Causation, Propagation and Detection of Cylindrical Electromagnetic Fields

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Abstract— **A dielectric array transmitting structure, formed into a partial circle, demonstrated the propagation of electromagnetic fields that decayed with distance by 1/R rather than 1/R^2. The array had an electromagnetic field wavefront with an angular rate which will present signal detection and identification problems to conventional antenna-receiver-signal processing systems. A properly structured cylindrical electromagnetic field creates a contiguously linked field from the point of emission to where it has propagated.**

Index Terms—**electromagnetic fields, polarity, magnetic moment, electrons, ions**

I. INTRODUCTION

Los Alamos National Laboratory (LANL) personnel were involved in the construction and testing of an electromagnetic (EM) transmission device, referred to as the *array* in the report, that consisted of a 2m long continuous dielectric structure of alumina, formed into a curvature of 10° arc of a circle of average radius of 10.025 m, and having 41 amplifiers that are activated and deactivated sequentially along its length to produce an angular rate to the EM wave front.[1] The authors of the paper emphasized the difficulty a receiving site would have in identifying where such a signal came from. This issue was noted in a patent issued in 2012, based upon the characteristics of the array, that was issued to Los Alamos National Security, LLC, the LANL facility manager.[2]

The angular rate was controlled by another frequency and the rate directly influences the intensity of the propagated EM field; the higher the rate, the higher the intensity. The emitted frequencies were independent of the diameter of the array. The *array* produced two output frequencies; 552.654 MHz and 598.696 MHz. The observations were made at the higher frequency. Ref. (1) did not use the terms helix, helical or orbital angular momentum.

The LANL *array* was never referred to as an antenna. An antenna is defined as a reciprocal structure, it can detect and transmit EM fields. The term *polarization synchrotron* was used in reference to the *array* in follow-up presentations, which are not cited herein. A 2003 paper proceeded the development of the *array*.[3]

My interpretation of some the material in ref. (1) differs from that of the authors. Rather than the EM field distribution pattern being the result of a Cerenkov-like envelope with two sheets that meet along a cusp, the same measured result could be produced by an EM source that is producing both transverse and parallel EM field components that present a cylindrical EM field with a radius, a hole in the center, and an angular rate.

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It is not an issue that an EM field can have vector components transverse and parallel to the axis of propagation as they are being produced artificially.[4] In the cited report, the beam types are hybrids, which can have components that are transverse and parallel to the axis of propagation. EM manipulation and visual observation techniques available at optical frequencies are not available at radio-microwave frequencies.

Earlier research by G. Giakos and T. Ishii reported the measurement of pulse fronts in a waveguide that arrived faster than the expected propagation time, and the detection of EM fields in the far zone that did not decay with distance by 1/R^2.[5]-[7]

In assessing the differences between the above results, those of ref. (1), and how conventional transverse EM (TEM) fields are created, raised the question, "*Does the magnetic moment of electrons and ions influence the polarization of a propagated EM field?*" A literature search and inquiries to technically qualified individuals did not provide an answer. Electron and ion interactions within various material are complex.

A field vector that decays with distance by 1/R, and has a fractional power level at the source, will become a major power level after a short distance in the far field in comparison to a field vector that decays with distance by 1/R^2.

II. DECAY WITH DISTANCE BY 1/R

The radius of the *array* introduces a new EM field vector factor; subsequent vectors do not emanate from a fixed point source. Cartesian coordinates, Fig. 1a, are used to describe the orientation of EM fields that have their origin at the crossing point of the **xy** axes. The symbol **B** is used to identify the *magnetic field vector* direction and **E** the *electric field vector* direction. The terms *transverse* and *parallel* are referring to the direction of the field vector in relationship to the axis of propagation.

Over a century ago, Eugenio Beltrami used Maxwell's equations to describe an EM field vector that is parallel to its own curl, curl=0.[8] Fig. 1b illustrates the vector. There is no reason why such a field vector cannot propagate and be detected by a properly sized and oriented antenna. The argument that a Beltrami field presents a *radiation cancelling* condition exists

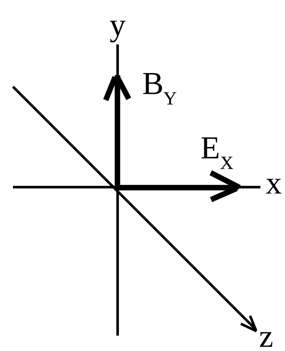

Fig. 1a
Transverse - Transverse

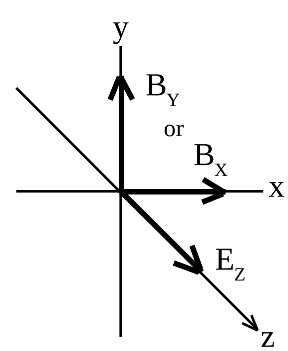

Fig. 1b
Parallel - Transverse

Electromagnetic Field Vectors

only on paper where there is no angular motion. For man-made radiating structures with a radius, the angular rate can be controlled to give a degree of predictable field vector positioning.

EM field vectors at some radius from the crossing point of the xy axis, with angular rotation, are depicted using the cylindrical coordinate system, Figure 2.

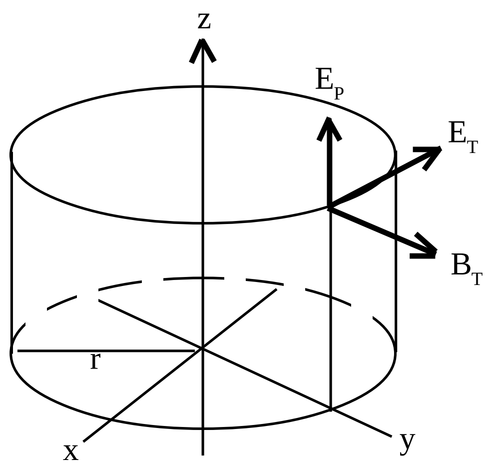

Figure 2. Cylindrical Coordinates

The E-field vector, **E**, can be in the same plane as the B-field vector, **B**, or parallel with the axis of propagation, **z**, both presenting a helical EM (HEM) field configuration. When **E** and **B** are in the same plane, both transverse, they trace out a pair of infinitely wide helical ramps with a hole in the center, a helicoid; a minimal surface. When **E** is aligned with **z**, **E** traces out a helix in the direction of the axis of propagation, which defines a cylinder with radius **r**. The electric and magnetic fields retain their 90° relationship in both orientations.

With the B-field vector fixed as transverse, the E-field vector can be either transverse or parallel, or both if the EM field generation mechanism permits that. For notation purposes, an HEM-TT field will have both **B** and **E** as transverse, and a HEM-PT will have **E** parallel and **B** transverse; the electric field is denoted first. The HEM-PT field configuration should have more efficient energy transfer characteristics than HEM-TT or TEM fields, as the **E** vector is in the direction of propagation, a non-spherically decaying field.

The Fig. 2 E-field vectors produced on a circular structure can be described as a series of parallel Beltrami type vector fields. The E-field traces out a helix that is parallel with the axis of propagation, which places the plus and minus field vectors around a cylinder asymmetrically; the *field influence* will not cancel in the **z** axis direction.

The pitch of a HEM-PT E-field wave front is illustrated in Fig. 3. A generic wavelength has a length of 2π and if the pitch has the same value, it would result in a 45° angle on the cylinder. Fig. 3 is a side view of a cylinder, with a 45° pitch, that has been cut at the 2π,0 axis and flattened, with the starting point, 0, to the left. To illustrate the field vector alignments, two complete cycles are shown. All the positive field vectors are aligned sequentially and all the negative field vectors are aligned sequentially, creating *contiguous field vector alignment* (CFVA).

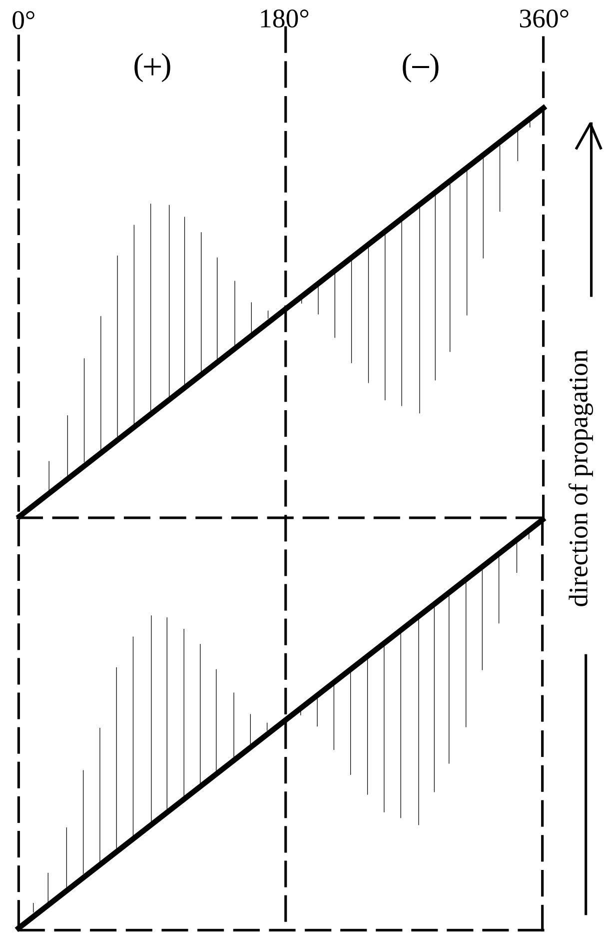

Fig. 3-Flattened cylinder depicting two complete cycles of an electric field with parallel polarization

Chirality is another characteristic of the HEM-PT field structure, as another field of the same type and frequency will readily couple to another when one is at 180° to the other. The coupling would be a sinusoidal Coulomb type force with nonspherical decay that is a function of source amplitude and frequency; the force would have a RMS value.

III. COMPLEX PARAMETERS

Identifying the characteristics of EM signals that have an angular rate about a radius will require a different approach to designing antennas and associated receiver-signal processing systems. Some of the characteristics that need to be considered are noted below:

a. main lobe or side lobe reception
b. angular rate, fixed or variable
c. handedness
d. large or small radius
e. short or long wavelength
f. modulated or unmodulated
g. transverse and parallel field components
h. phase relationship at fixed angular point or varying

i. artificial or natural phenomena

The above is not an exhaustive set of variables, but it illustrates some of the individual parameters and combinations that have to be considered.

Even knowing how the *array* generated the EM fields, it took considerable descriptive material to describe them and there are unanswered questions. The patent issued describing the *array* invention stated, “Given the crucial role played by the phases of the constructively interfering waves that form the cusps, a similar investigation of the characteristics of the phase difference Δy for the nonspherically-decaying component of the radiation is essential to further development of the present invention.”

IV. ANGULAR RATE SYNCHRONIZED

Accommodating the angular rate is a major challenge in itself. It is important to know whether an EM emission has an angular rate about a radius, as this will allow a better interpretation of a natural phenomenon and in identifying the characteristics of a man-made signal.

One could expect that a man-made array-type device could have variable angular rates and even switch handedness periodically, all intended to create problems for a receiving site in identifying the characteristics and purpose of that type of EM source.

A single antenna, with an appropriate length and polarization, pointed toward the direction of an incoming HEM-PT field, could detect the presence of the signal and identify a limited number of parameters. Depending on distance from the source, the diameter of the structure that creates the HEM field, and where the receiving antenna system is in respect to the signal source, side lobe or main lobe, will make a difference in the nature of the signal characteristics observed.

Fig. 4 is a generic example of a type of HEM-PT field receiving antenna with 18 individually sequenced elements. The antenna element size would be related to the frequency range of interest. Each successive element output would have to be synchronized with the handedness and angular rate of the emission.

Individual rod antennas would be equally capable of receiving off-axis transverse signals, which will require some method to shield the antenna structure from those emissions.

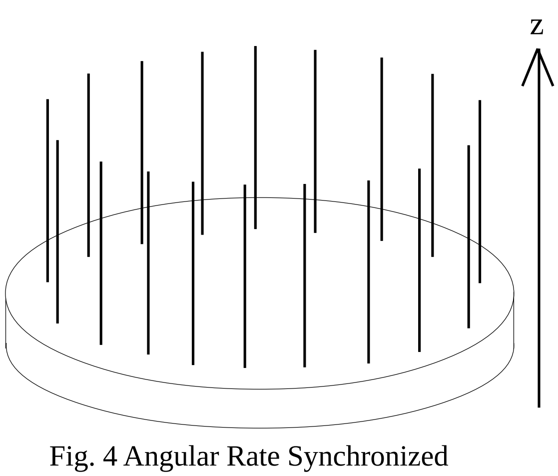

Fig. 4 Angular Rate Synchronized Antenna Array

What is not known is whether the radius of the receiving antenna system has to be the same as that of the transmitting array or some ratio relative to that of the source radius. The beam shape produced by the source could be one of the governing factors, but a critical element, regardless of radius, is that the receiving array has to be sufficiently aligned with the transmitting array to obtain the complete field; otherwise an off-axis receiving site would receive periodic pulses at the fields angular rate.

The methods used to implement a sequentially synchronized signal detection process will have to be examined based upon current and emerging technology. Software defined radios, using Field Programmable Gate Arrays, have the flexibility to alter the variables, such as angular rate and handedness. To eliminate antenna switching noise, it may be necessary to have dedicated receiver front-ends for each antenna and the sequence switching and handedness is accomplished in the later digital signal processing circuits.

V. LEARN FROM NATURE

The abstract of a paper titled, “Possible Structures of Sprites” stated, “These stationary electromagnetic fields are helical and/or column-like once they are represented in a suitable frame of reference.”[9] I had deduced that Beltrami-type fields could produce a helix structure that defines a column, and the Chu paper was found while searching for information on helical fields. Beltrami fields are a significant feature of the Chu paper. The Chu paper includes an isosurface plot showing helical and column shaped electromagnetic fields.

The NASA ARCADE high altitude balloon instrument, with its conical horn antennas, detected unusually strong signals.[10] A quote from the NASA article stated,"The universe really threw us a curve," Kogut says. "Instead of the faint signal we hoped to find, here was this booming noise six times louder than anyone had predicted." A horn antenna would detect, but not properly identify, the characteristics of a HEM-PT emission.

In the ARCADE article, NASA referred to Karl Jansky as a physicist, but was a *radio engineer*.[11] Although Jansky identified the existence of cosmic noise, it was Grote Reber that built a parabolic radio telescope and identified specific cosmic signal characteristics. Reber managed to get a paper published in a professional astronomy journal in 1940, titled, “Cosmic Static”, a notable achievement for an individual that was an amateur astronomer; he was a radio amateur and radio engineer.[12] In the 1930s, Jansky and Reber would have been unaware of the atmospheric radio window.

Nature puts a *spin* on processes in the universe and there is a left hand bias.[13] Whyte would not have been aware that an EM field could have an angular rate. Out of the proliferation of sources in the universe that have angular characteristics, one might suspect that there will be some EM emissions with an angular rate that will be Beltrami-types with a radius.

Upper atmospheric EM structures produce terrestrial gamma ray flashes (TGF), something that was not known until 1994.[14] The report used the term “rare occurrence,” but the Fermi satellite, launched in 2008 with a gamma ray telescope, is observing hundreds a day, which is a “small fraction of the 1,100 TFGs that fire up each day somewhere on Earth.”[15] If gamma rays had been detected by Geiger-Muller tubes in high altitude balloon and rockoon instruments, the radiation origin would have been interpreted as “coming from space,” as everyone knew, before 1994, there were no gamma ray sources in the upper atmosphere.

In 2008, some of the same principal authors involved with the *array* published a paper about the Crab Nebula pulsar, describing the pulsar field as having characteristics like those produced by the *array*.[16] The paper extensively cited the *array* report and states that the pulsar *subbeams* account for the non-spherical decay of the energy intensities.

V. SUMMARY AND OBSERVATIONS

The presence of EM emissions with a polarization other than transverse may be very common, but contemporary antenna-receiver systems are not designed to properly detect their presence.

Current technology applications do not permit identifying man-made or cosmic sources that produce HEM-type fields with a hole in the center. The improper determination of this type of source characteristic can lead to erroneous conclusions.

If field-to-field coupling is responsible for the observed superluminal measurements, we do not possess timing instruments with sufficient precision to measure the influence velocity. A suggestion for improving timing systems is contained in my cited IEEE Potentials article which stated, “Timing devices can be produced, referenced to the mathematically calculated numeric value, that will have more significant figures than using the current definition for the SI second.”[17]

There are unanswered questions on how nature produces very long wavelengths from miniscule sized sources. Even if it is temporary, some type of conducting structure is required to contain the electrons and/or ions to produce a specific frequency or set of frequencies.

Man-made and natural HEM-type fields will efficiently couple their energy to biological helical structures in a manner not currently considered.

The existence of artificial and natural EM emissions with both transverse and parallel components will pose a problem in using the Planck constant in determining energy or frequencies. It appears that the constant was derived using temperature measurement instruments that were polarization-neutral. The Planck constant definition does not mention polarization.

It cannot be dismissed that nature produces EM field structures that are much more complicated than what is currently known and with forms different than suggested in this, the Ardavan and Chu papers. These structures will not be identified unless efforts are directed toward developing instruments and associated antenna arrays that can detect them.

The various papers and presentations related to the *array* have been in the public domain for over a decade and it is quite possible that some group or groups have recognized the value of the *array* and 1/R decay and are developing devices that exploit its features. Our signal detection systems are ill-prepared to identify EM signatures having an angular rate about a radius.

Before the publication of Reber’s “Cosmic Static” article, all physical science theories were developed without knowing, other than for light, we are constantly bathed in a sea of broadband EM energy exchanges within the universe and there is an EM link between the basic mathematical constants and basic physical constants; see cited IEEE Potentials paper.

The magnetic moment of an electron was discovered in 1925. It seems odd the magnetic moment and EM field polarity issue has not been explored.

The potential between the top and bottom of waveguides can produce ions. It will have to be determined whether the magnetic moment of ions is responsible for the production of EM fields with non-spherical decay reported by Giakos and Ishii.

Improved instruments and methods of observation are regularly overturning long held physical science conclusions. The better resolution of an electron microscope identified the existence of *quasi-crystals*, overturning 100 years of what was considered settled science in crystallography.

Efforts should be directed toward identifying different methods to produce non-spherically decaying EM fields. Where the array produced an angular rate using sequential segments, it would be desirable to identify a method to produce an angular rate as a smooth continuous process.

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