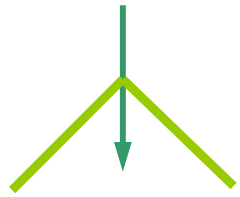
# New Magnetism



**New Magnetism**

Robert J Distinti
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**Revised for New Electromagnetism V3**

**The original version can be found at www.distinti.com/docs/v2**

Note to Reader: The V3 models were available in 1998. I did not get around to revising this paper for V3 models until the time of my graduate thesis (2007). The derivations in the paper are sound (TBOMK); however, other info such as internet links or addresses may no longer be valid.
--R Distinti -- July 2019

Copyright Page



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A new model for magnetism effects called New Magnetism is released in this publication as well as the Spherical Field concepts of both New Magnetism and New Induction. This is the original work of Robert J Distinti. A prior art search conducted shows that no prior work exists which releases such models or spherical field concepts for any magnetic phenomenon.

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# 1 Preface

It is our intent to create the most reader friendly publications possible. We decided that high quality full color publishing with as many pictures and diagrams as possible is the most appropriate course of action.

We try not to assume the capability of the reader except for those skills listed in the "prerequisite" section. There are many text books that just print an answer and demean the reader by saying that the derivation is obvious. We print full derivations to help out those who may not have a strong math background.

We also understand that our readers come from many varying backgrounds and may not be familiar with certain electrical engineering short-hands such as phasor notation. We strive to use the most common techniques wherever possible in order to carry along as many readers as possible.

We strive to enlighten the reader with the power, simplicity and versatility of the New Electromagnetic models and concepts. Some of the technology shown in this book is either impossible or impractical to derive with classical electromagnetic theory.

## 1.1 Prerequisites

Some sections of this book require skill level 5 (An example is section 5.5 which requires knowledge of Gauss's Law and Laplace transforms). The remainder of this book requires a skill level 3+ understanding of mathematics and physics which includes:

1) Calculus: second year college or honors high school level
2) Trigonometry: high school level+
    a. Sine
    b. Cosine
    c. Distance formula
    d. Euler expansion of sine and cosine
3) Vectors:
    a. Position vector
    b. Direction vectors

   c. Dot product
   d. Cross product
4) Differential Equations: Just enough to know what one is
5) Electricity and magnetism
   a. Charge, Voltage, emf, and Current.
   b. Familiar with the papers New Induction and New Electromagnetism
   c. Biot-Savart and Ampere's Law
6) Physics: General College Physics.
7) Familiarity with fragmentary notation (See paper New Induction (ni.pdf) for complete definitions – see the appropriate appendix in New Induction).

## 1.2 Color Coding

In this text we color code both headings and text. Although we may use the same colors for headings and text, the colors mean different things.

### 1.2.1 Heading Colors

The following are examples of color coded headings. The color helps distinguish the heading level.

**1 Introduction** ← Chapter headings (Level 1)
**1.1 Color Coding** ← Subchapter (Level 2)
**1.1.1 Heading Colors** ← Subchapter (Level 3)
**Example 1** ← Subchapter (Level 4) not-numbered

### 1.2.2 Text Colors

The primary purpose for coloring the text is to provide different voices to different reader levels or to channelize information.

- Black: Read by everyone
- Sky Blue: Items of interest, helpful hints.
- Lime Green: unused.
- Green: unused.

- Magenta: unused.
- Brown: unused.
- Red: Red text MUST be understood before venturing foreword.
- Violet: unused.
- Blue: web access password (see back cover).
- Grey: unused.

Red Text contains very important points that must be understood before venturing forward.

We intend to use the same color coding throughout the New Electromagnetism publications. Other publications such as the “New Electromagnetism for the Conceptually Brilliant” series makes heavy use of the colors listed above. The Conceptually brilliant series of books are intended for people who are not classically trained; however, many classically trained people use the books as a primer for New Electromagnetism; therefore, we add blocks of text in a different color which speak to classically trained scientists and engineers.

Text color coding does not apply to section headings or text in illustrations, figures and photographs.

# 2 Introduction

This book introduces a new magnetic field model (New Magnetism) which is spherical about a moving charge. This differs from the classical (Maxwell, Faraday, Ampere) model of magnetism which is toroidal (donut) shaped.

New Magnetism has the following characteristics:

1) The most complete description of magnetism.
2) Describes a completely spherical field phenomenon.
3) Solves Faraday's Final Riddle: Does the magnetic field move with a magnet?
4) Completely reconciles New Electromagnetism with the Theory of Relativity.
5) Explains why electron beams do not scatter.
6) The Biot-Savart and traditional Motional Electric Law ($\mathbf{F} = Q\mathbf{v} \times \mathbf{B}$) can be derived from the new model.
7) Explains magnetic attraction and the strange quirks of ferromagnetic interactions in simple terms.
8) Shows that a moving charge can affect a stationary charge ($-(\mathbf{v}_S \bullet \hat{\mathbf{r}})\mathbf{v}_S$).
9) Shows that longitudinal waves exist (See NIA1 in New Electromagnetism Application series for complete details).

This publication also shows:

1) The proper method for determining charge motion in conductive wire systems.
2) That wire (good conductor) systems obey Galilean relativity.
3) That New Induction (see paper "New Induction"—ni.pdf) is intimately related.

Also provided in this publication is the New Magnetism proof (which was a separate publication). The proof shows that the classical magnetic field models predict an "emf" at the corners of rectangular loops. These emf phenomena have never been detected nor are they predicted by New Electromagnetism.

New Magnetism along with New Induction and Coulomb's Model form the New Electromagnetism Version 3 (V3) models. The V3 models provide the most complete understanding of electromagnetic phenomenon to date.

When New Magnetism is applied to traditional closed loop wire systems, certain cancellations occur (derivation included in this paper) such that the resultant (NET) field energy produced by a wire fragment is identical to that described by the classical model. Because the pioneers in electromagnetism based their model of magnetism on observations made from conducting wire systems, the spherical nature of magnetism was not apparent.

# 3 Terms, Definitions and Identities

This section describes Terms, Definitions and Identities that are used in this text.

## 3.1 New Electromagnetism Terms

Like classical electromagnetic literature, New Electromagnetism may have many names to describe the same thing (See the following table). For example, in classical literature, an electric field may also be called a Coulomb field.

| New Electromagnetic model that describes the effect | Field Responsible for carrying the effect | Classical name for the effect | Proper New Electromagnetic Terminology | Alternate New Electromagnetic Terminology |
|---|---|---|---|---|
| Coulomb's Model | Electric Field | Electrostatic field<br>Coulomb field<br>Electric field | Positional Field<br>Positional Force(s)<br>Positional Effect(s) | Electric Field<br>Electric Forces<br>Coulomb field<br>Coulomb force(s) |
| New Magnetism | Magnetic field | Magnetism | Motional Field<br>Motional Force(s)<br>Motional Effect(s) | Magnetic field<br>Magnetic Force(s)<br>Magnetic Effect(s) |
| New Induction | Magnetic field | Electromagnetic Induction | Inertial Field<br>Inertial Force(s)<br>Inertial Effect(s) | Inductive field<br>Inductive Force(s)<br>Inductive Effect(s) |

In New Electromagnetism we have introduced new names for the fields in order to better describe the source of the field. For example, Electric fields are now called Positional fields since the observed effects are related by the relative position between charges. The field generated by a magnet or a wire carrying a constant current is called a motional field since it is created by the motion (velocity) of charges. The Inertial field is created by charge acceleration (acceleration and inertia are directly related).

Some people may be confused that we treat induction and magnetism as different effects when both are carried by magnetic fields. There is really no need for confusion since the effects of a charge accelerating (induction) and the effects of charge motion (magnetism) can be modeled as separate effects due to the fact electromagnetic fields are linear. Thus, an Inertial field is a region of space disturbed by an accelerating charges, a Motional field is a region of space disturbed by charges in motion and an Electric field is a region of space disturbed by the presence of charge. The knowledge of what actually carries the disturbances from the source to the target does not affect the answer that we obtain. Those readers who want to go beyond New Electromagnetism can find the actual field mechanisms in the Ethereal Mechanics series.

## 3.2 Definitions

New Electromagnetism 3 (V3) introduces new terms and definitions which are less confusion and more appropriate than previous definitions.

### 3.2.1 Volts and emf, $V_P$ and $V_K$

Voltage and emf are used in both classical and V1 nomenclature. The term "electro-motive-force" (emf) is confusing since it implies a "force." A "force" would suggest that emf is a vector quantity with the units of Newtons, Newtons/coulomb or something of that nature. Instead, emf is a scalar quantity with the units of "energy-per-coulomb" or Volts. In New Electromagnetism it is demonstrated that the emf generated from magnetic effects is more precisely defined as kinetic-energy-per-coulomb or kinetic voltage. To reduce the confusion, the V3 models us the symbol $V_K$ to represent kinetic voltage and $V_P$ to represent potential-voltage.

Note1: in the case of no subscript, potential voltage is assumed.

### 3.2.2 E and M fields

In classical electromagnetism, **E** is a variable that denotes a vector field known as an Electric field. The unit of **E** is force-per-coulomb.

Consider the following: Suppose a charge is caught in the gravitational field of the Earth. The gravity exerts a force on the charge's mass. 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 V3, **E** denotes a vector "force-per-coulomb" field which is specifically due to an electric field. This is different from the V2 (and earlier) definitions where we attempted to keep **E** as a ubiquitous force per charge quantity in order not to stray to far from classical definitions. The V3 definitions also introduce the M-field which is denoted by the symbol **M** and represents a vector "force-per-coulomb" field which is specifically due to magnetic fields (both NI and NM).

Properties of E-Fields and M-Fields

| Property | E-Field | M-Field |
|---|---|---|
| Conservative | Yes | No |
| Units | Force/coulomb | Force/coulomb |
| Type | Potential | Kinetic |
| Source model | Coulomb's Model | NI, NM |

For more detail about E and M fields, see ne.pdf.

NOTE: It is being considered to have a separate I-Field for New Induction for reasons that will be released in the future.

### 3.2.3 Point Charge Systems

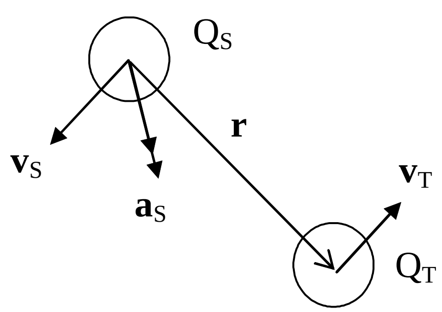


**Figure 3-1 Point Charge systems**

Figure 3-1 shows a system of point charges with vectors representing various properties of position, velocity and acceleration.

In New Electromagnetism, each field model has a form that is directly applicable to point charge systems. These are called the point charge forms; they are the most fundamental forms.

 

## 3.2.4 Wire Fragment Systems

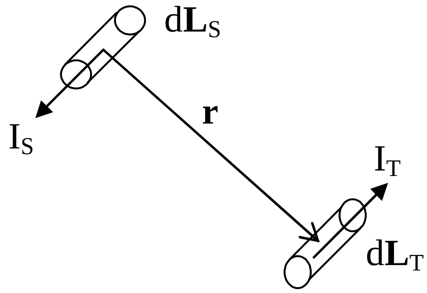


**Figure 3-2 Wire Fragment systems**

New Electromagnetism enables us to model a system as a collection of fragments (fragment = vector differential length of wire = $d\mathbf{L}$ ). Each fragment can be a source ( $d\mathbf{L}_S$ ) that emits energy into surrounding media and each fragment can be a receptor (target fragment = $d\mathbf{L}_T$ ) to energy that strikes it.

In New Electromagnetism, each field model has a form that is directly related to wire fragment systems. The variations are called the wire fragment forms. The wire fragment form of the Inertial field is derived by direct substitution of the Fragment-to-Point conversion identity into the point charge form of the equation (Shown in section 3.3.1). The wire fragment forms for New Magnetism are derived in this book using a sophisticated model of charge behavior in conductive wire. This model enables reconciliation between New Electromagnetism and Relativity by showing a mechanism whereby current carrying conductors (and magnetic fields produced there from) obey Galilean relativity.

## 3.2.5 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:

$K_E = \frac{1}{4\pi\varepsilon}$ Electric Field Constant = $8.98755 \bullet 10^9$

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

These forms give us $C=\sqrt{\frac{K_E}{K_M}}$ for the speed of light in a vacuum instead of $C=\frac{1}{\sqrt{\mu\varepsilon}}$. The new form is symmetrical with classical wave mechanics.

# 3.3 Identities

## 3.3.1 Point-to-Fragment conversion Identity

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

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

This identity states that the current (I) traveling through a fragment (d**L**) is equal to a point charge (Q) moving at velocity (**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:

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

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

For d**L** and d(**position)/dt** along the x axis:

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

# 3.4 General

**Table 3-1 Definitions**

| | |
|---|---|
| Classical models<br>Classical (…) | When the word classical is used in conjunction with an electromagnetic term, it describes the version of that electromagnetic term prior to New Electromagnetism. For example, classical magnetism refers to the Biot-Savart (Ampere) magnetic model. |
| V1 | The New Electromagnetism V1 equations are comprised of the following three fundamental equations:<br>1) PEL: Coulomb's Model<br>2) MEL(V1): which is derived in the paper "New Electromagnetism" (ne.pdf) from the classical motional electric law (CMEL) f=QvxB and Biot-Savart.<br>3) IEL: New Induction. See the paper "New Induction" (ni.pdf) or "New Electromagnetism" (ne.pdf) |
| V2 | The New Electromagnetism V2 equations are comprised of the following three fundamental equations:<br>1) PEL: Coulomb's model<br>2) MEL: New Magnetism (as released in this book)<br>3) IEL: New Induction |
| V3 | Models Same as V2.<br>Changes include (but are not limited to):<br>1. Detailed definitions of potential and kinetic energy<br>2. Elimination of PEL, MEL, IEL nomenclature<br>3. Eradication of the usage of the word "Law." Only Mother Nature has Laws, mathematical models are merely feeble attempts to mimic those laws.<br>4. Disclosure of M-Field; M-Field replaces $E_M$<br>5. More rigid definition of potential and kinetic voltage<br>6. Improved wire fragment forms |

| | |
|---|---|
| NI | Abbreviation for New Induction |
| NE | Abbreviation for New Electromagnetism |
| 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 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. |
| **Bold Face** | Bold face characters represent vector quantities. |
| $\mathbf{r}$ | This symbol represents the vector distance from source to target in all usage. |
| $\hat{\mathbf{r}}$ | A symbol embellished this way represents a direction vector. |
| $\lvert\mathbf{r}\rvert = r$ | Vertical bars around an expression denote that the magnitude of the enclosed quantity is desired. Non bold characters are always scalar. |
| $\mathbf{E}$ = Electric field. | An electric vector "force per coulomb" field due to Coulomb forces. This is a conservative field. E-Fields convey kinetic energy. |
| $\mathbf{M}$ = Magnetic field. | A magnetic vector "force per coulomb" field generated from the velocity or acceleration of charge. This is a non-conservative field. M-Fields convey kinetic energy. |

| | |
|---|---|
| V<br>$V_P$ | Potential Voltage: Potential Energy per charge (volts = J/C) due to an electric field. |
| $V_K$ | Kinetic Voltage: Kinetic Energy per charge (volts = J/C) due to charges in motion. The term emf is the classical term for kinetic voltage. |
| $d\mathbf{L}_S, d\mathbf{L}_T$ | Source fragment, Target fragment. |
| $Q_S, Q_T$ | Source and Target point charges. |
| $K_E = \frac{1}{4\pi\varepsilon}$ | 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. |
| $\longrightarrow$ | Velocity or Current. |
| $\longrightarrow\!\!\!\blacktriangleright\!\blacktriangleright$ | Acceleration or Current change. |
| $\boldsymbol{\longrightarrow}$ | Force. |
| $\longleftrightarrow$ | Distance. |
| BMP | Binary Mass Particle. This is the general name given to the Positive Mass Binary Model described the paper New Electromagnetism (Ne.pdf) |
| BMP- | The Binary Mass Particle constructed with negative charges. |
| BMP+ | The Binary Mass Particle constructed with positive charges. |
| BAP | The Binary Anti-mass Particle. This is the general name given to the Negative Mass Binary Model described the paper New Electromagnetism Ne.pdf |
| CMEL<br><br>Classical Motional Electric Law | Classical Motional Electric Law:<br>The following two equations are forms of the motional electric law from classical or traditional electromagnetism.<br>$\mathbf{E} = \mathbf{v} \times \mathbf{B}$<br>$emf = (\mathbf{v} \times \mathbf{B}) \bullet \mathbf{l}$<br>The above two equations are used in conjunction with the Biot-Savart field model shown here:<br>$d\mathbf{B} = \mu \frac{(Id\mathbf{L} \times \hat{\mathbf{r}})}{4\pi\lvert\mathbf{r}\rvert^2}$ |

| | |
|---|---|
| MEL(V1) | Motional Electric Law<br>The version of MEL derived from CMEL found in the publications previous to this in the series.<br><br>The original derivation of MEL(V1) from CMEL is found in the paper titled "New Electromagnetism" – (ne.pdf).<br><br>MEL(V1): point charge form:<br>$\mathbf{F} = \frac{-K_M Q_S Q_T (\mathbf{v}_S \times \mathbf{r} \times \mathbf{v}_T)}{\lvert\mathbf{r}\rvert^3}$<br><br>MEL(V1): point charge form: The dual cross product replaced with equivalent vector expression:<br>$\mathbf{F} = \frac{\mathrm{K_M Q_S Q_T}}{\lvert\mathbf{r}\rvert^2}\left[(\mathbf{v}_\mathrm{T} \bullet \hat{\mathbf{r}})\mathbf{v}_\mathrm{S} - (\mathbf{v}_\mathrm{S} \bullet \mathbf{v}_\mathrm{T})\hat{\mathbf{r}}\right]$<br><br>MEL(V1): wire fragment forms:<br>$emf_{TS} = \frac{-K_M I_S (d\mathbf{L}_S \times \mathbf{r}) \bullet (\mathbf{v}_T \times d\mathbf{L}_T)}{\lvert\mathbf{r}\rvert^3}$<br>$\mathbf{F}_{TS} = \frac{-K_M I_S I_T (d\mathbf{L}_S \times \mathbf{r} \times d\mathbf{L}_T)}{\lvert\mathbf{r}\rvert^3}$<br>alternate variation<br>$emf_{TS} = \frac{-K_M I_S (d\mathbf{L}_S \times \hat{\mathbf{r}}) \bullet (\mathbf{v}_T \times d\mathbf{L}_T)}{\lvert\mathbf{r}\rvert^2}$<br>$\mathbf{F}_{TS} = \frac{-K_M I_S I_T (d\mathbf{L}_S \times \hat{\mathbf{r}} \times d\mathbf{L}_T)}{\lvert\mathbf{r}\rvert^2}$ |
| | |
| | |
| | |

# 4 New Magnetism (NM)

## 4.1 The New Magnetism equations

The fundamental form of New Magnetism is Equation 4-1. From this point charge form, all other variations are derived. Some variations of NM are shown in Table 4-1. These equations may look intimidating; however, once you become familiar with them, you will find that they actually describe very simple interactions that are easier to understand and more useful than the classical models.

$$\mathbf{F} = \frac{K_M Q_S Q_T}{|\mathbf{r}|^2}\left[(\mathbf{v}_T \bullet \hat{\mathbf{r}})\mathbf{v}_S - (\mathbf{v}_S \bullet \hat{\mathbf{r}})\mathbf{v}_S - (\mathbf{v}_S \bullet \mathbf{v}_T)\hat{\mathbf{r}}\right]$$

**Equation 4-1: New Magnetism (point charge form)**

**Table 4-1: Forms of New Magnetism**

| | | |
|---|---|---|
| Point Charge Form | $\mathbf{F} = \frac{K_M Q_S Q_T}{\lvert\mathbf{r}\rvert^2}\left[(\mathbf{v}_T \bullet \hat{\mathbf{r}})\mathbf{v}_S - (\mathbf{v}_S \bullet \hat{\mathbf{r}})\mathbf{v}_S - (\mathbf{v}_S \bullet \mathbf{v}_T)\hat{\mathbf{r}}\right]$ | Note: $K_M = \frac{\mu}{4\pi}$ |
| Wire Fragment Form | $d^2 V_K = \frac{-K_M I_S}{r^2}\left[\begin{array}{l}\left(\frac{I_S}{Q_S}(d\mathbf{L}_S \bullet \hat{\mathbf{r}}) + (\mathbf{v}_{FS} \bullet \hat{\mathbf{r}}) - (\mathbf{v}_{FT} \bullet \hat{\mathbf{r}})\right)(d\mathbf{L}_S \bullet d\mathbf{L}_T) \\ + (d\mathbf{L}_S \bullet \hat{\mathbf{r}})(\mathbf{v}_{FS} \bullet d\mathbf{L}_T) + (d\mathbf{L}_T \bullet \hat{\mathbf{r}})(\mathbf{v}_{FT} \bullet d\mathbf{L}_S)\end{array}\right]$ | |
| Wire Form | $V_K = -K_M I_S \oint_S \oint_T \frac{1}{\lvert\mathbf{r}\rvert^2}\left[\begin{array}{l}((\mathbf{v}_{FS} - \mathbf{v}_{FT}) \bullet \hat{\mathbf{r}})(d\mathbf{L}_S \bullet d\mathbf{L}_T) \\ + (d\mathbf{L}_S \bullet \hat{\mathbf{r}})(\mathbf{v}_{FS} \bullet d\mathbf{L}_T) \\ + (d\mathbf{L}_T \bullet \hat{\mathbf{r}})(\mathbf{v}_{FT} \bullet d\mathbf{L}_S)\end{array}\right]$<br>The above equation is the kinetic voltage generated in a target loop and is for closed loop systems only. For uniform current distribution. | |

# 4.2 Why?

The following subsections detail the reasoning that lead to the search for the new model of magnetism. None of the following subsections by itself represents a very strong argument; however, all of the arguments together were compelling.

## 4.2.1 Spherical Symmetry

A review of the New Electromagnetic equations prior to New Magnetism (the V1 equations) shows that all of the electromagnetic effects (including gravity) are spherical except for magnetism (CMEL or MEL(V1)). Both the NI and the Coulomb's model show that field energy is distributed spherically about a source; however, the classical Biot-Savart model, which defines the distribution of magnetic field energy, shows that a magnetic field is distributed in a direction transverse to the motion of the source (like a toroid or donut).

Consequently, the classical electromagnetic equations (which include Biot-Savart and Coulomb's model) are formatted such that $4\pi r^2$ appears in the denominator. Is it just coincidence that $4\pi r^2$ represents the surface area of a sphere and that Biot-Savart does not represent a spherical field?

The Anomalies of Classical Electromagnetism series of papers show many examples where the donut shaped field (the transverse only field) does not properly predict what we see in real life. Antenna modeling is one of the mismatches of great distinction which is covered in great detail in the New Electromagnetism Application Series book NIA1. Another mismatch between classical field theory and experiment is presented as a proof of the spherical field in a later section of this book.

## 4.2.2 Relation to New Induction (NI)

In the V1 version of the New Electromagnetism paper (www.distinti.com/docs/v1/ne.pdf), is a derivation of the transverse component of NI from the Classical MEL (CMEL). The longitudinal component can not be derived from the CMEL because according to the Biot-Savart model, there is no magnetic field emitted in the longitudinal direction.

If induction depends upon magnetism, then it should be possible to derive all components of induction from magnetism or visa-versa. If magnetism and induction are independent field effects, then neither component of induction should be derivable from magnetism.

Since both NI and other magnetic field effects share the same constant of relation $K_M$, then they must be intimately related, such that it should be possible to derive one from the other.

### 4.2.3 Reconciliation with Relativity

In the V1 version of the Paper titled "New Gravity" (www.distinti.com/docs/v1/ng.pdf) it is shown that Einstein's time dilation equation can be derived from New Electromagnetism (V1); however, the derivation is only correct when the motion of the Binary Mass Particle (BMP) is orthogonal to the radii between the charges.

New Magnetism completes the New Electromagnetic equations by introducing a model that is spherical in symmetry and which reconciles New Electromagnetism with Relativity.

## 4.3 The Derivation of New Magnetism (NM)

The new model for magnetism is found by solving for the missing components of charge motion under the following assumptions:

1) NM must show that Time dilation for the BMP is not dependant of direction of motion.
2) NM must be a spherical field
3) NI must be completely derivable from NM.

In the following sections, the above assumptions are explored. Each section produces a different set of results, that when combined, yields a complete description of what will be the new mode for magnetism (NM)

### 4.3.1 The BMP

The Binary Mass Particle (see ne.pdf and ng.pdf) is an effective model for matter that enables us to derive many of the properties of matter from New Electromagnetism. Such properties include inertia and time dilation. In order to explore the correct model of magnetism we should like to know what model of magnetism completely satisfies motional time dilation, for the BMP, in all directions.

To start this process we write the equation that defines the BMP (using V1 models):

1) $0 = +\frac{K_E Q_S Q_T \hat{\mathbf{r}}}{|2\mathbf{r}|^2} - \frac{K_M Q_S Q_T ((\mathbf{v}_S \times \hat{\mathbf{r}}) \times \mathbf{v}_T)}{|2\mathbf{r}|^2} - \frac{K_M Q_S Q_T \mathbf{a}_S}{|2\mathbf{r}|}$

The above simplifies to:

2) $0 = +\frac{C^2 \hat{\mathbf{r}}}{|2\mathbf{r}|} - \frac{((\mathbf{v}_S \times \hat{\mathbf{r}}) \times \mathbf{v}_T)}{|2\mathbf{r}|} - \frac{\mathbf{a}_S}{1}$

Since the acceleration of the source is the centripetal acceleration due to the tangential velocity (Vt) of the source then:

3) $0 = +\frac{C^2 \hat{\mathbf{r}}}{|2\mathbf{r}|} - \frac{((\mathbf{v}_S \times \hat{\mathbf{r}}) \times \mathbf{v}_T)}{|2\mathbf{r}|} - \frac{V_t^{\,2} \hat{\mathbf{r}}}{r}$ and

4) $0 = C^2 \hat{\mathbf{r}} - ((\mathbf{v}_S \times \hat{\mathbf{r}}) \times \mathbf{v}_T) - 2V_t^{\,2} \hat{\mathbf{r}}$

The equation in step 4 is the essential equation for the BMP. Recalling from v1/ne.pdf; $\mathrm{V_t}$ is the tangential velocity of the charges that comprise the system such that $|\mathbf{v}_\mathrm{T}| = |\mathbf{v}_\mathrm{S}| = \mathrm{V_t}$. $\mathrm{V_t}$ is measured relative to the system.

The following diagrams represent a BMP moving in different direction relative to the instantaneous charge positions. In the following diagrams, V is the velocity of the system.

In order to determine the correct form of New Magnetism we must solve the equation in step 4 such that $\mathrm{V_t}^2 = \mathrm{C}^2 - \mathrm{V}^2$ for any given direction of V.

 

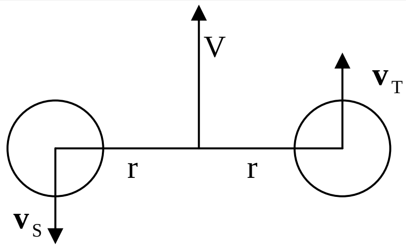


Figure 4-1

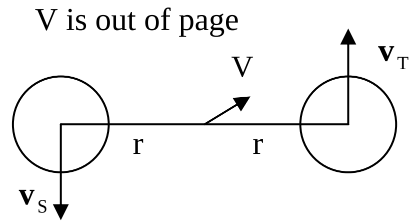


Figure 4-2

For Figure 4-1 and Figure 4-2, the equation (of step 4) resolves to $V_t^2 = C^2 - V^2$ without intervention. For readers who wish more background with the BMP in motion, the system of Figure 4-2 is solved in the paper titled "New Gravity"—(ng.pdf).

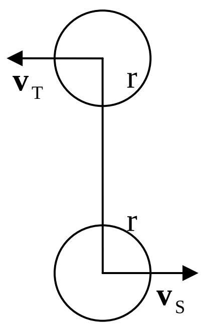


Figure 4-3

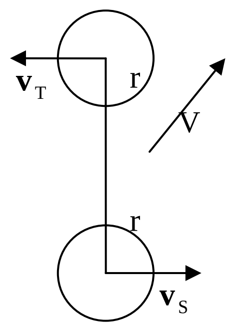


Figure 4-4

For Figure 4-3 and Figure 4-4 the equation does not properly resolve to $V_t^2 = C^2 - V^2$. In order to resolve the system for all directions of V, the following must be added to the system:

5) $-(\mathbf{v}_S \bullet \hat{\mathbf{r}})\mathbf{v}_T + (\mathbf{v}_S \times \mathbf{v}_T \times \hat{\mathbf{r}})$

This yields the total motional force to be

6) $-(\mathbf{v}_S \times \hat{\mathbf{r}} \times \mathbf{v}_T) - (\mathbf{v}_S \bullet \hat{\mathbf{r}})\mathbf{v}_T + (\mathbf{v}_S \times \mathbf{v}_T \times \hat{\mathbf{r}})$

Performing vector expansion:

7) $-(\mathbf{v}_S \times \hat{\mathbf{r}} \times \mathbf{v}_T) = (\mathbf{v}_T \bullet \hat{\mathbf{r}})\mathbf{v}_S - (\mathbf{v}_T \bullet \mathbf{v}_S)\hat{\mathbf{r}}$

8) $-(\mathbf{v}_S \bullet \hat{\mathbf{r}})\mathbf{v}_T = -(\mathbf{v}_S \bullet \hat{\mathbf{r}})\mathbf{v}_T$

9) $(\mathbf{v}_S \times \mathbf{v}_T \times \hat{\mathbf{r}}) = (\mathbf{v}_S \bullet \hat{\mathbf{r}})\mathbf{v}_T - (\mathbf{v}_T \bullet \hat{\mathbf{r}})\mathbf{v}_S$

(Remember, Step 7 is MEL(V1))

Resolving the components yields a very simple relation for the motional force of the BMP:

10) $-(\mathbf{v}_S \bullet \mathbf{v}_T)\hat{\mathbf{r}}$

The result in step 10 is the only component of magnetism required to maintain proper stability and time dilation of the BMP in all directions.

Inspection of 10 shows that it is a component of the MEL(V1) (see step 7); which is derived from CMEL and Biot-Savart. What happens to the other component ($(\mathbf{v}_T \bullet \hat{\mathbf{r}})\mathbf{v}_S$)? Perhaps it is cancelled by other previously unknown motional components.

The other unknown components of magnetism are inferred from NI in the next section(s). It is to be shown that the complete equation for magnetism includes all of the components of the MEL(V1) plus one. This new component, in the case of the BMP, cancels with the components of the MEL(V1) leaving just the effect shown in step 10 above.

### 4.3.2 New induction (NI)

This section reverse engineers the NI to discover components of NM. It was shown in the V1 version of ne.pdf that the transverse component of NI can be derived from the Biot-Savart and the traditional form of MEL (CMEL). Since the NI and MEL both share the same constant of relation, then it should be logical to assume that both fields should be completely interrelated. It must be possible to backwards derive components of NM from the NI. We say "backwards" derive because NI is based on charge acceleration which is the derivative of charge velocity. This means that there may be other NM components that must be inferred. This is analogous to the way constants are inferred when performing integration (anti-differentiation).

This "backward" derivation starts with NI:

11) $\mathbf{F} = \dfrac{-K_M Q_S Q_T \mathbf{a}_S}{|\mathbf{r}|}$

Next we reintroduce the field velocity equation from v1/ne.pdf:

12) $|\mathbf{v}_B|\hat{\mathbf{r}} = \left(\dfrac{\mathbf{a}_S \times \mathbf{r}}{\mathbf{v}_S \times \mathbf{r}}\right)\mathbf{r}$

This equation can be simplified by realizing that the velocity and acceleration are both in the same direction Thus:

13) $\dfrac{\mathbf{v}_B}{\mathbf{r}} = \dfrac{\mathbf{a}_S}{\mathbf{v}_S}$

In step 13 one must realize that $\mathbf{v}_B$ and $\mathbf{r}$ are both in the same direction; likewise, $\mathbf{a}_S$ and $\mathbf{v}_S$ are in the same direction; therefore, both sides of the equation are scalar. If we multiply both sides of 13 by $\mathbf{v}_S$ we arrive at:

14) $\dfrac{|\mathbf{v}_B|}{|\mathbf{r}|}\mathbf{v}_S = \mathbf{a}_S$

Because $\mathbf{v}_B$ and $\mathbf{r}$ are in the same direction, the following is equivalent to 14

15) $\dfrac{(\mathbf{v}_B \bullet \hat{\mathbf{r}})}{|\mathbf{r}|}\mathbf{v}_S = \mathbf{a}_S$

Substituting 15 into 11 yields:

16) $\mathbf{F} = \dfrac{-K_M Q_S Q_T (\mathbf{v}_B \bullet \hat{\mathbf{r}})\mathbf{v}_S}{|\mathbf{r}|^2}$

Step 16 shows that as the field expands outward from the source $(\mathbf{v}_B \bullet \hat{\mathbf{r}})$, force is imparted to the target charge proportional to $\dfrac{-\mathbf{v}_S}{|\mathbf{r}|^2}$. The direction of the imparted force is opposite to the direction of the source.

For simplicity, strip step 16 down to the essential equation:

17) $-(\mathbf{v}_B \bullet \hat{\mathbf{r}})\mathbf{v}_S$ (It should be understood that this is multiplied by $\frac{K_M Q_S Q_T}{|\mathbf{r}|^2}$ to yield Force).

We will use the essential equation in step 17 to infer the other components of magnetism.

It must be remembered that $\mathbf{v}_B$ is the velocity of expansion of the magnetic field resulting from the change in velocity (acceleration) of the source. Since the above equation is the effect of the moving field "crashing" into a stationary target, then what would happen if the target crashed into a stationary field? Logically, since outward motion of the magnetic field crashing into the target causes the target to move in a direction opposite to the velocity of the source $\mathbf{v}_S$, then the effect of the target moving toward the source should have the same effect. Thus we add the following component:

18) $(\mathbf{v}_T \bullet \hat{\mathbf{r}})\mathbf{v}_S$

Next, suppose that the source is moving toward the target (not accelerating). Although the field is not expanding, it is "crashing" into the target by the simple fact that it is carried along by the source. Following the symmetry of the above, when the source moves toward the target, the field crashes into the target imparting energy to the target. Therefore, the direction of energy should be opposite to the direction of the source, thus the final component is realized:

19) $-(\mathbf{v}_S \bullet \hat{\mathbf{r}})\mathbf{v}_S$

The following line summarizes the magnetic components inferred from NI

20) $(\mathbf{v}_T \bullet \hat{\mathbf{r}})\mathbf{v}_S - (\mathbf{v}_S \bullet \hat{\mathbf{r}})\mathbf{v}_S - (\mathbf{v}_B \bullet \hat{\mathbf{r}})\mathbf{v}_S$

### 4.3.3 Combining the Components

Collecting the components from both preceding sections yields the total of all components of magnetism:

 

21) $(\mathbf{v}_T \bullet \hat{\mathbf{r}})\mathbf{v}_S - (\mathbf{v}_S \bullet \hat{\mathbf{r}})\mathbf{v}_S - (\mathbf{v}_B \bullet \hat{\mathbf{r}})\mathbf{v}_S - (\mathbf{v}_S \bullet \mathbf{v}_T)\hat{\mathbf{r}}$

By observing step 21, it is realized that the first and last components comprise the MEL(V1) which is derived from the classical model of magnetism (see step 7 or definitions section). Also, realizing that the third component is NI, we find that the only previously "unknown" component of magnetism is the second component.

The "unknown" component of magnetism is proven easily. If we have two parallel wires with a current flowing in the source, we know that by moving the target closer/farther to the source, an emf is generated in the target (outlined by first component). Consequently, it is also well known that an emf is generated in the target, if the source is moved closer/farther to the target (defined by new component).

A person knowledgeable in electromagnetism would know that the effects described in the previous paragraph have been known for hundreds of years. This is true; except that this "new" component seems to have been omitted from the traditional models of magnetism. This omission is easily highlighted by the following:

1) The new component completes the sphere. The magnetic field described by in step 21 is completely spherical about a moving charge. In traditional magnetism the magnetic field (as described by Biot-Savart) is only transverse to a moving charge.
2) To this very day, there is still a debate raging regarding something known as "Faraday's Final Riddle." In the riddle, the question is posed: Does a magnetic field move with the source (magnet)? The new component shows that the magnetic field moves with the charges and has nothing to do with the rest of the magnet. This is explored in section 9 Faraday's Final Riddle.

Although we can now describe both magnetism and induction in a single expression, we prefer to keep them separate for simplicity; therefore, we remove the third component of step 21 and allow it to remain separately as NI. We could recombine the first and last component into the crazy cross product of previous models, or we could combine the first two components; however, it's much easier to see the different effects when the components are kept separate thus:

22) $(\mathbf{v}_T \bullet \hat{\mathbf{r}})\mathbf{v}_S - (\mathbf{v}_S \bullet \hat{\mathbf{r}})\mathbf{v}_S - (\mathbf{v}_S \bullet \mathbf{v}_T)\hat{\mathbf{r}}$

And New Magnetism is:

$$\mathbf{F} = \frac{K_M Q_S Q_T}{|\mathbf{r}|^2}\left[(\mathbf{v}_T \bullet \hat{\mathbf{r}})\mathbf{v}_S - (\mathbf{v}_S \bullet \hat{\mathbf{r}})\mathbf{v}_S - (\mathbf{v}_S \bullet \mathbf{v}_T)\hat{\mathbf{r}}\right]$$

**Equation 4-2: New Magnetism: point charge form**

The above equation satisfies the requirements put forward in this section. The requirements are that the new field is spherical, BMP Time Dilation is the same in all directions, and NI is intimately related.

The first two components of Equation 4-2 are called the relative motion components. These components cancel each other if there is no relative motion between source and target.

The last component of Equation 4-2 is the parallel motion component. The effect of this component is at maximum when the charges are moving parallel to each other. This component essentially states that like moving currents attract and dislike moving currents repel.

A later chapter of this paper will develop the wire fragment form of NM. The wire fragment form of NM is not simply a substitution of the Point-to-Fragment identity into the above. The actual dynamics of charge flowing through conductors must be understood in order to properly render the wire fragment form(s) of New Magnetism.

# 5 Conduction: Charges in Motion

It has always been known that charges in motion generate magnetic fields; however, science has traditionally treated the motion of the mobile carries (i.e. electrons) through a conductor as the sole source of a magnetic field. For a stationary system this is true; however, for a system in motion, this is not correct.

The following sections disclose a more detailed understanding of the dynamics of conductors and charge motion.

## 5.1 The Stationary Current

Current flowing in a good conductor is composed of two components. The first component is the traditional current that is measured with an AMP meter. The second component is the "stationary" current. The "Stationary" current is important for systems in motion and enables the magnetic fields of good conductors, to obey Galilean relativity.

We can infer the stationary current with the following simple logical argument.

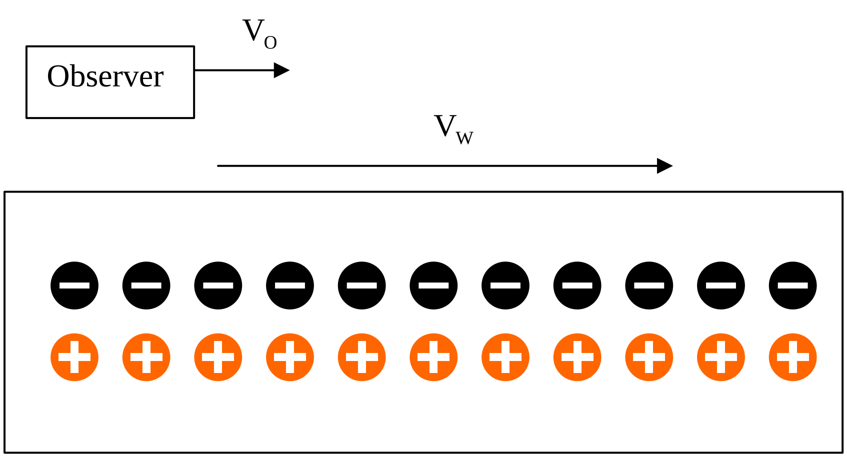


**Figure 5-1 Observer and section of wire**

Figure 5-1 shows a wire moving with velocity $V_w$, constructed of a good conductor, with no current traveling in it. We know from experience that the amount of charge contained in the wire is equal and opposite. Because there is no current in the wire, the magnetic field from the current is zero. Likewise, because the charges that comprise the wire are equal and opposite, the magnetic field generated from the motion of the wire is also zero.

If the total number of electrons in the wire is N, then the total number of positive charges in the wire is also N. Since there is no current in the wire, the velocity of all charges is equal to the velocity of the wire $V_w$. Writing the relationship that describes the total charge motion of the system (I) as seen by an observer moving parallel to the wire with velocity $V_O$ becomes:

1) $I = (V_w - V_O)(NQp + NQe) = 0$. Remember that $Qp = -Qe$

Next, suppose that a current is established in the wire such that Z electrons (Z<N) are moving with velocity $V_e$ (relative to the wire). Further suppose that the direction of $V_e$ is the same as $V_w$ and it is along the length of the wire as shown in Figure 5-2.

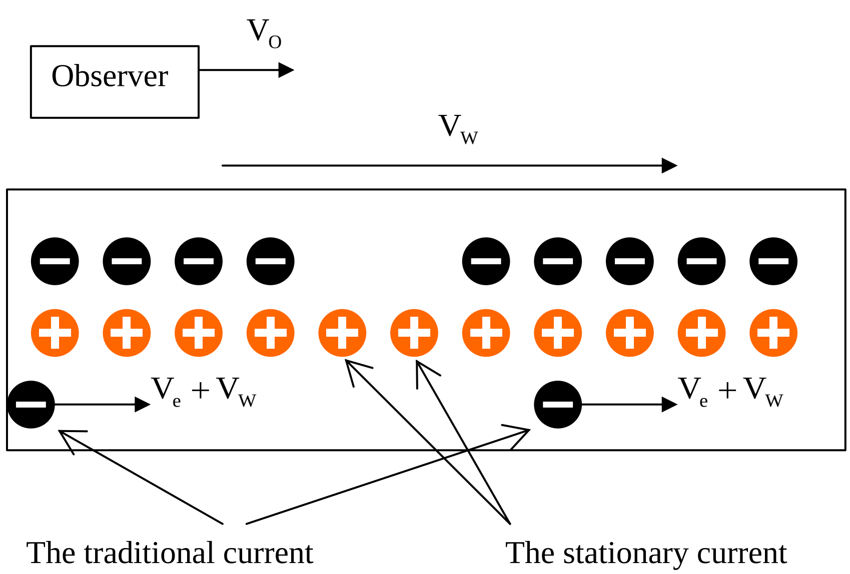


**Figure 5-2**

Therefore, the equation for the total charge motion of the system (as seen by observer) becomes:

2) $I = (V_w - V_O)(NQp + (N - Z)Qe) + (V_e + V_w - V_O)(ZQe)$

And

3) $I = (V_w - V_O)(-ZQe) + (V_e + V_w - V_O)(ZQe)$

Since $Qp = -Qe$ then

4) $I = (V_w - V_O)(ZQp) + (V_e + V_w - V_O)(ZQe)$

The stationary positive charges that are not balanced by stationary electrons comprise what is hereafter called the "stationary current". The equation in Step 4 shows that the stationary current does have an effect on the total magnetic field generated by the system. The stationary charges produce a magnetic field that cancels the additional magnetic field of the traditional current that results from the motion of the wire. This is found by continuing the simplification (from step 3) to arrive at:

5) $I = V_e ZQe$

The above result is surprising for the following reasons:

1) The magnetic field of a good conductor is the same regardless of the motion of the conductor.
2) Since the magnetic field intensity of a good conductor is proportional only to the traditional current, this system obeys Galilean relativity.
3) The magnetic field generated by the system is the same to all observers in all reference frames.

NOTE: It is always best to calculate the effects of the stationary current and the traditional current separately then add the results together. The reason for this is that the new component $[-(\mathbf{v}_S \bullet \hat{\mathbf{r}})\mathbf{v}_S]$ is a velocity squared component. We all know, from simple algebra, that $V_1^2 + V_2^2 \neq (V_1 + V_2)^2$ . An example of the proper methodology is found when wire fragments are considered.

## 5.2 The Stationary Current and NI

Since NI is a magnetic phenomenon, then the stationary current affects NI in a manner similar to NM. The acceleration of the system in the previous section will not produce an inertial emf if the system were physically accelerated. The emf caused by the acceleration of the current would be negated by the emf caused by the acceleration of the stationary charges.

If you do not follow the above logic then consider the following apparatus:

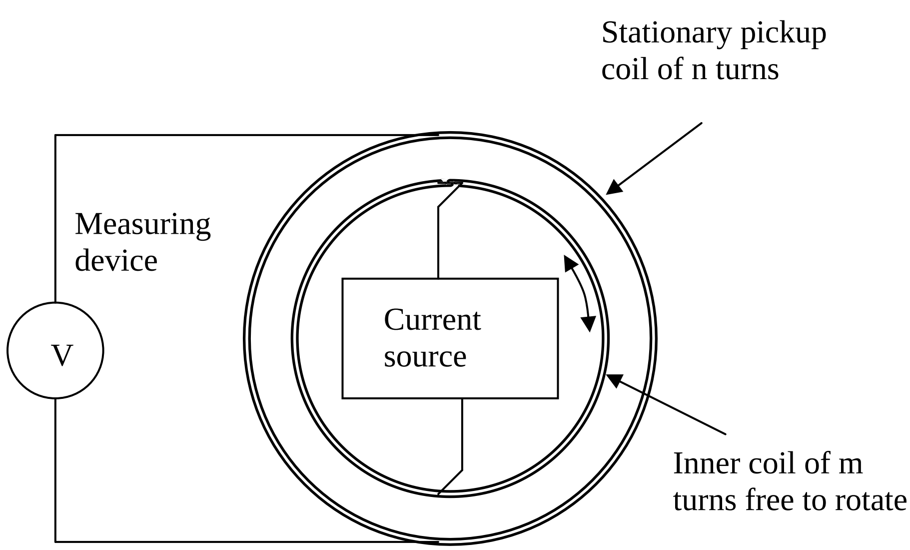


**Figure 5-3**

Figure 5-3 shows a concentric loop experiment that enables us to prove that the stationary current balances NI. In the experiment, the outer coil (secondary) is stationary and attached to a measuring device. The inner coil (primary) is free to rotate concentrically with respect to the outer coil.

To highlight the effect of the stationary charges with respect to NI, two experiments are run.

In the first experiment, the primary coil is stationary and energized with a time varying current (such as $\frac{di}{dt} = A\sin(2\pi ft)$). This experiment is identical to the Mutually Inducting Loop Experiment found in the paper titled “New Induction” and is analogous to a transformer. As such, an emf induced in the secondary is proportional to the time derivative of the current in the primary.

 

In the second experiment, the primary is energized with a DC current and the angular acceleration of the primary is non zero (such as $\alpha = A\sin(2\pi ft)$). It may seem to the casual observer that the charge motion is similar to that of the previous experiment. For the mobile charges, this is true; however, the stationary charges are now in motion where they weren't in the first experiment. Because the mobile and stationary charges are accelerated in the exact same way, they produce equal and opposite emfs in the secondary. Therefore there is no NET emf detected. You can replace the inner coil with a disk magnet and the effect will be the same, for the same reasons.

Similar to the moving wire experiment in the previous section, the stationary current prevents any effect due to the relative motion between the observer (outer coil) and the observed system (inner coil). For a system constructed of good conductors, the Inertial field observed by the outer coil is dependant upon the acceleration of the charges relative to the inner coil and nothing else.

This chapter applies to systems where the balance of charge in a given fragment is substantially equal. The next sections address systems where the charge is not in balance.

## 5.3 The Gaussian Current

In the previous section we considered current where the charges in motion were balanced by stationary charges. This balancing allows classical circuit analysis to obey Galilean relativity. Logically, there should exist systems where there is an imbalance between charges in motion and stationary charges. New Electromagnetism defines these currents as Gaussian currents with the following formal definition:

A Gaussian current is a current not balanced by stationary charges. As such, a Gaussian surface constructed around the current will yield a non-zero result. An example of a Gaussian current is a charged sphere moving with velocity V. Another example of a Gaussian current is an electron beam.

If the total number of charges (moving or stationary) of a system is in balance, the Gaussian of the system is zero. When the Gaussian of any fragment of a system is zero, that fragment will obey Galilean relativity as demonstrated in the previous section. Subsequently, the current of such a system is hereafter defined as a non-Gaussian current. The currents in permanent magnets, super-conductors and good conductors (driven with small currents) are examples of non-Gaussian or low-Gaussian currents. The magnetic fields generated by such systems are hereby referred to as non-Gaussian or low-Gaussian magnetic fields.

The purest example of a Gaussian current is an electron beam. Because there are no stationary charges in the beam, a Gaussian surface constructed around the beam yields the number of electrons in motion. This is called a pure Gaussian current. (See Electron beam coherency in section 7).

Another method for generating a Gaussian current is to establish a current in a resistive wire. The currents in a resistive wire will have both Gaussian and non-Gaussian components. (See Gaussian Currents in Resistive wires in section 5.5).

A device which generates Gaussian currents is realized by intentionally offsetting the balance between mobile charges and stationary charges. This is accomplished in semiconductors by the process of doping.

We can explore Gaussian currents by modifying the experiment of the previous section as follows:

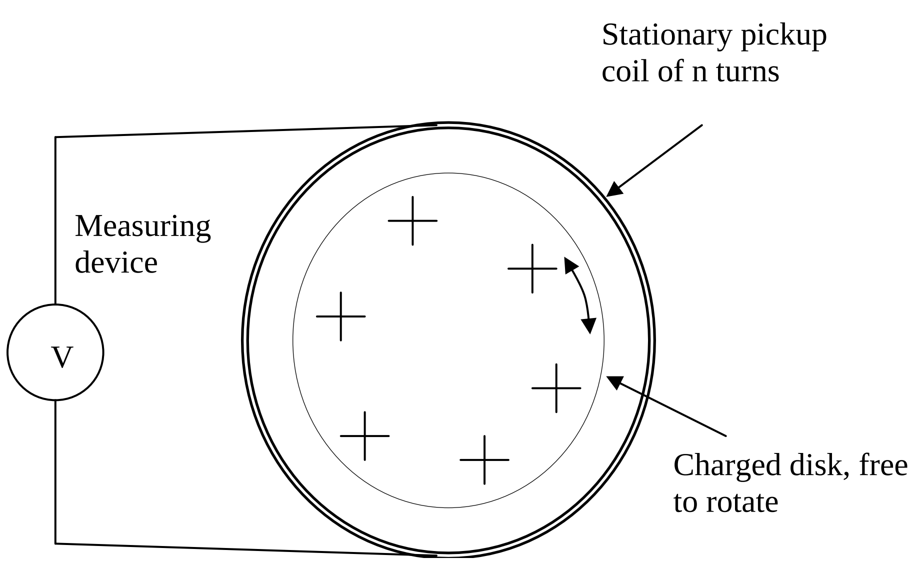


**Figure 5-4**

Figure 5-4 shows an experiment similar to the one shown in the previous section except that the inner coil is replaced by a charged disk. The disk is comprised of a material that does not allow the charges to freely conduct; in other words, the charges move with the disk. If the disk is rotated such that the angular acceleration of the disk is non zero (such as $\alpha = A\sin(2\pi ft)$) then an emf (kinetic voltage) will be detected by the measuring device.

Magnetism is generated by charges in motion. Both the QUANTITY and VELOCITY of charge are a factor in determining the magnitude of charge motion. A troubling question of science for the past few centuries is VELOCITY RELATIVE TO WHAT? The next section considers the reference frame of magnetism against which we measure the velocity of the charges that we study.

## 5.4 The reference frame of magnetism

The magnetic models revealed in this publication are based on the velocity of charges. The question should arise: the velocity relative to what? What do you measure the velocity of the charges relative to, in order to accurately calculate the strength of a magnetic field? We can explore this question with the following thought experiment.

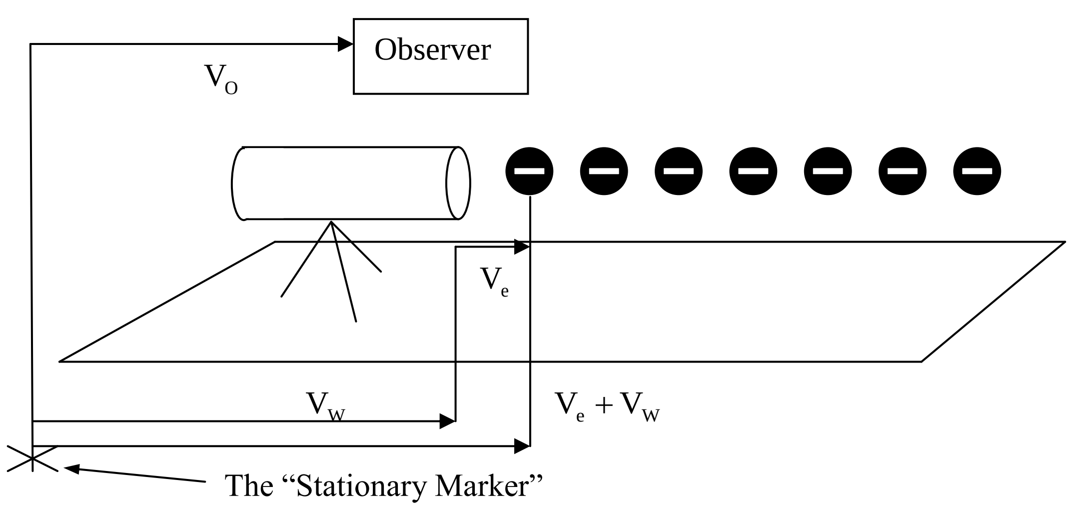


**Figure 5-5**

Figure 5-5 shows and electron gun mounted on a moving workbench. The velocity of the workbench is $V_w$ relative to a "stationary" marker. The gun emits a burst of Z electrons at a muzzle velocity of $V_e$ (relative to muzzle). Since the system is pure Gaussian, the charge motion equation, relative to the observer is:

1) $I = ZQe(V_W + V_e - V_O)$

We seem to be in trouble here because it looks as though the intensity of the magnetic field will vary depending upon the velocity of the observer. If the observer were moving with the same velocity as the electrons ($V_O = V_w + V_e$) then is no magnetic field observed? We know that there must be a magnetic field because if the observer were an electron, it will experience an attractive component of force due to magnetism. Therefore, a magnetic field is generated regardless of the velocity of the observer. This allows us to discard the velocity of the observer from the charge motion equation. Thus:

2) $I = ZQe(V_W + V_e)$

Since $V_e + V_w$ is the velocity of the electron relative to the reference point let us simply replace it with the variable $V_{eA}$ which represents the absolute velocity of the electron. Thus

3) $I = ZQe(V_{eA})$

The next question is: what is the reference point? Is it a spot in the Earth? Is it located at the center of a black hole? Is it in a parallel universe? The answer: it is everywhere. The reference point is the actual space that the electrons pass through. According to the paper "Rules of Nature"—(ron.pdf), the mechanism rule requires that the mechanism of an electron converting its motion into a field phenomenon must occur at the interface between the electron and space itself. The electron does not care about an arbitrary point somewhere else. The disturbance of the medium of space itself, caused as the electron passes through it, is the source of the magnetic field. New Electromagnetism introduces a new model for the old concept of the ether; this new model is consistence with the results of the Michelson-Morley experiment and the postulates of Relativity. This new model is introduced in the paper titled "New Gravity" (ng.pdf available at www.distinti.com) and is covered in greater detail in a later paper.

One may counter the above logic with the following:

Since the television image is projected by an electron beam, then the image on the tv should be disturbed by the motion of the set; yet this is not so.

The reason that the image on a television set is not affected by the motion of the set is due to the fact that the magnetic field used to deflect the beam is generated by a non-Gaussian current. Considering that the electron is the "observer" to the field generated by the non-Gaussian current, it will experience the same force regardless of the motion of the set.

The final argument to support the notion that the proper reference frame for Gaussian magnetic fields is not the reference frame of the observer, we consider a system of two parallel moving charges. Two parallel moving electrons will experience an attractive component of force due to magnetism. This effect is demonstrated by the parallel wire experiment of classical electromagnetism. Each electron observes no relative motion in the other electron yet a magnetic field is present which indicates charge motion. One may argue that the parallel wire experiment may have something to do with the stationary current; and it does, the stationary current enables the experiment to work consistently regardless of the motion of the experiment. Otherwise it would seem to produce "random" results; perhaps causing classical science to develop some kind of magnetic uncertainty principle to explain it.

To summarize, the motion of charges is always measured relative to the ether, regardless if the system is Gaussian or non-Gaussian. The benefit of a non-Gaussian system is that charges in the system are in balance; allowing the observer to calculate the magnetic field based on the motion of the charges relative to the system. Inversely, Gaussian systems allow one to measure ethereal properties such as velocity, density and acceleration.

## 5.5 Gaussian Currents in Resistive wires

This section will show that it is possible to establish Gaussian currents in resistive wire.

We start this derivation by considering a length of resistive wire

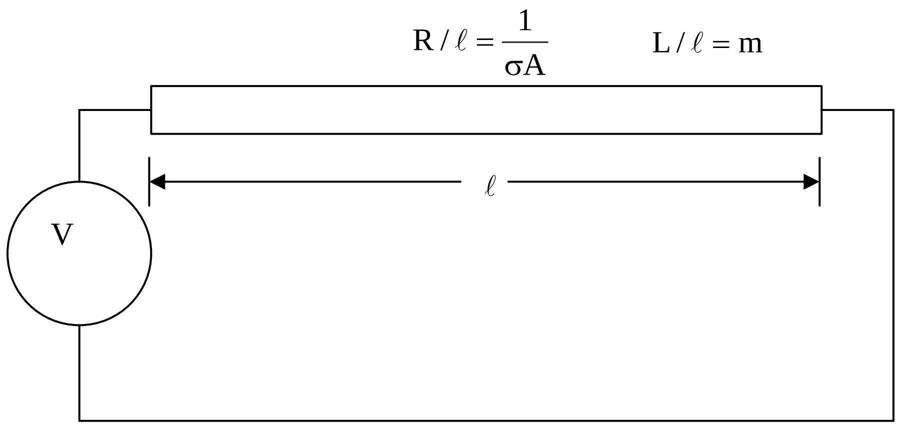


**Figure 5-6**

Figure 5-6 shows a resistive wire segment as part of a circuit. The voltage difference between the ends of this wire is V.

Since the resistance per unit length of the wire is uniform, then the voltage per unit length is also uniform. According to Poisson's equation, the charge density of the wire is zero. This seems confusing since we know that charge is flowing in the wire. How can there be charge flowing in the wire and there be no charge density?

We can answer this question by realizing that Poisson's Equation is only for potential fields (static systems with no charge motion). Since charges are in motion, there are kinetic voltages that must be considered. Therefore, to properly address conduction in resistive wires, we must consider charge velocity, acceleration and charge distribution by deriving an expression from scratch:

1) $e = -IR$ (e = Joules/Coulomb) this is negative because it is a voltage drop. In other words, the buildup of the "back potential" across a resistor is opposite the current flow through it.

2) $e = -L\frac{dI}{dt}$ (e=Joules/Coulomb) this is negative because the "back potential" across an inductor is opposite to the current change through it.

By dividing both of the above by the length of the wire yields:

3) $E = -\frac{I}{\sigma A}$ (E=Force/Coulomb)

and

4) $E = -m\frac{dI}{dt}$ (E=Force/Coulomb)

The above two equation are the force per charge resulting from the motion of the charges. The next relationship we desire is the force per charge due to just the charge distribution in the wire. We derive from one of Maxwell's equations $\nabla \bullet E = \frac{\rho}{\varepsilon}$ an equation for the charge density of wire:

5) $\rho A / \varepsilon = \frac{dE}{d\ell} A$ The quantity $\rho A$ is the charge per unit volume times Area. This is charge per unit length.

By multiplying both sides of step 5 by $\varepsilon$ then integrating with respect to dl we arrive at the total charge in the wire segment thus:

6) $Q = E\varepsilon A$ This represents the net charge in the wire. Solving for the electric field of the net charge:

6A) $E = \frac{Q}{\varepsilon A}$ Then realize that the net charge contained in the wire repels applied charges; therefore, the "Back pressure" is:

7) $E = -\frac{Q}{\varepsilon A}$ This is the "Back pressure".

Equations in 7, 3 and 4 represent the reactive forces in the wire. The total reactive force is the summation above thus:

8) $E_{reactive} = -\frac{I}{\sigma A} - m\frac{dI}{dt} - \frac{Q}{\varepsilon A}$

Because of conservation of force, the reactive force plus the applied force must equal zero thus:

 

9) $0 = E_{reactive} + E_{applied}$

Since the applied voltage is V, then the energy/charge imparted per unit length is:

10) $E_{applied} = dV / d\ell$

Substituting steps 10 and 8 into 9 Yields

11) $$\frac{dV}{d\ell} = m\frac{d^2Q}{dt^2} + \frac{1}{\sigma A}\frac{dQ}{dt} + \frac{1}{\varepsilon A}Q$$

We have stated previously that the voltage per unit length is constant; therefore, the left of step 11 is replaced as follows:

12) $$\frac{V(t)}{\ell} = m\frac{d^2Q}{dt^2} + \frac{1}{\sigma A}\frac{dQ}{dt} + \frac{1}{\varepsilon A}Q$$

Multiplying both sides by $\ell$, then taking the Laplace transform of both sides yields:

13) $$V(s) = LS^2Q(s) + RSQ(s) + \frac{\ell}{\varepsilon A}Q(s)$$

Solving for Q(s)/V(s) yields:

14) $$\frac{Q(s)}{V(s)} = \frac{1}{LS^2 + RS + \frac{\ell}{A\varepsilon}}$$

Applying a unit step of V volts across the wire:

15) $$Q(s) = \frac{V/L}{S\left(S^2 + \frac{R}{L}S + \frac{\ell}{LA\varepsilon}\right)}$$

The result in step 15 is the total excess charge in the conductor due to an applied voltage step.

The steady state result of the above equation is found by multiplying through by S, then taking the limit as s→0:

**Equation 5-1: Steady state Excess Charge.**

$$Q_X = \frac{V\varepsilon A}{\ell}$$

This means that there is $Q_X$ more charge (excess charge) in the wire than is balanced by positive charge from the structure of the wire. This excess charge moving through the wire generates a Gaussian current (by definition of section 5.3). Along with the excess charges, there are the "Non-excess" or free charges that comprise the normal current of a wire in conduction. We know that isotropic conductors have a certain number of free carriers per unit volume. This quantity, multiplied by the volume of the wire, yields the total free charge:

$Q_F = \rho_F A\ell$ The free charge contained in the element.

Thus the total charge available for conduction is then the sum of the free and excess charges:

16) $Qtotal = Q_X + Q_F = \frac{V\varepsilon A}{\ell} + \rho_F A\ell$

In order to discuss the above charge in terms of current, we would like to know the velocity of the charges. If we assume that the mobility of free and excess charges is the same then the total current in the wire (from excess and free charges) must equal ohm's Law:

17) $\mathrm{V/R = I}$

Since this is a steady state system we can use a non-differential version of the Point-to-Fragment conversion identity as follows:

18) $\mathrm{I}\ell = \mathrm{Qv}$

Substituting step 17 into the left of 18 and step 16 into the right side of 18 yields:

19) $\frac{V\ell}{R} = (\frac{VA\varepsilon}{\ell} + \rho_F A\ell)v$

Solving for v

**Equation 5-2: Conduction Charge Velocity (approximate)**

$$v = \frac{1}{AR\left(\frac{\varepsilon}{\ell^2} + \frac{\rho_F}{V}\right)}$$

To find the Gaussian current we recall the modified Point-to-Fragment conversion identity of step 18:

20) $I\ell = Qv$

Substituting the conduction charge velocity equation (Equation 5-2) for v in step 20 and the excess charge equation (Equation 5-1) for Q; then solving for I yields

**Equation 5-3: Gaussian Current**

$$I_G = \frac{V}{R}\left(\frac{1}{1 + \frac{\rho_F \ell^2}{V\varepsilon}}\right)$$

Equation 5-3 is the Gaussian component of charge flow in a wire. The equation is only the steady state value. The Gaussian component of charge motion can be further expanded by considering the effects of time varying currents.

An interesting relation is found by taking the ratio of Gaussian current to non-Gaussian current. This can be found by the following

$$\frac{I_G}{I_{NG}} = \frac{I_G}{I - I_G}$$

This reduces to:

**Equation 5-4: Ratio of Gaussian to non-Gaussian current**

$$\frac{I_G}{I_{NG}} = \frac{V\varepsilon}{\rho_F \ell^2}$$

The derivations in this section make use of two assumptions and one simplification. The first assumption is that the mobility between the free and excess charges is the same. The second assumption (which is based on the first assumption) is that the velocity of both current components is the same. The simplification used in the derivation requires that the voltage per unit length is constant. This simplification is sufficient for the steady state case; however, time varying voltages applied to the wire may need more attention. This is especially true if the frequency of the applied signal is such that more than ¼ wave length is contained within the length of the wire.

In this derivation we used lumped parameters (R, L) to represent conduction properties. By applying New Magnetism and New Induction to derive conduction properties, we find very interesting and enlightening results. You can try these derivations yourself, or you can find them in the New Electromagnetism Application Series.

# 6 The wire fragment forms

To keep consistence within New Electromagnetism, non-Gaussian wire fragment forms of the new model for magnetism (New Magnetism) are developed in this section.

Because of the canceling effect of the Stationary current and other factors (all will be discussed), the resultant wire fragment forms derived from new magnetism are identical to the wire fragment forms (MEL(V1)) derived from classical models (CMEL).

This section only develops the wire fragment forms for non-Gaussian systems. Gaussian wire fragment forms will not be considered. The main reason that fragment forms for Gaussian systems are not derived is that these systems are most likely to be charge transport systems, such as the belt of a Van de Graaff generator; therefore, the development of wire fragment forms is of little use. Some Gaussian systems, such as a transport system comprising a charged fluid pumped trough a tube, could benefit from wire fragment forms; however, this system can be modeled by substituting the Point-to-Fragment conversion identity $I d\mathbf{L} = Q\mathbf{v}$ (see "New Electromagnetism" for details) where required.

A hybrid Gaussian system is a system that contains both Gaussian and non-Gaussian components of charge flow. An example of a hybrid system is the charge flow in a resistive wire. The field effects of a hybrid system can be analyzed by modeling the Gaussian and non-Gaussian components separately. The modeling of the Gaussian components is better done with the point forms of the equations. The non-Gaussian component can be analyzed with the wire fragment forms developed in this section.

Since we are only considering non-Gaussian systems then we MUST analyze both the traditional and stationary currents. The exact sequence of steps that are carried out in the subsequent sections is listed below:

Here are the steps that are performed:

1) The effects from each of the three components of magnetism ($-(\mathbf{v}_S \bullet \hat{\mathbf{r}})\mathbf{v}_S$, $(\mathbf{v}_T \bullet \hat{\mathbf{r}})\mathbf{v}_S$, and $-(\mathbf{v}_S \bullet \mathbf{v}_T)\hat{\mathbf{r}}$) acting on a test charge due to the traditional current in source fragment are computed.

 

2) The effects from each of the three components of magnetism ($-(\mathbf{v}_S \bullet \hat{\mathbf{r}})\mathbf{v}_S$, $(\mathbf{v}_T \bullet \hat{\mathbf{r}})\mathbf{v}_S$, and $-(\mathbf{v}_S \bullet \mathbf{v}_T)\hat{\mathbf{r}}$) acting on a test charge due to the stationary current in source fragment are computed.
3) The effects from 1 to 2 are summed to arrive at a Total Force (force-acting-on-a-test-charge) equation.

The derivation of the Total Force equation (outlined in steps 1-3 above) commences in section 6.1 and completes in section 6.4. After the Total Force equation is derived, it is used to derive the relationship for emf ($V_K$ in later usage) induced in a target fragment and mechanical force acting on a target fragment.

To find the emf in a target fragment, divide the total force equation by charge and perform dot product along the length. This derivation is found in section 6.6.

To find the mechanical force acting on a target fragment, two steps are performed. First, the total force equation is applied to the stationary current in the target. Then the total force equation is applied to the traditional current in the target fragment. The summation of the force acting on the stationary current with the force acting on the traditional current results in the Fragment-to-Fragment mechanical force model. This derivation is found in section 6.5.

**NOTE: The following derivations use engineering current notation (current flows from positive to negative). Some may find this notation awkward, since electrons are the mobile charge carriers and the positive charges are stationary; however, it is the standard practice and it yields the correct results in the case of non-Gaussian systems.**

The following diagram represents the parameterization of the two fragments to be used in the derivation of the fragment-to-fragment models of New Magnetism.

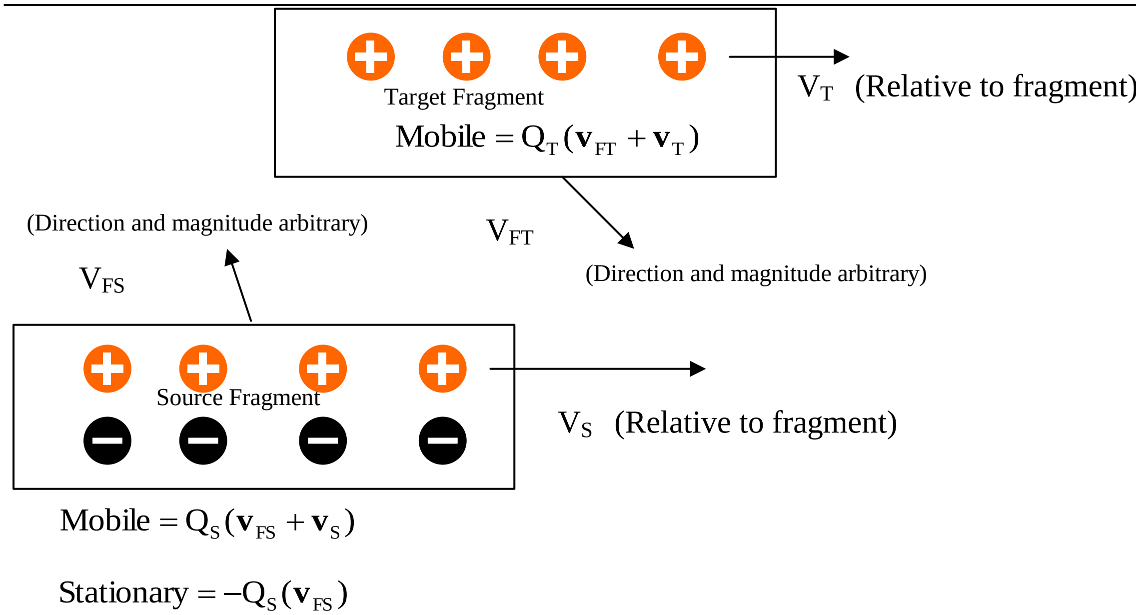


**Figure 6-1 Conceptual diagram used for derivation**

## 6.1 $-(\mathbf{v}_S \bullet \hat{\mathbf{r}})\mathbf{v}_S$

This interaction states that the component of source velocity that is in the direction of the target will impart force into the target in the direction opposite the velocity of the source.

Figure 6-1 is the charge motion diagram. The first step is to calculate the effect of the mobile source charges:

$$1)\ \mathbf{F} = \frac{-K_M Q_S Q_T}{r^2}\left((\mathbf{v}_S + \mathbf{v}_{FS}) \bullet \hat{\mathbf{r}}\right)(\mathbf{v}_S + \mathbf{v}_{FS})$$

Expanding:

$$2)\ \mathbf{F} = \frac{-K_M Q_S Q_T}{r^2}\left[(\mathbf{v}_S \bullet \hat{\mathbf{r}})\mathbf{v}_S + (\mathbf{v}_{FS} \bullet \hat{\mathbf{r}})\mathbf{v}_S + (\mathbf{v}_S \bullet \hat{\mathbf{r}})\mathbf{v}_{FS} + (\mathbf{v}_{FS} \bullet \hat{\mathbf{r}})\mathbf{v}_{FS}\right]$$

Then calculate the effect of the stationary charges:

$$3)\ \mathbf{F} = \frac{+K_M Q_S Q_T}{r^2}\left[(\mathbf{v}_{FS} \bullet \hat{\mathbf{r}})\mathbf{v}_{FS}\right]$$

Then sum the effects of the source mobile and source stationary charges:

4) $\mathbf{F} = \frac{-K_M Q_S Q_T}{r^2}\left[(\mathbf{v}_S \bullet \hat{\mathbf{r}})\mathbf{v}_S + (\mathbf{v}_{FS} \bullet \hat{\mathbf{r}})\mathbf{v}_S + (\mathbf{v}_S \bullet \hat{\mathbf{r}})\mathbf{v}_{FS}\right]$

The result in 4 is the force equation for this component of New Magnetism. Since this effect is calculated only against a test charge, this equation is equivalent to the fragment effect on a free charge in space.

The fragment to fragment effects will be calculated with this force equation in a following section.

## 6.2 $(\mathbf{v}_T \bullet \hat{\mathbf{r}})\mathbf{v}_S$

In this section, the same steps are performed. Finding the effects from the mobile charges:

5) $\mathbf{F} = \frac{K_M Q_S Q_T}{r^2}\left((\mathbf{v}_T + \mathbf{v}_{FT}) \bullet \hat{\mathbf{r}}\right)(\mathbf{v}_S + \mathbf{v}_{FS})$

Expanding:

6) $\mathbf{F} = \frac{K_M Q_S Q_T}{r^2}\left[(\mathbf{v}_T \bullet \hat{\mathbf{r}})\mathbf{v}_S + (\mathbf{v}_{FT} \bullet \hat{\mathbf{r}})\mathbf{v}_S + (\mathbf{v}_T \bullet \hat{\mathbf{r}})\mathbf{v}_{FS} + (\mathbf{v}_{FT} \bullet \hat{\mathbf{r}})\mathbf{v}_{FS}\right]$

The effects of stationary charges:

7) $\mathbf{F} = \frac{-K_M Q_S Q_T}{r^2}\left[(\mathbf{v}_T \bullet \hat{\mathbf{r}})\mathbf{v}_{FS} + (\mathbf{v}_{FT} \bullet \hat{\mathbf{r}})\mathbf{v}_{FS}\right]$

Combining 6 and 7 yields the force equation for this component

8) $\mathbf{F} = \frac{K_M Q_S Q_T}{r^2}\left[(\mathbf{v}_T \bullet \hat{\mathbf{r}})\mathbf{v}_S + (\mathbf{v}_{FT} \bullet \hat{\mathbf{r}})\mathbf{v}_S\right]$

## 6.3 $-(\mathbf{v}_S \bullet \mathbf{v}_T)\hat{\mathbf{r}}$

Again, the same steps are applied. Finding the effects of mobile charges:

9) $\mathbf{F} = \frac{-K_M Q_S Q_T}{r^2}\left((\mathbf{v}_S + \mathbf{v}_{FS}) \bullet (\mathbf{v}_T + \mathbf{v}_{FT})\right)\hat{\mathbf{r}}$

Expanding:

10) $\mathbf{F} = \frac{-K_M Q_S Q_T}{r^2}\left[(\mathbf{v}_S \bullet \mathbf{v}_T)\hat{\mathbf{r}} + (\mathbf{v}_S \bullet \mathbf{v}_{FT})\hat{\mathbf{r}} + (\mathbf{v}_{FS} \bullet \mathbf{v}_T)\hat{\mathbf{r}} + (\mathbf{v}_{FS} \bullet \mathbf{v}_{FT})\hat{\mathbf{r}}\right]$

The effects of stationary charges:

11) $\mathbf{F} = \frac{K_M Q_S Q_T}{r^2}\left[(\mathbf{v}_{FS} \bullet \mathbf{v}_T)\hat{\mathbf{r}} + (\mathbf{v}_{FS} \bullet \mathbf{v}_{FT})\hat{\mathbf{r}}\right]$

Combining 10 and 11

12) $\mathbf{F} = \frac{-K_M Q_S Q_T}{r^2}\left[(\mathbf{v}_S \bullet \mathbf{v}_T)\hat{\mathbf{r}} + (\mathbf{v}_S \bullet \mathbf{v}_{FT})\hat{\mathbf{r}}\right]$

## 6.4 The total fragment force equation

Summing together 4, 8 and 12 yields the total force equation:

$$\mathbf{F} = \frac{-K_M Q_S Q_T}{r^2}\begin{bmatrix}(\mathbf{v}_S \bullet \hat{\mathbf{r}})\mathbf{v}_S + (\mathbf{v}_{FS} \bullet \hat{\mathbf{r}})\mathbf{v}_S + (\mathbf{v}_S \bullet \hat{\mathbf{r}})\mathbf{v}_{FS} - (\mathbf{v}_T \bullet \hat{\mathbf{r}})\mathbf{v}_S - (\mathbf{v}_{FT} \bullet \hat{\mathbf{r}})\mathbf{v}_S \\ + (\mathbf{v}_S \bullet \mathbf{v}_T)\hat{\mathbf{r}} + (\mathbf{v}_S \bullet \mathbf{v}_{FT})\hat{\mathbf{r}}\end{bmatrix}$$

**Equation 6-1: Total fragment to test charge motional effects**

To convert this to wire fragment form we can substitute the Point-to-Fragment conversion identity; however, this would be quite messy. The next sections show how the application of the above equation causes further cancellation of terms.

## 6.5 Mechanical force on target fragment

To find the mechanical force acting on a target fragment, we apply Equation 6-1 to the mobile and stationary charges in the target. The effect on the mobile charges is:

$$13)\ \mathbf{F} = \frac{-\mathrm{K_M Q_S Q_T}}{\mathrm{r}^2}\begin{bmatrix}(\mathbf{v}_\mathrm{S} \bullet \hat{\mathbf{r}})\mathbf{v}_\mathrm{S} + (\mathbf{v}_\mathrm{FS} \bullet \hat{\mathbf{r}})\mathbf{v}_\mathrm{S} + (\mathbf{v}_\mathrm{S} \bullet \hat{\mathbf{r}})\mathbf{v}_\mathrm{FS} - (\mathbf{v}_\mathrm{T} \bullet \hat{\mathbf{r}})\mathbf{v}_\mathrm{S} - (\mathbf{v}_\mathrm{FT} \bullet \hat{\mathbf{r}})\mathbf{v}_\mathrm{S} \\ + (\mathbf{v}_\mathrm{S} \bullet \mathbf{v}_\mathrm{T})\hat{\mathbf{r}} + (\mathbf{v}_\mathrm{S} \bullet \mathbf{v}_\mathrm{FT})\hat{\mathbf{r}}\end{bmatrix}$$

The effect on the stationary charges ($v_T$=0, $Q_T$=-Q) is:

$$14)\ \mathbf{F} = \frac{\mathrm{K_M Q_S Q_T}}{\mathrm{r}^2}\begin{bmatrix}(\mathbf{v}_\mathrm{S} \bullet \hat{\mathbf{r}})\mathbf{v}_\mathrm{S} + (\mathbf{v}_\mathrm{FS} \bullet \hat{\mathbf{r}})\mathbf{v}_\mathrm{S} + (\mathbf{v}_\mathrm{S} \bullet \hat{\mathbf{r}})\mathbf{v}_\mathrm{FS} - (\mathbf{v}_\mathrm{FT} \bullet \hat{\mathbf{r}})\mathbf{v}_\mathrm{S} \\ + (\mathbf{v}_\mathrm{S} \bullet \mathbf{v}_\mathrm{FT})\hat{\mathbf{r}}\end{bmatrix}$$

Summing 13 and 14 yields:

$$15)\ \mathbf{F} = \frac{-\mathrm{K_M Q_S Q_T}}{\mathrm{r}^2}\left[-(\mathbf{v}_\mathrm{T} \bullet \hat{\mathbf{r}})\mathbf{v}_\mathrm{S} + (\mathbf{v}_\mathrm{S} \bullet \mathbf{v}_\mathrm{T})\hat{\mathbf{r}}\right]$$

Applying the Point-to-Fragment conversion identity:

$$16)\ d^2\mathbf{F} = \frac{-K_M I_S I_T}{r^2}\left[-(d\mathbf{L}_T \bullet \hat{\mathbf{r}})d\mathbf{L}_S + (d\mathbf{L}_S \bullet d\mathbf{L}_T)\hat{\mathbf{r}}\right]$$

**Equation 6-2: NM (V3) Fragment Force Equation**

Applying vector algebra on the above yields the well known fragment to fragment force equation MEL(V1) as derived from the classical model of magnetism CMEL (see the paper titled “New Electromagnetism” –ne.pdf for details):

$$d^2\mathbf{F} = \frac{-K_M I_S I_T}{|\mathbf{r}|^2}\left((d\mathbf{L}_S \times \hat{\mathbf{r}}) \times d\mathbf{L}_T\right)$$

**Equation 6-3: NM (V3): Fragment force equation**

The result above is astonishing for the fact that it is identical to that arrived at by classical electromagnetism. Because of cancellations that occur, we are left with a donut shaped effect around a source fragment. This explains why the pioneers of classical electromagnetism arrived at the donut shaped field instead of the proper spherical field as disclosed in this paper.

**Note 2:** Equation 6-2 **is the preferred form since it is simpler to use**

## 6.6 $V_K$ on target fragment

The kinetic voltage on a target fragment is determined by simply dividing the total force equation by $Q_T$ and then performing a dot product with $dL_T$. Thus:

17) $$dV_K = \frac{\mathbf{F} \bullet d\mathbf{L}_T}{Q_T}$$

Thus:

18) $$\mathbf{F} = \frac{-K_M Q_S}{r^2}\begin{bmatrix}(\mathbf{v}_S \bullet \hat{\mathbf{r}})(\mathbf{v}_S \bullet d\mathbf{L}_T) + (\mathbf{v}_{FS} \bullet \hat{\mathbf{r}})(\mathbf{v}_S \bullet d\mathbf{L}_T) + (\mathbf{v}_S \bullet \hat{\mathbf{r}})(\mathbf{v}_{FS} \bullet d\mathbf{L}_T) \\ -(\mathbf{v}_T \bullet \hat{\mathbf{r}})(\mathbf{v}_S \bullet d\mathbf{L}_T) - (\mathbf{v}_{FT} \bullet \hat{\mathbf{r}})(\mathbf{v}_S \bullet d\mathbf{L}_T) \\ +(\mathbf{v}_S \bullet \mathbf{v}_T)(\hat{\mathbf{r}} \bullet d\mathbf{L}_T) + (\mathbf{v}_S \bullet \mathbf{v}_{FT})(\hat{\mathbf{r}} \bullet d\mathbf{L}_T)\end{bmatrix}$$

19) Substitute the following into 18 $\mathbf{v}_S = \frac{I_S}{Q_S} d\mathbf{L}_S$ and $\mathbf{v}_T = \frac{I_T}{Q_T} d\mathbf{L}_T$

$$d^2V_K = \frac{-K_M Q_S}{r^2}\begin{bmatrix} \left(\frac{I_S}{Q_S} d\mathbf{L}_S \bullet \hat{\mathbf{r}}\right)(\frac{I_S}{Q_S} d\mathbf{L}_S \bullet d\mathbf{L}_T) + (\mathbf{v}_{FS} \bullet \hat{\mathbf{r}})(\frac{I_S}{Q_S} d\mathbf{L}_S \bullet d\mathbf{L}_T) + \left(\frac{I_S}{Q_S} d\mathbf{L}_S \bullet \hat{\mathbf{r}}\right)(\mathbf{v}_{FS} \bullet d\mathbf{L}_T) \\ -\left(\frac{I_T}{Q_T} d\mathbf{L}_T \bullet \hat{\mathbf{r}}\right)(\frac{I_S}{Q_S} d\mathbf{L}_S \bullet d\mathbf{L}_T) - (\mathbf{v}_{FT} \bullet \hat{\mathbf{r}})(\frac{I_S}{Q_S} d\mathbf{L}_S \bullet d\mathbf{L}_T) \\ +\left(\frac{I_S}{Q_S} d\mathbf{L}_S \bullet \mathbf{v}_T\right)(\hat{\mathbf{r}} \bullet d\mathbf{L}_T) + \left(\frac{I_S}{Q_S} d\mathbf{L}_S \bullet \mathbf{v}_{FT}\right)(\hat{\mathbf{r}} \bullet d\mathbf{L}_T) \end{bmatrix}$$

Reducing Is and Qs:

$$d^2V_K = \frac{-K_M I_S}{r^2}\begin{bmatrix} \frac{I_S}{Q_S}(d\mathbf{L}_S \bullet \hat{\mathbf{r}})(d\mathbf{L}_S \bullet d\mathbf{L}_T) + (\mathbf{v}_{FS} \bullet \hat{\mathbf{r}})(d\mathbf{L}_S \bullet d\mathbf{L}_T) + (d\mathbf{L}_S \bullet \hat{\mathbf{r}})(\mathbf{v}_{FS} \bullet d\mathbf{L}_T) \\ -\frac{I_T}{Q_T}(d\mathbf{L}_T \bullet \hat{\mathbf{r}})(d\mathbf{L}_S \bullet d\mathbf{L}_T) - (\mathbf{v}_{FT} \bullet \hat{\mathbf{r}})(d\mathbf{L}_S \bullet d\mathbf{L}_T) \\ +\frac{I_T}{Q_T}(d\mathbf{L}_S \bullet d\mathbf{L}_T)(\hat{\mathbf{r}} \bullet d\mathbf{L}_T) + (d\mathbf{L}_S \bullet \mathbf{v}_{FT})(\hat{\mathbf{r}} \bullet d\mathbf{L}_T) \end{bmatrix}$$

Collecting like terms

$$d^2V_K = \frac{-K_M I_S}{r^2}\begin{bmatrix} \left(\frac{I_S}{Q_S}(d\mathbf{L}_S \bullet \hat{\mathbf{r}}) + (\mathbf{v}_{FS} \bullet \hat{\mathbf{r}}) - (\mathbf{v}_{FT} \bullet \hat{\mathbf{r}})\right)(d\mathbf{L}_S \bullet d\mathbf{L}_T) \\ +(d\mathbf{L}_S \bullet \hat{\mathbf{r}})(\mathbf{v}_{FS} \bullet d\mathbf{L}_T) + (d\mathbf{L}_T \bullet \hat{\mathbf{r}})(\mathbf{v}_{FT} \bullet d\mathbf{L}_S) \end{bmatrix}$$

It will be shown in an appendix that the very first term cancels when the above equation is applied to closed loop systems: Therefore, the equation reduces to:

**Equation 6-4: MEL: Wire Fragment form (closed loop)**

$$d^2V_K = \frac{-K_M I_S}{r^2}\left[((\mathbf{v}_{FS} - \mathbf{v}_{FT}) \bullet \hat{\mathbf{r}})(d\mathbf{L}_S \bullet d\mathbf{L}_T) + (d\mathbf{L}_S \bullet \hat{\mathbf{r}})(\mathbf{v}_{FS} \bullet d\mathbf{L}_T) + (d\mathbf{L}_T \bullet \hat{\mathbf{r}})(\mathbf{v}_{FT} \bullet d\mathbf{L}_S)\right]$$

Equation 6-4 is the complete motional relationship between fragments in motion for closed loop systems. If $V_{FS}$ were set to 0, then the equation would reduce to:

$$d^2V_K = \frac{-K_M I_S}{r^2}\left[-(\mathbf{v}_{FT} \bullet \hat{\mathbf{r}})(d\mathbf{L}_S \bullet d\mathbf{L}_T) + (d\mathbf{L}_T \bullet \hat{\mathbf{r}})(\mathbf{v}_{FT} \bullet d\mathbf{L}_S)\right]$$

Which is the same as:

$$d^2V_K = \frac{-K_M I_S}{r^2}\left[(d\mathbf{L}_S \times \hat{\mathbf{r}}) \bullet (\mathbf{v}_{FT} \times d\mathbf{L}_T)\right]$$

The above result is that same arrived at in previous papers. In previous papers, the equation was derived from classical magnetism (CMEL). The above is incomplete since the effect caused by the motion of the source fragment is missing.

Again we have a donut shaped effect resulting from the cancellations that occur.

## 6.7 Summary

This chapter has shown the proper methodology for considering magnetic effects in conjunction with good conductors.

These procedures are executed again in the section that explains Faraday's Final Riddle. By following the proper procedures, it become clear that there is no contradiction between the results of the experiment in Faraday's Final Riddle and the Theory of Relativity.

# 7 Electron beam coherency

Why do electron beams not scatter?  An electron beam is a line of like charges moving at velocity V.  Since the charges repel each other due to Coulomb forces, there must be great electric potential along the beam that would force the charges to locations of lesser potential.  The logical conclusion is that the charges would scatter in all directions, yet they don't.  According to classical teaching, this phenomenon is due to Time Dilation; however, New Electromagnetism clearly shows that Time Dilation is derived from electromagnetism.  If Time Dilation is derived from electromagnetism then electromagnetism can not be affected by time dilation otherwise a recursive derivation would occur.  This would be a paradox.

The simple answer is given to us by New Magnetism.

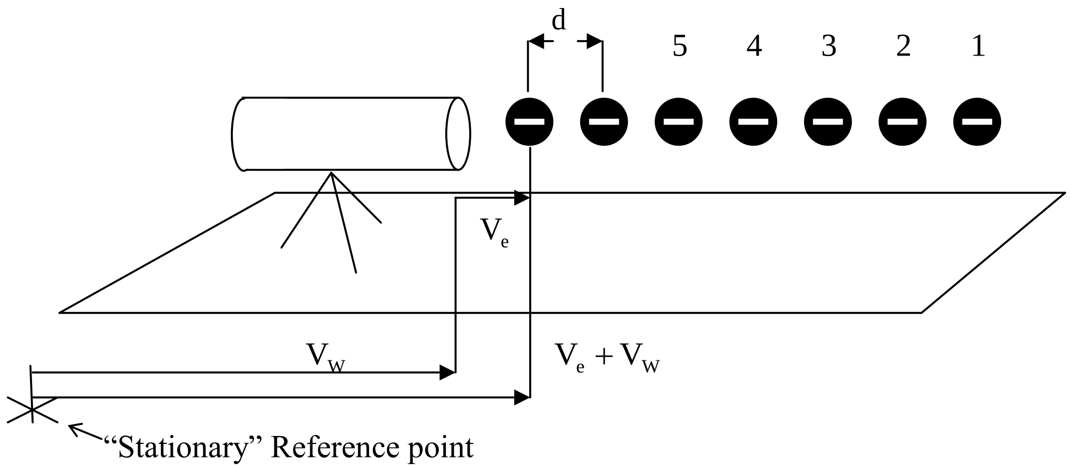


**Figure 7-1**

Figure 7-1 shows an electron gun emitting a constant beam of electrons.  The velocity of the electrons with respect to the stationary reference point is V=Ve+Vw.  The distance between electrons is d.

Since the charges are not accelerating, NI is not used.  Since the charges are not moving relative to each other, only Coulombs model and the "parallel motion component" of New Magnetism need to be considered, thus:

1) $F_{23} = \frac{Q_2 Q_3}{d^2}\left(K_E - K_M V^2\right)$

The above equation shows that as the velocity of the beam approaches the speed of light, the Coulomb forces are cancelled by the magnetic force; thereby allowing the beam to maintain coherency.

# 8 Simplified model of Permanent Magnets

This chapter divulges a simplified model of permanent magnetism that enables us to solve some very interesting problems. This model uses Stokes' Theorem to provide a model for permanent magnets for which only the "Edge Currents" need to be considered. This technique is not new; it is described in Maxwell's book "A Treatise on Electricity and Magnetism" Volume 2 articles 423 and 492 which describe the interaction of magnetic "shells" (essentially flat magnets) as being analogous to current carrying loops.

New Electromagnetism extends this simplified model of permanent magnets by applying our charge motion model from section 5. This vastly improved model enables much simpler and more accurate results to be realized. An application of this New Model for magnets is found in section 9 where Faraday's Final Riddle is finally resolved.

Note1: This simplified model is only for analysis of systems where the scale is much much larger than the distance between the magnetic molecules in the magnet. For quantum level analysis, the magnetic effects of each magnetic molecule must be considered individually.

Note2: There are other effects present in magnetic materials for which this model does not address. For most applications, these effects can be ignored; however, for complete modeling of magnetic materials, to include a proprietary Method of Images, see our upcoming New Electromagnetism Application Series for a complete book and software samples which cover the different types of magnetic materials to include ferromagnetic, paramagnetic, diamagnetic and heliomagnetic.

This chapter is divided into two sections. The first section details the existence of the Edge Current which forms the basis for the simplified model of permanent magnets. The second section demonstrates that the edge currents are the predominant effect.

## 8.1 The Edge Current

The section shows how the cancellation between the magnetic molecules in a magnet occurs to enable us to model permanent magnets as a non-Gaussian current loop.

A square flat permanent magnet, like the one shown in Figure 8-1, can be modeled as plane of electrons orbiting around parent atoms (The magnetic molecules).

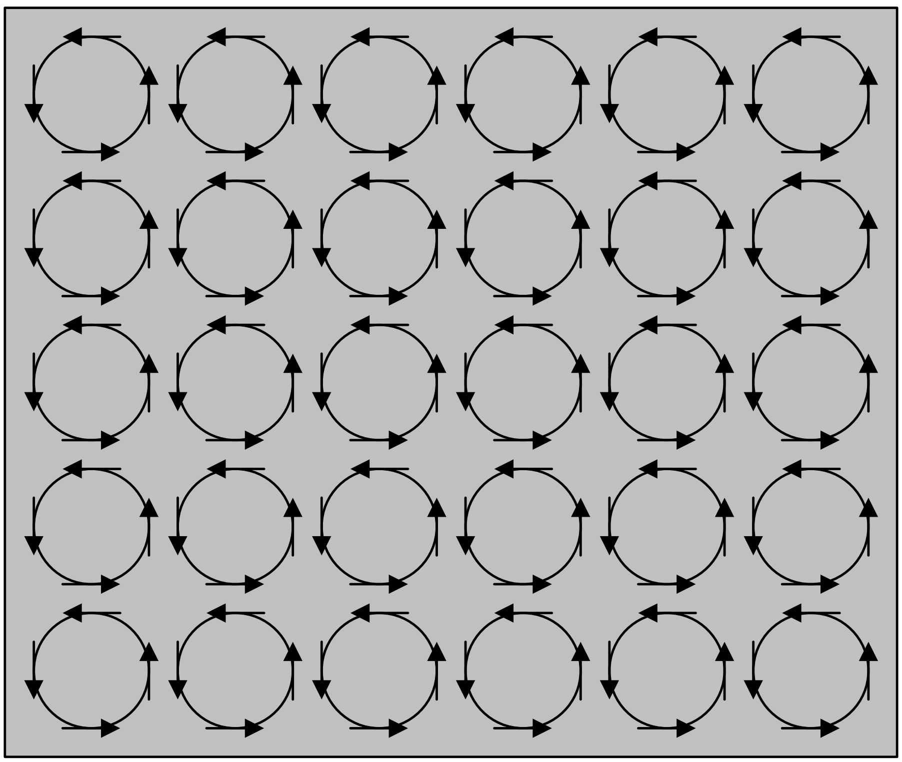

**Figure 8-1: Permanent Magnet**

The electrons orbits can be thought of as very tiny circular currents. By observing Figure 8-1, one will notice that everywhere, except at the edges of the magnet, there are equal and opposite current motions. These equal and opposite current motions effectively cancel (for large scale systems) leaving just the current motion described in the following diagrams.

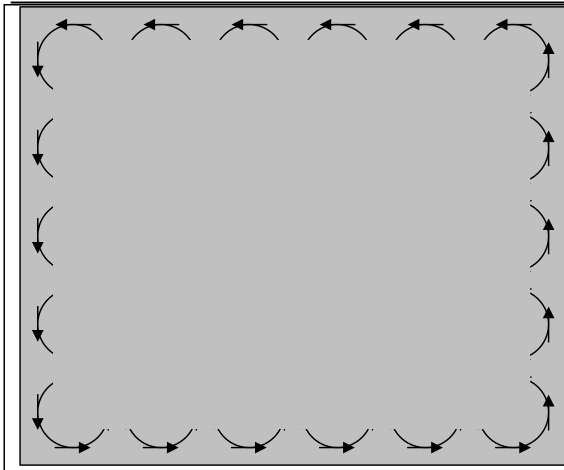

Figure 8-2: Effective current (Edge Current)

The equal and opposite current motions cancel, leaving a net charge motion around the edges of the magnet as shown in the above figure.

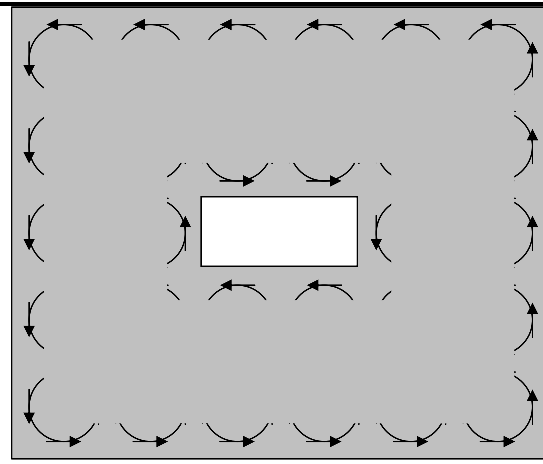

Figure 8-3 Effective current of magnet with hole.

If a hole were cut from the center of the magnet, the cancellation effect from the missing material "uncovers" the edges of the hole allowing a net counter rotating current to appear at the center.

Figure 8-4: Disk Magnet and MagnaView film

The location of these "Edge Currents" can be confirmed with the use of MagnaView film as shown in Figure 8-4. The film is available from science retailers.

Figure 8-5: Direction of edge currents

Since like moving currents attract, we use the edge current of a small disk magnet to explore the direction of the edge currents of the larger magnet. In the photograph, the south side of the small magnet is showing; thus, the edge current of the hole is traveling clockwise. (Using right hand notation).

By placing the small disk magnet (Figure 8-5) on the outside of the magnet (at the 7 o'clock position), we still see the south face of the magnet. This means that the internal edge current and external edge currents are indeed counter-rotating as indicated by the arrows painted in the magnet.

Before we accept the results interpreted from the images shown in the MagnaView film, we run a small test to confirm that the MagnaView film actually shows the edge currents and nothing else.

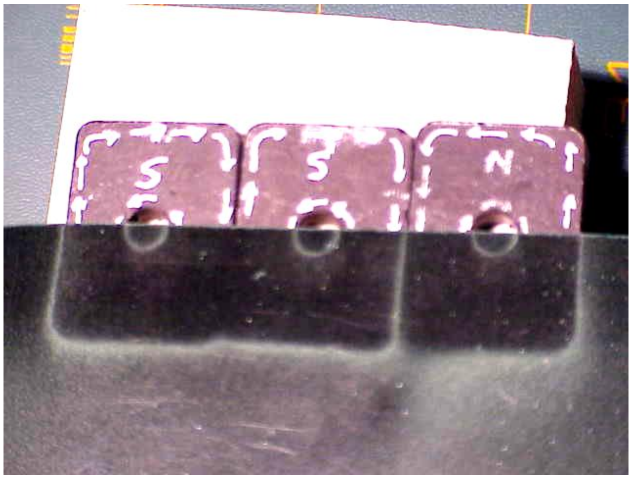


**Figure 8-6: Proof that MagnaView shows currents**

The two magnets on the left of the above photo are both south side up. This means that, where they meet, their edge currents are in opposite directions. Therefore, the edge currents should cancel. This cancellation is confirmed by the absence of a bright line in the film. Also, since the currents are in the opposite directions, these magnets are in repulsion (They are glued to the block with hot melt glue).

The poles of the middle and right magnets are in opposite directions. This means that the edge currents are in the same direction. Since like moving currents attract, these magnets are attracted to each other. Also since the parallel currents do not cancel, there is an indication of the current in the film by the presence of the bright line where the magnets meet.

This confirms that the MagnaView film shows the edge currents. If the edge current model is correct, then the location between the magnets where both edge currents are running in the same direction should have the most powerful magnetic effect. The next test confirms this using a steel ball.

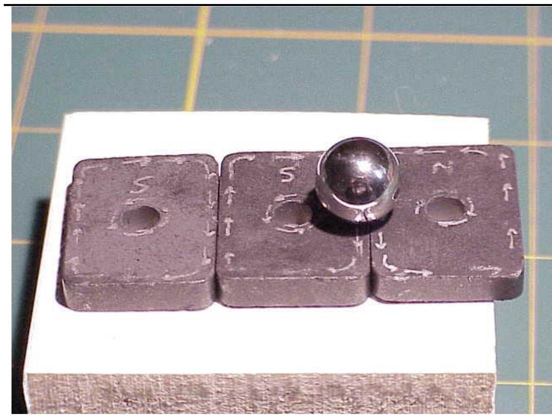

**Figure 8-7: Strength of the interface.**

Since the edge current between the middle and right magnets is the combined effect of two edges, it should have the strongest magnetic effect of this configuration. This is confirmed with a steel ball. The steel ball is attracted to other edges; however, the most powerful point of attraction is the interface between the right two magnets.

**Note: use a steel ball for this test. Other objects (such as pointed, or flat) will react differently; these interactions are explained in a book of the New Electromagnetism Application series that covers magnets and magnetic materials in depth.**

Now that the existence of Edge Currents and the utility of MagnaView film have been demonstrated, we continue the exploration of the Edge Current using the MagnaView film to reveal more properties of the Edge Current.

The first of these properties is that the Edge Current exists at the center of the sides as shown in the next photographs.

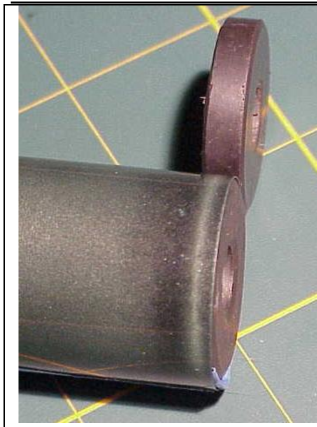

Figure 8-8: Edge current position

The MagnaView Film shows that the edge currents are centered along the sides.

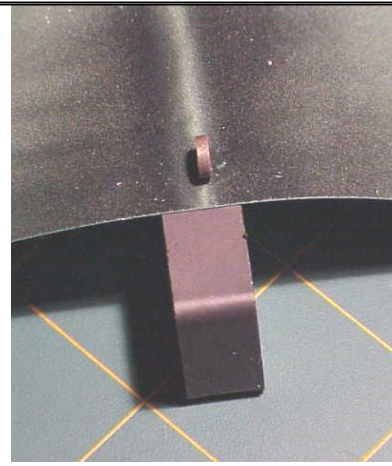

Figure 8-9: Edge current of rectangular magnet

The small disk magnet is strongly attracted to the edge current.

To understand why the edge current exists at the center of the side of the magnet we must remember that the axes of the charge orbits of magnetic material can pivot. The next diagram (Figure 8-10) shows what happens at the edge of a magnet. The charge orbits at the left side of the magnet do not have countering charge orbits to the left to cancel the charge motion effects. Since like moving charges attract, the edge orbits are pivoted toward each other due to the attraction of charge motion. This can be further demonstrated by stacking two magnets together as shown in Figure 8-11.

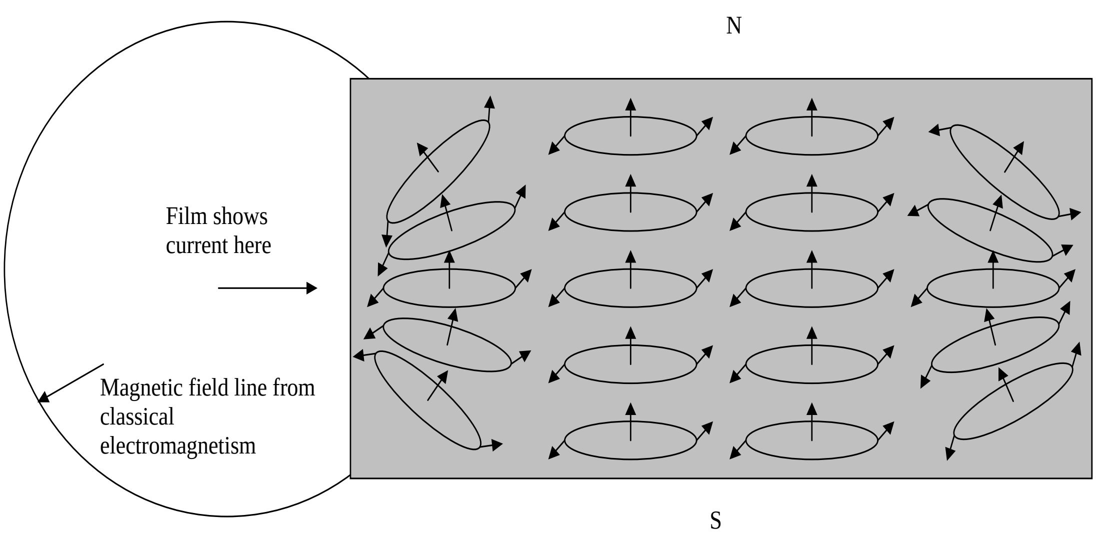


**Figure 8-10: Edge current of single magnet.**

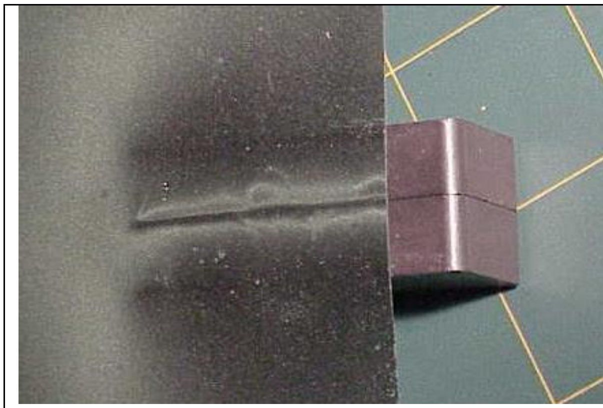

**Figure 8-11: Edge Current of two magnets in attraction**

Like moving currents attract

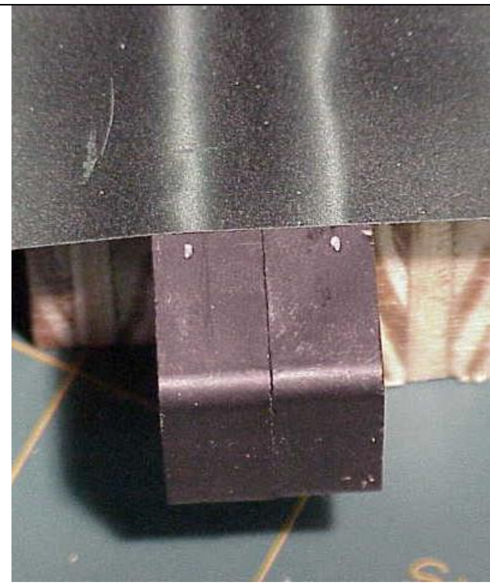

**Figure 8-12: Edge Current of two magnets in repulsion**

Dislike currents repel

In Figure 8-11, the edge currents of the two magnets are drawn toward each other; likewise, if the magnets are in repulsion as shown in Figure 8-12, the edge currents are pushed away from each other.

Now that the edge currents have been explored in great detail, here are some notes about the proper use of the MagnaView film.

1) The type of light source is important. A point light source is recommended. Twin tube fluorescent lights can give the false impression of two parallel currents.
2) The direction of the light and the viewing angle are important. For best results the light source and the angle that the film is viewed from should be as close together as possible. Divergent directions between light source and viewing angle will cause the current to appear at a slightly different position.
3) The bright lines on the film say that a current is located in a direction normal to the surface of the film. This is explored in the next paragraphs.

Placing the film on top of a magnet (Figure 8-13) might give the false impression that there is an edge current along the top edge. By slowly moving the film from the top, to the side, you will notice that the image apparent on the film originates from the edge currents along the sides. This brings up an interesting observation about the nature of the film. The film is brightest when the direction toward the current is normal (perpendicular) to the surface of the film.

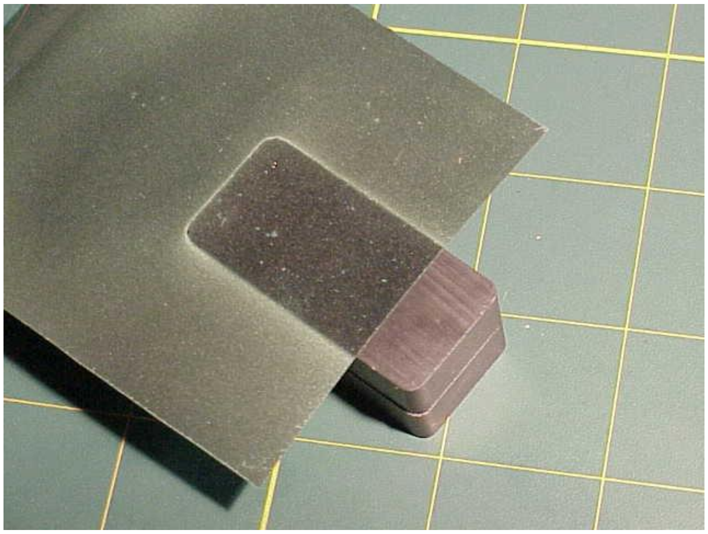

**Figure 8-13: Top Image**

This observation is verified by placing the film next to the edge current as shown in Figure 8-14. In this case, the film is right up against the edge current; however, because the direction from the film to the edge current is not perpendicular to the surface of the film, there is no indication of an edge current. In fact the film seems to darken a bit near the edge current. The enhanced darkening of the film is an indication that the direction toward an edge current is tangent to the surface of the film. This enhanced darkening is seen very vividly in many of the previous photos.

**Figure 8-14: Film Against edge current**

Finally, use the film to ensure that the magnets that you are using do not have strange domains such as the one in the following picture:

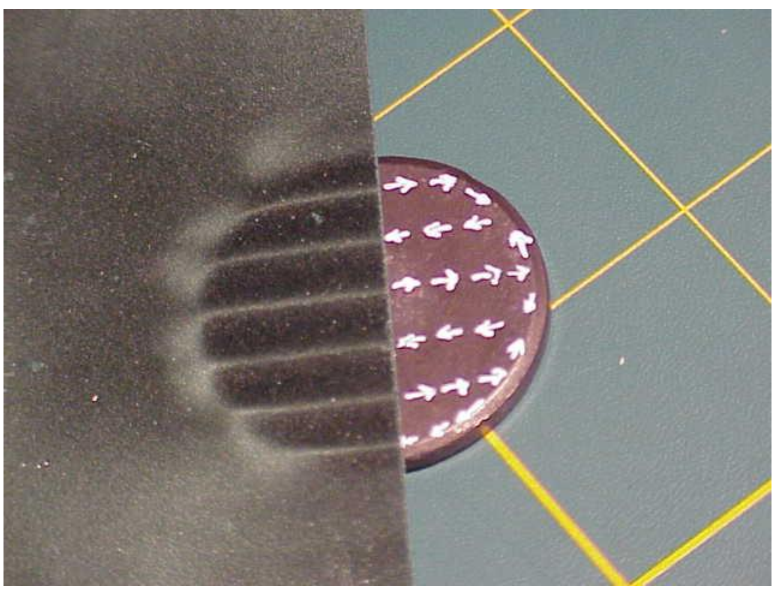

**Figure 8-15: Disc magnet with non-standard domains**

Now that the edge currents of magnets have been explored thoroughly, we can use the knowledge of these edge currents to explore how magnets interact with other magnets.

## 8.2 Magnet to Magnet attraction

As shown in the previous section, the edge currents are of great importance. In this section it is shown that the edge currents are the major effect when considering how magnets attract and repel from each other. The minor effects are considered in a later publication.

The following experiments are carried out with a small disc magnet (test disc) suspended from a string.

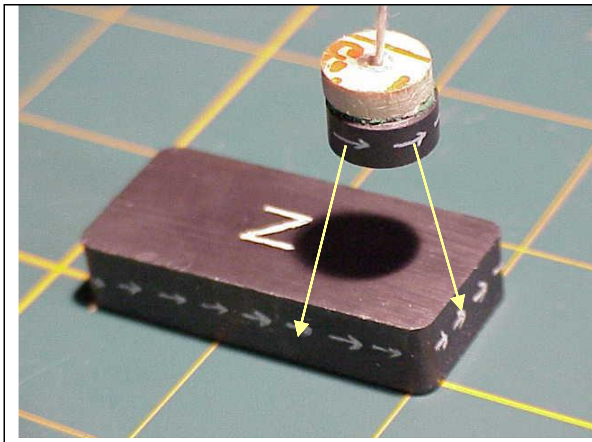


**Figure 8-16: Attraction of disk to Rectangular magnet**

For the first experiment, the test disk is suspended over a larger rectangular magnet as shown in Figure 8-16. The yellow arrows added to the picture show the attraction between the edge currents

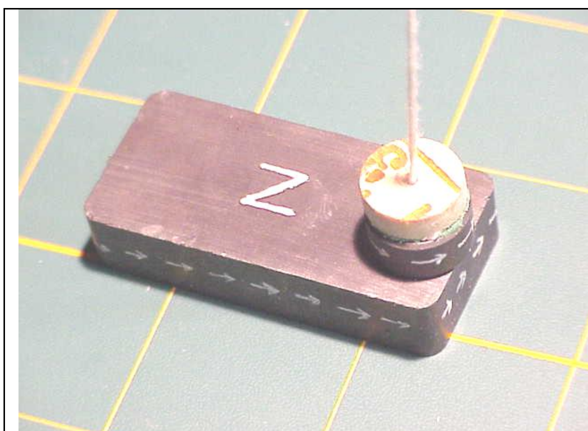


**Figure 8-17: Disk fall on large rectangle**

As the test disk is slowly lowered over the larger magnet, it tends to seek out an edge. This shows the strong attraction between edge currents.

 

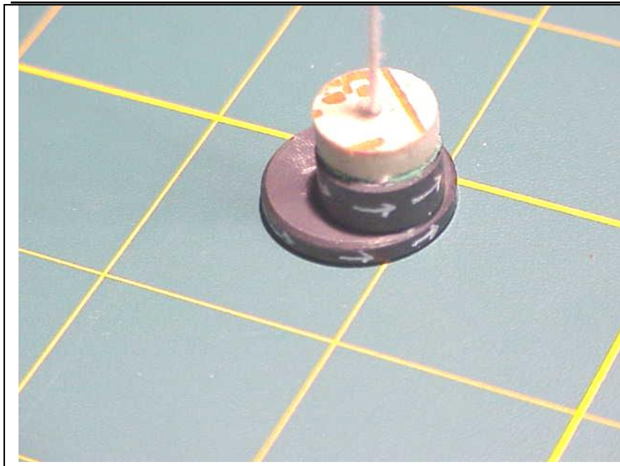

Figure 8-18: Disc fall on large disk

If the test disk is slowly lowered on a larger disk magnet, it will still seek to maximize edge to edge alignment.

Figure 8-19: Disk fall on same size disk

If the test disk were slowly lowered over a disk of the same diameter, it maximizes edge to edge alignment.


Figure 8-20: Effect of magnets in repulsion

If the large rectangular magnet is flipped over, the disk is no longer attracted edge-to-edge along the inside of the magnet. Instead it is attracted edge-to-edge around the outside of the magnet. If the disk were cut free, it would flip over and attach in a manner similar to Figure 8-17. The reason why it prefers the configuration in Figure 8-17 is that each "face" of the disk is looking at a side of the rectangle where the currents are running in the same direction; therefore, the amount of parallel moving currents is at maximum. In this figure(Figure 8-20) only one "side" of the disk and one side of the rectangle share like moving currents. The other facets are in repulsion.

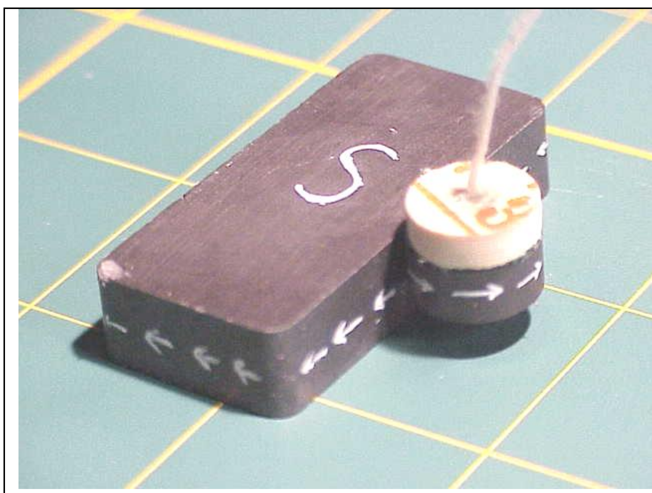


Figure 8-21: Like moving edge currents seek each other

By allowing the test disc to ride in slowly at a steep angle, the test disk will attach to the side of the large magnet such that the edge currents are aligned.

This section clearly shows that "like moving" edge currents attract and oppositely moving edge currents repel.

# 8.3 Conclusion of new model of magnets

This section demonstrates a simplified model for magnets that allows us to view magnets as current rings around the edge of a magnet. This model is applicable to systems where the scale of modeling is much much larger than the mean distance between magnetic molecules in the magnetic material (which is just about all practical applications).

When buying a from a science catalog, magnets are typically specified in terms of Gauss or Teslas; this is useless information unless you know where the measurement was made relative to the physical dimensions of the magnet.

This improved model of magnets allows magnets to be specified in terms of amps and the location of the edge currents (which are always at the domain boundaries). This methodology is more precise and enables designers to reduce development time.

This improved model is also simpler to use than the classical definition of magnets since a magnet can be reduced to a simple ring of current (pure-non-Gaussian). An example of an application of this new model for magnets is found in the following section where Faraday's Final riddle is finally solved.

For more advanced treatment of magnets and magnetic materials (ferromagnetic, paramagnetic, diamagnetic, etc) see the New Electromagnetism Application Series. In the series, we are publishing technical manuals which describe and model the behavior of magnetic materials to include, magnetic reflection and refraction, magnetic equivalent of the method of images, magnetization, high frequency considerations, and much much more. These manuals come with simulation software fragments and/or Excel Spread sheet applications. Also included is the proper method for measuring the amperage of permanent magnets.

# 9 Faraday's Final Riddle

Faraday developed a generator consisting of a disk magnet coaxial to a conductive disk as shown in Figure 9-1. There are 4 modes of operation of the Homopolar Generator (HPG); the results of which comprise what is known as Faraday's Final Riddle: Does a magnetic field move with the magnet.

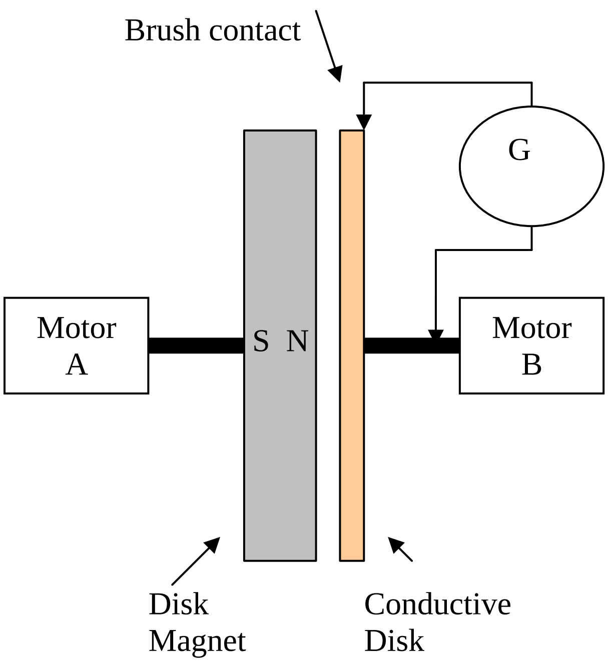


**Figure 9-1: Faraday's homo-polar generator**

The generator is comprised of a disk magnet attached to a motor (A) placed next to a conducting copper disk attached to motor B. A stationary galvanometer is connected to the edge of the conductive disk and to the shaft of motor B with brush contacts. The Galvanometer enables the operator to detect the radial current generated in the disk (when power is being generated).

In the first mode of operation, both the disk and the magnet are stationary. Because there is no relative motion between the disk and the magnet, there is no power generated in the disk.

In the second mode of operation, the magnet is stationary and the disk is rotated by motor B. In this mode, the galvanometer detects power generated in the disk.

In the third mode of operation, the magnet is rotated by motor A and the disk is stationary. One might assume that since there is still relative motion between the magnet and the disk that there should be power generated; however, no power is detected.

In the fourth mode of operation, both the magnet and the disk are rotated together. Power is detected. One would think that because there is no relative motion between the disk and the magnet that no power should be detected. This seems to contradict Relativity.

One of the prediction made by Einstein based on his theory of Relativity is that the magnetic field must move with the magnet. If this were the case, then according to the Lorentz Force equation of classical electromagnetism, there should only be a current detected when there is relative motion between the disk and the magnet. This seems to be contradicted by the results of the experiment since there is power detected even when there is no relative motion between the magnet and the disk as shown in mode 4. This is also contradicted by mode 3 where there is relative motion but no power is generated.

New Magnetism resolves this by restating Einstein's prediction. Instead of saying that a magnetic field moves with the magnet, we now say that a magnetic field moves with its source. In the case of a magnet, each charged particle is its own source of magnetic field energy. When the effect of each charge is considered separately, the proper operation of the Homopolar Generator is revealed without violating Einstein's Relativity.

For simplicity we do not have to consider each individual charge, we can instead group together charges with similar velocities as a component of charge motion. Then resolve each component of charge motion separately and then sum the results to arrive at the final answer. This is explained as follows:

According to our understanding of permanent magnets, we can model the edge current of the magnet with a ring shaped conductor carrying a current as shown in Figure 9-2.

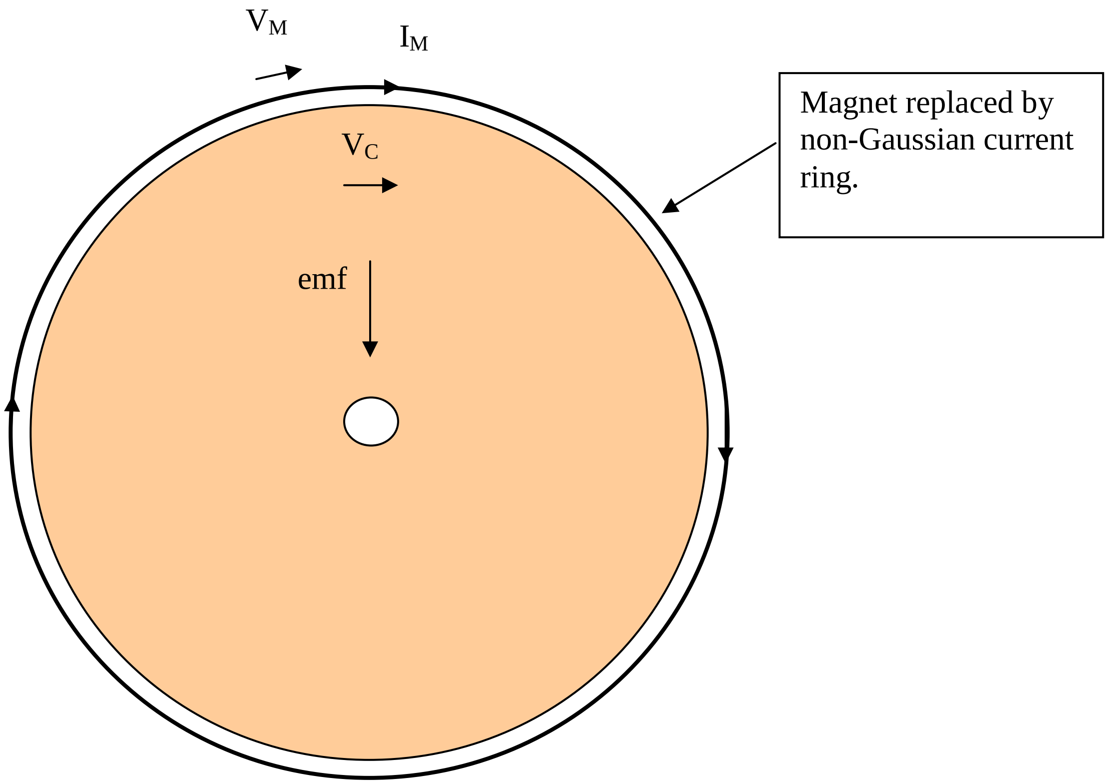


**Figure 9-2**

For simplicity consider only a small sector of the disk and a corresponding fragment of the "edge current" conductor as shown in Figure 9-3.

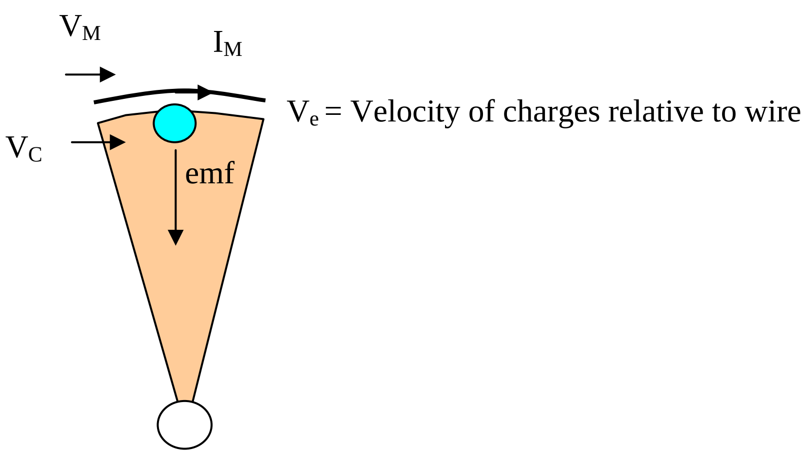


**Figure 9-3**

To even further simplify, just consider the effects of the edge fragment on a small section of the conductive disk delineated by the blue dot in Figure 9-3.

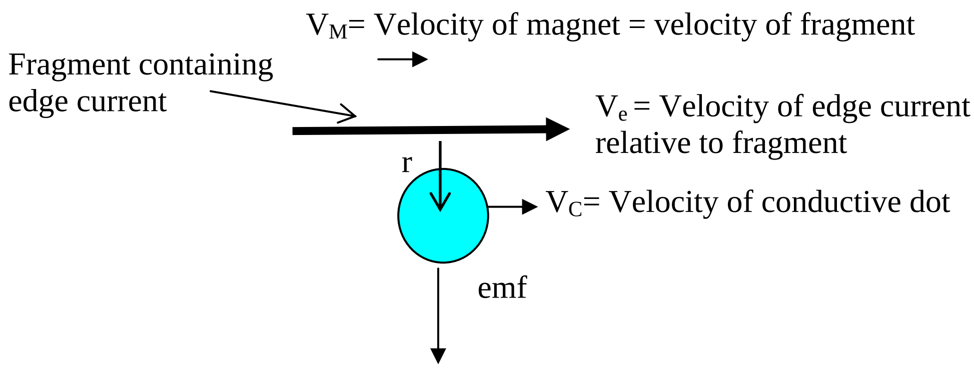


**Figure 9-4: Essence of problem.**

Since a Gaussian surface constructed around the magnet shows that there is no net charge in the magnet we can be sure that the edge current of the permanent magnet is non-Gaussian. Thus we write the charge motion equation for the edge current as a non-Gaussian current. Like the example in section 5.1 we assume that the traditional current in the fragment is comprised of Z charges moving with velocity $V_e$, relative to the wire. Thus, the total charge motion of the edge fragment, including stationary current is:

$$Q_M V_{QM} = (V_M)(-ZQe) + (V_e + V_M)(ZQe)$$

Next we write the charge motion equation for the blue dot. Assume that the blue dot contains Y positive and Y negative charges:

$$Q_C V_{QC} = (V_C)(-YQe) + (V_C)(YQe)$$

Since ( r ) is perpendicular to the velocities, only the parallel motion component of New Magnetism has an effect.

$$\mathbf{F} = \frac{K_M Q_S Q_T}{|\mathbf{r}|^2}\left[-(\mathbf{v}_S \bullet \mathbf{v}_T)\hat{\mathbf{r}}\right]$$

From our understanding of conductive systems (section 6) we understand that we must compute the effects of each charge motion separately, thus

1) $F_{PS}$ = The force acting on the positive charges in the blue dot due to the stationary charges in the fragment.

2) $F_{NS}$ = The force acting on the negative charges in the blue dot due to the stationary charges in the fragment.

3) $F_{PI}$= The force acting on the positive charges in the blue dot due to the traditional current in the fragment.
4) $F_{NI}$= The force acting on the negative charges in the blue dot due to the traditional current in the fragment.

To find the emf in the blue dot we only need to find the force acting on the positive charges.

5) $F_{Ptotal} = F_{PI} + F_{PS}$

Calculating the effect from the charges that comprise the traditional current on the positive charges in the blue dot first yields

6) $$\mathbf{F}_{PI} = \frac{K_M Q_S Q_T}{|\mathbf{r}|^2}\left[-(\mathbf{v}_S \bullet \mathbf{v}_T)\hat{\mathbf{r}}\right] = -\frac{K_M YZQ_e^{\ 2}}{|\mathbf{r}|^2}(V_e V_C + V_M V_C)\hat{\mathbf{r}}$$

Next calculating the effects of the stationary charges on the positive charges in the blue dot:

7) $$\mathbf{F}_{PS} = \frac{K_M Q_S Q_T}{|\mathbf{r}|^2}\left[-(\mathbf{v}_S \bullet \mathbf{v}_T)\hat{\mathbf{r}}\right] = +\frac{K_M YZQ_e^{\ 2}}{|\mathbf{r}|^2}(V_M V_C)\hat{\mathbf{r}}$$

Total charge force on positive charges in blue dot is:

8) $$\mathbf{F}_{Ptotal} = F_{PI} + F_{PS} = -\frac{K_M YZQ_e^{\ 2}}{|\mathbf{r}|^2}(V_e V_C)\hat{\mathbf{r}}$$

**Note1: Notice that the velocity of the magnet cancels out.**

**Note2: Since the positive and negative charges in the disk have the same velocity, it is obvious that the force on the negative charges in the blue dot is the opposite of the above.**

We convert the total force equation to Kinetic Voltage by dividing by the target charge and then perform dot product of both sides with a differential length oriented along the radius of the conductive disk.  Thus:

$$dV_K = -\frac{K_M Z Q_e}{|\mathbf{r}|^2}(V_e V_C)dL$$

The above equation is the fragmentary emf. The entire emf along the radius of the sector (due only to the effects of the fragment) is found by performing an integration of this equation along a path from the edge of the disk to the hub.

It would not take much to write the equation that describes this entire system; however, the above equation shows us what we came to see. The above equation states that the velocity of the magnet has no effect on the emf detected in the disk. The emf in the disk is proportional to the strength of the magnet and the velocity of the disk; the rotational velocity of the magnet has no effect.

The above equation agrees with the observations made by Faraday.

The above explanation also satisfies Einstein since the magnetic field does move with the charges which are the source the magnetic field. One component of magnetic field is produced by the mobile carries and the other component from the stationary charges. These two magnetic field components produce equal and opposite effects thus canceling any added effect due to the motion of the magnet. This phenomenon is explained in more detail in chapter 5.1.

Note: this derivation only describes the no-load emf generated in a very small section of the disk. Under load, the disk will supply a non-zero current that results in effects (such as back-torques and eddy currents) which are not considered in this derivation. Although this book does not contain the complete models of the HPG; this book does contain the necessary models and techniques required to derive the general operation of any motor/generator.

For those who do not wish to derive the general solutions for Homopolar generators/motors on their own, we are publishing a full set of general solutions for Homopolar generators and motors in the New Electromagnetism Application Series.

# 10 Proof of the spherical magnetic field

**(This section was originally published as a separate paper titled nmproof.pdf)**

New Magnetism introduces a new model for magnetic interactions. The new model describes a completely spherical field phenomenon as opposed to the donut shaped field of classical electromagnetism. This derivation provides a simple proof that magnetic fields must be spherical.

For the sake of discussion, we call the classical field a transverse field since it exists transverse to the direction of a moving charge. New Magnetism proposes a completely spherical field that exists in both the transverse and longitudinal directions. Both New Magnetism and classical magnetic field theory are consistent with regard to the transverse effects; however, only New Magnetism proposes that there are effects in the longitudinal direction. Although New Magnetism professes a uniform spherical field, it has become customary to refer to the longitudinal effects as the “longitudinal component” of a magnetic field; consequently, the classical component of the magnetic field is referred to as the “Transverse component.”

The difficulty in proving the existence of the longitudinal component is two fold. First, the longitudinal component cancels in conductive wire systems preventing direct measurement of the phenomenon. Secondly, the simplest demonstrations of the longitudinal component involve charges moving at relativistic velocities such as an electron beam. New Magnetism shows, very simply, that the longitudinal component of magnetism is responsible for preventing an electron beam from scattering. The difficulty with the electron beam proof, rests with the fact that the accepted explanation for electron beam coherency is time dilation. It is ironic that the phenomenon of time dilation can be derived from the New Electromagnetic equations (See New Gravity--ng.pdf); therefore, a different proof is required.

At first the “cancelative” nature of the spherical magnetic field about wire systems seemed to be an insurmountable stumbling block. It seemed pointless to propose a new field model that does not predict anything beyond what is ordinarily expected from magnetic systems; however, this actually becomes the most concrete proof since only the new field geometry predicts what is expected. The question then becomes: does classical magnetic field theory, due to its missing "cancelative" longitudinal component, predict effects that are unexpected? The answer is a resounding yes!

Before we continue, we need to highlight definitions and conventions that are used in this section:

## 10.1 Conventions

1) We use engineering current notation: Positive current flows from the positive terminal to the negative terminal of a power source.
2) Right Hand Rule: Placing the thumb of the right hand in the direction of positive current flow; The curl of the fingers shows the north to south flow of magnetic flux lines ( For classical field theory)
3) Test charges are positive.

## 10.2 Special Symbols

The special symbols **ax** , **ay** and **az** used in this derivation represent unit direction vectors in the x, y and z direction respectively. Do not confuse with $\mathbf{a}_S$ which represents the vector acceleration of a source element.

## 10.3 The Models

This chapter introduces the mathematical models used in the experiment/proof. In this proof, only magnetic field phenomena are of interest. The Electric field model of Coulomb, which is a spherical model, is unchanged from classical to New Electromagnetism, and is not a factor in this experiment/proof.

The models of interest involve the fields of constant currents (magnetism) and time changing currents (induction). Both of which are magnetic field phenomena.

Note: $K_M = \frac{\mu}{4\pi}$ in all equations

The following table lists the classical (transverse) models for magnetic interactions. These equations are derived from the classical Biot-Savart and Lorentz force equations. The derivations for both are found in the paper titled "New Electromagnetism"—ne.pdf. The reason why they are called the transverse models is that these models only predict effects transverse to the direction of velocity or acceleration of a charge. These are different from the New Electromagnetism models which predict effects in ALL directions (transverse and longitudinal).

**Table 10-1: Transverse only models (Derived from Biot-Savart and CMEL)**

| | These forms are derived from classical electromagnetic equations. See paper New Electromagnetism V1 (v1/ne.pdf) for derivations. | In this paper we change the forms to get rid of the cumbersome cross products using the following vector identity $(\mathbf{A}\times\mathbf{B})\times\mathbf{C}\equiv(\mathbf{A}\bullet\mathbf{C})\mathbf{B}-(\mathbf{B}\bullet\mathbf{C})\mathbf{A}$ |
|---|---|---|
| Induction: Transverse model, derived from classical electromagnetic models | $\mathbf{F}=\frac{K_M Q_S Q_T((\mathbf{a}_S\times\mathbf{r})\times\mathbf{r})}{\lvert\mathbf{r}\rvert^3}$ same as $\mathbf{F}=\frac{K_M Q_S Q_T((\mathbf{a}_S\times\hat{\mathbf{r}})\times\hat{\mathbf{r}})}{\lvert\mathbf{r}\rvert}$ | (After application of identity) $\mathbf{F}=\frac{-K_M Q_S Q_T(\mathbf{a}_S-(\mathbf{a}_S\bullet\hat{\mathbf{r}})\hat{\mathbf{r}})}{\lvert\mathbf{r}\rvert}$ |
| Magnetism: Transverse model, derived from classical electromagnetic models<br><br>a.k.a Motional Electric Law MEL(V1) | $\mathbf{F}=\frac{-K_M Q_S Q_T((\mathbf{v}_S\times\mathbf{r})\times\mathbf{v}_T)}{\lvert\mathbf{r}\rvert^3}$ Same as $\mathbf{F}=\frac{-K_M Q_S Q_T((\mathbf{v}_S\times\hat{\mathbf{r}})\times\mathbf{v}_T)}{\lvert\mathbf{r}\rvert^2}$ | (After application of identity) $\mathbf{F}=\frac{K_M Q_S Q_T}{\lvert\mathbf{r}\rvert^2}[(\mathbf{v}_T\bullet\hat{\mathbf{r}})\mathbf{v}_S-(\mathbf{v}_S\bullet\mathbf{v}_T)\hat{\mathbf{r}}]$ |

The following table contains the spherical models of magnetic interactions as proposed by the New Electromagnetism Series of papers.

**Table 10-2: New Electromagnetic models (V3) for magnetic interactions (Spherical)**

| | Point charge forms |
|---|---|
| New Induction | $\mathbf{F}=\frac{-K_M Q_S Q_T\mathbf{a}_S}{\lvert\mathbf{r}\rvert}$ |
| New Magnetism | $\mathbf{F}=\frac{K_M Q_S Q_T}{\lvert\mathbf{r}\rvert^2}[(\mathbf{v}_T\bullet\hat{\mathbf{r}})\mathbf{v}_S-(\mathbf{v}_S\bullet\hat{\mathbf{r}})\mathbf{v}_S-(\mathbf{v}_S\bullet\mathbf{v}_T)\hat{\mathbf{r}}]$ |

A casual observer will notice that the point forms of the equations have been selected instead of the wire fragment forms. The point forms are chosen for three reasons. The first reason is that they are simpler to write down. The second reason is to provide another example of how the "point to fragment" conversion identity enables one to convert between forms. The "point to fragment" conversion identity ( $I\mathbf{dL} = Q\mathbf{v}$ ) is derived in the paper titled "New Electromagnetism"—ne.pdf. The most important reason involves the nature of the experiment to be analyzed. The experiment involves centripetal acceleration of charge around a conductive corner for which the wire fragment forms are difficult to apply (not impossible). This derivation develops hybrid forms of the equations. These hybrid forms involve the action of a wire system on a point charge.

## 10.4 The experiment

Consider a constant current in a rectangular loop; at the corners of the loop the current makes an abrupt 90 degree change in direction. This change in current should produce an inductive effect on a test charge placed nearby; however, this "corner effect" is not detectable by experiment (we have included a corner effect experiment as an appendix) nor is there mention of a corner effect found in our search of over 100 years of scientific literature. Since this corner effect has never been noticed, it either does not exists, or it is cancelled in some manner. The experiment analyzed using the classical toroidal (donut) shaped magnetic field predicts measurable kinetic voltages (emfs) at the corners; whereas, the spherical magnetic field of New Electromagnetism (by both New Induction and New Magnetism) provides for complete cancellation of the "corner effect".

Consider the corner of a square loop of wire (the Source) carrying a constant current ( $I_S$ ) as shown in Figure 10-1. The loop exists in the z=0 plane and is situated such that a corner rests on the origin. The constant current enters the corner from the -45 degrees direction and exits the corner from the +45 degrees direction. Since the current changes direction, there must be charge acceleration involved. The total impulse required to change direction is $impulse = a_S t = V_S \sqrt{2}$ ; where $V_S$ is the charge velocity in the source wire.

To measure the effect of the impulse, a test charge is placed directly above the corner at position (0,0,h)

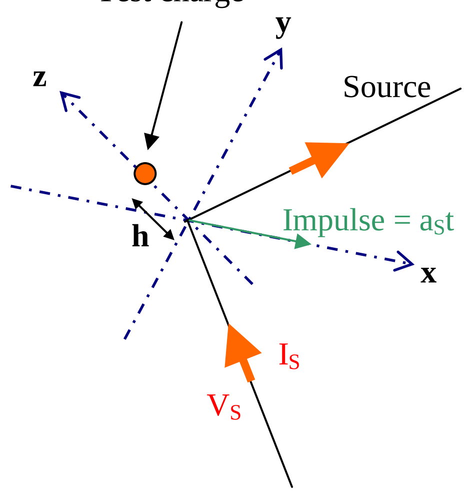


**Figure 10-1: Inductive corner**

Since the location of the test charge is transverse to the impulse; both the classical and spherical models for induction agree that there exists a force (effect) acting on the test charge. The direction of the resultant force is in the direction opposite to the direction of the impulse. The following section derives this “Corner effect”.

According to the New Magnetic model, the corner effect is only one of many magnetic effects acting upon the test charge in this example. By considering the other effects, the NET force acting upon the target charge is zero. This confirms the well known observation that a magnetic field derived from a stationary loop of wire and a constant current source, does not affect a stationary charge.

The classical magnetic models provide for no effects other than the corner effect. Without other effects to cancel the corner effect, it should then be possible to construct a transformer that converts DC current into a DC voltage. An example of such a device (which does not work) is given in an appendix.

This paper will derive the exact solutions for all magnetic effects acting upon the test charge (from both classical and New Electromagnetism). The results are then compared to show that New Electromagnetism predicts no effects on the target charge while classical models predict effects that we just do not see in reality.

## 10.4.1 Calculating the "Corner Effect" on the test charge (target)

The corner effect is caused by the change in direction of the current accelerating around the corner. The effects can be calculated by assuming a perfectly sharp corner and then substituting the impulse value into the calculation; however, some readers may find this engineering shortcut distasteful. Instead, parameterize the corner as shown in Figure 10-2.

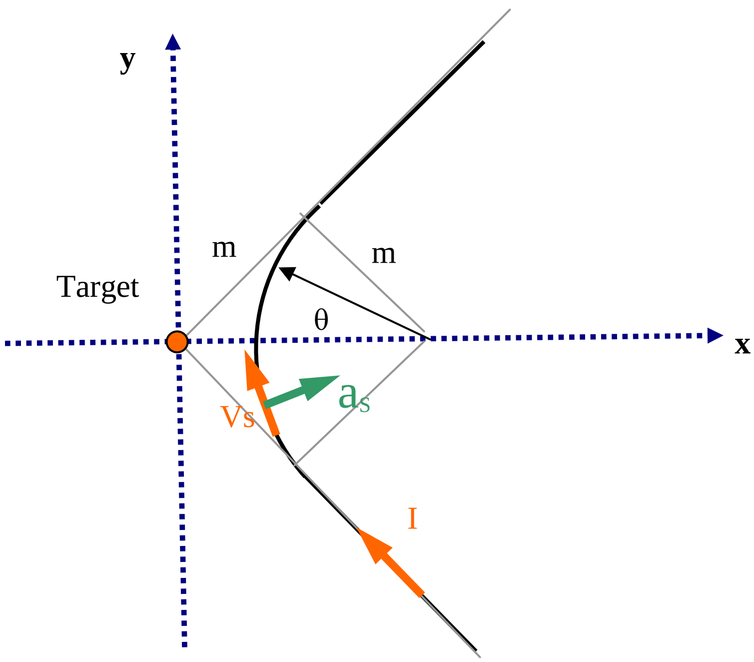


**Figure 10-2: Corner Parameterization**

The corner is modeled with an arc (quarter-circle) of radius m. The radial center of the arc is located $\sqrt{2}m$ from the origin along the x-axis.

Since charge acceleration (centripetal) only occurs for the current in the arc; then there is no need to calculate inductance for anything else but the arc.

To parameterize the source arc use the symbol $\theta$. The following are written by inspection:

1) Source fragment position $\mathbf{S} = \left(\sqrt{2}m - m\cos\theta\right)\mathbf{ax} + \left(m\sin\theta\right)\mathbf{ay} + 0\mathbf{az}$
2) Source fragment length $\left|d\mathbf{L}_S\right| = m d\theta$
3) Source fragment direction $d\hat{\mathbf{L}}_S = \sin\theta\mathbf{ax} + \cos\theta\mathbf{ay}$

4) Direction of charge velocity $\hat{\mathbf{v}}_S = d\hat{\mathbf{L}}_S = \sin\theta\mathbf{ax} + \cos\theta\mathbf{ay}$
5) Direction of centripetal acceleration $\hat{\mathbf{a}}_S = \cos\theta\mathbf{ax} - \sin\theta\mathbf{ay}$
6) Magnitude of centripetal acceleration $|\mathbf{a}_S| = \frac{V_S{}^2}{m}$
7) Source to target vector
   $\mathbf{r} = \mathbf{T} - \mathbf{S} = (0 - \sqrt{2}m + m\cos\theta)\mathbf{ax} + (0 - m\sin\theta)\mathbf{ay} + (h - 0)\mathbf{az}$. This is equal to
   $\mathbf{r} = \mathbf{T} - \mathbf{S} = (-\sqrt{2}m + m\cos\theta)\mathbf{ax} + (-m\sin\theta)\mathbf{ay} + (h)\mathbf{az}$
8) Magnitude of source to target vector $|\mathbf{r}| = \sqrt{(\sqrt{2}m - m\cos\theta)^2 + (m\sin\theta)^2 + h^2}$
9) Derivation of Qs from point-to-fragment conversion identity. Start with identity: $I_S d\mathbf{L}_S = Q_S \mathbf{v}_S$. Then solve: $Q_S = \frac{I_S d\mathbf{L}_S}{\mathbf{v}_S}$. Next realize that dLs and Vs are in same direction; therefore direction vectors cancel leaving only scalars, thus: $Q_S = \frac{I_S d\mathrm{L}_S}{\mathrm{V}_S}$

Starting with the inductance model derived from classical electromagnetism.

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

First, divide both sides by target charge in order to change the results to force per charge (**M**), then substitute the derivation of Qs (see step 9).

11) $$\mathbf{M} = \frac{-K_M \frac{I_S d\mathrm{L}_S}{\mathrm{V}_S} (\mathbf{a}_S - (\mathbf{a}_S \bullet \hat{\mathbf{r}})\hat{\mathbf{r}})}{|\mathbf{r}|}$$

Keep in mind that **M** in step 11 is the effect of only a small part of the arc. This must be integrated over the entire arc in order to derive the full effect acting upon the target (test charge). To integrate over the arc, parameterize as a function of theta.

Next, substitute 5 and 6 for acceleration and $\hat{\mathbf{r}} = \frac{\mathbf{r}}{|\mathbf{r}|}$, then clean up:

12) $$\mathbf{M} = \frac{-K_M I_S d\mathrm{L}_S V_S}{m} \left[ \frac{(\cos\theta\mathbf{ax} - \sin\theta\mathbf{ay})}{|\mathbf{r}|} - \frac{((\cos\theta\mathbf{ax} - \sin\theta\mathbf{ay}) \bullet \mathbf{r})\mathbf{r}}{|\mathbf{r}|^3} \right]$$

Next substitute 2 for dls:

13) $$\mathbf{M} = -K_M I_S V_S \int_{-\pi/4}^{\pi/4} \left[ \frac{(\cos\theta\mathbf{ax} - \sin\theta\mathbf{ay})}{|\mathbf{r}|} - \frac{((\cos\theta\mathbf{ax} - \sin\theta\mathbf{ay}) \bullet \mathbf{r})\mathbf{r}}{|\mathbf{r}|^3} \right] d\theta$$

Since the radius of the corner (m) is a constant, choose a value of m that will save the most work. A very sharp corner is realized as m approaches zero; therefore take the limit as m approaches zero. Another benefit for choosing a very sharp corner is that it forces the corner directly under the target. This means that the effect on the target is purely due to the transverse inductive field. Since the transverse field is accepted by both classical and New Electromagnetism, then this calculation for the corner effect will be used for both examples.

Take the limit:

14) $$\mathbf{M} = -K_M I_S V_S \int_{-\pi/4}^{\pi/4} \left[ \frac{(\cos\theta\mathbf{ax} - \sin\theta\mathbf{ay})}{h} \right] d\theta$$

Integrate:

15) $$\mathbf{M} = -K_M I_S V_S \left[ \frac{(\sin\theta\mathbf{ax} + \cos\theta\mathbf{ay})}{h} \right]_{-\pi/4}^{\pi/4}$$

Substitute integration limits

16) $$\mathbf{M} = K_M I_S V_S \sqrt{2} \left( -\frac{1}{h} \right) \mathbf{ax}$$

Note: $V_S$ is the velocity of the charges in the wire (drift velocity); not voltage.

The result in step 16 shows that the corner produces a non-zero force-per-coulomb field acting on the target along the x-axis. This effect is predicted by both classical and New Electromagnetism. This effect is hereafter referred to as the “Corner Effect”.

## 10.5 The whole loop

The previous section only derives the effects on the target generated from a single corner of the square loop. This section considers the effects from the remaining parts of the loop.

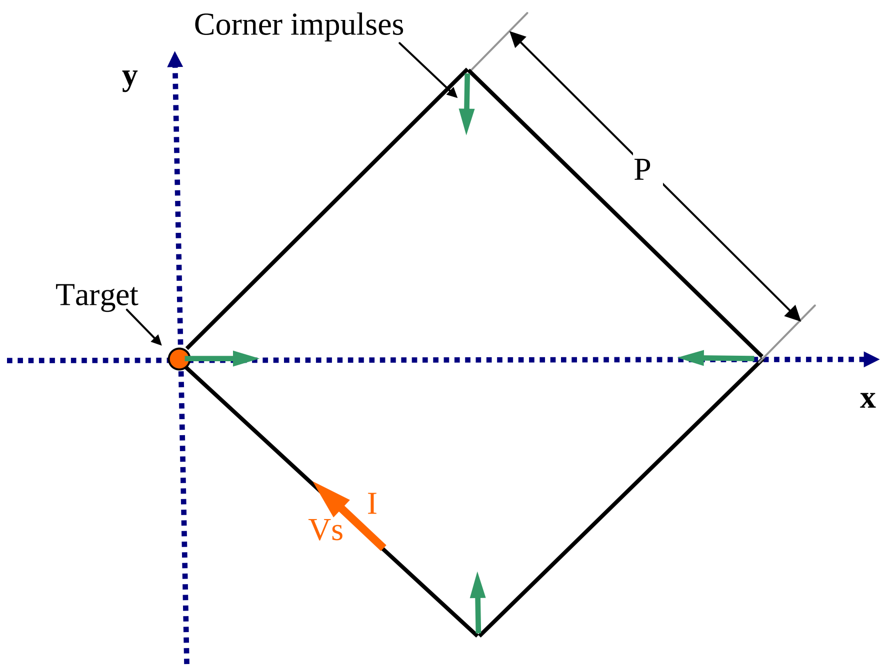


**Figure 10-3: The whole loop**

Figure 10-3 shows a conductive square loop with a constant current flowing in a clockwise direction.

The green arrows show the corner impulses. The effects from the top and bottom impulses cancel each other; therefore, they have no effect on the target.

For classical electromagnetism, the right impulse can not offset the effects felt by the target since the target exists in a longitudinal direction relative to the corner impulse (remember that according to classical theory the longitudinal component of a magnetic field does not exists). The right impulse could only help if the lengths of the sides of the loop (P) were much smaller than the height of the target (h). This would effectively bring the right impulse directly underneath the target and in full effect of its transverse field component. In this case all corner effects would cancel.

For sufficiently large values of P, classical electromagnetism shows that the other corners offer no “cancelative” effect.

In the case of New Electromagnetism; where the inductive field is spherical, the effect of the right corner is found by simply dividing the impulse magnitude ($K_M I_S V_S \sqrt{2}$) by the distance to target $r = \sqrt{2P^2 + h^2}$. Since the direction of the impulse is in the negative x direction, the effect of the target will be in the positive x direction, thus:

17) $M \;= K_M I_S V_S \sqrt{2}\left(\frac{1}{\sqrt{2P^2 + h^2}}\right)\mathbf{ax}$ (spherical inductance effect from far corner)

The effect in step 17 goes to zero as P approaches infinity; therefore, there must be some other “cancelative” effect. A review of the New Magnetic model shows that it is only different from the classical model by the addition of the following term $-(\mathbf{v}_S \bullet \hat{\mathbf{r}})\mathbf{v}_S$. This term gives the new magnetic model longitudinal effects that are not predicted by the classical Biot-Savart magnetic field model. This new term also shows that a magnetic field can affect a stationary charge. Finally, this new term provides the remaining cancellation of the corner effects required to bring magnetic field theory into compliance with observation.

## 10.6 Applying New Magnetism

This section derives the “cancelative” effects resulting from the New Magnetic model. The New Magnetic model is:

18) $\mathbf{F} = \frac{K_M Q_S Q_T}{|\mathbf{r}|^2}\left[(\mathbf{v}_T \bullet \hat{\mathbf{r}})\mathbf{v}_S - (\mathbf{v}_S \bullet \hat{\mathbf{r}})\mathbf{v}_S - (\mathbf{v}_S \bullet \mathbf{v}_T)\hat{\mathbf{r}}\right]$

Since there is no motion in the target charge, the first and third terms are dropped leaving just the longitudinal component:

19) $\mathbf{F} = -\frac{K_M Q_S Q_T}{|\mathbf{r}|^2}(\mathbf{v}_S \bullet \hat{\mathbf{r}})\mathbf{v}_S$

 

From inspection of step 19 we find that current traveling toward and away from the target have an effect. Therefore all four sides need to be considered.

## 10.6.1 Effects from the left sides

This section derives the effects from the left top and left bottom of the loop. Referring to Figure 10-4, the blue arrows show the direction of the effects that each side exerts on the target. Since the components of force in the Y direction cancel, only the x-components of force are of interest. Consequently, since both top and bottom produce an equal effect along the x-axis, the derivation calculates the x-component of force from the top and then multiplies by two to account for the total force.

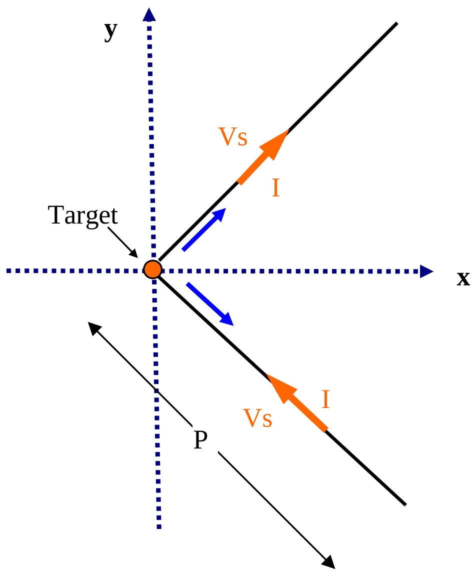


**Figure 10-4: The New Magnetic effects**

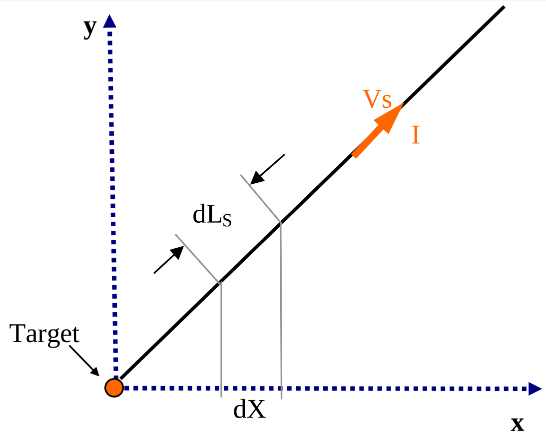


**Figure 10-5: Parameterization of Source with X**

The derivation is setup with the following observations:

20) Target position (0,0,h)

21) Source position $S = X\mathbf{ax} + X\mathbf{ay} + 0\mathbf{az}$

22) Source fragment length $|d\mathbf{L}_S| = \sqrt{2}dX$

23) Source fragment direction $d\hat{\mathbf{L}}_S = \frac{1}{\sqrt{2}}\mathbf{ax} + \frac{1}{\sqrt{2}}\mathbf{ay} + 0\mathbf{az}$

24) Source to target vector $\mathbf{r} = -X\mathbf{ax} - X\mathbf{ay} + h\mathbf{az}$

25) Source to target distance $|\mathbf{r}| = \sqrt{2X^2 + h^2}$

26) Vector velocity of source charges $\mathbf{v}_S = V_S d\hat{\mathbf{L}}_S$

27) Reusing the derivation of Qs from step 9 substitute 22, thus: $Q_S = \frac{I_S\sqrt{2}dX}{\mathrm{V}_S}$

Next, divide both sides of 19 by $Q_T$, then substitute Qs from step 27 thus:

28) $\mathbf{M} = -\frac{K_M I_S \sqrt{2}dX}{|\mathbf{r}|^2 \mathrm{V}_S}(\mathbf{v}_S \bullet \hat{\mathbf{r}})\mathbf{v}_S$

Substitute $\mathbf{v}_S$:

29) $\mathbf{M} = -\frac{K_M I_S \sqrt{2} dX \mathrm{V}_S}{|\mathbf{r}|^2}\left(\left(\frac{1}{\sqrt{2}}\mathbf{ax} + \frac{1}{\sqrt{2}}\mathbf{ay}\right) \bullet \hat{\mathbf{r}}\right)\left(\frac{1}{\sqrt{2}}\mathbf{ax} + \frac{1}{\sqrt{2}}\mathbf{ay}\right)$

Substitute $\hat{\mathbf{r}} = \frac{\mathbf{r}}{|\mathbf{r}|}$:

30) $\mathbf{M} = -\frac{K_M I_S \sqrt{2} dX \mathrm{V}_S}{|\mathbf{r}|^3}\left(\left(\frac{1}{\sqrt{2}}\mathbf{ax} + \frac{1}{\sqrt{2}}\mathbf{ay}\right) \bullet \left(-X\mathbf{ax} - X\mathbf{ay} + h\mathbf{az}\right)\right)\left(\frac{1}{\sqrt{2}}\mathbf{ax} + \frac{1}{\sqrt{2}}\mathbf{ay}\right)$

Perform the dot product, perform multiplication and set up integration. Since parameterization is along the x-axis, the upper integration limit is $X = \frac{P}{\sqrt{2}}$

31) $\mathbf{M} = K_M I_S \mathrm{V}_S \sqrt{2}\int_0^{P/\sqrt{2}} \frac{(X\mathbf{ax} + X\mathbf{ay})}{|\mathbf{r}|^3} dX$

This is the total force-per-coulomb effect felt by the target resulting from the charge motion along the top-left side. The effect from the bottom–left cancels the y-component and doubles x-component. Thus:

32) $\mathbf{M} = K_M I_S \mathrm{V}_S 2\sqrt{2}\int_0^{P/\sqrt{2}} \frac{X}{|\mathbf{r}|^3} dX\mathbf{ax}$

Substitute $|\mathbf{r}|$:

33) $\mathbf{M} = K_M I_S \mathrm{V}_S 2\sqrt{2}\int_0^{P/\sqrt{2}} \frac{X}{\left(2X^2 + h^2\right)^{\frac{3}{2}}} dX\mathbf{ax}$

Reduce:

34) $\mathbf{M} = K_M I_S \mathrm{V}_S \int_0^{P/\sqrt{2}} \frac{X}{\left(X^2 + \frac{h^2}{2}\right)^{\frac{3}{2}}} dX\mathbf{ax}$

Integrate:

35) $$\mathbf{M} = K_M I_S V_S \left[ \frac{-1}{\sqrt{X^2 + \frac{h^2}{2}}} \right]_0^{P/\sqrt{2}} \mathbf{ax}$$

Substitute limits:

36) $$\mathbf{M} = K_M I_S V_S \left[ \frac{-1}{\sqrt{\frac{P^2}{2} + \frac{h^2}{2}}} - \frac{-1}{\sqrt{\frac{h^2}{2}}} \right] \mathbf{ax}$$

37) $$\mathbf{M} = K_M I_S V_S \sqrt{2} \left[ \frac{1}{h} - \frac{1}{\sqrt{P^2 + h^2}} \right] \mathbf{ax}$$

Step 37 is the force per charge effect acting on the target charge due to the charge motion in the left sides.

### 10.6.2 Effects from the right sides

Like the calculations for the left sides, calculate for the right-top then drop the Y-component and multiply by two to find the total effect.

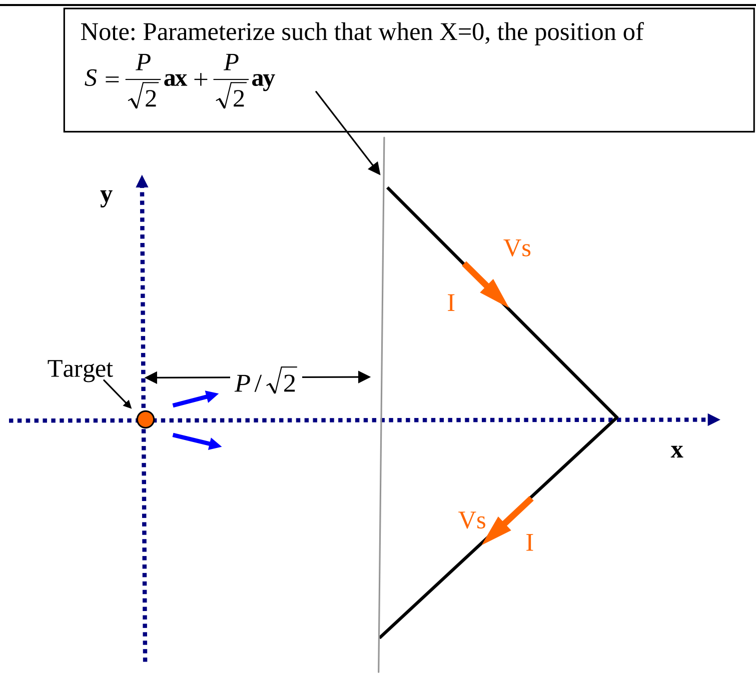


**Figure 10-6: The Right side effects**

Start with parameterizations. Use the letter X to parameterize the source:

38) Target position $T = 0,0,h$

39) Source position $S = \left(\frac{P}{\sqrt{2}} + X\right)\mathbf{ax} + \left(\frac{P}{\sqrt{2}} - X\right)\mathbf{ay}$

Note: when X=0 the position of S is at $\left(\frac{P}{\sqrt{2}}\right)\mathbf{ax} + \left(\frac{P}{\sqrt{2}}\right)\mathbf{ay}$ .

40) Source fragment length $|d\mathbf{L}_S| = \sqrt{2}dX$

41) Source fragment direction $d\hat{\mathbf{L}}_S = \frac{1}{\sqrt{2}}\mathbf{ax} - \frac{1}{\sqrt{2}}\mathbf{ay} + 0\mathbf{az}$

42) Source to target vector $\mathbf{r} = -\left(\frac{P}{\sqrt{2}} + X\right)\mathbf{ax} - \left(\frac{P}{\sqrt{2}} - X\right)\mathbf{ay} + h\mathbf{az}$

43) Source to target distance $|\mathbf{r}| = \sqrt{2X^2 + P^2 + h^2}$

44) Vector velocity of source charges $\mathbf{v}_S = V_S d\hat{\mathbf{L}}_S$

45) Reusing the derivation of Qs from step 27, thus: $Q_S = \frac{I_S \sqrt{2} dX}{V_S}$

Again substitute Qs and divide by Qt

46) $\mathbf{M} = -\frac{K_M I_S \sqrt{2} dX}{|\mathbf{r}|^2 V_S}(\mathbf{v}_S \bullet \hat{\mathbf{r}})\mathbf{v}_S$

Substitute Vs:

47) $\mathbf{M} = -\frac{K_M I_S \sqrt{2} dX V_S}{|\mathbf{r}|^2}\left(\left(\frac{1}{\sqrt{2}}\mathbf{ax} - \frac{1}{\sqrt{2}}\mathbf{ay}\right) \bullet \hat{\mathbf{r}}\right)\left(\frac{1}{\sqrt{2}}\mathbf{ax} - \frac{1}{\sqrt{2}}\mathbf{ay}\right)$

Substitute $\hat{\mathbf{r}} = \frac{\mathbf{r}}{|\mathbf{r}|}$:

48)
$$\mathbf{M} = -\frac{K_M I_S \sqrt{2} dX V_S}{|\mathbf{r}|^3}\left(\left(\frac{1}{\sqrt{2}}\mathbf{ax} - \frac{1}{\sqrt{2}}\mathbf{ay}\right) \bullet \left(-\left(\frac{P}{\sqrt{2}} + X\right)\mathbf{ax} - \left(\frac{P}{\sqrt{2}} - X\right)\mathbf{ay} + h\mathbf{az}\right)\right)\left(\frac{1}{\sqrt{2}}\mathbf{ax} - \frac{1}{\sqrt{2}}\mathbf{ay}\right)$$

Perform the dot product and multiplication:

49) $\mathbf{M} = \frac{K_M I_S \sqrt{2} dX V_S}{|\mathbf{r}|^3}(X\mathbf{ax} - X\mathbf{ay})$

Set up the integration. Since we are parameterizing along the x-axis, the integration limits are from $X = 0$ to $X = P/\sqrt{2}$. These limits correspond to $x = \frac{P}{\sqrt{2}}$ to $x = \sqrt{2}P$

50) $\mathbf{M} = K_M I_S V_S \sqrt{2}\int_0^{P/\sqrt{2}} \frac{(X\mathbf{ax} + X\mathbf{ay})}{|\mathbf{r}|^3} dX$

This is the total force-per-coulomb effect felt by the target resulting from the charge motion along the top-right side. The effect from the bottom-right cancels the y-component and doubles x-component. Thus:

 

51) $\mathbf{M} = K_M I_S V_S 2\sqrt{2}\int_0^{P/\sqrt{2}} \frac{X}{|\mathbf{r}|^3} dX\mathbf{ax}$

Substitute $|\mathbf{r}|$ then divide top and bottom by $2\sqrt{2}$:

52) $\mathbf{M} = K_M I_S V_S \int_0^{P/\sqrt{2}} \frac{X}{\left(X^2 + \frac{P^2}{2} + \frac{h^2}{2}\right)^{\frac{3}{2}}} dX\mathbf{ax}$

Perform integration:

53) $\mathbf{M} = K_M I_S V_S \left[\frac{-1}{\sqrt{X^2 + \frac{P^2}{2} + \frac{h^2}{2}}}\right]_0^{P/\sqrt{2}} \mathbf{ax}$

Substitute limits:

54) $\mathbf{M} = K_M I_S V_S \left[\frac{1}{\sqrt{\frac{P^2}{2} + \frac{h^2}{2}}} - \frac{1}{\sqrt{\frac{P^2}{2} + \frac{P^2}{2} + \frac{h^2}{2}}}\right]\mathbf{ax}$

Multiply top and bottom by $\sqrt{2}$:

55) $\mathbf{M} = K_M I_S V_S \sqrt{2}\left[\frac{1}{\sqrt{P^2 + h^2}} - \frac{1}{\sqrt{2P^2 + h^2}}\right]\mathbf{ax}$

Step 55 represents the total force per charge field felt by the target charge due to the current through the right sides of the loop.

### 10.6.3 Combining the effects

In this section all of the effects acting upon the target charge are collected and summed to find the total effect on the target.

### For the Spherical field

For the spherical field theory of New Electromagnetism:

The near corner effect:

From step 16) $\mathbf{M} = K_M I_S V_S \sqrt{2}\left(-\frac{1}{h}\right)\mathbf{ax}$

The far corner effect:

From step 17) $\mathbf{M} = K_M I_S V_S \sqrt{2}\left(\frac{1}{\sqrt{2P^2 + h^2}}\right)\mathbf{ax}$

The effect of the left sides:

From step 37) $\mathbf{M} = K_M I_S \mathrm{V}_S \sqrt{2}\left[\frac{1}{h} - \frac{1}{\sqrt{P^2 + h^2}}\right]\mathbf{ax}$

The effect of the right sides:

From step 55) $\mathbf{M} = K_M I_S \mathrm{V}_S \sqrt{2}\left[\frac{1}{\sqrt{P^2 + h^2}} - \frac{1}{\sqrt{2P^2 + h^2}}\right]\mathbf{ax}$

It is not hard to see that the summation of the above 4 equations yields zero (0).

### For the Transverse Field

For the Classical (transverse) field model, the effect on the target charge due to the corner effect is the result found in step 16) $emf = K_M I_S V_S \sqrt{2}\left(-\frac{1}{h}\right)\mathbf{ax}$.

Classical Electromagnetism provides no “cancelative” means to reconcile this effect with physical observation.

## 10.7 Conclusion

This section shows that only a spherical magnetic field is capable of reconciling the corner effects produced by a conductive wire system containing a constant current. Although this proof only covers a single point on a square shaped loop, logic allows one to conclude that this “cancelative” effect holds true for all points around any shape of loop as long as the loop is closed.

 

The corner effects and the $-(\mathbf{v}_S \bullet \hat{\mathbf{r}})\mathbf{v}_S$ term of New Magnetism are the only mechanisms by which a constant current, in a stationary loop, could affect a stationary charge. Without the self cancellation of these terms, engineers would have detected corner "hot spots" years ago.

The cancellation of the $-(\mathbf{v}_S \bullet \hat{\mathbf{r}})\mathbf{v}_S$ term in closed wire systems leaves only the magnetic field components associated with the classical field model described by Biot-Savart. This cancellation (which only occurs in closed wire systems) explains why the pioneers of electromagnetism overlooked the true spherical model of magnetism.

Again, the spherical magnetic field model, proposed by New Induction and New Magnetism, predict no anomalous behavior with regard to magnetic systems such as a wire loops. This is compared to the classical (transverse) model which seems to predict corner effects which have never been observed.

# 11 Conclusion

This publication introduces a new model for the phenomenon known as magnetism. This new model is different from traditional magnetic models because it is spherical in nature. This spherical symmetry is consistent with the other known spherical fields such as Coulomb's Model, New Induction and Gravity.

This new model of magnetism replaces the MEL(V1) from previous papers in the New Electromagnetism series. With this new model of magnetism, New Electromagnetism provides the most complete description of electromagnetic phenomenon.

Coupling the new magnetic field model with an improved understanding of the nature of charge motion in conductors allows us to solve Faraday's Final Riddle: Does the field move with the magnet? In fact we can say that the field does not move with the magnet, the field does move with the charges that comprise the magnet. Some of the charges are in motion even when the magnet is stationary.

New Magnetism enables the BMP to experience consistent time dilation regardless of direction of travel. This was not possible using traditional motional electric models. Because of this electromagnetic reconciliation of Time Dilation and the solution to Faraday's Final Riddle, New Electromagnetism and Einstein's Relativity are in complete agreement. In fact, Relativity can be entirely derived from New Electromagnetism.

This publication has also demonstrated the following:

1) Why electron beams do not scatter.
2) Moving charges can affect stationary charges.
3) The wire system comprising good conductors obey Galilean relativity.

Finally, when New Magnetism is applied to wire systems, cancellations occur leaving only the effects predicted by traditional electromagnetism. This explains why the pioneers of electromagnetism missed the spherical nature of magnetism.

Because New Magnetism is a spherical field, this paper anticipates the existence of longitudinal electromagnetic waves. These longitudinal waves account for the fact that a dipole antenna does transmit and receive off its ends. This transmission mode is not accounted for in classical electromagnetic theory since classical theory is a transverse only model.  The discussion of dipole antennae is covered in the New Electromagnetism Application series book NIA1.

# Appendix A. Corner Effect Experiment

The experimental apparatus shown in Figure 11-1 is designed to measure the corner effects predicted by classical electromagnetism. It consists of a square loop of N turns mounted to a 4-lobed loop of M turns as shown. The N loop is excited by a DC current while the M loop contains a device for measuring emf.

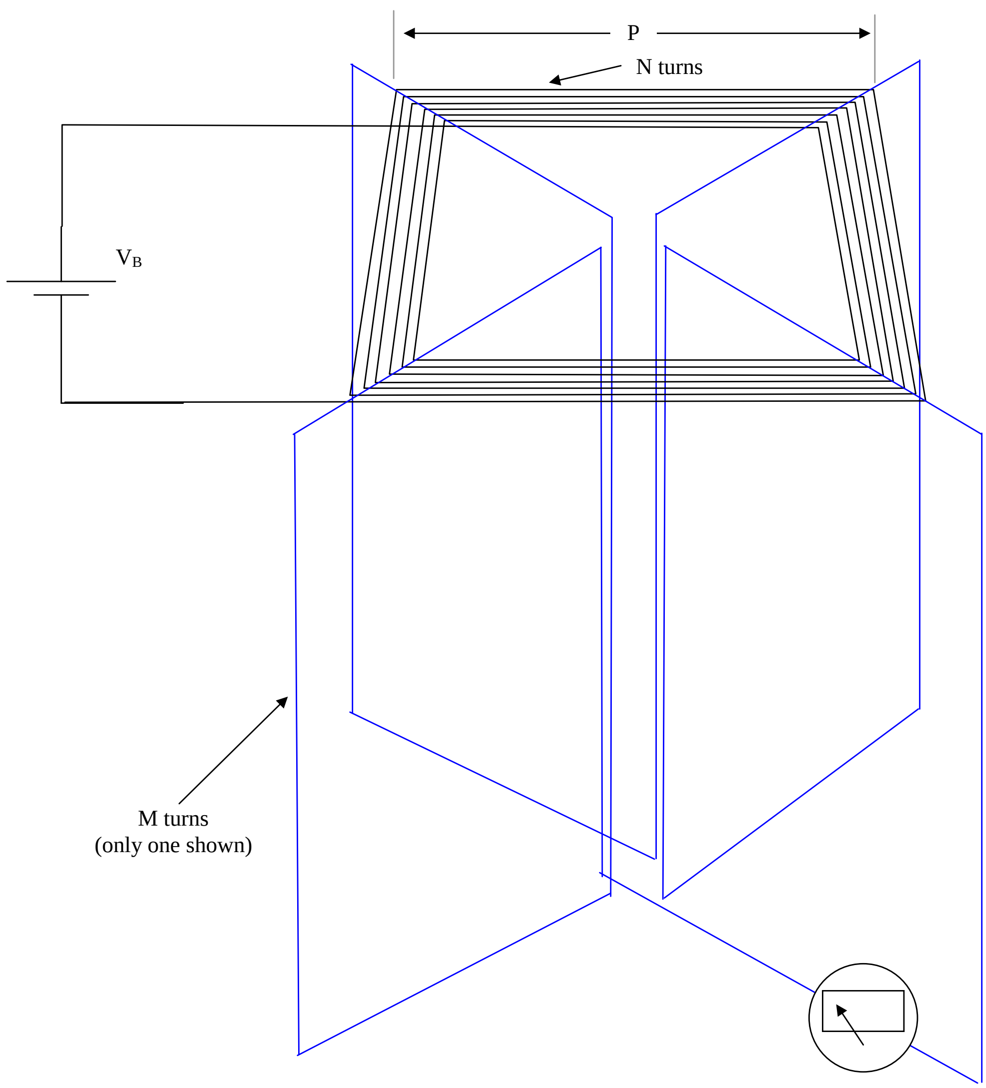


**Figure 11-1: Corner Effect Transformer**

 

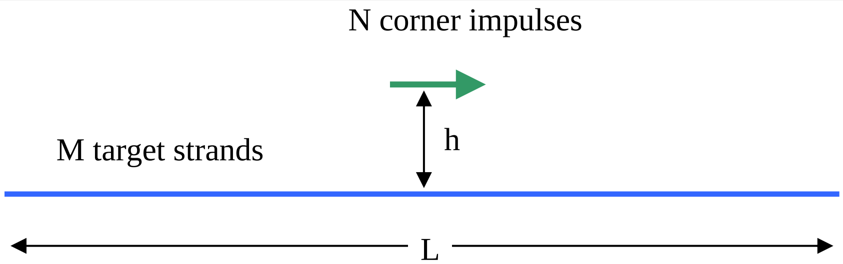


**Figure 11-2: Diagram for parameterization**

For simplicity center each lobe of the target loop (M) such that the lobe top is centered underneath the corners as shown in Figure 11-2. For Figure 11-2 the positive x direction is to the right.

From the derivations in this publication, the field generated by the corner impulse for a transverse field is written by inspection:

1) $$emf = -K_M I_S V_S \sqrt{2}\,\frac{\hat{U} - (\hat{U} \bullet \hat{\mathbf{r}})\hat{\mathbf{r}}}{|\mathbf{r}|}$$

Note: $V_S$ is the velocity of the charges in the source wire; not voltage.

In the above equation, $\hat{U}$ is the direction of the charge impulse, and $I_S V_S \sqrt{2}$ is the magnitude of the charge impulse.

To find the emf long the target strand, perform dot product of 1) with dLt, thus:

2) $$d(emf) = \mathbf{E} \bullet dL_T = -K_M I_S V_S \sqrt{2}\,\frac{\hat{U} \bullet d\mathbf{L}_T - (\hat{U} \bullet \hat{\mathbf{r}})(\hat{\mathbf{r}} \bullet d\mathbf{L}_T)}{|\mathbf{r}|}$$

Next set up using X to parameterize:

3) $d\mathbf{L}_T = dX\mathbf{ax}$

4) Position of impulse 0,0,h

5) Position of target fragment $T = X,0,0$

6) Vector from source to target $\mathbf{r} = X\mathbf{ax} + 0\mathbf{ay} - h\mathbf{az}$

7) Distance from source to target $|\mathbf{r}| = \sqrt{X^2 + h^2}$

8) Direction of impulse $\hat{U} = \mathbf{ax}$

Substituting yields

9) $$d(emf) = -K_M I_S V_S \sqrt{2}\frac{dX}{|\mathbf{r}|} - \frac{X^2 dX}{|\mathbf{r}|^3}$$

Integrate from –L/2 to L/2

10) $$emf = -K_M I_S V_S \sqrt{2}\int_{-L/2}^{L/2} \frac{dX}{\sqrt{X^2+h^2}} - \frac{X^2 dX}{\sqrt{X^2+h^2}^3}$$

11) $$emf = \left[-K_M I_S V_S \sqrt{2}\frac{X}{\sqrt{X^2+h^2}}\right]_{-L/2}^{L/2}$$

12) $$emf = -K_M I_S V_S \sqrt{2}\frac{L}{\sqrt{\left(\frac{L}{2}\right)^2 + h^2}}$$

For the total emf of each lobe multiply by MN. Since there are 4 lobes, multiply by 4 to arrive at the total emf of the system:

13) $$emf = -K_M I_S V_S 4\sqrt{2}MN\frac{2}{\sqrt{\left(\frac{2h}{L}\right)^2 + 1}}$$

If h<<L then the equation limits to:

14) $$emf = -K_M I_S V_S 8\sqrt{2}MN$$

Determine values for $I_S$ and $V_{S.}$

$V_S$ is to be substituted by the charge drift velocity of the N loop given by:

15) $V_e = \mu_e \mathbf{E}$ where $\mu_e$ is the charge mobility of the material that comprises the N loop (the source) and E in the electric field in the source loop. The Electric field in the source loop is:

16) $E = \frac{V_B}{\ell}$ where $V_B$ is the battery voltage and $\ell$ is the total length of the loop. The total Length of the loop is:

17) $\ell = 4PN$

Combining steps 15, 16 and 17 yields:

18) $V_S = V_e = \frac{\mu_e V_B}{4PN}$

For $I_S$:

19) $I_S = \frac{V_B}{R}$ Where R is to total resistance of the source loop. To make the source loop material choice independent of the length of the loop, rewrite step 19 using material conductivity per unit length ($\sigma$), thus

20) $I_S = \frac{V_B}{4PN}\sigma$

Substituting 18 and 20 into 14 yields:

21) $emf = \frac{-K_M \mu_e \sigma M}{\sqrt{2}N}\left(\frac{V_B}{P}\right)^2$

The result in step 21 shows that if the classical transverse model of magnetism were correct, then experimental evidence should be obtainable with the experiment mentioned in this chapter.

Since it is scientifically accepted that the corners of loops do not have measurable “hot spots”, there is no need to build this experiment.

# Appendix B. Alternate experiment

Another version of the experiment included for completeness. This experiment is much easier to construct but more difficult to model.

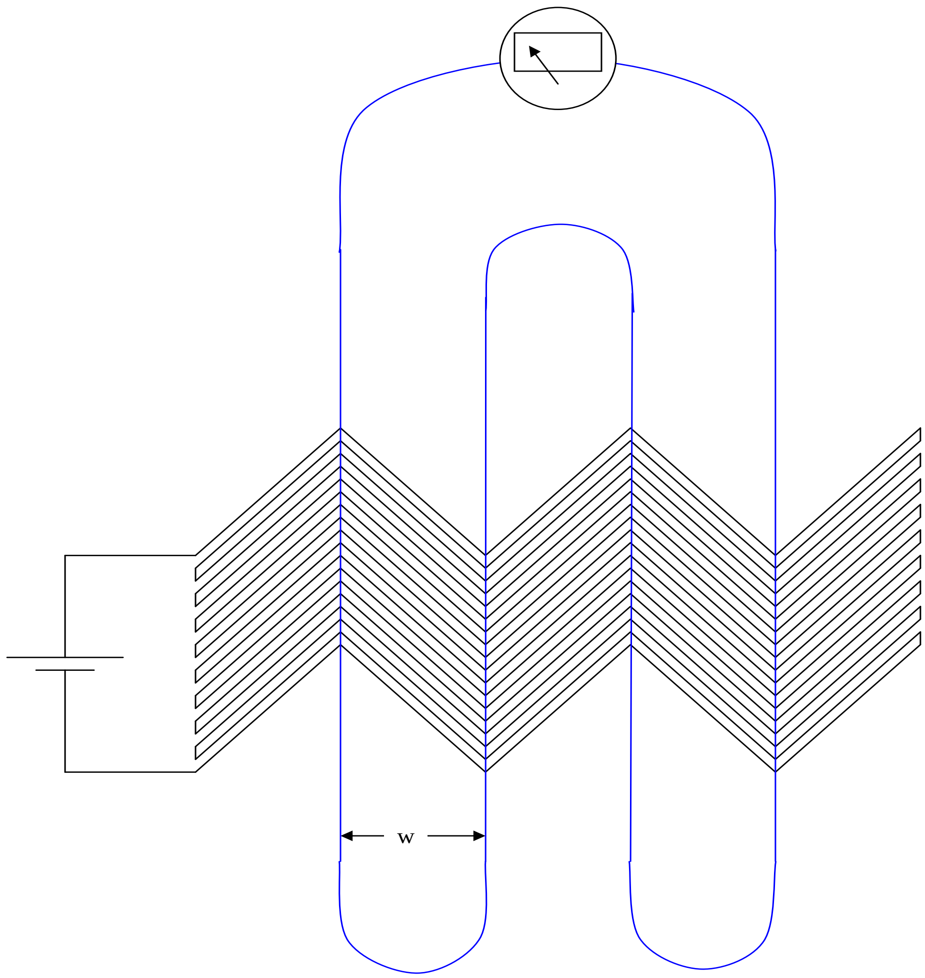


**Figure 11-3**