The Interaction Velocity of the Electric Force

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I. Background

In the first part of the nineteenth century, when interest and experimental work in electrical and magnetic effects was rapidly expanding, much effort was directed toward an understanding of the mechanism whereby electric charges and permanent and electric magnets were able to exert forces on one another through empty space. A closely related issue was the question of the velocity of this interaction; was it *finite* or was it *infinite*? It appeared that a theoretical solution to this question was arrived at by J. C. Maxwell when he discovered that the traveling wave solution of the set of electric and magnetic field equations, commonly known as *Maxwell's equations*, appeared to propagate at a velocity determined by the permittivity and permeability of free space and which was found to be very nearly equal to the velocity of light. At that time it was still widely believed that light waves were propagated through an ether that pervaded all of space and Maxwell concluded not only that his newly discovered electromagnetic waves also propagated through the same ether, but that light also was of an electromagnetic nature. When Hertz produced in the laboratory the waves predicted theoretically by Maxwell and demonstrated that they had many of the same properties of light, the unification of the two phenomena was essentially complete, although they were still believed to be transmitted through an all pervasive ether.

This assumption was undermined by the negative result of the Michelson-Morley experiment of 1887 and was generally abandoned with the acceptance of the Special Theory of Relativity, published by Albert Einstein in 1905. The cumulative result of these discoveries and inventions was the conclusion that varying or moving electric charges radiate energy in the form of electromagnetic waves which propagate through space at a maximum velocity c, the velocity of light. As to the validity of this conclusion, there can, of course, be no debate. It has been proven time and time again and countless practical devices have been constructed in accordance with the principles derived therefrom. An important question has been left unanswered and it is to this question that this paper is addressed.

The basic law of electrostatics is known as Coulomb's Law and may be written in the following form:

$$F = k\frac{q_1 q_2}{r^2}$$

This law, which forms the basis of the electrostatic system of units (ESU) and is essentially identical in form to Newton's *Law of Universal Gravitation*, states that the force between two charges is proportional to the product of their magnitudes and inversely proportional to the square of the distance between them. Being defined as a law of electrostatics it is strictly valid only in the case where the two charges are at relative rest and are not varying in magnitude as a function of time. This does not, however, necessarily preclude its applicability in the time varying case and we shall now inquire into the nature of the force exerted on q_2 if q_1 is perturbed, either in magnitude or in position with respect to q_2.

It is immediately obvious that q_1 will radiate electromagnetic waves, some of whose characteristics will depend on the type of perturbation and which will spread radially outward at the velocity of light. After a period of time, determined by the distance between q_1 and q_2, has elapsed, the electromagnetic waves will interact with q_2, producing a perturbation thereof. A question now presents itself: is the nature of the force that exists between the unvarying and fixed charges similar to that of the transient force exerted by the passing wave front initiated by the variation or the translation of one of the charges? Contemporary science has regarded the two as being one in the same, which, I submit, is an assumption that has been accepted on the basis of collateral and possibly unrelated evidence and for which no direct proof exists at all. In the general case, and on the basis of the lack of reliable experimental evidence currently available, one must not rule out the possibility that if an impulse either in magnitude or displacement is applied to charge q_1, that two impulses will be detected by charge q_2, one resulting from the electromagnetic disturbance and another resulting from the purely electric force disturbance.

Let us examine the consequences derived from Coulomb's law if we do not make the common assumption that all time varying electric charges give rise to only electromagnetic effects. Let q_1 be restrained from motion and be allowed to vary sinusoidally in intensity such that

$$q_1(t)=q_0\cos(\omega t)$$

where ω is the frequency in radians per second. Substituting this into Coulomb's law:

$$F=k\frac{q_0 q_2}{r^2}\cos(\omega t)$$

Equating with Newton's Second Law, where m is the mass of charge q_2

$$m\frac{dv}{dt}=k\frac{q_0 q_2}{r^2}\cos(\omega t)$$

Integrating with respect to t:

$$\int m\,dv(t)=\int\left(k\frac{q_0 q_2}{r^2}\cos(\omega t)\right)dt$$

$$m\,v(t)=k\frac{q_0 q_2}{r^2}\sin\frac{(\omega t)}{\omega}$$

Integrating again with respect to t to obtain $x(t)$

$$x(t)=\int v(t)\,dt=-\left(k\frac{q_0 q_2\cos(\omega t)}{\omega^2 r^2 m}\right)$$

This result indicates that the displacement of q_2 about its equilibrium point varies in phase with the disturbance $q_1(t)$ and that this phase relationship is not a function of the distance r separating them, as would be the case if this were a traveling wave phenomenon. On this basis, we would expect that an impulse applied to q_1 would result in two impulses received by q_2 whose separation in time is proportional to the distance between them.

The specific purpose of the experiment described herein will be to determine whether or not these impulses arrive at q_2 simultaneously or whether they are separated by some time interval. A search of the literature has revealed that an experiment of this type has not yet been performed, in spite of its most fundamental nature. The data generated by this experiment will be of importance, irrespective of what the specific result turns out to be. If the test reveals that the pulses arrive at q_2 simultaneously, it will remove the unfounded assumption described previously and place the current theoretical paradigm

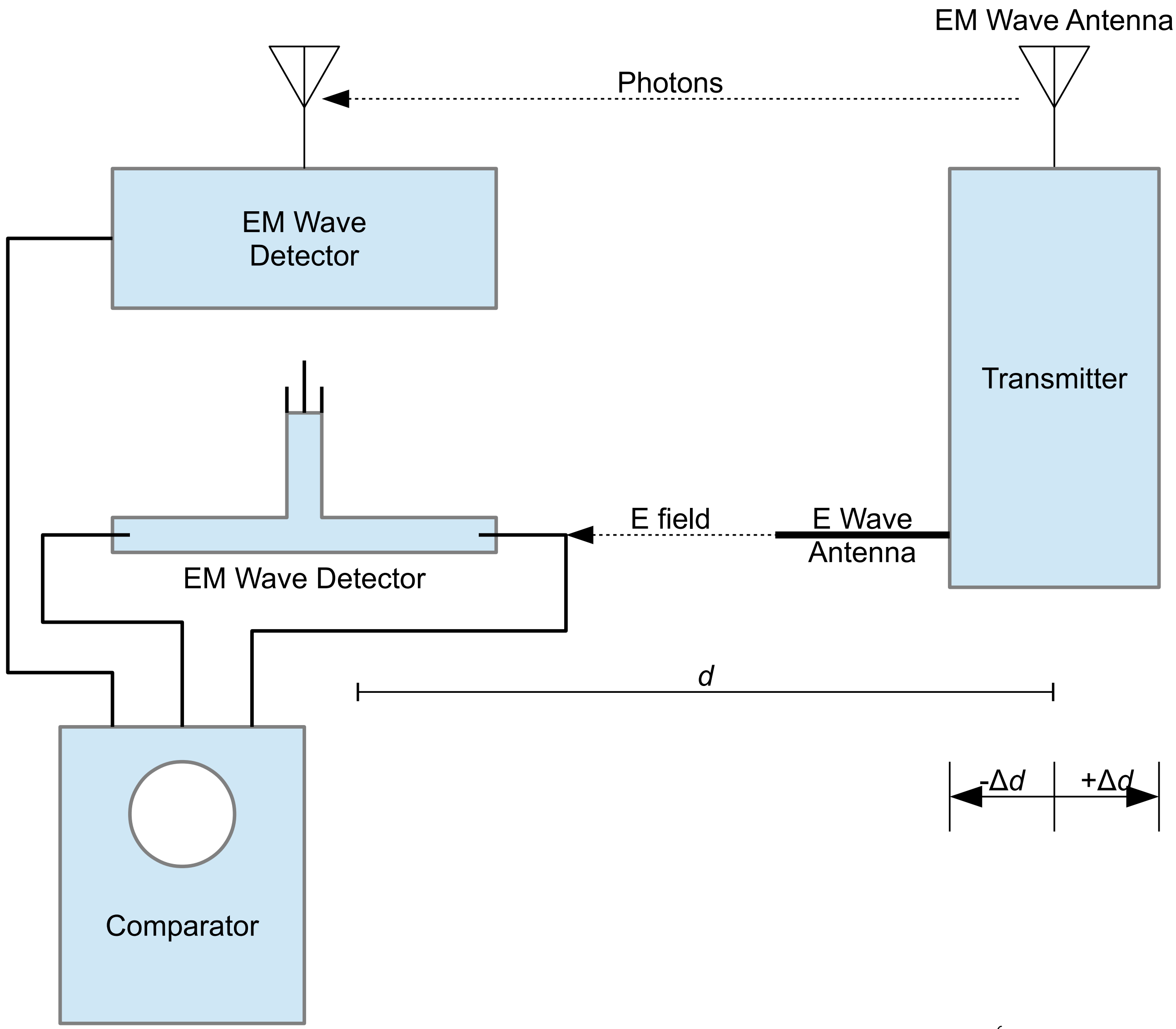

Figure 1: Experimental Apparatus for the Determination of $t = (t_{em} - t_E)\begin{cases} = 0 \\ \neq 0 \end{cases}$

on a sounder footing. If, on the other hand, the pulses arrive at distinct times, whose separation is a function of the intervening distance, then this experiment could provide a basis for an entirely new type of communications system whose characteristics may be markedly different from those currently in use.

II. Experimental Proposal

The proposed experiment will initially be geared to determine whether $\Delta t = t_{em} - t_E$ is either zero or non-zero only, rather than attempting to determine the magnitude of Δt, should it be non-zero. This is done so as to enable not only a lower cost experimental apparatus, but also to reduce the amount of time required to obtain the result. The apparatus consists of a single transmitter with antennas designed to maximize both the electromagnetic wave transmission and the electric force transmission. In addition, there are two separate receivers, one of which can be a common, electromagnetism wave receiver tuned to the frequency of the transmitter and the second, a special type, designed so as to be sensitive to the Colombic force exerted by a varying charge; and is insensitive as possible to the electromagnetic radiation, which is also emitted.

These receivers will be located some distance *d* from the transmitter and their outputs observed in the form of a sinusoidal wave shape on the display of a dual-trace oscilloscope. After these waveforms have been set in some reference position, the separation between the transmitter and receivers will be increased or decreased and any phase shift from the reference position noted. If the two impulses travel at the same velocity then we should expect no relative phase shift of the waveforms as the transmitter is moved. In the alternative, if the transmission rates differ then we would expect to see a phase shift. Thus, it is seen that whatever the results of a properly done experiment of this type are, an important question will be answered (see Figure 1).

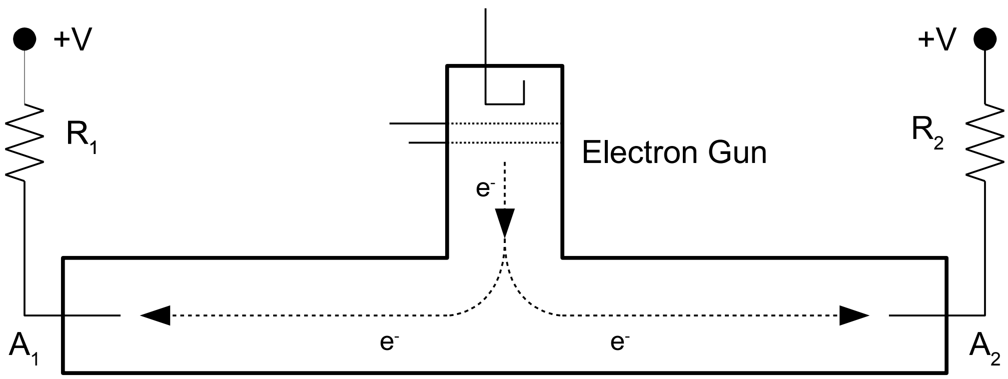

Figure 2: Electron Gun

III. The Electric Force Detector

A new type of detector must be developed such that it will provide a maximum response to a changing electric field and a minimum response to an electromagnetic field, here are undoubtedly many conceivable designs to accomplish this end, but the one described below has been selected from the many possibilities considered as being one which offers a high degree of potential suitability. Its sensitivity and noise rejection are enhanced by operating in the differential mode and the fact that it offers its greatest sensitivity to the electric disturbances along the longitudinal axis provides substantial rejection of any electromagnetic contamination of the signal. The tube uses a standard cathode ray gun as a source of charged electrons in a beam. This beam is split into two components which travel in opposite directions towards two anodes, A_1 and A_2. In operation, the beam is balanced so that the current flow, and thus the potential present at each of these anodes is equal. When an external electric charge is present along the longitudinal axis of the tube, the effect will be to unbalance the electron beams causing a differential voltage to appear across the two anodes. Preliminary calculations indicate that a charge of 10^{-10} coulombs at a distance of 10m from the tube will give rise to a differential voltage of approximately 1.6mv, a signal easily retrievable and processable by rather unsophisticated equipment. (See Figure 2)

IV. Progress to Date

The apparatus assembled to date consists of the tube described above, a power supply capable of presenting variable voltages to the various elements of the detector tube and signal processing devices to provide sufficient gain and noise rejection to present a suitable signal to the oscilloscope display. Satisfactory operation of this system has not yet been obtained and the probable cause has been traced to excessive return of electrons to the accelerator anode of the cathode ray gun through elastic collisions at the intersection at the longitudinal arm of the tube. It is anticipated that one or more generations of modification of the tube must be made in order to ensure satisfactory operation. See Figure 3.

V. Conclusion

It should be reemphasized that this experiment is designed to test an aspect of electric theory that has not yet been subject to proper experimental verification and that the results of this work will be valuable to the scientific community independently of the assumptions that they support. Furthermore, if it should turn out that the pulses arrive at distinct times, there will be some substantial theoretical and practical ramifications.

The theoretical consequences will undoubtedly be dominated by a long overdue reevaluation of the significance of the Special Theory of Relativity and its eventual removal from the center stage of scientific dogma. This will create a suitable atmosphere for the consideration and examination of new and more fruitful ideas by the majority of the scientific community.

In the way of practical applications, a two pulse experimental result could open the way to the development of a new communications system that might permit the establishment of contact with distant places without the annoying time delay resulting from the finite velocity of light. A great deal of effort is currently being expended in an attempt to detect electromagnetic signals from hopefully intelligent extraterrestrial beings. To date these attempts have resulted in repeated disappointment. Rather than indicating that there are no intelligent beings out there sending signals, these failures might be suggesting that we are not looking at the right kind of transmission mode.

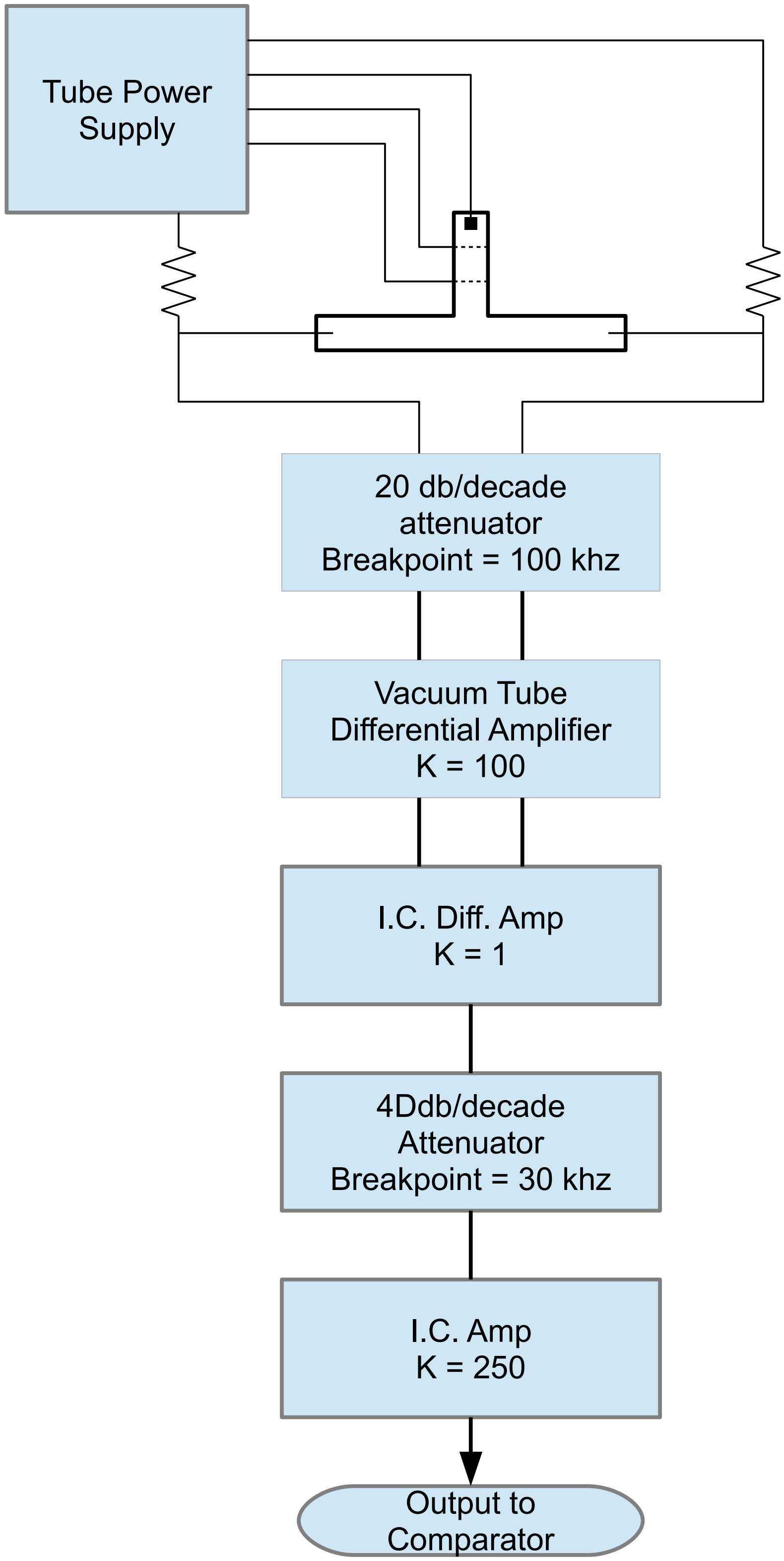

Figure 3: E Field Detector Tube and Associated Systems