



## New Electromagnetism

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This is the second paper in the New Electromagnetism series. Other Papers in the series include: New Induction (ni.pdf), New Gravity (ng.pdf), Rules of Nature (ron.pdf). This material on file with U.S. Patent office. Applications of this technology are patent pending. This material is copyright protected 1999-2003 and is solely the work/discovery of Robert J. Distinti.

### ABSTRACT

This paper introduces the Version 1 (V1) models for New Electromagnetism. New Electromagnetism is founded on the following principles:

- 1) Electromagnetic fields are generated by forcing charges to behave a certain way.
- 2) Electromagnetic fields are measured by observing the behavior of charges contained in the field.

With the above true, it is reasonable to conclude that all electromagnetic phenomena should be resolvable to charge-to-charge interactions in free space (e.g. Coulombs law). Since electric circuits are second order systems, it is reasonable to conclude that free-space charge interactions should be second order as well. This means that charge-to-charge models for charge position, velocity and acceleration should exist. The positional model is already given to us as Coulomb's Law. The velocity equation (we call the Motional Electric Law) is derived from the Biot-Savart flux model and the classical motional electric law ( $\mathbf{F} = q\mathbf{v} \times \mathbf{B}$ ).

The acceleration model was more elusive. Since electromagnetic induction is the only phenomenon which relates time changing currents (charge acceleration) to a field phenomenon, the only model available at the beginning of this project was Faraday's Law (Maxwell's Equation for time changing flux is Faraday's Law in another form). After many attempts to formulate Faraday's Law into a reasonable charge-to-charge form, it was decided that Faraday's Law was not an adequate description of electromagnetic induction (See "The Quintessential Argument" and "Classic Flux Anomaly" papers at our site). Through experimental means and a powerful computer hashing algorithm, a new model for induction (See New Induction ni.pdf) emerged that satisfied the New Electromagnetism requirements. The New Induction model (See IEL below) is unique in that it describes magnetic fields as spherical in nature; not toroidal as described by the Biot-Savart model of classical magnetism.

The three equations (below) comprise what is known as the Version 1 (V1) New Electromagnetic models. Applying the V1 models to a hypothetical system of two like charges (page 19), yields an equation for Effective Mass (page 20). This application demonstrates the use of electromagnetic induction to model the property of matter known as inertia (page 20). The V2 models replace MEL with a new spherical relationship. For more information see "New Magnetism" and "New Electromagnetism 2" at our site.

#### Other Highlights:

- 1) Einstein's Energy Equation  $E = mc^2$  is derived from New Electromagnetism (page 20).
- 2) Mass of electron derived from New Electromagnetism (page 20).
- 3) Magnetic field velocity equation (page 14).

Name	Point Charge form	Wire fragment form	Notes
Positional Electric Law (PEL) (Position)	$\mathbf{F} = \frac{K_E Q_S Q_T \mathbf{r}}{ \mathbf{r} ^3}$	$emf_{TS} = \frac{K_E Q_S \mathbf{r} \cdot d\mathbf{L}_T}{ \mathbf{r} ^3} = \mathbf{E}_E \cdot d\mathbf{L}_T$	$K_E = \frac{1}{4\pi\epsilon}$
Motional Electric Law (MEL) (Velocity)	$\mathbf{F} = \frac{-K_M Q_S Q_T (\mathbf{v}_S \times \mathbf{r} \times \mathbf{v}_T)}{ \mathbf{r} ^3}$ <a href="#">Improved models for magnetism (MEL) disclosed in later paper titled "New Magnetism"—(nm.pdf)</a>	$emf_{TS} = \frac{-K_M I_S (d\mathbf{L}_S \times \mathbf{r}) \cdot (\mathbf{v}_T \times d\mathbf{L}_T)}{ \mathbf{r} ^3}$ $\mathbf{F}_{TS} = \frac{-K_M I_S I_T (d\mathbf{L}_S \times \mathbf{r} \times d\mathbf{L}_T)}{ \mathbf{r} ^3}$	$K_M = \frac{\mu}{4\pi}$
Inertial Electric Law (IEL) (Acceleration)	$\mathbf{F} = \frac{-K_M Q_S Q_T \mathbf{a}_S}{ \mathbf{r} }$ This is the composite equation.	$emf_{TS} = -K_M \left( \frac{dI_S}{dt} \right) \frac{d\mathbf{L}_S \cdot d\mathbf{L}_T}{ \mathbf{r} }$ This is the composite equation.	$K_M = \frac{\mu}{4\pi}$

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# 1 Please Read.

The contents of this paper are protected by a number of schemes to include pending patents, trademarks, copyrights, and trade secrets. There is considerable research, publications and products based on the New Electromagnetism models which as yet have not been released. These items are to be released in phases over the next few years.

We publish a small portion of our research for free to allow those who are interested to judge the quality and value of our work. Our freely published papers may be duplicated and distributed without license as long as they are duplicated and distributed intact (all pages without changes).

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## 2 INTRODUCTION

New Electromagnetism is the following three models: the Positional Electric Law (Coulomb’s Law), the Motional Electric Law, and the Inertial Electric Law. The Positional Electric Law relates the force on a charge due to its position relative to other charges. The Motional Electric law relates the force on a charge due to its velocity relative to other charges. The Inertial Electric law relates force on a charge to the acceleration of other charges. By knowing the position, velocity, and acceleration of a charge, one can determine its effect on other charges. Thus, one can model electrical interactions without the intermediate step of resolving fields.

Each of the new models is represented in two forms: the point charge form suitable for physicists, and the wire fragment form suitable for electrical engineers. The point charge form enables the modeling of interactions between charges in free space. The wire fragment form enables the modeling of interactions between current carrying conductive fragments..

Readers should familiarize themselves with the Definitions section to understand terminology and notations used in later sections. The constants  $K_M$  and  $K_E$  as well as the evaluation of cross product chains ( $\mathbf{A} \times \mathbf{B} \times \mathbf{C}$ ) are of special importance. Table 2 lists the traditional laws used as foundations for New Electromagnetism.

The new model of electromagnetic induction (the IEL) is revealed in the paper titled “New Induction”. The reader is encouraged to read “New Induction” prior to reading this paper. “New Induction” details what is called Fragmentary Notation. Fragmentary Notation is used throughout this paper and described briefly below.


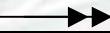
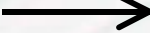

## 2.1 Definitions

### 2.1.1 General

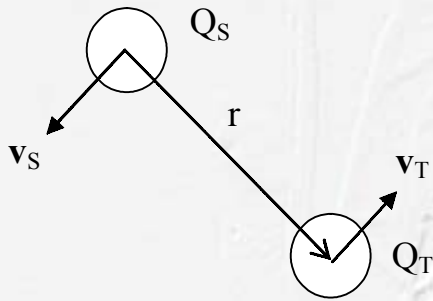
**Table 1 Definitions**

SOURCE	A source is an object emitting energy into space. This energy affects the object we are observing known as the TARGET. A subscript “S” denotes a property, object or energy of the source.
TARGET	A target is the object we desire to understand. We measure (or compute) the forces acting on a target by summing the effects produced by all of the sources. A subscript “T” denotes a property, object or energy of the target.
FRAGMENT	A differential length of conductor is represented by a differential vector length $d\mathbf{L}$
POINT CHARGE	A quantity of charge occupying an infinitesimally small space. Point charges are represented by a “Q” and have the units of Coulombs.
$\times$	This Symbol denotes a Cross Product, not scalar multiplication.
$\mathbf{A} \times \mathbf{B} \times \mathbf{C} = (\mathbf{A} \times \mathbf{B}) \times \mathbf{C}$	Chains of cross products without parenthesis are evaluated from left to right. $\mathbf{A} \times \mathbf{B} \times \mathbf{C} = (\mathbf{A} \times \mathbf{B}) \times \mathbf{C} \neq \mathbf{A} \times (\mathbf{B} \times \mathbf{C})$
$\bullet$	This symbol represents Dot Product. In some cases, smaller dots are used.

<b>Bold Face</b>	Bold face characters represent vector quantities.
<b>r</b>	This symbol represents the vector distance from source to target in all usage.
<b><math>\hat{r}</math></b>	A symbol embellished this way represents a direction vector.
<b><math> \mathbf{r}  = r</math></b>	Vertical bars around an expression denote that the magnitude of the enclosed quantity is desired. Non bold characters are always scalar.
<b>E = Vector “force per charge” field.</b>	Any vector field (able to move a charge) that can be represented in the units of “force per charge”. This is not necessarily an Electric Field.
<b><math>E_E</math> = Electric field.</b>	An Electric Field, i.e., a vector “force per charge” field due to Coulomb forces.
<b><math>E_M</math> = Magneto field.</b>	A magnetic “force per charge” field generated from the actions of magnetic field lines.
<b>V</b>	Potential Energy per charge (volts = J/C) due to an electric field.
<b>emf</b>	Kinetic Energy per charge (volts = J/C) due to charges in motion.
<b><math>dL_S, dL_T</math></b>	Source fragment, Target fragment.
<b><math>L_{TS}</math></b>	Fragmentary inductive linkage in Henries. This is the ratio of the emf in a target fragment due to the current change in a source fragment. The source and target may be the same.
<b>L</b>	Self inductance (henries): This is the back emf in an inductor resulting from the current change through it such that: $emf = -L \frac{dI}{dt}.$ L is determined from $L_{TS}$ as follows: $L = -\int \int_{T S} L_{TS}$ (Where source and target loops are the same).
<b>M</b>	Mutual inductance (henries): This is the emf generated in a target loop resulting from the current change in a source loop such that:

	$emf = -M \frac{dI}{dt}.$ <p>M is determined from <math>L_{TS}</math> as follows:  <math>M = -\int \int_{T S} L_{TS}</math> (Where source and target loops are NOT the same).</p>
$emf_T,$ $emf_T = \mathbf{E} \cdot d\mathbf{L}_T$	<p>The target fragmentary emf. To find the total emf in a target system (such as the entire target loop) one must integrate the emf contributed by each fragment, such that <math>emf = \int_T emf_T = \int_T \mathbf{E} \cdot d\mathbf{L}_T.</math></p>
$emf_{TS}$ $emf_{TS} = d\mathbf{E} \cdot d\mathbf{L}_T$ $emf_{TS} = \mathbf{E}_S \cdot d\mathbf{L}_T$	<p>The fragment to fragment emf. The emf across a target fragment due to the actions of a source fragment such that :</p> $emf_T = \int_S emf_{TS}, \text{ and:}$ $emf = \int \int_{T S} emf_{TS}$
$Q_S, Q_T$	Source and Target point charges.
$K_E = \frac{1}{4\pi\epsilon}$	The Electric field constant.
$K_M = \frac{\mu}{4\pi}$	The Magnetic field constant.
$C = \sqrt{\frac{K_E}{K_M}}$	The Speed of light.
	Velocity or Current.
	Acceleration or Current change.
	Force.
	Distance.

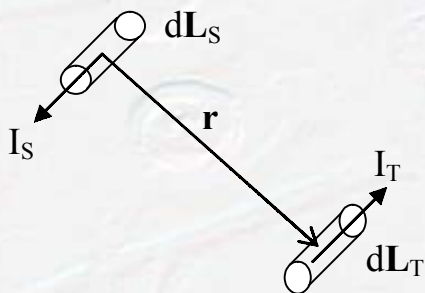
## 2.1.2 Point Charge Systems



**Figure 2-1 Point Charge systems**

Figure 2-1 shows that vector motion (velocities and accelerations) and scalar point charges comprise point charge systems. The total effect on the target is the vector summation of the effects produced by all sources.

## 2.1.3 Wire Fragment Systems



**Figure 2-2 Wire Fragment systems**

The new laws of electromagnetism enable us to model a system as a collection of fragments (fragment = vector differential length of wire =  $dL$ ). Each fragment can be a source ( $dL_S$ ) that emits energy into surrounding media and each fragment can be a receptor (target fragment =  $dL_T$ ) to energy that strikes it.

Wire fragment systems are modeled using fragmentary notation described in Appendix C of the paper titled “New Induction.”

Fragments comprise total systems. To find the total emf induced in a loop of wire, integrate the emf produced along each of its fragments. The emf contributed by each fragment may be determined by integrating the energy received by that fragment from other fragments and other sources.

## 2.1.4 Electric Fields and $\mathbf{E}$

In the traditional equations for electromagnetism,  $\mathbf{E}$  is a variable that denotes a vector field known as an Electric field. The unit of  $\mathbf{E}$  is force per charge. Electric fields are produced from Coulomb forces.

Consider the following: Suppose a charge is caught in the gravitational field of the Earth. The gravity exerts a force on the charge. If we then divide the force by the quantity of the charge, we will have a vector field quantity identical to the properties of an electric field. In the same manner as an Electric Field, this field can be inserted into any of the traditional equations to derive other properties such as work or energy.

For New Electromagnetism,  $\mathbf{E}$  will denote a vector “force per charge” field that is not necessarily an Electric Field. It is the responsibility of the reader to know what the source of  $\mathbf{E}$  is. This is analogous to the way  $\mathbf{F}$  is used to represent Force. It is common for  $\mathbf{F}$  to represent any Force and require the reader to understand the cause of  $\mathbf{F}$  through the equations used, or by nature of the problem.

For New Electromagnetism, the term “electric field” represents an  $\mathbf{E}$  field resulting from Coulomb forces. In equations where an electric field must be specified, the symbol  $\mathbf{E}_E$  is used. The symbol  $\mathbf{E}_M$  is used where a force per charge field resulting from the actions of a magnetic field must be specified.

## 2.1.5 $V$ and emf

$V$  and emf (“electromotive force”) have the same units of energy per charge (volts) and are interchangeable according to many traditional textbooks. New Electromagnetism treats  $V$  and emf differently.

The term emf will represent kinetic energy per charge and the term  $V$  will represent potential energy per charge. In the paper “New Induction” it is shown that magnetic fields store kinetic energy and electric fields store potential energy.

The following equations highlight the difference between emf and  $V$ .

$emf = \int_a^b \mathbf{E} \cdot d\mathbf{l}$  -- The amount of kinetic energy acquired by a charge caught in an E field of any type.

$V = -\int_a^b \mathbf{E}_E \cdot d\mathbf{l}$  -- The amount of potential energy stored in separated charges.

To clarify the difference between emf and V, consider the emf generated in an almost closed loop of wire existing in a changing magnetic field. The changing magnetic field imparts kinetic energy to the mobile charges in the loop. These mobile charges then race around the loop converting their kinetic energy to potential energy in the form of a depletion of charge at one end and a concentration at the other end. A voltmeter placed across the gap in the loop measures the voltage due to electric field of the separated charge, NOT the emf that caused the charges to separate.

An analogy to this would be shooting at a tin can to keep it suspended in the air. The bullets transfer kinetic energy to the can. As the can rises against the pull of gravity, the kinetic energy is converted to potential energy. The transferred bullet energy is analogous to emf, and the height of the can analogous to voltage.

Magnetic fields store kinetic energy and electric fields store potential energy. Changing a magnetic field causes kinetic energy to be transferred. A changing electric field is the indication of energy transferring.

Note: for those wishing more detail on this subject, it is covered quite exhaustively in the paper titled "New Induction" in the chapter titled "Kirchhoff's law."

### **2.1.6 emf and Wire Fragment Notation**

For systems involving conductors, or other items that can be modeled as collections of fragments, the emf generated in an entire system is the summation of the emf contributed by each fragment of the system. The emf generated across the length of a fragment is:

$$emf_T = \mathbf{E} \cdot d\mathbf{L}_T$$

Here a given fragment is treated as the target and all other fragments in the system as sources.  $\mathbf{E}$  is determined by summing the effects, at the target, of all sources that can be resolved to a force per charge field. This process is then repeated for all fragments in the system. In short, we find the total emf generated in a loop by integrating the emf contributed by each fragment:

$$emf = \int_T emf_T = \int_T \mathbf{E} \cdot d\mathbf{L}_T$$

## 2.1.7 The constants $K_E$ and $K_M$

To ease the handling of the constants for electromagnetism and to make the constants symmetrical with other branches of physics we use:

$$K_E = \frac{1}{4\pi\epsilon} \quad \text{Electric Field Constant} = 8.98755 \cdot 10^9$$

$$K_M = \frac{\mu}{4\pi} \quad \text{Magnetic Field Constant} = 1 \cdot 10^{-7}$$

These forms give us  $C = \sqrt{\frac{K_E}{K_M}}$  for the speed of light in a vacuum instead of

$C = \frac{1}{\sqrt{\mu\epsilon}}$ . The new form is symmetrical with the wave velocity equations of classical mechanics.

## 2.2 Identities

### Fragment to Point conversion Identity

The Fragment to Point conversion identity allows one to convert the fragment form of an equation to the point charge form. The Identity is:

$$Id\mathbf{L} = Q\mathbf{v} \quad \text{for} \quad d\hat{\mathbf{L}} = \hat{\mathbf{v}}.$$

This identity states that the current ( $I$ ) traveling through a fragment ( $d\mathbf{L}$ ) is equal to a point charge ( $Q$ ) moving at velocity ( $\mathbf{v}$ ).

To prove this identity, we remember that  $Q$  is a point charge and is therefore equivalent to  $dq$ . Then substitute the differentials into each of the above equations to obtain:

$$Id\mathbf{L} = \frac{dq}{dt} d\mathbf{L} \quad \text{and} \quad Q\mathbf{v} = dq \frac{d(\text{position})}{dt}.$$

Since  $d\hat{\mathbf{L}} = \hat{\mathbf{v}}$  (from above), then  $d\mathbf{L}$  and  $d(\text{position})/dt$  are in the same direction.

For  $d\mathbf{L}$  and  $d(\text{position})/dt$  along the  $x$  axis:

$$\frac{dq}{dt} dx = dq \frac{dx}{dt}. \quad \text{Thus} \quad Id\mathbf{L} = Q\mathbf{v}.$$

## 2.3 Founding Equations

In the following table, the middle column represents the equations as they are found in traditional textbooks. The equations in the right column are used as foundations of New Electromagnetism.

**Table 2 Founding Equations**

	Standard form	Founding Equations for New Electromagnetism.
Coulomb's Law	$\mathbf{F}_2 = \frac{Q_1 Q_2 \hat{\mathbf{r}}}{4\pi\epsilon  \mathbf{r}_{12} ^2}$	$\mathbf{F} = \frac{K_E Q_S Q_T \hat{\mathbf{r}}}{ \mathbf{r} ^2}$
Biot-Savart	$d\mathbf{B} = \mu \frac{(Id\mathbf{L} \times \hat{\mathbf{r}})}{4\pi  \mathbf{r} ^2}$	$\mathbf{B}_S = \frac{K_M (I_S d\mathbf{L}_S \times \hat{\mathbf{r}})}{ \mathbf{r} ^2}$  This is the magnetic field at a target fragment due to the current through a single source fragment.
Motional Electric Law	$\mathbf{E} = \mathbf{v} \times \mathbf{B}$ $emf = (\mathbf{v} \times \mathbf{B}) \cdot \mathbf{l}$	$emf_T = (\mathbf{v} \times \mathbf{B}) \cdot d\mathbf{L}_T$ $emf_T = -\mathbf{B} \cdot ((\mathbf{v}_T - \mathbf{v}_B) \times d\mathbf{L}_T)$ $emf_T = -\mathbf{B} \cdot (\mathbf{v}_T \times d\mathbf{L}_T)$
Faraday's Law	$emf = -N \frac{d\Phi}{dt}$	Not used.

# 3 THE NEW LAWS and EQUATIONS

## 3.1 The Positional Electric Law (PEL) - Coulomb's Law.

The Positional Electric Law (PEL) relates the position of electric charges to a force or emf. The mechanism of conveyance is an electric field. The PEL is Coulomb's Law represented in a different form. Given Coulomb's Law:

$$\mathbf{F} = \frac{K_E Q_S Q_T \hat{\mathbf{r}}}{|\mathbf{r}|^2}. \text{ Simply replace the direction vector } (\hat{\mathbf{r}}) \text{ with its equivalent } \frac{\mathbf{r}}{|\mathbf{r}|}.$$

**Equation 1: Positional Electric Law: Point Charge Form**

$$\mathbf{F} = \frac{K_E Q_S Q_T \mathbf{r}}{|\mathbf{r}|^3}$$

This changes the equation to match the symmetry of the other equations. This format of the equation is preferred for numerical integration algorithms. Other than this cosmetic change, there is no difference in the behavior of the law.

## 3.2 Motional Electric Law (MEL)

The Motional Electric Law relates the motion (specifically velocity) of electric charges to a force or emf. The mechanism of conveyance is a magnetic field. Combining the Biot-Savart law with the traditional form of the Motional Electric Law yields a form of the Motional Electric Law compatible with New Electromagnetism. It should be noted that a more complete description of magnetism will be released at the appropriate time in the paper titled "New Magnetism"—(nm.pdf). For now, the classical definition of magnetism is sufficient. The derivation follows:

Given: the Biot-Savart law,

- 1)  $d\mathbf{B} = (\mu / 4\pi r^2)(I_S d\mathbf{L}_S \times \hat{\mathbf{r}})$ , where the subscript "S" represents the source fragment and  $(\hat{\mathbf{r}})$  represents the unit direction vector from source to the position where  $d\mathbf{B}$  is computed.

Given traditional form of the Motional Electric Law:

$$2) \mathbf{E} = \mathbf{v} \times \mathbf{B} .$$

Substitute 1) directly into 2) and rearrange:

$$3) d\mathbf{E} = (\mu / 4\pi r^2)(\mathbf{v} \times (I_S d\mathbf{L}_S \times \hat{\mathbf{r}})) .$$

$$4) d\mathbf{E} = -(\mu / 4\pi r^2)(I_S d\mathbf{L}_S \times \hat{\mathbf{r}} \times \mathbf{v} ) .$$

Step 4) describes the force per unit charge acting at a given point on a target object moving with velocity ( $\mathbf{v}$ ). A current in a source fragment ( $I_S d\mathbf{L}_S$ ) generates the field that affects the target. The total effect ( $\mathbf{E}$ ) is determined by integrating the component effects ( $\mathbf{E} = \int d\mathbf{E}$ ) acting on the target.

Instead of integrating, substitute a fragment as the target; this will format the equation to fit the “fragment to fragment” style of new electromagnetism.

Equation 4) can be viewed as the amount of field generated at a target point due to the contribution of a single source fragment. This can then be rewritten using the fragmentary notation (see section 2.1):

$$5) \mathbf{E}_S = -(\mu / 4\pi r^2)(I_S d\mathbf{L}_S \times \hat{\mathbf{r}} \times \mathbf{v} ) . \text{ Where } \mathbf{E}_S \text{ is the force per charge at a given target point due to the current through a given source fragment } (I_S d\mathbf{L}_S) .$$

Remembering that  $emf = \int \mathbf{E} \cdot d\mathbf{L}$  and that any field is uniform across a differential length (such as a fragment), then the emf generated across a target fragment becomes  $emf_{TS} = \mathbf{E}_S \cdot d\mathbf{L}_T$ , therefore:

$$6) emf_{TS} = -(\mu / 4\pi r^2)(I_S d\mathbf{L}_S \times \hat{\mathbf{r}} \times \mathbf{v}_T) \cdot d\mathbf{L}_T .$$

Replacing the direction vector with its equivalent and then applying the following vector identity  $(A \times B) \cdot C \equiv A \cdot (B \times C)$  yields:

$$7) emf_{TS} = -(\mu / 4\pi r^3) I_S (d\mathbf{L}_S \times \mathbf{r}) \cdot (\mathbf{v}_T \times d\mathbf{L}_T) .$$

Rearranging and simplifying yields the wire fragment form of the Motional Electric Law.

### Equation 2: Motional Electric Law: Wire Fragment Form 1

$$emf_{TS} = \frac{-K_M I_S (d\mathbf{L}_S \times \mathbf{r}) \cdot (\mathbf{v}_T \times d\mathbf{L}_T)}{|\mathbf{r}|^3} .$$

Equation 2 is the emf along a single moving target fragment due to the field generated from the current through a single source fragment. The total emf of a system is found with a double line integration of Equation 2.

To find the emf along a target fragment where a magnetic field ( $\mathbf{B}$ ) is known then simply substitute out the Biot-Savart law:

### Equation 3 : Motional Electric Law: Wire Fragment Form 2

$$emf_T = -\mathbf{B} \cdot (\mathbf{v}_T \times d\mathbf{L}_T).$$

To find the physical force acting upon the target fragment we remember that

8)  $Q\mathbf{v} = Id\mathbf{L}$  or  $\mathbf{v} = \frac{Id\mathbf{L}}{Q}$  and substituting this into 5) yields:

9)  $\mathbf{E}_{TS} = -(\mu / 4\pi r^2)(I_S d\mathbf{L}_S \times \hat{\mathbf{r}} \times \frac{I_T d\mathbf{L}_T}{Q_T})$ . Then multiply both sides by  $Q_T$  and  $\mathbf{r}/|\mathbf{r}|$  to yield:

### Equation 4: Motional Electric Law: Wire Fragment Form 3

$$\mathbf{F}_{TS} = -K_M I_S I_T \frac{(d\mathbf{L}_S \times \mathbf{r} \times d\mathbf{L}_T)}{|\mathbf{r}|^3}.$$

Equation 4 represents the force acting on the charges moving in the target fragment. The mechanical force acting on the target fragment ( $\mathbf{F}_{Mechanical}$ ) is maximum when  $\mathbf{F}_{TS}$  is normal to the length of the fragment  $d\mathbf{L}_T$ . By the very nature of this equation the direction of the force will always be orthogonal to the length of the fragment; therefore, Equation 4 is both  $\mathbf{F}_{Mechanical}$  and  $\mathbf{F}_{TS}$ .

To derive the point charge equation of MEL we substitute  $Q\mathbf{v} = Id\mathbf{L}$  in Equation 4 to obtain:

### Equation 5: Motional Electric Law: Point Charge Form

$$\mathbf{F} = -K_M Q_S Q_T \frac{(\mathbf{v}_S \times \mathbf{r} \times \mathbf{v}_T)}{|\mathbf{r}|^3}.$$

Equation 5 is used to find the magnetic interaction of charged particles moving through free space.

## 3.3 Inertial Electric Law (IEL)

### 3.3.1 Introduction

The Inertial Electric Law (IEL) replaces Faraday's Law as the description of electromagnetic induction.

The IEL was found by sifting experimental data through a specially designed computer search algorithm. For details of the origin and derivation of the IEL, the reader is invited to read the work entitled "New Induction."

Since the publication of "New Induction" it has been found that the IEL is composed of two components, the Transverse component and the Longitudinal component.

The Transverse component (Figure 3-1 : Transverse IEL) is a field that radiates spherically from an accelerating charge (source). The dense arrows in Figure 3-1 represent the relative magnitude and direction of force affecting other charges (targets). The largest magnitude of energy is emitted in the direction transverse to the accelerating charge. The direction of force felt by a target is transverse to the radial direction from the source to the target.

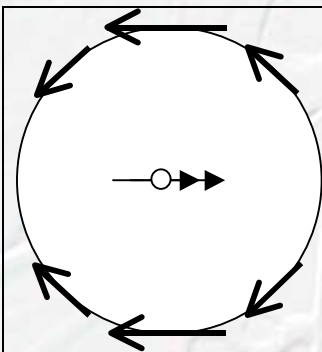


Figure 3-1 : Transverse IEL

$$\mathbf{F} = \frac{K_M Q_S Q_T (\mathbf{a}_S \times \mathbf{r} \times \mathbf{r})}{|\mathbf{r}|^3}$$

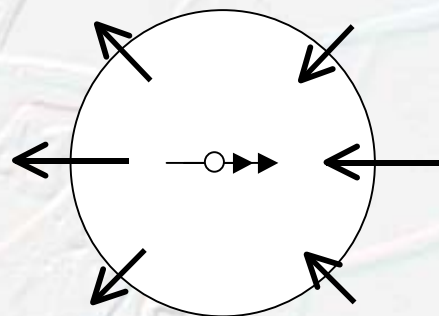


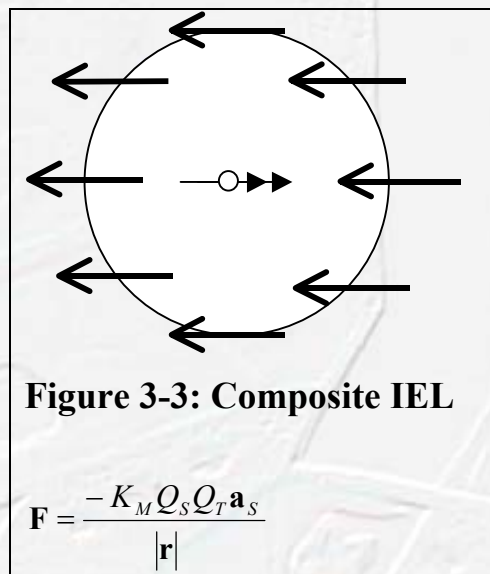
Figure 3-2: Longitudinal IEL

$$\mathbf{F} = \frac{-K_M Q_S Q_T (\mathbf{a}_S \cdot \mathbf{r}) \mathbf{r}}{|\mathbf{r}|^3}$$

The Longitudinal component (Figure 3-2: Longitudinal IEL) is a field that radiates spherically from an acceleration charge. The largest magnitude of energy is emitted in a direction longitudinal to the accelerating charge. The direction of force affecting targets is longitudinal to the radial direction from the source to the target.

The direction of the force arrows in the diagrams represents the effect on like charges. For interactions between dislike charges, the direction of force is opposite.

For most applications, the two component fields are summed to yield composite form of the IEL. The composite IEL is a field that radiated spherically from an accelerating charge. The magnitude of energy emitted in each given direction is the same. The direction of force affecting targets is directly opposite (for like charges) to the direction of the source.



**Figure 3-3: Composite IEL**

While the IEL and its components were found though experiment, this paper includes a derivation of the transverse component from traditional laws.

### 3.3.2 The Composite IEL

Equation 6 is the point charge form of the composite IEL. This equation states that an accelerating source charge  $Q_S \mathbf{a}_S$  will emit force that affects other charges. The force generated causes like charges to accelerate in a direction opposite to the acceleration of the source. Charges of the opposite

polarity will experience acceleration in the same direction as the source. The magnitude of the effect is inversely proportional to the distance from the source.

### Equation 6: IEL: Composite: Point Charge Form

$$\mathbf{F} = \frac{-K_M Q_S Q_T \mathbf{a}_S}{|\mathbf{r}|}$$

The wire fragment form of the IEL is found by substituting  $Q_S \mathbf{a}_S$  with

$\frac{dI_S}{dt} d\mathbf{L}_S$  yielding:

$$\mathbf{F}_S = -K_M \left( \frac{dI_S}{dt} \right) \frac{Q_T d\mathbf{L}_S}{|\mathbf{r}|} .$$

Dividing both sides by  $Q_T$  yields a force per charge equation. Since force per charge is an  $\mathbf{E}$  field, we then find the emf in a target fragment by dotting (performing dot product) both sides by the length of the target fragment ( $emf_T = \mathbf{E} \cdot d\mathbf{L}_T$ ). This yields the wire fragment form of the Inertial Electric Law:

### Equation 7: IEL: Composite: Wire Fragment Form

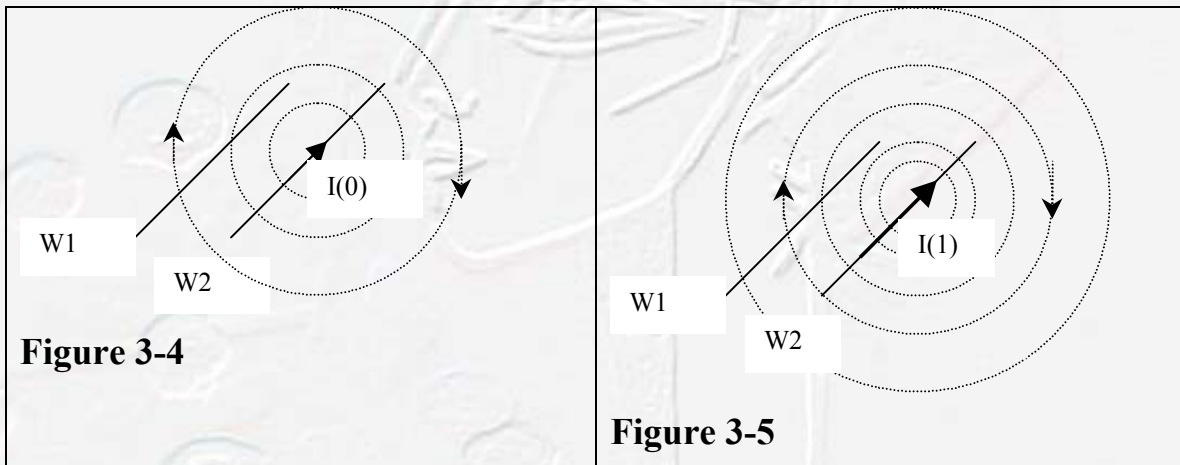
$$emf_{TS} = -K_M \left( \frac{dI_S}{dt} \right) \frac{d\mathbf{L}_S \cdot d\mathbf{L}_T}{|\mathbf{r}|} .$$

Equation 6 and Equation 7 are called the composite equations because they represent the vector summation of the two components of the IEL. The components are described in the following sections. Although the composite forms of the equation are simpler than the component forms, they must be used only when it is known that the component fields are in phase. This is important because it is possible to construct conductive surfaces/barriers that will affect only one component of the IEL and not the other. Under such conditions, the components of the IEL must be evaluated separately.

## 3.3.3 Transverse Component

The transverse component of the IEL can be derived from traditional laws. The derivation begins by considering two parallel filamentary conductors W1 and W2. In Figure 3-4, W2 is shown to have a current  $I(0)$  passing

through it. This current generates a magnetic field represented by the dashed lines. The magnetic field is static and therefore has no effect on W1 (assume no current through W1). In Figure 3-5 the current through W2 is increased to  $I(1)$  and the corresponding magnetic field about W2 increases as shown. The magnetic field shown in Figure 3-5 is also static and does not effect W1. Although the magnetic field has no effect on W1 at  $I(0)$  and  $I(1)$ , the magnetic field is changing in the period between  $I(0)$  and  $I(1)$ . This change in the magnetic field should produce an effect on W1.



Before we can determine the effect on W1 we must first understand how the magnetic field changes in the time between  $I(0)$  and  $I(1)$ . There are two possible ways in which the magnetic field can grow:

- 1) New magnetic field lines just appear instantaneously at pre-selected distances from W2 at given instances of time.
- 2) New magnetic field lines are created near W2 and displace pre-existing field lines outward.

The first possibility can describe an effect only if modeled in conjunction with Faraday's Law. This presents a problem because Faraday's Law requires us to compute the change in the number of flux lines enclosed by the target (W1) and it is not possible for a linear conductor or a fragment to enclose anything.

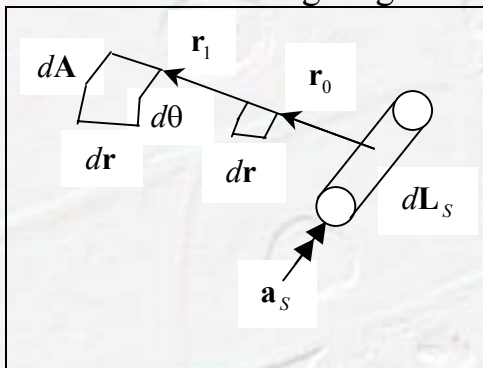
The second possibility can be modeled with the classical motional electric Law ( $emf = (\mathbf{v} \times \mathbf{B}) \cdot \mathbf{l}$ ). Where  $\mathbf{B}$  is the magnetic field intensity acting upon the target (W1). The magnetic field  $\mathbf{B}$  is determined from the Biot-Savart law. And  $\mathbf{v}$  is the velocity of the target (W1) relative to the magnetic field. Using the variable  $\mathbf{v}_B$  to define the vector velocity of the magnetic field, the

equation for the velocity of the target relative to the magnetic field then becomes  $\mathbf{v} = (\mathbf{v}_T - \mathbf{v}_B)$ . In our example, the target is not moving; however, the magnetic field is; therefore the equation becomes:  $emf = -(\mathbf{v}_B \times \mathbf{B}) \cdot \mathbf{l}$ . The next step is to derive the velocity of the magnetic field  $\mathbf{v}_B$  about a changing current.

## The Magnetic Field Velocity

If we assume that the magnetic field about a constant current is static, then it would be proper to conclude that the magnetic field about a changing current is in motion. More specifically, if the velocity of the charges, through a fragment at some point in space is constant, and the fragment itself is not in motion, then the magnetic field about that fragment is static. If we then increase the velocity of (accelerate) the charges through the fragment, then we should see a corresponding increase in the magnetic field about the fragment. To find the velocity of the magnetic field we need to determine how far a given set of field lines move and the amount of time taken.

Given the following diagram:



**Figure 3-6**

A differential sector area  $dA = r d\theta dr$  at a given distance  $r$  contains a quantity of magnetic field lines  $\Phi$ , where  $\Phi = \mathbf{B} \cdot d\mathbf{A}$ . For simplicity we define the area always to be normal to the magnetic field such that  $\Phi = BdA$ . To find  $\Phi$  we multiply the Biot-Savart law with the differential sector area and arrive at:

$$1) \Phi = \frac{K_M Q_S \mathbf{v}_S \times \mathbf{r}(rd\theta dr)}{r^3} = \frac{K_M Q_S \mathbf{v}_S \times \mathbf{r}(d\theta dr)}{r^2}$$

Add subscripts to this equation so that it represents the number of flux lines contained in a differential area at time  $t=0$ :

$$2) \Phi_0 = \frac{K_M Q_S \mathbf{v}_{S0} \times \mathbf{r}_0 (d\theta dr)}{|\mathbf{r}_0|^2}.$$

Next, make another version of the equation that represents the number of flux lines contained in a differential area at time  $t=1$ :

$$3) \Phi_1 = \frac{K_M Q_S \mathbf{v}_{S1} \times \mathbf{r}_1 (d\theta dr)}{|\mathbf{r}_1|^2}.$$

Because we want to find the distance between sectors containing the same number of flux lines, we set 2) equal to 3) and reduce to yield:

$$4) \frac{\mathbf{v}_{S0} \times \mathbf{r}_0}{|\mathbf{r}_0|^2} = \frac{\mathbf{v}_{S1} \times \mathbf{r}_1}{|\mathbf{r}_1|^2}$$

Now introduce the definition of magnetic field velocity  $\mathbf{v}_B$ . The velocity of the magnetic field is the change in distance divided by the change in time or:

$$5) v_B = \lim_{\Delta t \rightarrow 0} \left( \frac{r_1 - r_0}{\Delta t} \right). \text{ Rearranging yields:}$$

6)  $r_1 = r_0 + v_B \Delta t$  as  $\Delta t \rightarrow 0$ . Since the field expands radially about the fragment, then the direction of the magnetic field velocity is in the same direction as  $r$ .

Because the equation in step 4 relates the distance traveled by a given set of field lines relative to the velocity of the source, we now need to define a relationship between the change in velocity and acceleration. Thus:

$$7) \mathbf{v}_{S1} = \mathbf{v}_{S0} + \mathbf{a}_S \Delta t \text{ as } \Delta t \rightarrow 0.$$

Next we substitute 6 and 7 into 4; drop the subscripts, and take the limit to arrive at:

$$8) \frac{2|\mathbf{v}_B|}{|\mathbf{r}|} = \frac{\mathbf{v}_S \times \mathbf{v}_B}{\mathbf{v}_S \times \mathbf{r}} + \frac{\mathbf{a}_S \times \mathbf{r}}{\mathbf{v}_S \times \mathbf{r}}$$

Understanding that  $\mathbf{v}_B$  and  $\mathbf{r}$  are in the same direction rewrite 8 as:

$$9) \frac{2|\mathbf{v}_B|}{|\mathbf{r}|} = \frac{|\mathbf{v}_B|}{|\mathbf{r}|} \frac{\mathbf{v}_S \times \hat{\mathbf{r}}}{\mathbf{v}_S \times \hat{\mathbf{r}}} + \frac{\mathbf{a}_S \times \mathbf{r}}{\mathbf{v}_S \times \mathbf{r}} \quad \text{This yields:}$$

$$10) \frac{|\mathbf{v}_B|}{|\mathbf{r}|} = \frac{\mathbf{a}_S \times \mathbf{r}}{\mathbf{v}_S \times \mathbf{r}}$$

Step 10 is not the final form of the equation; however, it shows that the right hand side of the equation is equal to a scalar and can be treated as such as long as it is in that form. This identity will be handy later; for now, multiply both sides of the equation by the vector  $\mathbf{r}$ .

$$11) |\mathbf{v}_B| \hat{\mathbf{r}} = \left( \frac{\mathbf{a}_S \times \mathbf{r}}{\mathbf{v}_S \times \mathbf{r}} \right) \mathbf{r} \quad \text{-- (Simplified form disclosed in New Magnetism)}$$

Realizing that the direction of  $\mathbf{v}_B$  is the same as the vector  $\mathbf{r}$ ; simplify to yield the preferred form of the equation for point charges:

### Equation 8: Magnetic Field Velocity: Point Charge Form

$$\mathbf{v}_B = \left( \frac{\mathbf{a}_S \times \mathbf{r}}{\mathbf{v}_S \times \mathbf{r}} \right) \mathbf{r}. \quad \text{This is the point charge form.}$$

For wire fragments, the direction of the charge acceleration and charge velocity are the same; therefore, Equation 8 reduces to:

$$12) \mathbf{v}_B = \frac{|\mathbf{a}_S|}{|\mathbf{v}_S|} \mathbf{r}. \quad \text{Then substitute } \mathbf{a}_S = \left( \frac{dI_S}{dt} \right) \left( \frac{1}{Q_S} \right) d\mathbf{L}_S \text{ and } \mathbf{v}_S = \left( \frac{I_S}{Q_S} \right) d\mathbf{L}_S \text{ to achieve:}$$

### Equation 9: Magnetic Field Velocity: Wire Fragment Form

$$\mathbf{v}_B = \left( \frac{dI_S}{dt} \right) \left( \frac{\mathbf{r}}{I_S} \right). \quad \text{This is the wire fragment form.}$$

These equations (Equation 8 and Equation 9) seem to present the possibility that the magnetic field velocity approaches infinity as the charge velocity (or current) approaches zero. This is not a problem since these equations are

only valid for non-zero magnetic fields and there can be no magnetic field unless there is a non-zero charge velocity (or current). Furthermore, these equations are always used in conjunction with the Biot-Savart law in which case the denominators are canceled. This is shown in the next section.

## Concluding derivation of the Transverse component

To complete the derivation of the transverse component, substitute the Biot-Savart law and Equation 8 into  $\mathbf{E} = -\mathbf{v}_B \times \mathbf{B}$ . Thus:

$$1) \mathbf{E} = -\left(\frac{\mathbf{a}_S \times \mathbf{r}}{\mathbf{v}_S \times \mathbf{r}}\right) \mathbf{r} \times \frac{K_M Q_S (\mathbf{v}_S \times \mathbf{r})}{|\mathbf{r}|^3}. \text{ Moving the scalars to the left we have:}$$

$$2) \mathbf{E} = -\frac{K_M Q_S}{|\mathbf{r}|^3} \left(\frac{\mathbf{a}_S \times \mathbf{r}}{\mathbf{v}_S \times \mathbf{r}}\right) \mathbf{r} \times (\mathbf{v}_S \times \mathbf{r}). \text{ The term } \left(\frac{\mathbf{a}_S \times \mathbf{r}}{\mathbf{v}_S \times \mathbf{r}}\right) \text{ can be treated as a scalar (see step. 10 of previous section). As such, the following step is performed using the standard vector identity } \mathbf{A} \times \mathbf{B} = -\mathbf{B} \times \mathbf{A}, \text{ thus:}$$

$$3) \mathbf{E} = \frac{K_M Q_S}{|\mathbf{r}|^3} \left(\frac{\mathbf{a}_S \times \mathbf{r}}{\mathbf{v}_S \times \mathbf{r}}\right) (\mathbf{v}_S \times \mathbf{r}) \times \mathbf{r}$$

Perform the cancellation then multiply both sides by  $Q_T$  to arrive at the final form:

### Equation 10 : IEL: Transverse Component: Point Charge Form

$$\mathbf{F} = \frac{K_M Q_S Q_T (\mathbf{a}_S \times \mathbf{r} \times \mathbf{r})}{|\mathbf{r}|^3}$$

The derivation of the wire fragment form is even simpler than the point charge form. Starting with the standard form of the motional electric law in step 4)

$$4) \text{ emf} = (\mathbf{v} \times \mathbf{B}) \cdot \mathbf{l}. \text{ Rewrite this equation in wire fragment form:}$$

$$5) \text{ emf}_T = (\mathbf{v} \times \mathbf{B}) \cdot d\mathbf{L}_T. \text{ Replace velocity with magnetic field velocity, remembering that the direction of the magnetic field velocity is opposite to the effective velocity of the target.}$$

$$6) \text{ emf}_T = -(\mathbf{v}_B \times \mathbf{B}) \cdot d\mathbf{L}_T. \text{ Now substitute the wire fragment form of the magnetic field velocity (Equation 9) and the Biot-Savart law to yield:}$$

$$7) \text{ emf}_{TS} = - \left( \left( \frac{dI_S}{dt} \right) \left( \frac{\mathbf{r}}{I_S} \right) \times \left( \frac{K_M I_S d\mathbf{L}_S \times \mathbf{r}}{|\mathbf{r}|^3} \right) \right) \bullet d\mathbf{L}_T. \text{ Move all scalars to the left:}$$

$$8) \text{ emf}_{TS} = -K_M \left( \frac{dI_S}{dt} \right) \left( \mathbf{r} \times \left( \frac{d\mathbf{L}_S \times \mathbf{r}}{|\mathbf{r}|^3} \right) \right) \bullet d\mathbf{L}_T. \text{ Apply the same vector identity as}$$

in step 3:

$$9) \text{ emf}_{TS} = K_M \left( \frac{dI_S}{dt} \right) \left( \frac{d\mathbf{L}_S \times \mathbf{r} \times \mathbf{r}}{|\mathbf{r}|^3} \right) \bullet d\mathbf{L}_T. \text{ Apply the following vector identity}$$

$(A \times B) \bullet C = A \bullet (B \times C)$  to yield the preferred form:

### Equation 11 : IEL: Transverse Component: Wire Fragment Form

$$\text{emf}_{TS} = K_M \left( \frac{dI_S}{dt} \right) \frac{(d\mathbf{L}_S \times \mathbf{r}) \bullet (\mathbf{r} \times d\mathbf{L}_T)}{|\mathbf{r}|^3}$$

Note: You could also derive the wire fragment form of this equation from the point charge form by substituting the point to fragment conversion identity (section 2.2).

### 3.3.4 Longitudinal Component

Subtracting the Transverse component (Equation 10 or Equation 11) of the IEL from the Composite equation (Equation 6 or Equation 7) yields the longitudinal component. This is shown graphically in Figure 3-3.

Equation 12 shows the point charge form of the longitudinal component of the IEL.

### Equation 12 : IEL: Longitudinal Component: Point Charge Form

$$\mathbf{F} = \frac{-K_M Q_S Q_T (\mathbf{a}_S \bullet \mathbf{r}) \mathbf{r}}{|\mathbf{r}|^3}$$

Equation 13 shows the wire fragment form of the longitudinal component of the IEL.

### Equation 13: IEL: Longitudinal Component: Wire Fragment Form

$$emf_{TS} = -K_M \left( \frac{dI_S}{dt} \right) \frac{(d\mathbf{L}_S \cdot \mathbf{r})(\mathbf{r} \cdot d\mathbf{L}_T)}{|\mathbf{r}|^3}$$

### 3.3.5 Wave Equations

It has been shown in this paper, and the paper titled “New Induction”, that mathematical models that produce correct answers are not necessarily representative of the underlying mechanism of nature. Since Maxwell’s wave equations are based on Faraday’s Law and Faraday’s Law has been shown not to be the true mechanism of induction, then Maxwell’s wave equations should be applied with caution (see Note2 below).

To truly do justice to the phenomenon of electromagnetic waves traveling through free space, a model for free space must be developed. This modeling of free space is the topic of a later paper in this series.

It is important to develop a model for free space in order to understand the way that electromagnetic waves propagate. All other propagating phenomena, such as sound waves, are described by the medium through which they travel. Since the laws of electromagnetism really only describe the interactions between charges (see Note1 below), then any wave equations derived from these laws can only describe a wave that propagates along/among charges. This is not to say that the propagation of light does not exist, it only that it is not possible to describe it with Maxwell’s wave equations unless it is assumed that space is filled with charged particles (perhaps displacement charges).

**Note1: Electromagnetic laws only describe interactions between charges. The concept of a “field” is somewhat abstract since all equipment used to measure “field” phenomena does so by observing the effect of a “field” on charged particles. Consequently, all “field” generating equipment (that I know of) create “fields” by forcing charges to behave a certain way. Therefore, the concepts of a “field” and of “field lines” are only mathematical abstractions that enable us to perform calculations. Because these abstractions have been around for a long time, they have become reality in the mind of science. A later paper in this series will show a proposal for field mechanisms that enable a simple unification of gravity with electromagnetism. In fact it will propose that gravity, inertia and electromagnetic induction are one and the same.**

**Note2: The paper “New Induction” shows that the curl about a changing magnetic field can not be an electric field as proposed by Maxwell. An electric field by definition is conservative; therefore, the voltage about any closed path must equal zero. This is proved by considering the following experiment: Suppose it were your job to force a given target charge to move about a closed path and you were only allowed to place non moving static charges to do so (call them**

source charges). Is there a way to place source charges in such a way to generate Coulomb forces that would cause the target to move about a closed path? The answer is NO. It would only be possible if the source charges themselves were in motion. One could say that a changing magnetic field causes “virtual” source charges to move which then drag (or push) our target charge about a closed path. However, any field mechanism that causes these source charges to move would also have an effect on the target charge. There then remains no need to describe source or virtual charges, only that a changing magnetic field imparts kinetic energy directly to the charges it intersects.

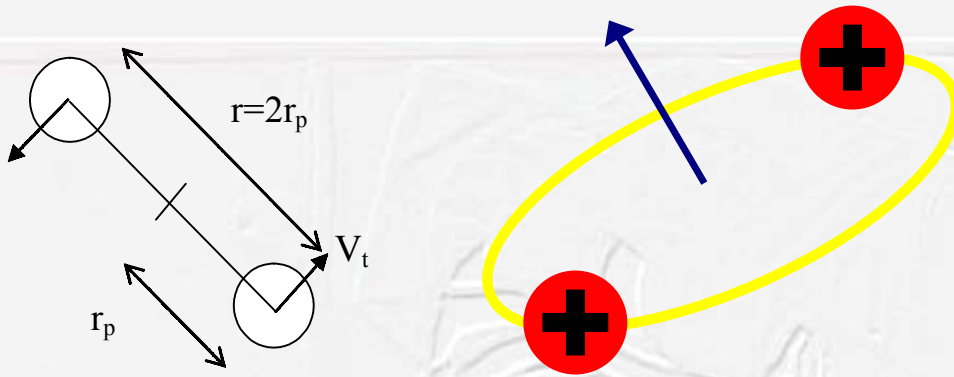
It is possible using New Electromagnetism to describe both transverse and longitudinal waves for distributed charge systems. Because these phenomena are well known and easily modeled using distributed impedance techniques, these models will not be covered here. The focus of New Electromagnetism is to develop useful free space models and free space wave equations. These developments are retained for future publications.

A later paper will also address the topic of field velocities. A field velocity is the velocity at which actual field material travels through space. For example, if a charge were to instantly materialize at point X, then how long would it take before a charge at point Y would be affected? Do field changes travel at constant velocities? The field velocity equation (Equation 8) describes the velocity of field lines at a distance, but how long after the source charge accelerates do the field lines at that distance attain the calculated velocity? See the paper “Classic Flux Anomaly” to see a distinction between field velocity and field propagation velocity. A later paper will show that electromagnetic fields must travel faster than the speed of light in order for light to propagate at the speed of light. That electromagnetic fields travel faster than the speed of light is a key point in the following hypothetical applications.

## **3.4 Binary Mass Particle (BMP)**

### **Formerly called Positive Mass Binary Model**

Consider a system of two like charges; both charges are either positive or negative. Each charge has a unit charge and no mass. Then take the two charges and place them close to each other. Is there a condition where the repulsive Coulomb forces would be mitigated allowing the two charges to become a steady system? The answer is yes.



**Figure 3-7**

One possible system has the two charges in orbit about each other as shown in Figure 3-7. To find a condition where the positional, motional and inertial forces cancel, we sum them and set them equal to zero:

$$1) \quad 0 = \frac{K_E Q_S Q_T \mathbf{r}}{|\mathbf{r}|^3} - \frac{K_M Q_S Q_T (\mathbf{v}_S \times \mathbf{r} \times \mathbf{v}_T)}{|\mathbf{r}|^3} - \frac{K_M Q_S Q_T \mathbf{a}_S}{|\mathbf{r}|}$$

The geometry of the system shows that the positional component and the motional component are repulsive forces while the inertial component is the sole attractive force.

Next, we substitute the variables of step 1):

- The distance ( $r$ ) between the two charges is twice the radius of the system ( $r_p$ ). Therefore  $2r_p$  replaces the distance between the charges ( $r$ ).
- The acceleration of the inertial component is replaced by the centripetal acceleration equation:  $a = \frac{V_t^2}{r_p}$ .
- The tangential velocity ( $V_t$ ) replaces the velocities of the motional component with opposite directions. Therefore  $(\mathbf{v}_S \times \mathbf{r} \times \mathbf{v}_T) = -V_t^2 \mathbf{r}$ .

Reducing yields:

$$2) \quad 0 = \frac{K_E}{2r_p} + \frac{K_M V_t^2}{2r_p} - \frac{K_M V_t^2}{r_p}. \quad \text{Further reduction yields: } 0 = \frac{K_E}{2} - \frac{K_M V_t^2}{2}.$$

Finally:

$$3) \quad V_t = \sqrt{\frac{K_E}{K_M}} = C.$$

Thus, in this hypothetical model, the forces cancel when the tangential velocity of the charges reaches the speed of light. This stability is independent of the distance between the charges.

Note: This system requires electromagnetic fields to travel much faster than the speed of light. This will be addressed in a later paper.

### 3.4.1 Effective mass of the System

Although the charges in the above system have no mass by definition, electromagnetic induction provides the system with effective mass (or inertia). We know from classical mechanics that the inertial force acting on an object is the product of the mass and the acceleration of the object. The inertial force retards the applied force and is in a direction opposite to the acceleration of the object. Therefore, the inertia force of an object is  $F = -Ma$ . Setting this equation equal to the Inertial Electric law and dividing through by acceleration yields the effective mass:

4)  $M = \frac{K_M Q_S Q_T}{2r_p}$ . Since there are two charges contributing inertia to the system, we multiply by two to yield the total effective mass of the system:

#### Equation 14: Effective Mass

$$M = \frac{K_M Q^2}{r_p}$$

The Effective Mass equation yields an interesting answer when Q is replaced by the charge of an electron ( $Q_e = 1.602177 \cdot 10^{-19}$ ) and  $r_p$  is replaced by the classical electron radius ( $r_e = 2.817941 \cdot 10^{-15}$ ):

$$M = \frac{K_M Q_e^2}{r_e} = \frac{\mu Q_e^2}{4\pi r_e} = \frac{4\pi \cdot 10^{-7} (1.602177 \cdot 10^{-19})^2}{4\pi (2.817941 \cdot 10^{-15})} = 9.109386 \cdot 10^{-31} \text{ kg}$$

The result is the mass of an electron. The reader is free to draw whatever conclusions he/she wants from this result. It is reasonable to conclude that electromagnetic induction is wholly or partially responsible for the phenomenon of inertia.

### 3.4.2 Energy of the model

The energy of the model is found by summing the potential and kinetic energies.

The kinetic energy is stored in the rotation the system. If you apply an impulse to each of the charges of the system to stop rotation, the total energy will equal:

1)  $KE = \frac{1}{2}MV^2 = \frac{1}{2}MC^2 = \frac{K_M Q^2}{2r_p} C^2$ , where M is replaced by the effective mass described in Equation 14.

The potential energy is the energy stored in the electrostatic field. If two like charges a distance of  $2r_p$  from each other were to fly apart due to the electrostatic force, how much energy would be released? The amount of energy released is equal to the amount of energy needed to bring the two charges within  $2r_p$  of each other. Any general physics textbook contains the equation that yields the answer:

$$2) PE = QV = -Q \int_{\infty}^{2r_p} \mathbf{E} \cdot d\mathbf{L} = -K_E Q^2 \int_{\infty}^{2r_p} \frac{1}{r^2} dr = \frac{K_E Q^2}{2r_p}.$$

Then, by summing 1) and 2), we get the total energy contained in the model:

$$3) E = KE + PE = \frac{K_M Q^2}{2r_p} C^2 + \frac{K_E Q^2}{2r_p}. \text{ We know that } K_E = K_M C^2; \text{ therefore:}$$

$$4) E = \frac{K_M Q^2}{r_p} C^2. \text{ Since } M = \frac{K_M Q^2}{r_p} \text{ (Equation 14) then:}$$

$$5) E = MC^2$$

### 3.4.3 Possibilities

Although this model is a hypothetical application of New Electromagnetism it is hard to ignore the results. With more refinement it is possible to model many standard model particles with techniques similar to that shown above.

The following problems of this basic application are addressed in later papers:

- 1) The charge of this system is twice that of an electron.
- 2) The magnetic moment does not match that of an electron.
- 3) What is the limiting mechanism that establishes  $r_p$  as the radius of the particle?
- 4) The radius of an electron is much smaller than the classical radius
- 5) In order for this model to be correct, the velocity of the electromagnetic fields must be greater than that of the speed of light.

## 3.5 Binary Antimass Particle (BAP)

Formerly titled Negative Mass Binary Model

Consider the same system as above except that the charges are opposite (one positive and one negative). Again, is there a condition where the two charges become a steady system? The answer is yes.

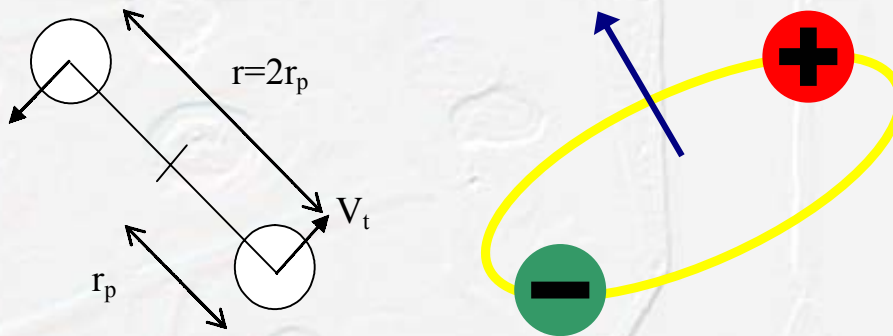


Figure 3-8

Following the same steps as before:

$$1) 0 = -\frac{K_E Q_S Q_T \mathbf{r}}{|\mathbf{r}|^3} + \frac{K_M Q_S Q_T (\mathbf{v}_S \times \mathbf{r} \times \mathbf{v}_T)}{|\mathbf{r}|^3} + \frac{K_M Q_S Q_T \mathbf{a}_S}{|\mathbf{r}|}$$

$$2) 0 = -\frac{K_E}{2r_p} - \frac{K_M V_t^2}{2r_p} + \frac{K_M V_t^2}{r_p}. \text{ Further reduction yields: } 0 = -\frac{K_E}{2} + \frac{K_M V_t^2}{2}.$$

Finally:

$$3) V_t = \sqrt{\frac{K_E}{K_M}} = C.$$

Just as in the previous model, the forces cancel when the tangential velocity of the charges reaches the speed of light. This stability is independent of the distance between the charges.

### 3.5.1 Effective mass of the system

Although the charges in the system have no mass by definition, electromagnetic induction provides the system with effective mass (or inertia). We know from classical mechanics that the inertial force acting on an object is the product of the mass and the acceleration of the object. The inertial force retards the applied force and is in a direction opposite to the acceleration of the object. Therefore, the inertia force of an object is  $F = -Ma$ . Setting this equation equal to the Inertial Electric law and dividing through by acceleration yields the effective mass:

- 4)  $M = -\frac{K_M Q_S Q_T}{2r_p}$ . Since there are two charges contributing inertia to the system, we multiply by two to yield the total effective mass of the system. Because the result is negative, it is called antimass.

#### Equation 15: Effective Antimass

$$M = -\frac{K_M Q^2}{r_p}$$

### 3.5.2 Energy of the model

The energy of the model is found by summing the potential and kinetic energies. The kinetic energy is simply:

- 1)  $KE = \frac{1}{2} MV^2 = \frac{1}{2} MC^2 = -\frac{K_M Q^2}{2r_p} C^2$ , where M is replaced by the effective antimass described in Equation 15.

The potential energy is found by calculating the amount of energy required to bring two dislike charges to within  $2r_p$  of each other. The answer is negative because of the fact that we are using dislike charges:

$$2) PE = QV = -Q \int_{\infty}^{2r_p} \mathbf{E} \cdot d\mathbf{L} = K_E Q^2 \int_{\infty}^{2r_p} \frac{1}{r^2} dr = -\frac{K_E Q^2}{2r_p}$$

Then, by combining 1) and 2), we get the total energy contained in the model:

$$3) \quad E = KE + PE = -\frac{K_M Q^2}{2r_p} C^2 - \frac{K_E Q^2}{2r_p}. \quad \text{We know that } K_E = K_M C^2; \text{ therefore:}$$

$$4) \quad E = -\frac{K_M Q^2}{r_p} C^2$$

The result is negative energy.

**Note: Other solutions for particle energy to be released when appropriate.**

## 4 Conclusion

The new equations for electromagnetism are arranged in section 5. A quick browse of that section will show an entire suite of equations that relate interactions between a source and a target (charge to charge; fragment to fragment; charge to fragment) without the need to consider a “field”.

By substitution of the “Fragment to Point conversion identity” one is able to convert between the point charge form of an equation to the wire fragment form. One may also decide that a particular hybrid form (charge to fragment) is more suitable for a particular application.

In a later paper a model of free space is developed that yields more accurate models for electromagnetic wave/field propagation through space. The free space model will also reveal an interesting relationship between gravity and electromagnetism.

In a following paper Titled “New gravity” the Binary models are used to derive a model for gravity based in the IEL. Consequently, many of the postulates for Einstein’s Relativity are derived.

The MEL is this paper was derived from classical equations. Although it is suitable for the applications in this paper, it is not the complete model of magnetism. The complete model of magnetism is disclosed in the paper titled “New Magnetism”—(nm.pdf to be available at [www.Distinti.com](http://www.Distinti.com)). New Magnetism completes the equations of New Electromagnetism by

disclosing a completely spherical magnetic field. New Magnetism also solves Faraday's Final Riddle and resolves the remaining contention between New Electromagnetism and the Theory of Relativity.

## 5 Quick Reference Tables

**Table 3 New Electromagnetic Equations**

Name	Point Charge form	Wire fragment form	Notes
Positional Electric Law (PEL)	$\mathbf{F} = \frac{K_E Q_S Q_T \mathbf{r}}{ \mathbf{r} ^3}$	$emf_{TS} = \frac{K_E Q_S \mathbf{r} \cdot d\mathbf{L}_T}{ \mathbf{r} ^3} = \mathbf{E}_E \cdot d\mathbf{L}_T$	$K_E = \frac{1}{4\pi\epsilon}$
Motional Electric Law (MEL)	$\mathbf{F} = \frac{-K_M Q_S Q_T (\mathbf{v}_S \times \mathbf{r} \times \mathbf{v}_T)}{ \mathbf{r} ^3}$ <p>See new and improved MEL in paper titled "New Magnetism" at <a href="http://www.Distinti.com">www.Distinti.com</a>.</p>	$emf_{TS} = \frac{-K_M I_S (d\mathbf{L}_S \times \mathbf{r}) \cdot (\mathbf{v}_T \times d\mathbf{L}_T)}{ \mathbf{r} ^3}$ <p><math>\mathbf{v}_T</math> = Velocity of the target fragment <math>d\mathbf{L}_T</math>.</p> $\mathbf{F}_{TS} = \frac{-K_M I_S I_T (d\mathbf{L}_S \times \mathbf{r} \times d\mathbf{L}_T)}{ \mathbf{r} ^3}$ <p><math>\mathbf{F}_{TS}</math> = Force acting on target fragment.</p>	$K_M = \frac{\mu}{4\pi}$
Inertial Electric Law (IEL)	$\mathbf{F} = \frac{-K_M Q_S Q_T \mathbf{a}_S}{ \mathbf{r} }$ <p>This equation is a summation of the two components shown in the next table.</p>	$emf_{TS} = -K_M \left( \frac{dI_S}{dt} \right) \frac{d\mathbf{L}_S \cdot d\mathbf{L}_T}{ \mathbf{r} }$ <p>This equation is a summation of the two components shown in the next table.</p>	$K_M = \frac{\mu}{4\pi}$

**Table 4 Components of the Inertial Electric Law**

Name	Point Charge form	Wire fragment form
Transverse component of Inertial Electric Law (IELT)	$\mathbf{F} = \frac{K_M Q_S Q_T (\mathbf{a}_S \times \mathbf{r} \times \mathbf{r})}{ \mathbf{r} ^3}$	$emf_{TS} = K_M \left( \frac{dI_S}{dt} \right) \frac{(d\mathbf{L}_S \times \mathbf{r}) \cdot (\mathbf{r} \times d\mathbf{L}_T)}{ \mathbf{r} ^3}$
Longitudinal component of Inertial Electric Law (IELL)	$\mathbf{F} = \frac{-K_M Q_S Q_T (\mathbf{a}_S \cdot \mathbf{r}) \mathbf{r}}{ \mathbf{r} ^3}$	$emf_{TS} = -K_M \left( \frac{dI_S}{dt} \right) \frac{(d\mathbf{L}_S \cdot \mathbf{r})(\mathbf{r} \cdot d\mathbf{L}_T)}{ \mathbf{r} ^3}$

**Table 5 Definitions**

$Q_S,$ $I_S$	Source charge or current. The motion and/or position of the source generate the effect we measure at the target.	$dL_S$	Source Fragment: A Differential Length of the conductor containing source current $I_S$ .	$\mathbf{r}$	A vector from source to target. For point charge equations, $\mathbf{r}$ is from $Q_S$ to $Q_T$ . For wire fragment forms, $\mathbf{r}$ is from center of $dL_S$ to center of $dL_T$ .
$Q_T,$ $I_T$	Target charge or current.	$dL_T$	Target Fragment: A Differential Length of the target conductor.	$\mathbf{a}_S$	The instantaneous vector acceleration of the source charge.
		$\mathbf{v}_T$	The instantaneous vector velocity of the target charge or fragment.	$\mathbf{v}_S$	The instantaneous vector velocity of the source charge or fragment.