TST: Applications of Topological Spin and Torsion

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1. Introduction

A topological perspective of electrodynamics goes beyond the present state of the art, and enables many new patentable devices and processes to be formulated.

1.1. Topological Format of Electrodynamics

When Maxwell's theory of electrodynamics is considered to be statements of topological (rather than geometrical) constraint on a variety, then the fundamental equations can be written in the mathematical language of exterior differential forms [1]:

$$Maxwell\ Faraday : dA - F = 0 \tag{1.1}$$

and

$$Maxwell\ Ampere : dG - J = 0. \tag{1.2}$$

These topological equations, known as an exterior differential system, are valid in every diffeomorphically equivalent system of reference and are independent of the geometrical constraints of metric and connections. In particular, these equations of electrodynamics are not limited to (geometrical) equivalence classes defined by

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Lorentz transformations. As an exterior differential system, and for an specific choice of coordinates, these topological equations are equivalent to a system of partial differential equations commonly known as Maxwell's equations.

On a 4 dimensional variety, following Maxwell, there are two species of Fields, the intensities, $\mathbf{E}$ and $\mathbf{B}$, that make up the components of the 2-form F, and the excitations, $\mathbf{D}$ and $\mathbf{H}$, which make up the components of the N-2 form density, G. These two entities of intensity and excitation are different thermodynamically. A ubiquitous geometrical (constituitive) constraint presumes that $\mathbf{D} = \varepsilon\mathbf{E}$ and $\mathbf{B} = \mu\mathbf{H}$; such a constraint masks the different and distinct features of the two entities. Such a constraint is not subsumed in the topological approach, where the intensities are related to the accelerations and stresses (forces) imposed on a physical system, while the excitations are related to the sources (isolated charges, plus charge-current densities, $\mathbf{j}$ and ρ). In geometrically constrained systems, the forces and sources are locked together such that if you have one, you have the other. In the topologically constrained systems you can have forces (field intensities, $\mathbf{E}$ and $\mathbf{B}$) without charge - current densities, and sources (excitations) that do not produce forces (intensities). This is a new idea that can lead to novel and practical devices and processes.

Practical applications will require that solutions exist for those topological constraints that define electromagnetism. One may ask, "When are such solutions unique and when are they not unique?" The classical approach, dominated by geometry rather than topology and where forces are correlated to sources, focuses attention only on those solutions which are unique and are in equilibrium. This is unnecessary dogma that requires that the 3-forms of Topological Torsion, $A\hat{}F$, and Topological Spin, $A\hat{}G$, vanish:

$$\text{Topological Spin: } A\hat{}G \Rightarrow 0, \qquad (1.3)$$

and

$$\text{Topological Torsion: } A\hat{}F \Rightarrow 0. \qquad (1.4)$$

Indeed, such uniqueness constraints have yielded a wealth of useful applications and inventions, but ignore the many possible useful and novel applications of situations where solutions exist, but are not unique. The novelty of the devices and processes to be described below is due to the fact that the above constraints of uniqueness are not employed in their design. The novel devices and processes

work because the solution sets are not unique. Prior art has invariably employed the uniqueness conditions in the design of devices and processes.

1.2. Topological constraints that admit non-uniqueness

The topological approach permits the creation of new patentable devices and processes that depend upon the heretofor neglected non-unique solution possibilities associated with Maxwell Electrodynamics. The equations of non-unique, non-equilibrium electrodynamics involve non-zero third order objects defined as Topological Torsion and Topological Spin. The equations of geometrically constrained electrodynamics only admits unique solutions, for which the third order objects are zero. For example, when these third order objects are not zero, it is possible to demonstrate the existence of Topological Torsion and Topological Spin waves. These topological waves are remarkable, for they are not transverse, nor longitudinal, (as our the standard geometrical waves) and cannot be expressed in terms of simple complex wave functions. Devices that employ such waves obviously go beyond the present state of the art.

The fundamental equations, (1) and (2) above, of Maxwell - Faraday and Maxwell - Ampere, remain the same and are unchanged; but now these fundamental equations are augmented by additional equations of topological constraints, expressing the properties of non-unique solutions to Maxwell Electrodynamics. These additional, non zero, equations of electromagnetism **??** also can be written as an exterior differential system, and are defined in terms of the

$$\text{Limit sets of Topological Torsion :} \quad d(A\hat{\,}F) = F\hat{\,}F \ = 0 \qquad (1.5)$$

and

$$\text{Limit sets of Topological Spin :} \ d(A\hat{\,}G) = F\hat{\,}G - A\hat{\,}J = 0. \qquad (1.6)$$

It is possible to prove that the 4 dimensional closed integrals of $F\hat{\,}F$ and $F\hat{\,}G - A\hat{\,}J$ describe topological deformation invariants for any evolutionary process that can be described in terms of a singly parameterized vector field of evolutionary flow (the standard basis for evolution in time).

There are two distinct classes of of new devices and processes associated with non-unique topological solutions. One class can be constructed when the 3-forms of Topological Torsion and Topological Spin are not zero, but their limit sets (exterior derivatives) vanish. Chaotic processes belong to such a class. A

second class of new devices and processes can be constructed when the Topological Torsion and Topological Spin are not zero, and in addition, their limit sets are not zero. When the limit sets are not zero, the processes involved are irreversible, and the systems are not in equilibrium.

On a 4 dimensional manifold, the object defined as Topological Torsion, $A\char`\^F$, is a 3-form with coefficients as a third rank anti-symmetric tensor. The object defined as Topological Spin, $A\char`\^G$, is a 3 form with coefficients as a third rank anti-symmetric tensor density. Tensor densities lead to functions which are independent from orientation, while tensors depend upon orientation. These two 3-forms were discovered by Dr R. M. Kiehn [3], and are only slowly making their way into the applied theoretical literature of electrodynamics.

It is the application of these additional equations of electrodynamics to physical systems in structured, stressed, accelerated and rotating environments that is the basis of the novel inventions and processes to be described below. When geometrical constraints of the prior art are imposed to insure uniqueness, the equations of Topological Spin and Topological Torsion disappear (are zero), and the many possible inventions and applications based on the non-unique solutions of electrodynamics are not exhibited.

1.3. The chemical solution as a structured vacuum.

A second important point in the development of novel practical applications is the realization that the structureless vacuum is not the usual or relevent reference state of matter for electrodynamic physical systems. The structureless Euclidean or Lorentzian vacuum is isotropic, homogeneous, non-chiral, flat and linear. These geometrical constraints, which lead to unique solutions of the Maxwell system, imply, for example, that the speed of light is a universal constant, insensitive to direction or domain. Such a structureless vacuum is only an approximation to the real universe, which is flooded with gravitational fields, plasmas and inhomogeneities.

On a local level, the fundamental reference state will be defined as a "chemically structured vacuum". This "chemically structured vacuum" is usually not isotropic, not homogeneous, and may be chiral and non-linear. The speed of signal propagation (non-unique discontinuous solutions to the topological Maxwell equations) may depend upon direction and domain and is not limited to c, the constant finite speed of light in a unstructured vacuum. The speed of signal

discontinuity propagation is not a universal constant over the domain of support. The "chemically structured" vacuum, unlike the Euclidean or Lorentzian vacuum, need not be geometrically flat in either a Riemannian or Finslerian sense, and is therefor sensitive to stresses, accelerations and rotations. These properties of structure, interacting with Topological Torsion and Topological Spin, will be used to define new processes and devices that connot be achieved with the current state of the art.

Recall that a fundamental assumption of electro - solvent chemistry is that chemical solutions produce a "plasma" of molecular ions in the solvent, thereby defining a structure in the solvent reference, or what is herein defined as a "structured vacuum", state. The recognition that such a structured reference state (which can be non-isotropic, inhomogeneous, chiral, non-linear, and with intrinsic curvature) can support non-unique solutions to the topological equations of Maxwell's electrodynamics is an important part of the development of novel processes and devices that go beyond the present state of the art. Note that the similarity invariants of the chemically structured vacuum can be put into correspondence with regions that are defined as different thermodynamic phases. Such thermodynamic phases do not exist in the non-structured vacuum. By manipulating the electrodynamic fields and acceleration or stress dynamics of such structured reference systems, it is possible to manipulate changes between the thermodynamic phases. These techniques will prove to be of value in applications of use to the drug, colloidal, rheological, polymer, and biological industries.

The usual assumption of chemical solutions is to consider that the ions are actually molecules composed of an assortment of atoms. When the molecules are simple (composed of a very few atoms), the present state of the art presumes that the analysis must be governed by the laws of discrete quantum mechanics. However, recent experimentation indicates that when the molecules consist of large numbers of atoms, such as in DNA, a continuum point of view is admissable and useful. These results give credence to the concept of a structured vacuum reference state, or chemical solvent, as employed herein. The structured vacuum in 4 dimensional space time supports the non-zero 3-forms of Topological Spin and Topological Torsion, which are requirements for the existence of non-unique solutions to Maxwell's electrodynamics. Note that these non-zero 3-forms may be interpreted in terms of vector fields in space - time which are tangent to "lines, or tubes" of topological defect structures. As these third order defect structures

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are irreducibly 3 dimensional, they will have a built in "helicity", and can form long narrow twisted ribbons or threads. That is, such topological defect structures are natural models for the nanometer twisted tubes representing DNA, or tubulins in cells. On the otherhand, a biological membrane for a cell (a layer of charge distribution) appears to have many properties of a minimal surface. Yet simple minimal sufaces in 3D have a negative Gauss sectional curvature (think soap films between boundaries), which does not seem compatable with the fact that most membranes appear to be compact without boundary and have positive Gauss curvature. However, when Topological Torsion is not zero, there exist minimal surfaces with positive Gauss curvature (in 4D !). These surfaces can have holes (topological defects) through which material from the outside can enter the interior (in a manner of cell infection). Hence the basic ideas of biological membrane appear to be related to the topological electrodynamics, where the topological defects could be manipulated and controlled by new non-unique processes and devices. The interaction of these defects, with perturbations induced by fields and dynamics of the structured vacuum, will lead to novel devices and processes, all based upon non-unique solutions to the fundamental topological equations of electrodynamics.

2. Specific Applications to be detailed later

Let TST be an acronym for Topological Spin and Torsion

Some specific applications include but are not limited to:

1. A TST process to separate left handed and right handed chemical and biological molecules.

2. A TST process to interact with DNA chains.

3. A TST process to remove impurities from water

4. A TST process to decalcify water.

5. A TST process to enhance colloidal separations

6. A TST process to reduce plaque formation and to reduce plaque buildup in arteries.

7. A TST communication device with a Q of 10^{+18} (Very high noise rejection)

8. A TST device to measure gravitational waves.

9. A TST process to activate and interact with nanometer devices and molecular transistors.

10. A TST process for interaction with superconductors.

11. A TST magnetic resonance imaging device.

12. A TST device to control tip vortices and drag induced by motion of aircraft through air and submarines through water.

13. A TST process to control longevity

14. A TST process for controlling virus interactions through membranes.

15. A TST process for controlling tumor growth.

16. A TST process to manipulate and control holes in biological membranes.

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17. A TST device for pressure gauges and accelerometers.

18. A TST process for enhancing crystal growth.

19. A TST device for enhancing combustion.

20. A TST battery device.

21. A TST device using polarization-diffraction modulation – a new concept in electormagnetic signal propagation.

22. A TST device that uses topological defects in an electromagnetic wave front to store and transmit information.

23. A TST device that utilizes superluminal signal transfers between wave front defects.

This list does not include other devices that also will be discussed under separate cover.

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