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Guest Commentary

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[This is an interesting 3-part commentary by Joseph F. Cuny cuny@onemain.com.]

A New Relativistic Paradox

As part of the developing age of planetary travel, a number of organizations have been working with the concept of solar sails. It happens that the fundamental equations for these were included in Einstein's original presentation of Special Relativity although they may have been overlooked. An Einstein approved English translation was published as 'On The Electrodynamics Of Moving Bodies' in the Dover book 'The Principle of Relativity'.

In *section 8* of that paper, Einstein developed the equation for radiation pressure on a perfect reflector moving at a speed v : an electromagnetic wave or photon impinging on and accelerating a perfect reflector. The equation of interest here is his $P=(2A^2/8\{\pi\}) (\cos\{\phi\}-v/c)^2/(1-v^2/c^2)$. When the angle of incidence is eliminated to maximize the pressure, the relativistic factor of this equation becomes $(1-v/c)^2/(1-v^2/c^2)$ which reduces to $(1-v/c)/(1+v/c)$. In the limit as v approaches c , this becomes zero thus the speed of the reflector (solar sail) cannot exceed c . This is in conformance with all of relativity; nothing can travel faster than c . Unfortunately, it introduces a paradox that apparently has not been previously recognized.

In developing this equation, Einstein used the electric field strength (A) of the wave, his relativistic transformations, and a mirror with perfect reflectance. Apparently no one has noticed that nowhere in his formulation and development did he use any properties of the mirror other than the reflectance. Since no other properties were involved, the limitation on the speed of the mirror cannot be due to the mass/energy of the mirror! In fact, Einstein's equation clearly states that in the limit as v approaches c , the **pressure (or force)** approaches zero. This is in opposition to his *section 10* 'Dynamics Of The Slowly Accelerated Electron' where the Coulombic force of the electric field is defined to be constant, leading to the well-known mass/energy change.

This is a very real paradox because Einstein's paper states that accelerating with Coulombic forces produces a mass change but using electromagnetic waves does not! In Einstein's development, the electric field strength in both cases is constant. Additionally, he used the same relativistic transformations in developing both formulations. This leaves only the interactions between the two types of field and the object being accelerated. Phrased differently, the paradox is not due to the mathematics but is apparently due to a physical difference between a Coulombic acceleration and one due to photons. Not only is this a new paradox, it is a new class that indicates a possible problem in our understanding of fundamental physics.

This raises an important question. Why does Einstein's paper indicate that an electric field in free space accelerates an object differently than the electric field of a photon in free space?

The Ubiquitous Pillbox

Joseph F. Cuny

The pillbox is usually introduced in first year physics where it is used to develop the idea of a field-free interior of a spherical shell. This idea is then carried over (directly or indirectly) into many other areas. It may be time, however, to look more closely at a major inference of the pillbox.

With inverse square laws it is easy to mathematically demonstrate that such an interior is field-free but is this physically correct? A mathematical field is defined by hypothetically inserting a 'test' mass or charge in the given space then 'observing' the virtual movement. Integration of the appropriate equations mathematically shows there is no net force applied to such a test particle thus there is no field present or is there?

The pertinent question may be philosophical but it is extremely important to modern physics. *Are compensating fields identical to a total lack of fields?* Treating the closure of the shell as a boundary condition and then opening the smallest pinhole in that shell immediately produces both a force field and an energy field within the shell, albeit very small fields. Since the instantaneous creation of such fields is physically unlikely, the closed shell apparently contains compensating fields that are no longer fully compensating when the pinhole is produced. There is a distinction between the mathematical and the physical cases.

Why is this distinction important? The belief that a void or vacuum is devoid of fields is the basis for a number of well known crucial experiments, both theoretical and real. Re-evaluation of these experiments and associated theories could result in new paradigms in physics. Contrary to the common inference from the concept of the pillbox, empty space may not actually be empty!

Assumptions Establish Perceptions

Joseph F. Cuny

In 'A New Relativistic Paradox'¹ it was shown that Einstein's presentation of Special Relativity (SR) contains two non-compatible results. Using an infinite sequence of electric fields supplying energy to an electron he concluded that much of the energy was converted to mass (mass/energy change). Using photons (electromagnetic fields) he showed that a perfect reflector (solar sail or electrons) could be accelerated to the speed of light with no change in mass. Whether or not there is a mass change raised a question about the difference in the means of acceleration by an electric (Coulombic) field and by a photon.

This problem is apparently due to normal assumptions about the means of energy transfer of a photon: tacit assumptions! Since the photon has mass and energy and, upon detection, exhibits properties of a particle, it must transfer momentum and energy as any other particle. With these assumptions (this knowledge) it is obvious there is no need to investigate the transfer mechanism. This is the present perception that led to the non-compatible results.

The above question cannot be answered by mathematical methods therefore it is necessary to question the assumptions and look at the physics or mechanics of the photon. As is well known, an electromagnetic wave (photon) is composed of crossed electric and magnetic fields that are perpendicular to the path of travel. This has been mathematically formulated in Maxwell's Equations that are familiar to third year physics students. To clarify and simplify the mechanism of energy transfer, define a continuous wave that is traveling along the X-axis and is polarized with the electric field in the vertical Y plane thus the magnetic field is in the Z plane.

The wave travels past an electron on the X-axis. The alternating electric field accelerates the electron up and down in the Y plane. The magnetic field, being out of phase with the electric field, is in phase with the vertical velocity of the electron. As a result of the crossed velocity and magnetic field, the vertically oscillating electron is rotated forward along the X-axis with each half-wave. In effect this pulsing mechanism is equivalent to an electrical engineer's rectifier.

The electrical field of the wave accelerates the electron in the same way that a Coulombic field accelerates the electron except for the periodicity due to the 'sinusoidal' wave and the direction of acceleration. Energy is transferred with the passage of each half-sine thus energy transfer per unit time is proportional to the difference in speeds (actually velocities), $c-v$. Additionally, if the wave is traveling in the opposite direction (retarding the electron) the speed difference is $c+v$. Mathematical games can be played with the reference systems leading to several ways of writing the velocity difference (including Einstein's transform) but physically, the above two describe the two different conditions. In either case, given a strong enough and long enough continuous wave, the electron will be 'captured' by and travel with the wave. When that happens, no further energy can be transferred.

With this change in assumptions (the mechanism is/is not important) there is a resulting change in perceptions. Since the above is fully compatible with Maxwell's Equations, Einstein's equation for the pressure on a perfect reflector is probably more valid than his other equation therefore his mass/energy change is invalid. It must be noted that this does not invalidate the mass/energy concept, only Einstein's explanation for it.

In order to further elucidate one of the problems this poses, it is necessary to look further at his fundamental assumptions. In his presentation of SR², Einstein stated that light travels at a given speed c in empty space. This assumption, based on all previous work, still appears valid although the speed measurements were performed in vacuua, not in empty space³. The application of this assumption, however, led to a state of mind (a perception) that relegated Newtonian physics to low-speed phenomena while all extremely high-speed phenomena became

the domain of relativity. This perception is questionable because Maxwell's Equations describing light, along with gaseous refraction, etc. (all high-speed phenomena) were all developed within Newtonian physics. An alternate perception that could have been made pertains to the 'empty space' of the assumption. With this in mind the domain of relativity becomes empty space, meaning space devoid of all things that could interact with light. Any 'earthly' space containing things like particles, ions, electric⁴ and magnetic fields, etc. are the domain of Newton.

This concept of empty space is critical to relativity because the presence of anything in that space would act as a 'special reference system'⁵ and thus invalidate the entire theory. It was also tacitly assumed that space beyond the atmosphere of the earth was empty. This was a reasonable assumption when it was presented but that assumption has not since been questioned because of the perception (belief) that Einstein was (is) correct. Now, a century later, Science and the general public know that within the heliopause there is no truly empty space. The existence of particles, ions, etc. within that space forms Einstein's nemesis, a special reference system.

In the existing perception, the difference between Newtonian and relativistic phenomena is determined by the speed of the phenomenon. This, however, cannot be the determinant because electromagnetic waves exist in and had their structure elucidated within Newtonian physics. Looking at the basic assumptions of SR it can be seen that the true determinant is the existence of constituents within the given space. In this new perception the entire heliopause, at a minimum, is the domain of Newtonian physics therefore SR cannot be validly applied within that space. Once Einstein's assumptions are reevaluated, the new perception can lead to a new scientific revolution, one based on physics not mathematics.

References:

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3. J. Cuny, "The Ubiquitous Pillbox", Journal of Theoretics, Vol. 5-4.
4. J. Cuny, "[The Photon and its Aether](#)", Journal of Theoretics, Vol. 3-2.
5. Einstein's phraseology, Ibid.

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