.'' This interpretation likewise throws out the independent existence of light by linking it to the motion of the observer.

Seeing advanced radiation from space with plasma antennas and not seeing it with conventional antennas, the electromagnetic radiation from an accelerating charge and not seeing it, depending on our reference frame and motion, is all similar to what happens to an observer in free fall, where an observer regards himself at rest, where gravity disappears, and to an observer on the ground regards there as being a gravitational field. Why we can see advanced energy and why we can't see it, and why we can't see and experience the past, all depend perhaps on our frame of reference.

Expanding on the above, I like to present what Michael Lockwood argues in his book [15] 'The Labyrinth of time', on frames of reference and simultaneity, and different observers agreeing on different viewpoints, as when the future or the present occurs: Einstein, Eddington, Jeans and others base their conclusions on the assumption that the correct way to interpret special relativity is to view it as describing a four-dimensional space-time manifold. As they see it, objects in this manifold - or more precisely, the corresponding world-lines are simply laid out, like pieces on a chessboard, with the key difference that the 'pieces' cannot move. Hilary Putnam (1967), however, in a celebrated article, argues for the same conclusion, without initially assuming this interpretation. His key premise is merely that there are no privileged observers or frames of reference. Putnam uses the term 'real' in a way that corresponds to the stronger of the two grades of reality that I distinguished above, and that I referred to earlier as 'full-blooded' existence. He uses it, that is to say, in the sense in which the man or woman in the street would regard only what exists or is happening right now as fully real.

In order to establish that, from a relativistic perspective, things lying in the future should be regarded (as Einstein regarded them) as being real in this 'full-blooded' sense, Putnam first considers the following situation. You and I are zooming along at different velocities in our respective spaceships. And as ships that pass in the eternal night of interstellar space, we have a close encounter in which we may be thought of (for all intents and purposes) as fleetingly occupying the same here and now. This gives rise to a crucial question, namely, 'At the time of this encounter, what should I regard as real? I must surely be entitled to regard myself, here and now, as real. And presumably, since we share the same here and now, I must likewise regard you, here and now, as real. But what else can I now regard as real? Putnam proposes the following two principles - let us call them (S) and (T) - to which I can appeal to answer this question.

(S) At any given event on my world-line, I am obliged to regard as real everything that is simultaneous with that event, in the frame of reference defined by my instantaneous state of motion at that event.

(T) If, at a given event, e_1 on my world line, I am obliged to regard someone else as real at an event, e_2 on that person's world-line, then I am obliged, at e_1 to regard as real everything that this other person, at e_2 is obliged to regard as real.

Both principles, superficially at least, are very plausible. (S) is merely a relativistic version of the common-sense principle, cited above, that we should regard as real, in a full-blooded sense, everything that exists or is happening now. (T) embodies the idea that we are not entitled to regard ourselves as privileged observers. When you and I meet, at any space-time location, it would seem arbitrary and egotistical for me to regard my state of motion as carrying greater authority than yours, when it comes to defining what is, and what is not, real from the perspective of our shared here-now.

It is easy to show that if (S) and (T) are correct, I am obliged to regard as real some things that lie in the future, with respect to the coordinate system defined by my current state of motion. This arises in consequence of our different states of motion, which lead you-now and I-now effectively to adopt different criteria of simultaneity.

Suppose that a general election has been called for a certain date, which is in the future from my perspective (and thus lies above the simultaneity hyperplane that, in my frame of reference, intersects the here-now). From your perspective, by contrast, the voting may be going on right now. The election, that is to say, is simultaneous with our shared here-now, with respect to your frame of reference. (In space-time terms, the election lies on the simultaneity hyperplane that, in your frame of reference, intersects the here-now). I can then argue as follows. Clearly, I am obliged to regard you-now as real. For you-now are simultaneous with me-now, not merely with respect to the frame of reference corresponding to my current state of motion, but with respect to all frames of reference. Since, according to (T), I am obliged to regard as real everything that you-now regard as real, it follows, therefore, that I am obliged to regard the election as already real, even though, by my own reckoning, it lies in the future! Similarly, if less dramatically, I am obliged to regard as still real some events that, by my reckoning, lie in the past (that is, are situated simultaneity hyperplane that, in my frame of reference, intersects the here-now). This is because, from your perspective, they too are present (that is, lie on the simultaneity hyperplane that intersects the here-now in your frame of reference).

Let me stress that the disagreements between you-now and me-now, as to whether events should be assigned to the past, present, or future, will affect only such events as lie outside the light-cone that is centred on our fleetingly shared here-now. And this means that neither you-now nor I-now can use the argument just presented to establish the current reality of events that occur in our personal future or past. The argument can readily be extended, however, so that it applies, not only to things that lie in the future of the here-now, with respect to the frame of reference defined by my current state of motion, but to things that lie within my future light-cone: things that I must therefore regard as future, from the perspective of the here-now, relative to any choice of a frame of reference. This means in particular, that I can use an argument similar to that just set out to establish the reality of things within my personal future, thus including states of affairs that result from my own, apparently free, choices.

From this, one can argue that the future and past exist as realities, but the reason we don't experience the future or past is that they're not in our frame of reference. Coming back to the equivalence paradox, there is a paper [14] by David G. Boulware, 'Radiation from a uniformly accelerated charge'. He says in his abstract: The electromagnetic field associated with a uniformly accelerated charge is studied in some detail. The equivalence principle paradox that the co-accelerating observer measures no radiation while a freely falling observer measures the standard radiation of an accelerated charge is resolved by noting that all the radiation goes into the region of space-time inaccessible to the co-accelerating observer.

What David Boulware argues in his paper, that the radiation from a uniformly accelerated charge, that the radiation goes to a region of the future light cone inaccessible to the co-accelerating observer, or that it's not in the co-accelerating observer's light cone. The same sort of thing is said in a paper [16] by Camila de Almeida and Alberto Saa, 'The radiation of a uniformly accelerated charge is beyond the horizon: A simple derivation.' They say in their abstract: By exploring some elementary consequences of the covariance of Maxwell's equations under general coordinate transformations, we show that even though inertial observers can detect electromagnetic radiation emitted from a uniformly accelerated charge, comoving observers will see only a static electric field. This analysis can add insight into one of the most celebrated paradoxes of the last century.

In both papers, they use space-time diagrams of light cones and show that for observers in different space-time regions, they will detect no radiation from an accelerating charged particle, which is beyond the frame of reference of these observers. The same argument can be said of why we don't experience the past or future, even though such past and future times exist, and makes the distinction for us of the past and future and why we are not aware of advanced radiation from the future, because matter can perceive only that part of the electromagnetic field that is sufficiently slow in the corresponding rest frame. And why is it detected with plasma antennas in the rest frame and not the transmitter's rest frame. Because the receiver's rest frame is in the light cone of the advanced electromagnetic radiation. Also, the reason no superluminal radio waves can normally be detected in the far-field of a dipole antenna is that they have gone into a different region of space-time, outside the light cone, and not in one's frame of reference, much similar to the equivalence paradox.

CONCLUSIONS

The fact that advanced electromagnetic radiation in the far field is outside our light cone, and therefore not detectable and not in our rest frame, only in the rest frame with plasma antennas, shows that it's also similar to the equivalence paradox of a uniformly accelerating charge that does not radiate. When the same explanation given above makes one wonder if that is the reason an observer in free fall will regard himself at rest, and the absence of a gravitational field, in this observer's frame, can be explained by a similar argument above, that the gravitational field is not in the rest frame of an observer in free fall. Even in a different space-time area?

One feels that one has given a hypothesis and explanation for regarding as superluminal of electromagnetic radiation as superluminal in both the near-field and the far-field. Also, one makes the suggestion that reason superluminal electromagnetic waves are only detected in the near-field and not the far field, is that in the far-field, the superluminal radio waves disappear in a different region of space-time, not in our light cone or reference frame.

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