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Electromagnetic Experiment

Propagation Time of a Coulomb Event

Introduction.

Maxwell's famous four equations are shown below in point form. The expressions have been manipulated so that the electric and magnetic field terms (**E** and **H**) are shown explicitly. These equations specify almost every aspect of that branch of physics involving electric fields, magnetic fields, and charge. This paper contains references to these equations, and it should be noted that the term "Coulomb field" is used in place of "electric field" in order to be consistent with other papers that have been referenced. Also note that this paper assumes the "superposition property" is applicable to Maxwell's equations. This seems to be a universally accepted assumption for most mediums.

1. $\nabla \cdot \mathbf{E} = \rho_v / \varepsilon$

2. $\nabla \cdot \mathbf{H} = 0$

3. $\nabla \times \mathbf{E} = -\mu\, \partial \mathbf{H}/\partial t$

4. $\nabla \times \mathrm{H} = \varepsilon\, \partial \mathbf{E}/\partial t + J$

Maxwell's Equation 1 defines the spatial relationship between charge and the Coulomb field that emanates from charge. When this equation is applied to a spherical surface enclosing a point charge it shows that the Coulomb field at the surface is a simple inverse square function of distance from the charge times the magnitude of the charge. If you apply this equation to a metal plate it specifies that the Coulomb field at every point in space surrounding the plate would be the superposition of the fields that emanate from each charge in the plate. If the plate had been given a negative charge (i.e., more negative charges than positive charges) the equation would specify a negative Coulomb field surrounding the plate since the fields that emanate from each of the negative charges in the plate would only be partially cancelled by the fields that emanate from the lesser number of positive charges in the plate. If the plate had been discharged (i.e., equal number of positive and negative charges) the equation would specify a zero strength Coulomb field surrounding the plate since the fields that emanate from each of the positive charges in the plate would be cancelled by the fields that emanate from each of the matching negative charges.

It is interesting to speculate about what transpires in the space surrounding the plate during the plate's transition from a charged to a discharged state. If the transition to zero charge takes place in a microsecond will the strength of the Coulomb field in Alpha Centauri be zero in a microsecond? Or, will there be a propagation delay of the diminishing Coulomb field such that the effect won't be felt on that distant star for years? A group of European researchers[1] addressed this very issue in a paper they published in 2015. Their laboratory measurements indicated that the Coulomb field is a rigid attribute of charge, which if true would mean the change in the Coulomb field caused by discharging the plate would be felt everywhere in the universe at the same time. This is tantamount to saying that a Coulomb event propagates at infinite velocity. A German researcher[2] in 2016 conducted an altogether different type of laboratory measurement which indicated that the Coulomb field propagates much faster than the speed of light.

Note that these experimental results do not in any way conflict with Maxwell's equations. Recall that although Maxwell's Equations 3 and 4 stipulate a speed-of-light propagation[3] of Coulomb and magnetic fields that have broken free from the parental charge that spawned them, those equations do not impose any such constraint on fields that are still linked with their parental charge. In addition, the speed of light constraint that those equations do impose only applies to propagation orthogonal to the liberated fields; the equations do not impose propagation constraints in any other direction on the liberated fields. Additionally, Maxwell's Equation 1 which specifies the strength of a Coulomb field that is still linked with its parental charge, does not impose any constraints whatsoever on propagation velocity. However, this fact is often disregarded. Maxwell's Equation 1 is generally treated as if there is some aspect of the equation that disqualifies it from consideration in matters involving propagation and/or a changing Coulomb field. Although the presumption of a disqualifying attribute may seem justified considering the equation's historical roots, the literal interpretation of the equation does not contain any such caveat. In fact, the literal interpretation of Maxwell's Equations in toto reveals only one constraint on field propagation velocity which is that Coulomb and magnetic fields that have bonded to form radiation will propagate at exactly the speed of light.

Clearly the experimental results of these outside-the-box researchers do not conflict with the literal interpretation of Maxwell's edicts. However, they flagrantly conflict with Einstein's. Of course, it is that conflict that makes their results so tantalizing.

Purpose.

The purpose of this experiment is to ascertain whether a coulomb event propagates at a velocity greater than the speed of light.

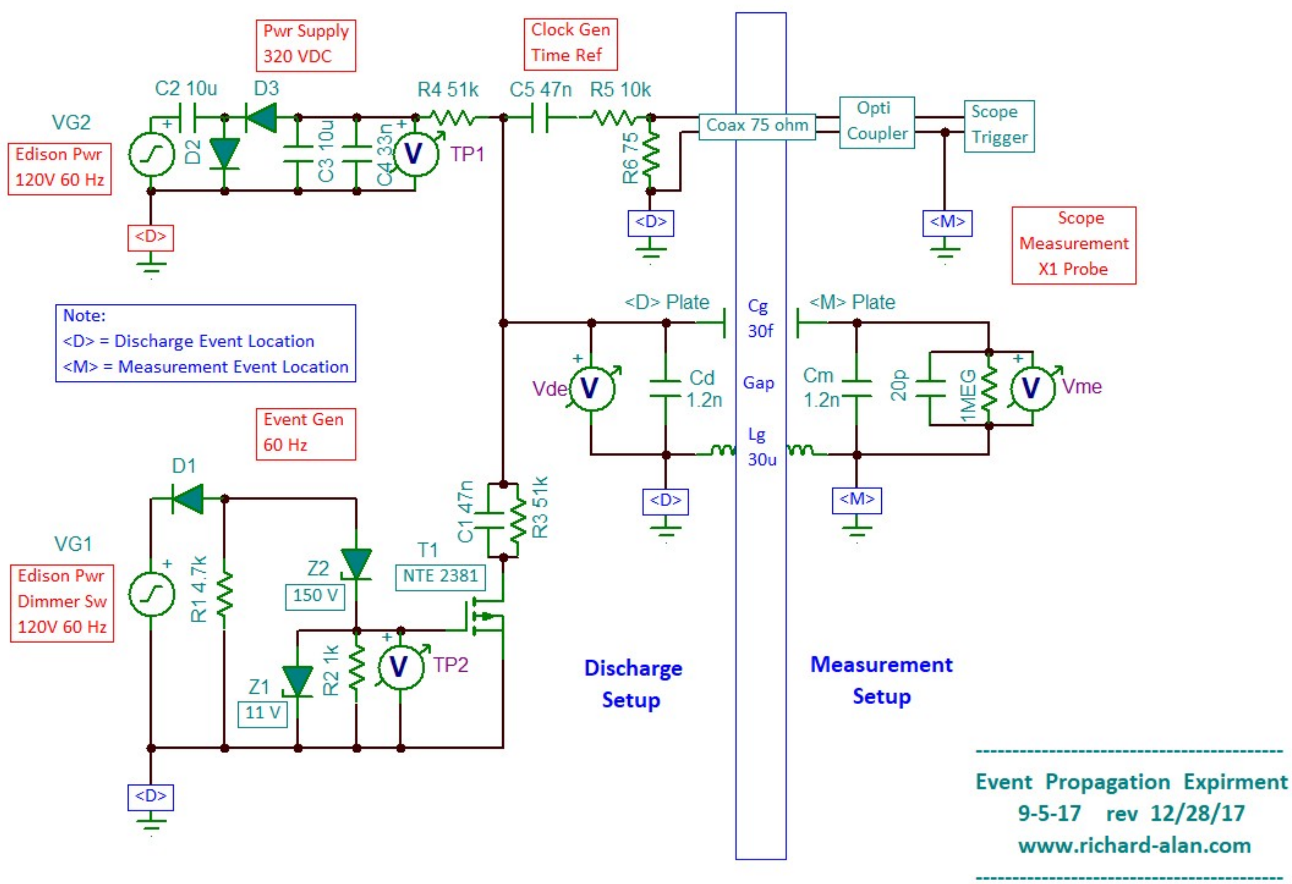
Approach.

The implementation of this experiment is straightforward. A coulomb event is generated by the sudden discharge of a metal plate, and measurements are made to ascertain the time lapse in sensing the event at a known distance from the plate. However, several issues make this straightforward approach somewhat complicated. First, "coulomb event" in the context of this experiment means a prominent change in the Coulomb field via the discharge of a metal plate. It is impossible to create such a change without the physical movement of charge. Thus, generating a Coulomb event via discharge of a metal plate will give rise to a corresponding "magnetic event" due to the motion of charge. You can think of the sudden discharge of the metal plate as a short duration electromagnetic explosion in which various orientations of field entities (both Coulomb and magnetic) populate the space surrounding the metal plate. Empirical observations suggest that many of the Coulomb and magnetic field entities will break free from their parental charge and bond together in accordance with Maxwell's Equations 3 and 4, forming a new electromagnetic entity that propagates at exactly the speed of light. This new entity, called radiation, invokes the same response in an oscilloscope measuring device as a change in the Coulomb field. Thus radiation could easily overshadow any measurement of a changing coulomb field, and the experiment must provide a means for discriminating against that. To this end, the implementation utilizes a measurement plate positioned at a distance of 48 feet from the discharge plate. Since radiation can only occur at a propagation velocity of exactly the speed of light, the measurement plate will have a 48 nanosecond window (1 nanosecond/ft) before radiation can arrive and corrupt the measurement. As long as the event duration is significantly less than that, the window will provide ample time to sense whether the coulomb event (or any other measurable event) propagates faster than light. There is a downside to this radiation free window, and it brings up a second complicating issue in implementing the experiment. The large distance between the location of the discharge event and the measurement of the event degrades signal to noise ratio, and gives rise to noise corrupting the measurement. To mitigate this problem the implementation must allow the experiment to be repeated multiple times in order for measurement averages to suppress the noise.

Schematic Diagram of Experiment Setup.

A Tina-Ti computer simulation diagram of the experiment setup is shown in Figure 1. The left side of the diagram shows the implementation at the location of the discharge event. The right side shows the implementation at the location of the measurement of the event. The circuitry shown in the upper left is a voltage doubler that charges the **<D> Plate** to negative 330 volts. The circuitry shown in the lower left is the event generator which consists of a dimmer switch to develop the drive to FET **T1** that initiates a repetitive discharge of the plate at a 60 Hz rate in synchronization with the power frequency. The circuitry shown in the lower right depicts the oscilloscope measuring device connected to the **<M> Plate**. The circuitry in the upper middle and upper right, depicts the oscilloscope trigger reference signal which communicates a small portion of the discharge event via coax to the trigger port of the oscilloscope. Thus the zero crossing of cycle N-1 is used to trigger the scope to capture the event on cycle N. This technique only works if cycle to cycle event timing is very stable. The short term cycle to cycle variation of event timing based on a 16 event average has been measured to be less than a nanosecond. The **Opti Coupler** isolates the measurement ground at the trigger port from the discharge ground (power neutral) carried by the coax. The length of the coax allows a **Gap** size from 0 to 48 feet. The **<D>Plate** stray capacity to earth is represented by **Cd**. The **<M> Plate** stray capacity to earth is represented by **Cm**. The stray capacitance parameters pertain to a plate elevation above earth of 39 inches. The **Gap** capacity is represented by **Cg**. The **Gap** ground inductance is represented by **Lg**. The **Gap** parameters pertain to a gap spacing of 48 feet.

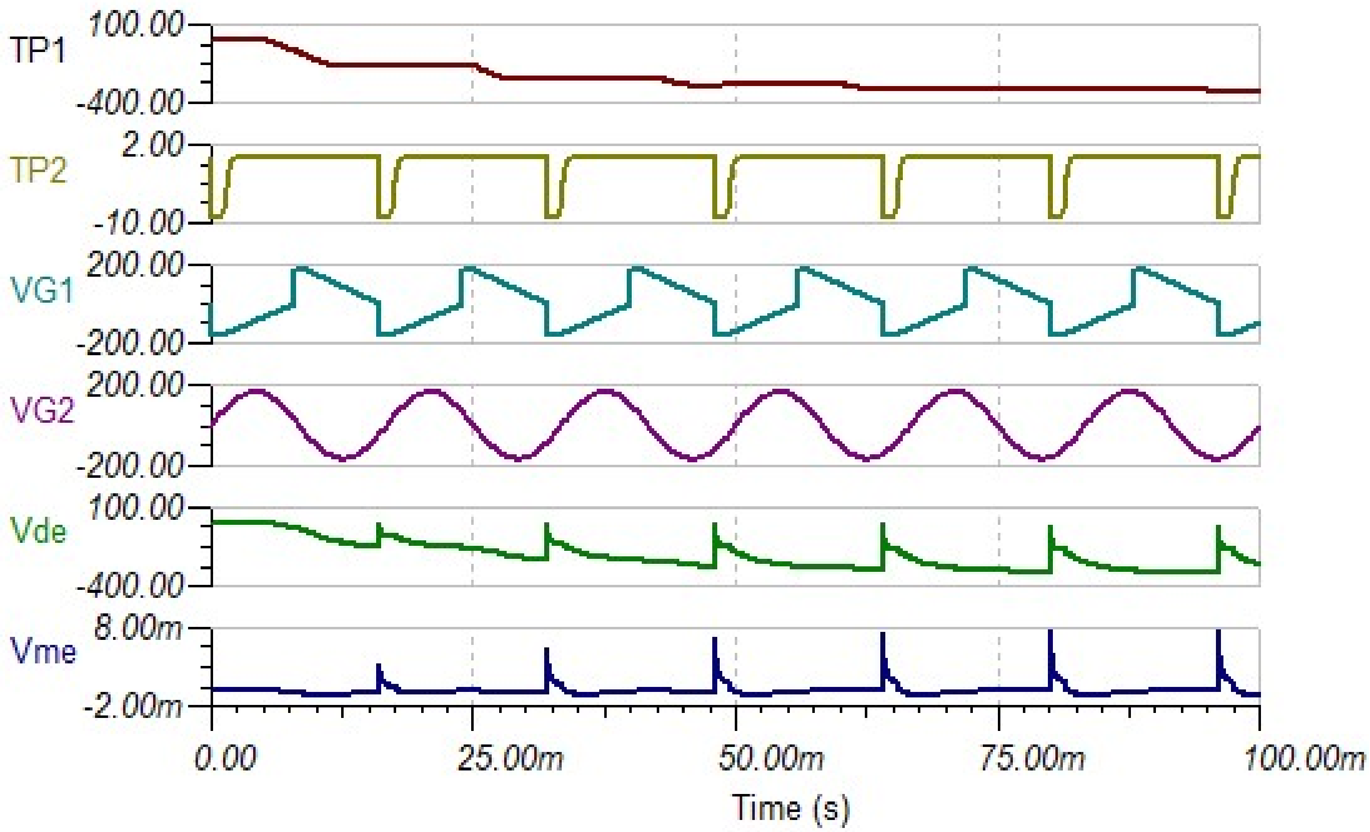
Figure 1. Experiment Setup.



Computer Simulation.

One purpose of the Tina-Ti computer simulation diagram shown in Figure 1 is simply to present a depiction of the electrical implementation of the experiment setup. A second purpose is to verify that the circuit design will produce repetitive discharge events that are identical. The simulation should not be taken as an accurate simulation of Coulomb propagation phenomenon. First of all, the simulation presumes that Coulomb and magnetic fields are rigid attributes of charge (i.e., propagation velocity is infinite). Also stray capacitance parameters and gap parameters are more complex that the simulation depicts, and in addition the parameters that are depicted are difficult to quantify. Even the computation of gap capacitance (capacitance between the **<D>Plate** and **<M>Plate**) is difficult because the capacitor aspect ratio (ratio of gap to plate size) is so high that the simple parallel-plate capacitance formula[4] can't be used. The value used in the simulation is more than an order of magnitude greater than that simple formula yields. With these disclaimers it is appropriate to present the Coulomb event simulation shown below.

Figure 2. Coulomb event simulation .
Gap distance 48 feet; plate elevation above



earth 39 inches.

Note that it takes about a tenth of a second for the voltage at **TP1** To stabilize After that the repetitive discharge denoted by **Vde** becomes stable. Although the horizontal time scale is too coarse to see this, the leading edge of the measured event, **Vme**, occurs at exactly the same time as the leading edge of the discharge event,**Vde**. This is because propagation velocity is not part of the simulation. In essence, the simulation simply depicts the discharge of the 48 foot gap capacitance as if it were a zero gap capacitor. In spite of this deficiency the simulation does provide a ballpark value for the signal amplitude, **Vme**, as being 8 millivolts for a gap of 48 feet and an elevation of 39 inches.

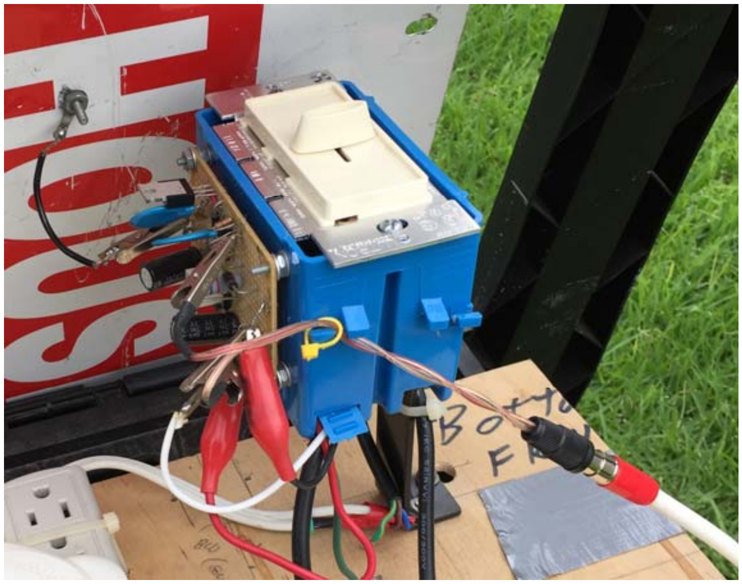
First Hardware Implementation of Experiment Setup.

A photo of the initial hardware setup is shown in Figure 3. The Gap size for the setup is 48 feet. The elevation above earth is 7 inches. The measurement portion of the setup appears in the foreground where you can see a small part of the backside of the **<M> Plate** behind the scope. The **Scope X1 Probe** can be seen connected to the center of the plate. The probe's ground lead is connected to a metal stake in the earth but is barely visible. The **Opti Coupler** is shown on the table in front of the scope; it is connected to the **Scope Trigger** port with a bright red connector. The event generation portion of the setup is shown in the distance. The power cables can be seen on the left. The coax line carrying the **Clock Gen Time Ref** can be seen on the right.

Figure 3. Gap 48 feet; elevation 7 inches.

The backside the setup shown in the distance in Figure 3 is shown up close in Figure 4. This is the hardware implementation of the setup depicted on the left side of Figure 1. The **<D> Plate** is shown in the upper left. The connection tab on the plate corresponds to **Vde** in Figure 1. The coax connector with the red band shown in the lower right transmits the **Clock Gen Time Ref** across the Gap to the measurement section of the hardware. The blue box contains the Dimmer Sw. The circuit board on the left side of the blue box contains all the other components shown on the left side of Figure 1.

Figure 4. Event Generator.



The hardware implementation of the **<D> Plate** is shown in Figure 5. The **<M> Plate** is not shown but is identical. Each plate is 2 feet by 1 foot.

Figure 5. Discharge Plate.

Figure 6 shows the waveform of the discharge event at **Vde** on the backside of the **<D> Plate**. The actual discharge takes place during the rising edge of the waveform. Since the vertical scale is 50 volts per centimeter the discharge shown is from -330 volts to 0 volts.

Figure 6 Vde.

Figure 7 is the same waveform as Figure 6 but at a much higher sweep rate that allows the rise time of the leading edge of the event to be ascertained. Since the horizontal scale is 8 nanoseconds per centimeter it shows the discharge event rise time to be approximately 30 nanoseconds.

Figure 7 Vde.

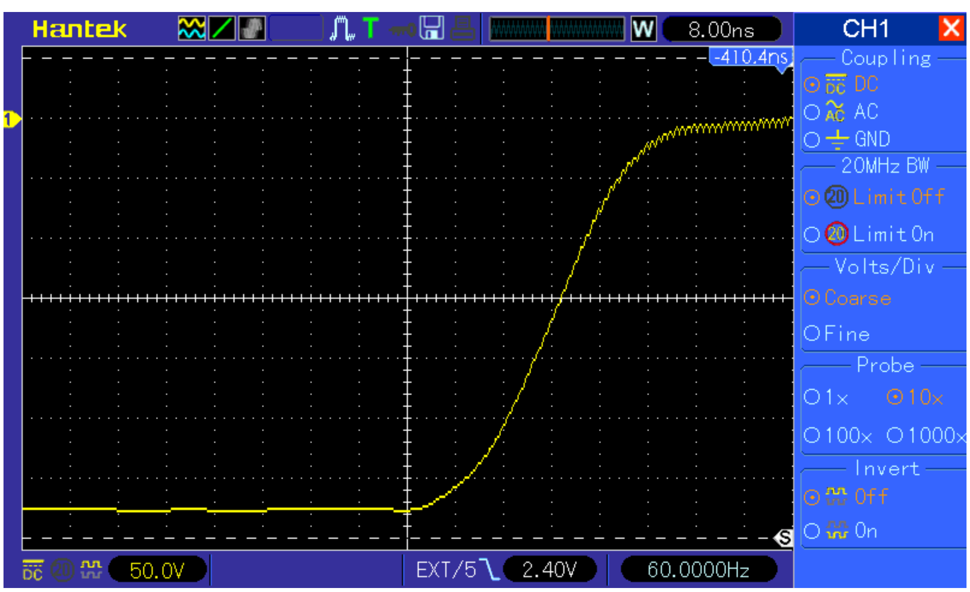


Figure 8 shows the measurement at the **<M>Plate** for a **Gap** size of approximately zero inches. This was done to adjust the horizontal position of the scope sweep to the center of the display so that propagation time measurements can be made using the center axis as the zero time reference.

Figure 8 Gap 0 feet.

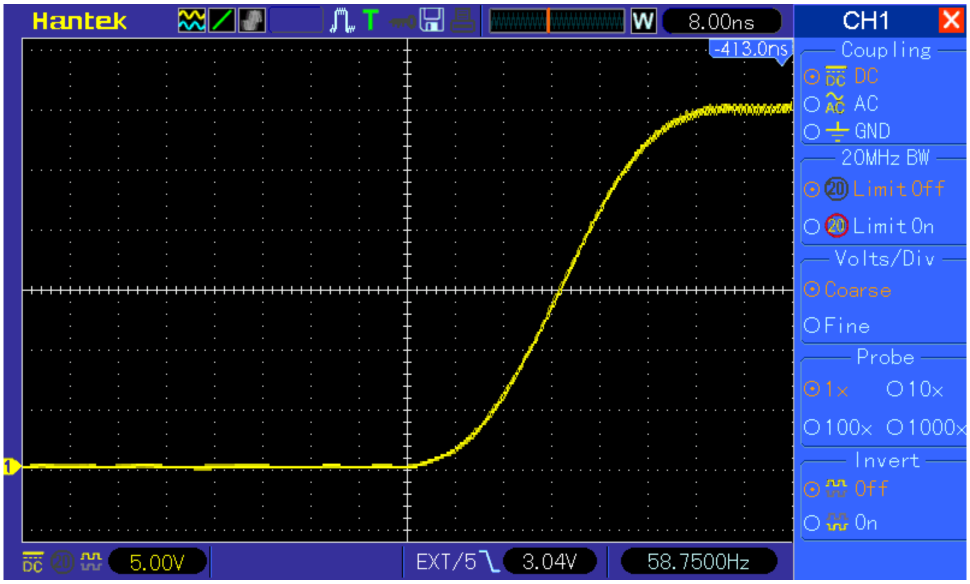
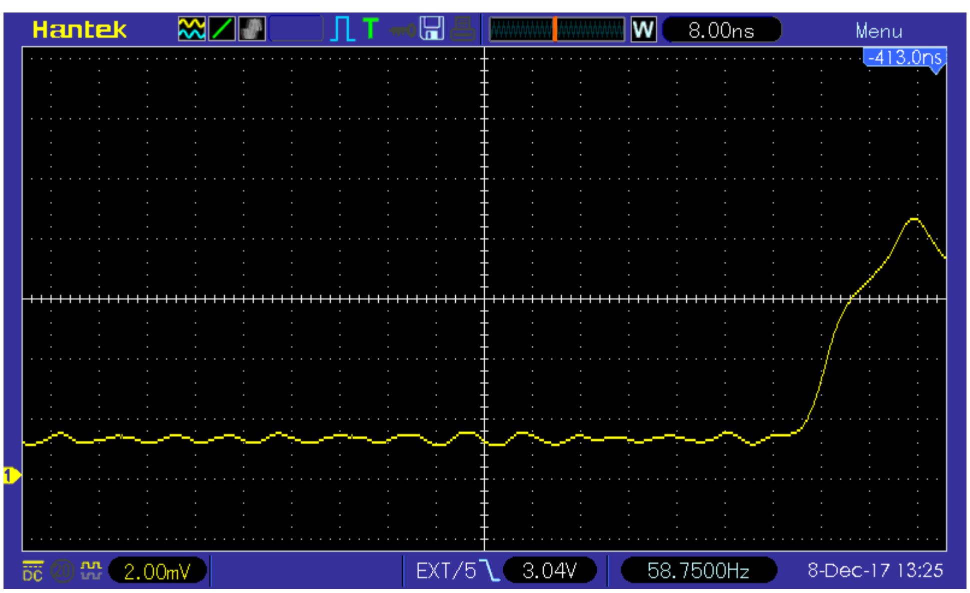


Figure 9 shows a 64 measurement average of the event detection at the **<M>Plate** for a **Gap** size of 48 feet.   Note that the leading edge of the detected event is approximately 48 nanoseconds (6 cm) which corresponds to the speed of light (1 nanosecond / foot). Also note no detectable event faster than the speed of light (i.e., less than 6 cm).

Figure 9. Gap 48 feet; elevation 7 inches.



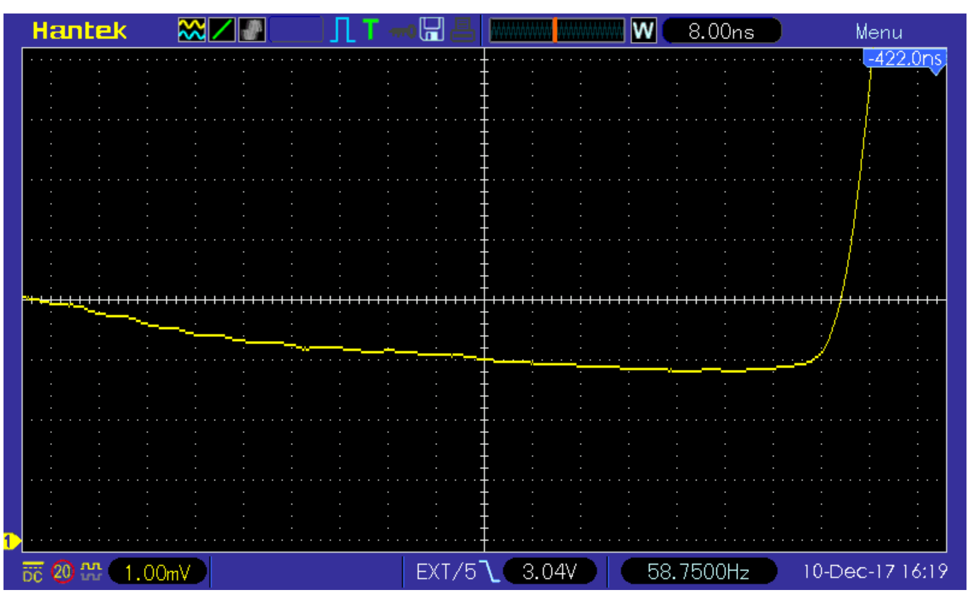
Second Hardware Implementation of Experiment Setup.

This implementation is identical to the first implementation except that the **<D>Plate** and **<M>Plate** has been elevated higher than in the initial setup shown in Figure 3. This was done to decrease ground attenuation of the signal and it resulted in a 500% increase in measurement signal amplitude. Figure 10 shows the **<D>Plate** at the higher elevation. The **<M>Plate** is not shown but is elevated in identical fashion.

Figure 10 <D>Plate elevated to 39 inches.

Figure 11 shows a 64 measurement average of the event detection at the **<M>Plate**. This measurement is comparable to the measurement shown in Figure 9 for the first hardware implementation. Note that the leading edge of the detected event is slightly greater than 48 nanoseconds (6 cm) which corresponds to the speed of light (1 nanosecond / foot). Also note no detectable event faster than the speed of light (i.e., less than 6 cm).

Figure 11 Gap 48 feet; elevation 39 inches.



Conclusion.

The stated purpose of this experiment was to ascertain whether a coulomb event propagates at a velocity greater than the speed of light as some researchers[1, 2] have reported. Figure 9 and Figure 11 each show the detection of an event whose propagation velocity is the speed of light. This was expected since at the source of an electromagnetic event there is generally electromagnetic radiation generated which propagates at exactly the speed of light. But when you scrutinize the scope traces in these figures they show no indication of an event detection faster than that. However, not detecting an event begs the question: Was such an event not noticed simply because its signal amplitude was below the sensitivity threshold of the measurement system? The list of computer simulation results shown in Figure 2 indicate that the signal amplitude of a detected Coulomb event is well above the sensitivity threshold of the measurement system. Note the last result in this list; it is the simulated signal amplitude **Vme** of a measured Coulomb event, and is shown to stabilize at 8 millivolts. The sensitivity threshold of the measurement system is a few hundred microvolts. Unless the simulation results are grossly in error the Coulomb event signal amplitude would be many times greater than the sensitivity threshold of the measurement system, and could not have gone unnoticed if it occurred in the first 6 centimeters from the center of the scope trace (i.e., propagated faster than the speed of light). Therefore the absence of a Coulomb event detection faster than the speed of light simply indicates that there was none, and that a Coulomb event does not propagate faster than the speed of light.

In a moment of folly I fantasized that this experiment might actually corroborate rather than refute, the findings of those outside-the-box researchers. I guess all the warp drives and wormholes on Star Trek caused me to think I might see some of that stuff in the here and now. I didn't. But I intend to keep looking.

References:

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