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Advanced Electromagnetic Theory

- Advanced Electromagnetic Theory Working Group
  Includes interactive discussion forums, experimental needs, papers under development, etc.
  (**Restricted access for program staff**)

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  - Passive Components for Power Electronics Workshop
    (PDF 101 KB) Download Acrobat Reader.

Electromagnetic History

A good account of electromagnetic history is given by T. W. Barrett in his article "Electromagnetic Phenomena not Explained by Maxwell's Equations" in A. Lakhtakia (ed.), "Essays on the Formal Aspects of Electromagnetic Theory" (World Scientific, Singapore, 1993).

The following is a short abstract of Barrett's account. The underlying concept of the theory of J. C. Maxwell was Faraday's electrotonic state, which is known in contemporary theory as the vector potential, a term introduced by Maxwell. Faraday had indicated the fundamental role of the electrotonic state in two experiments, and to Maxwell, this was the fundamental quantity in the classical theory of electromagnetism, changes in which produce the induction current. In modern terms this is represented by the inhomogeneous d'Alembert equation.

In place of action at a distance, Maxwell proposed a medium characterized by polarization and strain through which radiation propagated from one local region to another. Instead of force residing in the medium, Maxwell introduced the concept of force fields. Maxwell also introduced the distinction between quantity and intensity. Magnetic intensity was represented by a line integral, and referred to as the magnetic polarization of the medium. Magnetic quantity was represented by a surface integral and referred to as the magnetic induction in the medium.

The medium was the seat of all electromagnetic phenomena and Maxwell identified the electromagnetic medium with the luniniferous ether. Thus Maxwell's electromagnetic field did not exist in the vacuum but was the state of the medium. The medium had only a displacement current, and no conduction current or magnetic sources. The electricity **was** the disturbance in Maxwell's view, while in the view of William Thomson, with whom Maxwell corresponded in the 1830's, electricity **produced** the disturbance.

In Maxwell's view the equations of motion were defined only locally and the vector potential was physical and primary. This view held until about 1873.

Thereafter Heaviside, Fitzgerald, Lodge and Hertz reduced the vector potential to a mathematical subsidiary variable by assuming what is known as the Lorentz condition. However, the A field still remained as a repository of energy in the electrotonic state. Maxwell's original theory placed the A field at center stage and was developed in quaternions. The AIAS group has shown how Maxwell's original concepts can be expressed as a Yang-Mills theory of gauge symmetry O(3), homomorphic with gauge symmetry SU(2). Quaternionic algebra is represented by these groups and so the AIAS has developed Maxwell's original intent.

Heaviside's version of Maxwell theory was developed in about 1888 and this is what is known in all the textbooks as "the Maxwell Equations". In fact they are Heaviside's rendering of Maxwell's original intention. The papers on this website conclusively refute the Maxwell Heaviside view, by a careful re-analysis of basic phenomena such as interferometry, and by the use of basic symmetry. The resulting gauge theory of O(3) symmetry is probably what Maxwell was striving for in his work.

The AIAS has also developed Whittaker's work of 1903 and 1904 to show that there is in fact no gauge freedom in the Maxwell Heaviside theory. This refutes its basic axiom, that the A field be physical. Whittaker showed that the force potential can be defined both in terms of standing waves and in terms of propagating waves; and that **any** electric displacement and magnetic force can be expressed in terms of the derivatives of two scalar potential functions, G and F, and also be related to the inverse square law of attraction in electrostatics.

The AIAS papers on this site develop Whittaker's analysis to show that under well defined and engineerable circumstances the quantities A, B and E can be made to vanish while leaving only F and G. Physical timelike photons emerge from the canonical quantization of G or F without difficulty. These photons are massless bosons and the time-like photon has energy h bar omega, that of the Planck photon.

The time-like potential is phase dependent and can therefore undergo interference, with important consequences. The novel O(3) electrodynamics has been extended by AIAS to the level of quantum electrodynamics, and several useful phenomena indicated. It is far more richly structured than the Maxwell-Heaviside theory, and is a contemporary gauge theory, i.e. obeys all the laws of gauge theory. It describes several basic phenomena where Heaviside's version of Maxwell's intent fails. The most drastic failure of Maxwell-Heaviside theory is its inability to describe Snell's Law without violating parity. Other major failures are described in the papers.

There are many consequences for physics of the adoption of O(3) electrodynamics, and a novel electroweak theory due to Crowell is presented in two of the papers.

So there are two fundamental aspects to this work:

1. the complete refutation of the Maxwell Heaviside theory by many counter examples;
2. the suggestion that Maxwell's own theory is an O(3) Yang Mills gauge theory, far richer in structure and successful in explaining every refutation given of the Maxwell Heaviside theory.

Bearden's concepts are far in advance even of the O(3) electrodynamics presented here, and if proven, have astonishing consequences in many areas, especially energy acquisition.

What is a Gauge?

The term "gauge change" was introduced originally by Weyl and meant "change in length". The original concept was criticized by Einstein and abandoned by Weyl. However, the term remained in use in classical electrodynamics because with arbitrary potentials, Maxwell's equations have a built-in symmetry, and such arbitrary potentials become a useful calculating device. The Maxwell-Heaviside equations are said to be gauge invariant by accident, under what is known as a U(1) gauge transformation, where U(1) is a group symmetry. In the traditional view the potential in classical electromagnetism has no physical meaning.

This has been refuted recently by AIAS in many ways, as the papers on this Web site show. For example this type of gauge invariance cannot describe interferometry, or Snell's Law. In AIAS we have decided to use a gauge principle based on an internal O(3) symmetry group as the papers show, and have come up with many advantages. The five papers which develop the work of Edmund Whittaker show that there is actually no gauge freedom, or arbitrariness, in the potentials in the U(1) theory, the Maxwell-Heaviside theory, which we have decided to abandon in favor of a Yang-Mills type theory based on a physical internal space O(3). The new theory is gauge covariant, i.e. the potentials are physical. A physical gauge transformation produces the Sagnac effect as described in the papers.

Gauge theory is highly successful in modern physics in the field of elementary particles. It has successfully predicted the existence of quarks. The elementary particle gauge theory is technically known as non-Abelian, and the new electrodynamics developed by AIAS is also non-Abelian, leading to a new duality principle with consequences throughout unified field theory.

Program Goal

The goal is to develop an improved, higher topology electromagnetic theory that pulls together patches and threads used in chemistry, astrophysics and elsewhere to explain experimental and theoretical anomalies into a single model that leads to advanced understanding of time, space, energy and matter and unique energy sources and transportation systems.

Completed Papers and Books

The following documents are available as Adobe Acrobat PDFs. Download Acrobat

WKD Superluminal Experiment Explained by the Theory of Superluminal Relativity
By Petar K. Anastasovski (PDF 208 KB)

The Quantum Multipole Radiation
By Alexander S. Shumovsky (PDF 167 KB)

Ellipsoids in Holography and Relativity
By Nils Abramson (PDF 668 KB)

Permittivity Transitions
By Ken Shoulders (PDF 282 KB)

Space-Time Curvature Around Nucleons;
By Petar K. Anastasovski and David B. Hamilton (PDF 389 KB)

Superluminal Relativity Related to Nuclear Forces and Structures;
By Petar K. Anastasovski (PDF 624 KB)

Symmetry in Electrodynamics;
By Mendel Sachs (PDF 1.4 M)