A Brief Introduction to Scalar Physics

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Abstract

The forces of magnetism, electricity, and gravity are distortions of a single primordial field that permeates the universe and comprises the fabric of existence. Vorticity in this field gives rise to magnetic fields. Dynamic undulations give rise to electric fields. Compression or divergence gives rise to gravitational fields. When put into mathematical form, these relations reveal how electric and magnetic fields can be arranged to produce artificial gravity and many other exotic phenomena such as time distortion and the opening of portals into other dimensions.

Contents

Chapter 1

Introduction

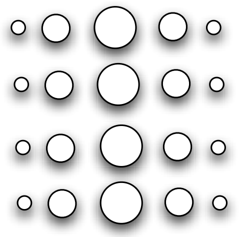
In this paper I will detail how the forces of electricity, magnetism, and gravity arise from a single field. Although you need to know vector calculus to fully understand and use the equations below, the text itself paraphrases the math and therefore allows any patient layman to follow along. The math reveals many ways to create gravity using only electric, magnetic, or electromagnetic fields. From there, seemingly impossible feats of artificial time dilation, antigravity, free energy, and time travel become feasible.

1.1 Basics

Knowing the language is essential to understanding any communication. The following math and physics terms must be used for conciseness and accuracy in discussing specific concepts. Once you understand them, this paper will be more transparent.

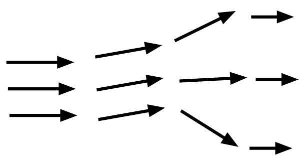
1.1.1 Math Terms

Scalar Field - a field where each coordinate has a single value assigned to it. An example would be air pressure; at each point in the atmosphere there is one value of pressure. Height is another; on a topographic map, each coordinate has a single value of height.



(size of circle denotes strength of field at that point)

Vector Field - a field where each coordinate has values of magnitude and direction. An example would be wind flow; at each point in the atmosphere the air moves at a certain speed in a certain direction.



Derivative - specifies how much one measured value changes with respect to another. For instance, the derivative of space with respect to time is velocity.

Gradient - the change in scalar value over distance. A gradient in height would signify an incline. Because the slope at various points has a certain steepness and direction, the gradient of a scalar field is a vector field.

Curl - the vorticity in a vector field. A curl in water current means there is circulation, like an eddy. The curl at a point is defined as a vector that points in the axis of circulation and has magnitude indicating the degree of vorticity. The curl of a vector field is another vector field at right angles to it.

Divergence - the degree of compression, expansion, inflow, or outflow of a vector field. Water flowing down the drain or air being sucked into a vacuum nozzle are examples. The divergence of a vector field is a scalar field.

Time Derivative - the rate at which something changes over time. If the temperature changes 24 degrees in one day, its time derivative would be one degree per hour.

1.1.2 Physics Terms

Superpotential field - penultimate field from which all other fields arise.

Potential field - arises from a time derivative, divergence, or gradient in the superpotential field. Potential fields give rise to force fields, but are simpler in form and can exist even in the absence of force fields.

Force field - arises from a gradient, curl, or time derivative of the potential field. This can impart acceleration upon corresponding particles or change their direction of motion. We are familiar with the three main force fields: electric, magnetic, and gravitational.

Scalar superpotential - superpotential field whose units are in Webers. It is a scalar field made of magnetic flux. Every point in spacetime has a certain value of Webers associated with it. This is the scalar superpotential field. It is the infamous "aether" that scientists once believed served as a medium for the propagation of electromagnetic waves.

Electric scalar potential - potential field from which electric force fields arise. It is better known as "voltage field." It arises from the time derivative of the scalar superpotential. It is a scalar field with units of Volts or Webers/second. When the value of flux at a point changes over time, a voltage or electric scalar potential exists there.

Magnetic vector potential - potential field from which magnetic force fields arise. It arises from the gradient in the scalar superpotential. It is a vector field with units of Weber/meter. The ether flow surrounding and being dragged along by an electric current is one example of the magnetic vector potential. James Maxwell considered this the fundamental force in electromagnetism and likened it to a form of electromagnetic momentum.

Gravitational potential - potential field from which gravitational force fields arise. Here it is revealed to be a divergence in the magnetic vector potential. Most importantly, it determines the rate of time.

Electric Field - field that imparts force to charged matter. It arises either from a gradient in the electric scalar potential or time derivative of magnetic vector potential. This is a force field with units of Volts/meter or Webers/meter-second. An electric field is essentially voltage changing over some distance, but is equivalently made of a time-changing magnetic vector potential field.

Magnetic field - field that accelerates matter depending on its magnetic moment. It arises from the curl in magnetic vector potential. Its units are Webers/meter^2. Whenever there is vorticity in the magnetic vector potential, a magnetic field exists pointing along the axis of that rotation.

Gravitational field - field that exerts force upon a mass in proportion to its mass. It arises from a negative gradient in the gravitational potential, or equivalently a gradient in the divergence of the magnetic vector potential.

Transverse wave - a wave whose displacements are perpendicular to the direction of travel. Shaking a rope sends a transverse wave down its length. Regular electromagnetic waves such as radio or light waves are transverse because the electric and magnetic field vectors comprising them point perpendicular to the direction of propagation.

Longitudinal wave - a wave whose displacement is in the direction of motion. Pushing a slinky in from one end sends a compressive wave towards the other end. Sound waves are longitudinal also, whereby air molecules are successively compressed and expanded as the wave passes by.

1.1.3 Symbols

Symbol	Name	Units
χ	scalar superpotential	Wb (Weber)
ϕ	electric scalar potential	V (Volts)
φ	gravitational potential	m^2 / s^2
$\vec{A}$	magnetic vector potential	Wb / m
$\vec{E}$	electric field	V / m
$\vec{B}$	magnetic field	Wb / m^2
$\vec{g}$	gravitational field	m / s^2
c	speed of light	m / s
G	gravitational constant	N m^2 / kg^2
m	mass	kg
q	electric charge	C
ρ	electric charge density	C / m^3
ϵ_o	vacuum permittivity	F / m
μ_o	vacuum permeability	Wb / (A · m)

Chapter 2

Potential Fields

Potential fields are less tangible and invariant than the physical force fields they may produce. If force fields are likened to the surface waves of the ocean, potential fields are more like the hidden underwater currents, while the superpotential represents the water itself. Potential fields really do exist and are not just convenient mathematical abstractions. It's just that their effects are subtle and quantum in nature, therefore harder to measure and not immediately obvious to our senses.

2.1 Scalar Superpotential

The scalar superpotential is the substrate of physicality, the ether permeating and underlying the universe, from which all matter and force fields derive.

It is a scalar field, meaning each point in that field has one value associated with it. This value is the degree of magnetic flux at that point, whose unit is the Weber. This is not the magnetic force field we all know, composed of vectors whose units are Wb/m^2, but a magnetic *flux* field of scalar values whose unit of measure is simply Wb.

Its symbol is χ (Greek letter chi). Scalar superpotential may be written as: $\chi = \chi(x, y, z, t)$, an equation assigning a flux value to each coordinate in spacetime.

By itself, the absolute flux value has no direct physical significance in terms of measurable forces, however it is closely associated with the quantum phase θ of a wave function as follows:

$$\chi = \frac{h}{q}\,\theta$$

So its effects are limited to the quantum domain and determine the degree of intersection and interaction between different probable realities. However, certain distortions in its distribution do give rise to measurable forces.

2.2 Magnetic Vector Potential

The magnetic vector potential $\vec{A}$ is the gradient of the scalar superpotential, meaning the flux must change over some distance to comprise a vector potential:

$$\vec{A}(x, y, z, t) = \nabla\chi$$

The absolute value of flux or superpotential does not figure into this, just as altitude above sea level does not figure into the measurement of "inclination" of a hillside:

$$\nabla\chi = \nabla(\chi + \chi_o)$$

While certain perturbations of the vector potential give rise to certain force fields, by itself $\vec{A_o}$ has no physical significance in terms of measurable forces, but because it is made of superpotential, it alters the quantum phase θ of charged particles per the Aharonov-Bohm effect:

$$\chi = \int \vec{A} \cdot dl$$

$$\theta = \frac{q}{h}\int \vec{A} \cdot dl$$

James Maxwell also considered $\vec{A}$ the primary field in electrodynamics and likened it to electromagnetic momentum.

2.3 Electric Scalar Potential

The electric scalar potential ϕ, whose unit is the Volt (or Wb/s), is the time derivative of the scalar superpotential:

$$\phi(x, y, z, t) = \frac{\partial \chi}{\partial t}$$

When the scalar superpotential changes over time, an electric scalar potential arises. That is to say, a voltage field is identically a time-varying scalar superpotential field.

As in the case of the magnetic vector potential, a change in the absolute scalar superpotential value does not change the scalar electric potential:

$$\frac{\partial \chi}{\partial t} = \frac{\partial(\chi + \chi_o)}{\partial t}$$

Chapter 3

Force Fields

Force fields are what we visibly experience everyday. Through forces, kinetic or potential energy is imparted to matter and changes ensue. It is through forces that we are directly impacted by the world, and directly impact the world. The electric and magnetic fields are what trigger our five physical senses, and it is through them that electronic measuring devices operate.

Since the potential and superpotential are hidden beneath force fields like computer code behind a digital image, senses and instruments responsive only to electromagnetic force fields cannot detect them.

3.1 Electric Field

The electric force field $\vec{E}$ is the result of certain distortions in the scalar potential ϕ and/or vector potential $\vec{A}$.

Electric field is defined as the negative gradient of the electric scalar potential; it is the "slope" of a voltage field (scalar electric potential field) that declines over some distance:

$$\vec{E}(x, y, z, t) = -\nabla\phi$$

where "∇" denotes the "gradient." Written in terms of the superpotential:

$$\vec{E} = -\nabla\frac{\partial\chi}{\partial t}$$

By bringing the gradient inside the time derivative,

$$\vec{E} = -\frac{\partial}{\partial t}\nabla\chi$$

it's clear that the electric field is also the negative time gradient of the magnetic vector potential:

$$\vec{E} = -\frac{\partial \vec{A}}{\partial t}$$

By combining these two contributors, the total electric field may be written as:

$$\vec{E} = -\nabla\phi - \frac{\partial \vec{A}}{\partial t}$$

3.1.1 Electric Singularities

The electric field of a point charge (like an electron) is:

$$\vec{E} = \frac{q}{4\pi\epsilon_0}\frac{1}{r^2}\hat{r}$$

This field is defined everywhere except at $r = 0$, where it blows up to infinity; there is a singularity there. How physics deals with this singularity is worth explaining, because the same techniques will apply in the upcoming discussion of magnetic fields.

Gauss's Law states that if you draw a spherical surface around a group of charges and measure the electric flux through that surface, that flux will stay the same no matter how the charges inside are distributed. It depends only on the quantity of charge enclosed. The charges can be spread out or be a single point charge; both cases should give the same answer.

As far as real world measurements are concerned, it doesn't matter that a point charge has an infinite electric field at the center; at the distant point of measurement, the electric field is finite and the same as if the charge were diffused into a cloud without a singularity.

The singularity *does* matter in showing how the usual mathematical approach fails, thereby indicating a more sophisticated approach is needed to handle that special case.

Here is an example. The differential form of Gauss's Law states:

$$\nabla \cdot \vec{E} = \frac{\rho}{\epsilon_0}$$

This says that E has a divergence in the presence of a charge density. It means the divergence should be nonzero so long as there are charges within the region being considered. But what if they are in the form of a point charge? Let's take the divergence of the point charge equation:

$$\nabla \cdot (\frac{q}{4\pi\epsilon_0}\frac{1}{r^2}\hat{r}) = \frac{q}{4\pi\epsilon_0}\frac{\partial}{\partial r}(r^2\frac{1}{r^2}) = 0$$

It appears that $\nabla \cdot \vec{E} = 0$ even though there is a charge within the region, in contradiction to Gauss's Law. But notice this is only true for $r \neq 0$. At the origin, there is division of 0 by 0 which is undefined. It's the fault of trying to use differentiation at the singularity point. A better method would be using integration to approach the singularity from its surroundings. This may be done as follows:

The divergence theorem states that the volume integral of a field's divergence equals the field's flux through that volume's surface.

$$\int_V (\nabla \cdot \vec{E}) d\tau = \oint_S \vec{E} \cdot d\vec{a}$$

We can calculate the term on the right using a point charge and a spherical surface:

$$\oint_{sphere} [\frac{q}{4\pi\epsilon_0}\frac{1}{r^2}\hat{r}] \cdot [r^2 sin(\theta) d\theta d\phi \hat{r}]$$

$$= \frac{q}{4\pi\epsilon_0}\oint sin(\theta) d\theta d\phi$$

$$= \frac{q}{4\pi\epsilon_0}\int_0^{\pi} sin(\theta) d\theta \int_0^{2\pi} d\phi$$

$$= \frac{q}{4\pi\epsilon_0}(2)(2\pi)$$

$$\oint_S \vec{E} \cdot d\vec{a} = \frac{q}{\epsilon_0}$$

So the flux through the sphere is q/ϵ_0 regardless of how the charges inside are distributed, as it only depends on the quantity of charge enclosed. Then this must also be the value of the left term:

$$\int_V (\nabla \cdot \vec{E}) d\tau = \frac{q}{\epsilon_0}$$

What then is the divergence of the electric field from this point charge? We know that $\nabla \cdot \vec{E} = 0$ everywhere but at the origin. Therefore the flux comes solely from the singularity at the center.

Here is where physicists invoke the three-dimensional Dirac delta function defined as:

$$\delta_3(r) = \begin{cases} +\infty, & r = 0 \\ 0, & r \neq 0 \end{cases}$$

It is a spike of infinite amplitude and infinitesimal width located at the origin. It's the very essence of a singularity, except its integral over all space is 1:

$$\int_V \delta_3(r)\, d\tau = 1$$

We can use this delta function to properly represent the divergence of a point charge's electric field. Multiplying through by q/ϵ_0:

$$\int_V [\frac{q}{\epsilon_0} \delta_3(r)\,] d\tau = \frac{q}{\epsilon_0} = \int_V (\nabla \cdot \vec{E}) d\tau$$

Then by comparing terms, we see that:

$$\nabla \cdot \vec{E} = \frac{q}{\epsilon_0} \delta_3(r)$$

The three dimensional delta function has units of inverse volume, so this function times charge is really just charge density:

$$\frac{q}{\epsilon_0} \delta_3(r) = \frac{\rho}{\epsilon_0}$$

Instead of charge being spread out through some finite volume and thus being a regular charge density, the delta function packs the charge into an infinitesimal point at the origin, for it is zero everywhere except at the origin. Either gives the same divergence.

That is how the singularity may be successfully represented while upholding Gauss's law:

$$\nabla \cdot \vec{E} = \frac{\rho}{\epsilon_0}$$

3.2 Magnetic Field

The magnetic force field $\vec{B}$ arises from vorticity or curl in the magnetic vector potential:

$$\vec{B}(x, y, z, t) = \nabla \times \vec{A}$$

where "$\nabla\times$" signifies "curl", the degree of vorticity in the field at some particular point in spacetime.

Since the vector potential is gradient of the superpotential, the magnetic field can also be written in terms of the scalar superpotential:

$$\vec{B} = \nabla \times \nabla \chi$$

So a magnetic field is simply the curl of the gradient of the scalar superpotential. As you can see, through a series of distortions, the scalar superpotential ultimately gives rise to a magnetic field. First it varies over some distance to create the magnetic vector potential, then the variation curls or twists to produce the magnetic force field.

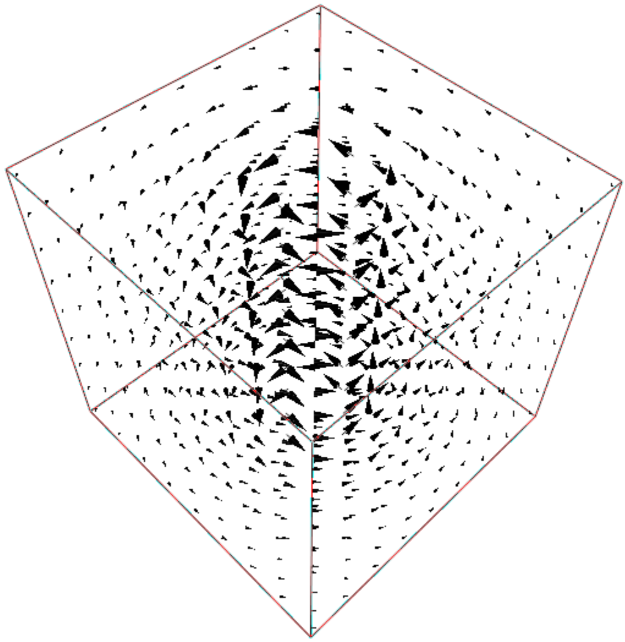
Readers may object because the curl of a gradient is said to *always* be zero. But that is only true for simply connected regions. If there is a singularity at the center, then there can be a nonzero curl around the center even though everywhere else, the curl of the gradient is indeed zero. This will be demonstrated in the next section.

3.2.1 Magnetic Singularities

Consider a vector potential field of the form:

$$\vec{A}_{cylindrical} = \frac{1}{s}\hat{\phi}$$

$$\vec{A}_{cartesian} = \frac{-y}{x^2 + y^2}\hat{x} + \frac{x}{x^2 + y^2}\hat{y}$$



This represents a circulating field that drops off linearly with distance from the vertical axis. Its curl is zero everywhere except along the z axis, where it is undefined.

$$\nabla \times \vec{A} = -\frac{\partial(1/s)}{\partial z}\hat{s} + \frac{1}{s}\frac{\partial}{\partial s}(s\frac{1}{s})\hat{z}$$

Whereas the electric singularity is a point, the magnetic singularity is a string. Here it is oriented vertically along the z axis with the field circulating around it.

The proper approach to this problem is to use Stoke's Theorem to first calculate the amount of circulation around the origin, which gives the value of magnetic flux that is present.

$$\oint_P \vec{A} \cdot d\vec{l} = \int_S \nabla \times \vec{A} \cdot d\vec{a} = \chi$$

$$\oint_P \vec{A} \cdot d\vec{l} = \oint_P \frac{1}{s}\hat{\phi} \cdot (s\, d\phi\, \hat{\phi}) = \oint_P d\phi = 2\pi$$

The singularity string contributes a flux of 2π for a circular path drawn around it. From Stoke's Theorem we see that the surface integral of the curl must equal this value.

$$\int_S \nabla \times \vec{A} \cdot d\vec{a} = 2\pi$$

Here we can invoke the 2 dimensional Dirac delta function defined as:

$$\delta_2(s) = \begin{cases} +\infty, & s = 0 \\ 0, & s \neq 0 \end{cases}$$

$$\int_S \delta_2(s)\, da = 1$$

For the surface, we may use a unit disc lying in the xy plane. Then:

$$\int_S \nabla \times \vec{A} \cdot d\vec{a} = \int_S (\nabla \times \vec{A})\hat{z} \cdot \hat{z}\, da = \int_S (\nabla \times \vec{A})\, da = 2\pi$$

By comparing this to the delta function integral, we see that

$$\nabla \times \vec{A} = 2\pi\delta_2(s)$$

Since $\delta_2(s)$ has units of inverse area, the curl represents flux per unit area, which is in agreement with the magnetic field $\vec{B} = \nabla \times \vec{A}$ being a magnetic flux density with units $\mathrm{Wb/m^2}$.

So an irrotational vector potential produces a magnetic field, but only in the form of a flux line at the center of rotation. Everywhere else, the curl is zero. In other words, the entire magnetic field is concentrated into a singularity string, just as the charge density in the previous example was concentrated into a single point. We see this same phenomenon in superfluids, in which irrotational vortices or singularity strings arise when stirred. This suggests the ether in which magnetic flux lines exist may actually be a superfluid.

3.2.2 Superpotential of a Magnetic Field

What is the underlying scalar superpotential of $\vec{A} = \hat{\phi}/s$? Well, the gradient of the superpotential gives rise to the vector potential,

$$\nabla\chi = \frac{1}{s}\hat{\phi}$$

By comparing this to the definition of gradient in cylindrical coordinates,

$$\frac{1}{s} = \frac{1}{s}\frac{\partial\chi}{\partial\phi}$$

$$\chi = \frac{s}{s}\phi$$

Outside the origin, this simplifies to $\chi = \phi$ while at the origin, the flux was already calculated to be 2π.

$$\chi = \begin{cases} 2\pi, & s = 0 \\ \phi, & s \neq 0 \end{cases}$$

So *this* is the fundamental superpotential field of an irrotational vector potential, which has a singularity at the central axis of rotation that produces a nonzero $\vec{B}$ at the origin. Since $\vec{B}$ is zero everywhere else, χ is allowed to have a gradient everywhere else besides the origin.

But what does this mean? The χ field is a corkscrew of infinite width that winds around the z axis. The infinite width is not a problem, it simply means that phenomena that depend on the path around the flux do not depend on distance from it.

One example is the Aharonov-Bohm effect, where an electron traveling around a long thin solenoid picks up a phase factor that depends on the magnetic flux inside the solenoid, but not distance from it. If this solenoid were bent into a closed toroid so that all flux were absolutely confined inside, the effect would still exist.

Another example is a loop of wire wound around a ferromagnetic rod in which there is a changing magnetic field. The electromotive force induced by the changing magnetic flux is independent of the diameter of the loop. If the flux were completely confined inside a toroidal core, it would still produce the same electromotive force. That is because the electron isn't actually experiencing the flux itself, but rather the corkscrew superpotential surrounding the flux lines.

A changing flux creates a changing gradient in the superpotential, and an electron in that path will be pumped along the gradient. Stated another way, a changing gradient generates an electric field, which places a force on the electron as expected.

3.3 Gravitational Field

There is nothing truly new in the equations given so far concerning the scalar superpotential, magnetic vector potential, electric scalar potential, electric force field, or magnetic force field. All of them you will find in, or can derive from, standard electrodynamics textbooks and the works of James Clerk Maxwell.

Now, if a *gradient* creates $\vec{A}$, *curl* of $\vec{A}$ creates $\vec{B}$, and *time rate of change* creates $\vec{E}$, then what might *divergence* of $\vec{A}$ create? Here is where my Scalar Superpotential Theory departs from mainstream science by making one key postulate: *Divergence of the magnetic vector potential is proportional to the gravitational potential.*

$$\varphi = \beta \nabla \cdot \vec{A} = \beta \nabla^2 \chi$$

where β is a constant of proportionality and "$\nabla^2 \chi$" is the Laplacian of the scalar superpotential signifying whether χ at a given point is greater or less than the surrounding χ.

This is the central postulate of my theory. It implies that gravity arises from compression or rarefaction in the superpotential. One example: when the vector potential surrounding an electric current is directed inward toward a common center. Gravity can therefore be neutralized by decompressing the ether, say through an outward current flow that pushes ether outward from a central point.

Gravitational *potential* is analogous to air pressure. This is different from the gravitational *force* field, which is analogous to wind. Just as difference in air pressure creates wind, so does change in the gravitational potential over some distance produce a gravitational force field that imparts acceleration to free falling objects.

The gravitational force field is the negative gradient of the gravitational potential:

$$\vec{g} = -\nabla \varphi$$

Written in terms of the magnetic vector potential and scalar superpotential:

$$\vec{g} = -\beta\nabla(\nabla \cdot \vec{A})$$

$$\vec{g} = -\beta\nabla(\nabla \cdot \nabla\chi) = -\beta\nabla(\nabla^2\chi)$$

The constant β is unknown to me at this time, but it can be found through electrogravitational or gravitomagnetic experiments, or derived from fundamental knowledge of the structure of spacetime. It relates electromagnetism to gravity and allows one to calculate the electromagnetic power requirements of all other setups to achieve a desired degree of gravitational and thus spacetime warping.

3.3.1 Vector Potential Function of Gravity

Let's examine how $\vec{A}$ may be distributed around a mass. If its divergence is indeed the gravitational potential, then like the latter it must drop off as $1/r$. By the definition of divergence:

$$\frac{1}{r^2}\frac{\partial}{\partial r}(r^2 A_r) = \frac{1}{r}$$

$$\vec{A} = (\frac{1}{2} + A_o)\hat{r}$$

We may redefine the constant to include the 1/2:

$$\vec{A} = A_o\,\hat{r}$$

That is, the vector potential around a mass points in the radial direction and is constant. So even if the mass were a lightyear away, its vector potential at your location would remain A_o. Hence we are being interpenetrated by the $\vec{A}$ of every mass in the universe.

What is A_o? Well, if the gravitational potential is proportional to the divergence, then:

$$\beta\,\nabla \cdot (A_o\hat{r}) = -\frac{Gm}{r}$$

$$\beta\,\frac{A_o}{r} = -\frac{Gm}{r}$$

$$A_o = -\frac{G}{\beta}m$$

So A_o is simply proportional to mass. In other words, the amount of mass is what determines the constant value of vector potential that it radiates in all directions. Conversely, by artificially changing this value you would be altering the mass.

If we take the gradient of the divergence of this, we get the gravitational force field in terms of $\vec{A_o}$:

$$\nabla(\nabla \cdot \vec{A}) = \nabla(\frac{A_o}{r}) = \frac{1}{r^2}\frac{\partial}{\partial r}(r^2\frac{A_o}{r})$$

$$\nabla(\nabla \cdot \vec{A}) = \frac{A_o}{r^2}\hat{r}$$

$$\vec{g} = -\beta\,\frac{A_o}{r^2}\hat{r}$$

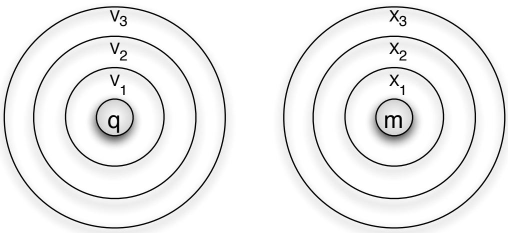
3.3.2 Superpotential Function of Gravity

The superpotential can be found just as easily from the definition of gradient:

$$\frac{\partial \chi}{\partial r} = A_o$$

$$\chi = A_o\,r + \chi_o$$

For every distance from the center of mass, there is a unique superpotential value. This superpotential increases linearly with r and is radially symmetric for a stationary symmetric mass. Like the electric scalar equipotential surfaces around a charge, the superpotential is distributed in concentric shells around mass like the layers of an onion.



Each shell is a surface with value $A_o r$. Mass determines how densely packed these concentric shells are, which is the aforementioned compression or rarefaction of the ether.

At the center of mass, there is only a single constant χ_o of any value. Whatever the value, it has no bearing on the gravitational potential or gravitational force. It can even fluctuate in time without affecting them. However, it may have significant quantum effects; for example, for two masses to be completely tangible to each other, they might need to share the same χ_o, which acts as an index variable signifying the timeline or universe to which it belongs.

3.3.3 Gravitational Flux

If we apply Gauss's Theorem to the gravitational field, as we did with the electric field, we can derive the gravitational flux.

Again, the divergence theorem states that the volume integral of a field's divergence equals the field's flux through that volume's surface.

$$\int_V (\nabla \cdot \vec{A}) d\tau = \oint_S \vec{A} \cdot d\vec{a} = \Omega_{\vec{A}}$$

We can calculate the term on the right using a spherical surface:

$$\oint_{sphere} [\frac{A_o}{r^2}\hat{r}] \cdot [r^2 sin(\theta)\, d\theta\, d\phi\, \hat{r}]$$

$$= A_o \oint sin(\theta) d\theta d\phi$$

$$= A_o \int_0^{\pi} sin(\theta) d\theta \int_0^{2\pi} d\phi$$

$$= A_o(2)(2\pi)$$

$$\oint_S \vec{A} \cdot d\vec{a} = 4\pi A_o = 4\pi(-\frac{G}{\beta}m)$$

The flux $\Omega_{\vec{A}}$ through the sphere is $4\pi A_o$ regardless of how the mass inside is distributed, as it only depends on the quantity of mass enclosed.

This flux is related to our conventional understanding of gravitational flux $\Omega_{\vec{g}}$ by the constant β, so

$$\Omega_{\vec{A}} = 4\pi A_o$$

$$\Omega_{\vec{g}} = -4\pi G m$$

That $\Omega_{\vec{g}}$ is proportional to mass doesn't say much about the structure of gravity. Rather, it is $4\pi A_o$ that shows what is actually going on: gravitational flux is physically comprised of the vector potential lines that radiate from the mass.

Beware not to confuse either of these fluxes with the scalar superpotential, which is technically the flux of the electric and magnetic force fields. While the superpotential ultimately also underlies the gravitational field, its mathematical relation to gravity is not identical as with electricity and magnetism; rather it is the vector potential that plays the analogous role.

Chapter 4

Force-Free Potentials

Potentials can exist without internal distortions that otherwise give rise to force fields. Because everyday technology utilizes force fields, force-free potential fields go largely undetected. There are indeed ways of detecting some potential fields, but these require very specialized equipment. Quantum mechanical devices like Josephson junctions must be used to measure the vector potential directly. Generally, however, potential fields stay hidden from regular test equipment.

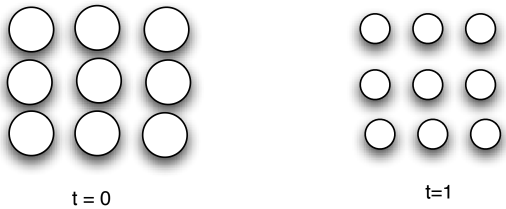
4.1 Potentials without Electric Fields

By setting the electric field equation to zero, we can get an idea of some hidden potential fields, ones that can piggyback on existing electric fields or be present where none are evident.

The equation $\vec{E}(x, y, z, t) = -\nabla\phi = 0$ shows that a scalar potential field $\phi(x, y, z, t)$ can be free of forces as long as it has no gradients. This leaves two possibilities:

> $\phi = \phi_o$ (voltage is absolute and constant in time and uniform in space)
>
> $\phi = \phi(t)$ (voltage is uniform in space but varies with time)

The first seems insignificant beyond perhaps indicating the fundamental "clock speed" of the universe, but the second says that if the voltage field (electric scalar potential) has no gradients, it can still change over time and therefore contain a signal that would be undetectable to most modern instruments. One example would be the field inside a hollow metal sphere or cage given a pulsed voltage; the field inside would be uniform in voltage, thus lacking an electric field, but the voltage would nonetheless pulse with the signal.



The equation $\vec{E} = -\frac{\partial \vec{A}}{\partial t} = 0$ shows that a magnetic vector potential field remains free of an electric field so long as it stays constant: $\vec{A}(x, y, z)$.

The equation $\vec{E} = -\nabla\phi - \frac{\partial \vec{A}}{\partial t}=0$ requires that $\nabla\phi = -\frac{\partial \vec{A}}{\partial t}$ which does not say much, other than that if a voltage gradient coexists with a time-changing vector potential pointed in the other direction, their combined electric fields cancel out.

4.2 Potentials without Magnetic Fields

Like in the case of electric fields, by setting the magnetic field equation to zero we can derive the hidden potential field:

$$\vec{B}(x, y, z, t) = \nabla \times \vec{A} = 0$$

Obviously this requires that $\vec{A}$ be curl-free, which implies four possibilities:

$\vec{A} = \vec{A}_o$ (uniform and constant)

$\vec{A} = \vec{A}(t)$ (uniform and time-varying)

$\nabla \cdot \vec{A}(x, y, z)$ (diverging and constant)

$\nabla \cdot \vec{A}(x, y, z, t)$ (diverging and time-varying)

The first specifies a constant vector potential such as one radiated by a mass, the second creates an electric field, the third creates a gravitational potential, and the fourth gives rise to a time-varying gravitational potential or in some configurations a gravitational force field.

4.3 Potentials without Gravitational Fields

According to $\vec{g}(x, y, z, t) = -\nabla\varphi = 0$ there are two possibilities for the gravitational potential to not generate a gravitational force field:

$\varphi = \varphi_o$ (uniform and constant)

$\varphi = \varphi(t)$ (uniform and time-varying)

These are equivalent to $\nabla \cdot \vec{A}(x, y, z)$ and $\nabla \cdot \vec{A}(x, y, z, t)$, respectively. And this reveals another key, one that shows space-time can be warped without the associated gravitational forces, just the gravitational potential.

4.4 Superpotential without Potential Field

The scalar superpotential can exist without associated potential fields.

Without the magnetic vector potential,

$$\vec{A}(x, y, z, t) = \nabla\chi = 0$$

requires that $\chi = \chi(t)$ or $\chi = \chi_o$, meaning the scalar superpotential must either be uniform and time varying or uniform and constant.

Without the electric scalar potential,

$$\phi(x, y.z, t) = \frac{\partial\chi}{\partial t} = 0$$

requires that $\chi = \chi(x, y, z)$, meaning χ must be constant through time but can change over space.

The scalar superpotential free of all potentials would be one that is uniform everywhere and constant through time. It would therefore be the base or absolute value of χ for any given universe.

Depending on how the superpotential is distributed through space and varies through time, it can give rise to any potential and any force field. The following summarizes what conditions allow for what type of fields:

1) $\chi_o \rightarrow$ no potential, no forces, just the base value (in units of Webers) for the universe.

2) $\chi(t) \rightarrow$ uniform or time-varying electric scalar potential.

3) $\chi(x, y, z) \rightarrow$ constant magnetic vector potential, constant gravitational potential, constant gravitational field, constant magnetic field.

4) $\chi(x, y, z, t) \rightarrow$ time-varying potentials, magnetic, electric, and gravitational fields.

The universal ether contains all these distortions:

$$\chi_{universe} = \chi(x, y, z, t) + \chi(x, y, z) + \chi(t) + \chi_o$$

4.5 Summary

Aside from the magnetic, electric, and gravitational force fields, there are plenty other possible distortions of the ether including:

1) uniform and constant χ
2) uniform and time-varying χ
3) uniform and constant ϕ
4) uniform and time-varying ϕ
6) uniform and constant $\vec{A}$
7) non-uniform but constant $\vec{A}$ (for no electric field)
8) curl-free $\vec{A}$ (for no magnetic field)
9) divergence-free $\vec{A}$ (for no gravity field)
10) uniform and constant $\nabla \cdot \vec{A}$
11) uniform and time-varying $\nabla \cdot \vec{A}$

These are exotic fields that, if technologically employed, would allow for time rate alteration, wormhole engineering, time travel, superluminal communication, antigravity, and free energy from the harvesting of time flow.

Chapter 5

Gauge Freedom

The baseline value of a potential cannot be detected by standard instruments, neither will a change in this value always cause a corresponding change in the electric or magnetic field. What science cannot measure absolutely it sets arbitrarily to whatever is most convenient. This is called setting the *gauge*. The ability to choose the gauge freely is called *gauge freedom*.

One special type of gauge is known as the *Coulomb gauge*:

$$\nabla \cdot \vec{A} = 0$$

This is the arbitrary setting of the divergence of the vector potential to zero, which unbeknownst to modern science is the case where there is no gravitational potential.

Another gauge comes in response to the question "What changes can we make to the potentials comprising an electric field without disturbing that field?" This is known as the *Lorentz gauge*:

$$\nabla \cdot \vec{A} = -\frac{1}{c^2}\frac{\partial \phi}{\partial t}$$

There is a big problem with setting the gauge arbitrarily. That the base value of something is relative or immeasurable does not mean it can simply be set subjectively. Maybe the problem is shortcomings in technology and not necessarily the unreality of the potential field. Maybe there is an unacknowledged difference between one "arbitrary" potential and another. Consider the scalar value of height; there is no absolute baseline for measuring height and the only objective measurement would be the difference between two heights, but that does not mean at the top of a mountain one can re-gauge altitude arbitrarily to zero and conclude that conditions there are no different from sea level. With an altimeter that measures air pressure and with the observation that there is less oxygen when atop a mountain, it is clear that despite being relative, the scalar value of height is not subjective. Same goes for the electromagnetic potentials.

The *Coulomb* and *Lorentz gauges*, while conveniently set to keep magnetic and electric fields isolated from unintended influences of the potentials, simply state the unique conditions where that isolation exists. The *Coulomb gauge* sets the divergence of $\vec{A}$ to zero, signifying the one condition where there is no gravitational potential and where physics may continue undisturbed by that exotic possibility. Likewise, the *Lorentz gauge* sets the one condition where potentials may change in mutually canceling ways without affecting the measurable force fields.

So by employing these gauges, science and engineering unwittingly limit themselves in their experiments and technology to only those applications where there are no electrogravitic or gravitomagnetic phenomena. And then they claim there is no proof of such phenomena, failing to see that their own arbitrary choice of gauges quarantines them from witnessing such proof in the first place.

Regauging relative values to zero, or pairing them in mutually canceling opposites, is how exotic phenomena are swept under the rug. This sleight of hand is the fundamental reason why humans today are facing an environmental crisis from the use of primitive energy and transportation technologies.

Chapter 6

Wave Equations

In this chapter we will derive the transverse and longitudinal wave equations for $\vec{A}$ in vacuum. The transverse case gives rise to electromagnetic waves. The longitudinal case gives rise to electrogravitational waves.

6.1 Derivation from Maxwell's Equations

First, start with Maxwell's fourth equation:

$$\nabla \times \vec{B} = \frac{1}{c^2}\frac{\partial \vec{E}}{\partial t}$$

Write this in terms of the potentials:

$$\nabla \times \nabla \times \vec{A} = \frac{1}{c^2}\frac{\partial}{\partial t}(-\nabla\phi - \frac{\partial \vec{A}}{\partial t})$$

The term on the left can be rewritten using a vector identity:

$$\nabla(\nabla \cdot \vec{A}) - \nabla^2\vec{A} = \frac{1}{c^2}\frac{\partial}{\partial t}(-\nabla\phi - \frac{\partial \vec{A}}{\partial t})$$

Simplifying:

$$\nabla^2\vec{A} - \nabla(\nabla \cdot \vec{A}) = \frac{1}{c^2}\frac{\partial}{\partial t}\nabla\phi + \frac{1}{c^2}\frac{\partial^2 \vec{A}}{\partial t^2} \qquad (1)$$

Now curl both sides:

$$\nabla^2(\nabla \times \vec{A}) - \nabla \times \nabla(\nabla \cdot \vec{A}) = \frac{1}{c^2}\frac{\partial}{\partial t}\nabla \times \nabla\phi + \frac{1}{c^2}\frac{\partial^2}{\partial t^2}(\nabla \times \vec{A})$$

Since curl of gradient is zero in this case,

$$\nabla^2(\nabla \times \vec{A}) = \frac{1}{c^2}\frac{\partial^2}{\partial t^2}(\nabla \times \vec{A})$$

That is the wave equation for $\vec{B}$:

$$\nabla^2 \vec{B} = \frac{1}{c^2}\frac{\partial^2 \vec{B}}{\partial t^2}$$

If we instead uncurl both sides, we get the general wave equation for $\vec{A}$:

$$\nabla^2 \vec{A} = \frac{1}{c^2}\frac{\partial^2 \vec{A}}{\partial t^2} \tag{2}$$

Both the electric and magnetic wave equations can be derived from this. What we visualize as electric and magnetic fields fluctuating into each other while propagating through space as part of an EM wave, may in actuality be a single magnetic vector potential wave. In fact, the primacy of the vector potential demands that it be more "real" than either, with the electric and magnetic components just being derived abstractions. This is important because one of the arguments that there is no ether was made on the basis that magnetic and electric fields can sustain each other while traveling through a vacuum, but if the real wave is a single vector potential wave without a supporting partner, then there *must* be a medium of propagation. In fact, the vector potential itself being made of scalar superpotential shows that, ultimately, even transverse EM waves are naught but ripples in a scalar field, the medium of ether.

6.2 Transverse Waves

The general wave equation for $\vec{A}$ can be rewritten using a vector identity:

$$\nabla(\nabla \cdot \vec{A}) - \nabla \times (\nabla \times \vec{A}) = \frac{1}{c^2}\frac{\partial^2 \vec{A}}{\partial t^2}$$

Notice that the left side has two spatial distortion components, the first a gradient in divergence and the second a curl of curl (or curl of magnetic field).

If we choose the *Coulomb gauge* where $\nabla \cdot \vec{A} = 0$ then:

$$\nabla \times (\nabla \times \vec{A}) = -\frac{1}{c^2}\frac{\partial^2 \vec{A}}{\partial t^2}$$

$$\nabla \times \vec{B} = \frac{1}{c^2}\frac{\partial \vec{E}}{\partial t}$$

Here, the changing electric field produces *only* a curled magnetic field. This also happens to be Maxwell's fourth equation per Oliver Heaviside's reformulation, which implicitly contains the Coulomb gauge. As can clearly be seen, Heaviside purposely eliminated $\nabla \cdot \vec{A}$ from Maxwell's original work and the rest is history.

6.3 Longitudinal Waves

So let's look at the case where $\vec{B} = 0$ and $\nabla \cdot \vec{A} \neq 0$:

$$\nabla(\nabla \cdot \vec{A}) = \frac{1}{c^2}\frac{\partial^2 \vec{A}}{\partial t^2}$$

This is the longitudinal wave equation for $\vec{A}$. The spatial component is entirely gravitational:

$$\vec{g} = -\frac{\beta}{c^2}\frac{\partial^2 \vec{A}}{\partial t^2}$$

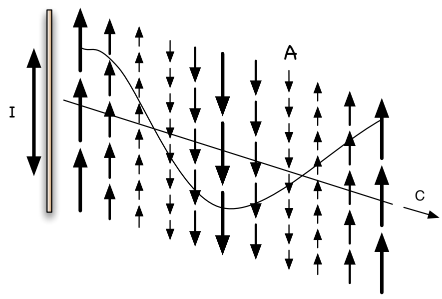
This equation implies that a nonlinear change in $\vec{A}$ produces a gravitational force. Since $\vec{A}$ is proportional to the electric current generating it, a nonlinear current change will produce a gravitational force as well. Hence the phenomena of exploding wires and buckling railguns, whereby nonlinear current pulses produce longitudinal gravitational forces that snap or warp the metal.

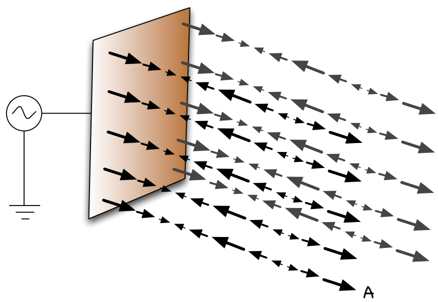
In terms of $\vec{E}$, we finally arrive upon the *electrogravitational field/wave equation*:

$$\vec{g} = \frac{\beta}{c^2}\frac{\partial \vec{E}}{\partial t}$$

So a changing electric field produces a gravitational field. But doesn't Maxwell's fourth equation say it produces a curled magnetic field? Well, that depends on the case. Depending on the geometry of the electric field, it can give rise to $\vec{B}$ or $\vec{g}$ or a mixture of the two. A long thin metal antenna will radiate mostly electromagnetic waves.

Meanwhile, a flat metal plate or sphere suppresses the magnetic field and radiates primarily electrogravitational waves.



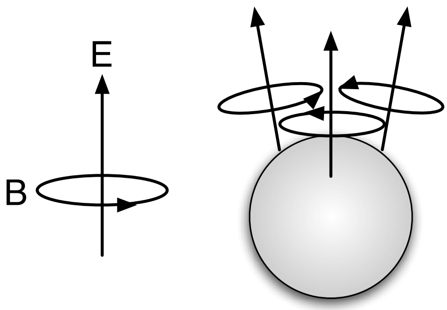


The mixture of longitudinal to transverse radiation therefore depends on surface area to edge ratio; more surface area produces more longitudinal radiation normal to the surface. A long thin antenna directs only a small amount of longitudinal radiation axially out the end of the antenna. A flat plate emits only a small amount of transverse radiation from the plate's edges, and a sphere from where the feed wire terminates.

6.4 Displacement Current

Observe that a parallel set of plates will act as reciprocal sender and receiver of longitudinal waves. This is simply a parallel plate capacitor. What Maxwell called the displacement current, which is transfer of electrical energy without transfer of charges, is actually the transmission of energy via electrogravitational radiation.

The conventional explanation for displacement current is that $\partial\vec{E}/\partial t$ from the first plate creates $\nabla \times \vec{B}$ which creates $\partial\vec{E}/\partial t$ on the second plate. But that cannot always be the case, because a spherical capacitor has a negligible magnetic field component due to the spherical geometry:



In an ideal situation, the magnetic field lines cancel out completely, yet the inner sphere still transfers electrical energy to the outer sphere via displacement current, showing the latter is accomplished via electrogravitation. The closest conventional science comes to this description is in calling it "electrostatic coupling" but that's a euphemism that avoids addressing a seeming violation of Maxwell's fourth equation. Yes, the electric field is the mediator, but its dynamic nature and radial or unidirectional geometry makes it identically a longitudinal magnetic vector potential wave or electrogravitational wave.

To summarize, a longitudinal $\vec{A}$ wave has electric and gravitational aspects, while a transverse wave has electric and magnetic aspects. When an electric field changes over time without also producing a changing magnetic field, it produces a changing gravitational field instead. Energy radiated this way is electrogravitic, and the transmission of this energy was termed "displacement current" by Maxwell without his knowing its true nature.

6.5 Electrogravitational Potential

By substituting equation (2) into (1):

$$\frac{1}{c^2}\frac{\partial^2\vec{A}}{\partial t^2} - \nabla(\nabla\cdot\vec{A}) = \frac{1}{c^2}\frac{\partial}{\partial t}\nabla\phi + \frac{1}{c^2}\frac{\partial^2\vec{A}}{\partial t^2}$$

$$\nabla(\nabla\cdot\vec{A}) = -\frac{1}{c^2}\frac{\partial}{\partial t}\nabla\phi$$

In examining the above, we can see that:

$$\nabla \cdot \vec{A} = -\frac{1}{c^2}\frac{\partial \phi}{\partial t}$$

which is the *Lorentz gauge*, thereby revealed to be implicitly contained within Maxwell's fourth equation just like the *Coulomb gauge* is. As explained previously, the *Lorentz gauge* is the specific case where a time-varying electric scalar potential cancels out the divergence of the vector potential, allowing only the curled curl component of the magnetic vector potential to survive and produce the transverse wave. It is another artifice to suppress longitudinal waves.

So if the *Lorentz gauge* is chosen such that one side of the equation is intentionally opposite the other, then in less contrived cases they are equal rather than opposite:

$$\nabla \cdot \vec{A} = \frac{1}{c^2}\frac{\partial \phi}{\partial t}$$

This shows the proper relation between a time varying voltage and the divergence of the vector potential it produces. Equivalently,

$$\varphi = \frac{\beta}{c^2}\frac{\partial \phi}{\partial t}$$

So a linearly changing voltage field generates a diverging vector potential, or equivalently a gravitational potential. Even if the voltage field were uniform and thus free of $\vec{E}$, as is the case inside a hollow metal sphere, there would still be an induced gravitational potential. If ϕ varies nonlinearly, say sinusoidally, then φ would also vary sinusoidally.

Thus the gravitational potential inside a conductive chamber can be manipulated by the voltage signal delivered to its walls. The sphere or chamber need not be metal; in some applications it can be Earth and its ionosphere.

6.6 The Nature of Charge

The Maxwell equation also known as the differential form of *Gauss's Law* states:

$$\nabla \cdot \vec{E} = \frac{\rho}{\epsilon_o}$$

In terms of the magnetic vector potential:

$$\nabla \cdot \ (-\frac{\partial \vec{A}}{\partial t}) = \frac{\rho}{\epsilon_o}$$

$$\frac{\partial}{\partial t}(\nabla \cdot A) = -\frac{\rho}{\epsilon_o}$$

$$\frac{\partial \varphi}{\partial t} = -\frac{\beta}{\epsilon_o}\rho$$

This first implies that if the gravitational potential in a region varies linearly over time, a corresponding "virtual" charge density ρ is induced within that region. Second, charges themselves generate a continually changing gravitational potential.

Since $\nabla \cdot \vec{E} = 0$ for regions containing no charge, $\partial\varphi/\partial t$ is likewise null in those regions. In the case of a single electron, the closed region just to the right of it will have no changing gravitational potential generated by that charge, while the small region containing it will indeed have one. This would still hold true if the region were shrunk to the very surface of the electron, if such a thing were possible. And that says something about the fundamental nature of charge itself, revealed as follows:

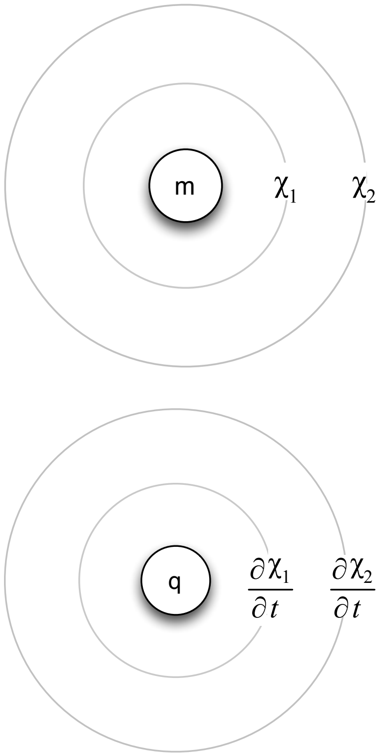
Take the volume integral of both sides:

$$\int_V \frac{\partial}{\partial t}(\nabla \cdot A) d\tau = \int_V -\frac{\rho}{\epsilon_o} d\tau$$

$$\frac{\partial}{\partial t} A_o(t) = -\frac{q}{\epsilon_o}$$

$$\frac{G}{\beta}\frac{\partial}{\partial t} m(t) = \frac{q}{\epsilon_o}$$

What then is charge? It is *mass cycling through time.* Positive charges cycle one way, negative the opposite way. This is further substantiated by comparing the superpotential field surrounding a mass compared to that of a charge:



Mass and charge both have concentric equipotential shells, just that for charges, the χ cycle through time. Thus if you were to place an electron in a "time vacuum" its charge would become mass, and likewise if mass were somehow given temporal momentum, it would become charge.

Chapter 7

Relativity

7.1 Time Dilation

According to General Relativity, the equation for time dilation (slowing of time due to presence of gravity) as a function of distance from an attracting mass is as follows:

$$t = \frac{t_o}{\sqrt{1 - \frac{2Gm}{rc^2}}}$$

where m is mass, r is radius from the center of mass, and G is the gravitational constant. The gravitational potential as a function mass and radius is:

$$\varphi = -\frac{Gm}{r}$$

therefore the time dilation equation may be rewritten in terms of the gravitational potential, and thus as a function of the magnetic vector potential:

$$t = \frac{t_o}{\sqrt{1 + \frac{2\varphi}{c^2}}} = \frac{T_o}{\sqrt{1 + \frac{2\beta\nabla\cdot\vec{A}}{c^2}}}$$

This implies several things. First, it says that gravity is a time gradient; as you get closer to an attracting mass like a planet or star, time slows down for you relative to the rest of the universe because the gravitational potential is becoming more intensely negative.

Second it implies that a diverging magnetic vector potential (like that inside a hollow sphere given a voltage signal) will affect the time rate, speeding it up if the divergence is positive and slowing it down if negative. And such a field can be created artificially, thus the key to using electric, magnetic, or electromagnetic fields to alter the time rate is to simply create a divergence in the magnetic vector potential.

Third, by setting the equation to zero, the equations show that if the gravitational potential is lower than $-c^2/2$ time slows to a stop. This condition may be found at the event horizon of a black hole. Beyond this point, time becomes imaginary relative to the rest of the universe and any matter inhabiting such a zone is severed from the space-time continuum and ejected into imaginary space. According to Relativity, that would set the *portal condition* for the gravitational potential:

$$\varphi_p < -\frac{c^2}{2}$$

From imaginary space one can enter the universe again, but not necessarily this universe. In other words, by lowering a uniform gravitational potential beneath $-c^2/2$ one can tear open a portal into other dimensions, establishing a singularity like a black hole minus the destructive gravitational forces. This can be done electromagnetically.

7.2 Ambient Gravitational Potential

The gravitational potential energy of an object is a product of its mass and the local gravitational potential.

$$E_P = m\varphi = m(-\frac{GM}{r})$$

For an object suspended over the surface of a planet, the higher the object, the greater (more positive) its potential energy. This function starts negative and asymptotically approaches zero.

Between earth and moon exists a gravitational null point where the attracting force of each body cancels the other. An object located at that point will experience no forces, however the gravitational potential is still nonzero, for it could fall either way and release its potential energy as kinetic energy by the time it hits the ground. If the energy is nonzero, then so is its gravitational potential. What is the value of gravitational potential at the null point? Merely the sum of potentials from both attracting masses.

It stands to reason that if a null point is surrounded by a spherical distribution of masses, its potential energy will be a function of their combined mass. We can extend this principle to the universe as a whole and define the ambient gravitational potential φ_a to be the sum contributions of potentials from all other masses in the universe:

$$\varphi_a = \sum_{i=1}^{n} -\frac{Gm_i}{r_i}$$

Because it is mass surrounding a point, rather than a point some distance from the center of mass, the potential is positive instead of negative. Stated in terms of mass density and integrals:

$$\varphi_a = G\rho_m \int_0^R r\,dr \int_0^\pi sin\phi\,d\phi \int_0^{2\pi} d\theta$$

where ρ_m is the average density of the universe and R the radius of the universe. This equation is only an approximation that assumes uniform spherical mass distribution.

Published values for density and radius vary as follows:

$$\rho_m = 4.5 \times 10^{-26} \rightarrow 18 \times 10^{-26}\,\frac{kg}{m^3}$$

$$R = 1.3 \times 10^{26} \rightarrow 4.34 \times 10^{26}\,m$$

Plugging these into the integral produces the following range for the ambient potential:

$$\varphi_a = 3.16 \times 10^{16} \rightarrow 142 \times 10^{16}\,\frac{m^2}{s^2}$$

Compare with the portal condition:

$$\varphi_p < -\frac{c^2}{2} = -4.49 \times 10^{16}\,\frac{m^2}{s^2}$$

Interestingly, these are both within the same order of magnitude. Could they be equal and opposite?

$$\varphi_a + \varphi_p = 0$$

Since the ambient potential is positive, the local potential represents a subtraction from this field. Such a subtraction results in a slowing of time. When the subtraction equals the ambient value, time slows to zero and the portal threshold is reached. This means the ambient potential sets the default time rate.

Since the ambient potential, which comes from the gravitational potential fields of masses in the universe, is solely a function of the speed of light, it follows that in a less massive universe with a lesser ambient potential, the speed of light is also lower. Thus the speed of light is set by the ambient potential, or equally by the distribution of matter in the universe.

Matter itself is responsible for establishing the boundary conditions of this universe. Without matter, there would neither be space nor time, nor velocity of light. In short, without matter the physical universe would not exist. There is no such thing as an empty universe consisting of flat space-time unoccupied by matter.

7.3 Mach's Principle

Ernst Mach (1838 - 1916) reasoned that mass is meaningless in an empty universe. Mach proposed that inertia, the resistance of mass to changes in motion, is not a fundamental property of that mass alone, but something that depends on its relationship to all other masses in the universe. Einstein coined this "Mach's Principle". Modern physics has never been able to explain why inertia should depend on matter in the rest of the universe.

Although Relativity discusses motion being relative to the observer, inertial resistance to changes in motion is not relative and does not depend on the observer at all, and that is what intrigued Einstein. For example, when mass is forced to move into a circular pathway, it will resist that force and pull outward against it. That is why stirred tea presses outward and up the inner wall of a mug. But the tea will do this regardless of whether you stand still, spin around, or run past the mug.

Such inertial effects must therefore be independent of the observer. Mach argued that the motion leading to such effects must be measured relative to something absolute, and that absolute is the fixed background of stars in the sky. When something spins, it spins relative to the stars. When something accelerates, it accelerates relative to the stars. Somehow masses far away affect how mass behaves right here. This was Mach's line of reasoning.

That is a big problem because how can local and distant masses possibly interact over such a vast range of space, and how would this interaction create inertia? No one has solved this problem.

But with the postulate that gravitational potential is divergence of the vector potential, the problem can indeed be solved.

7.4 Uniform Velocity

Let's examine what happens during uniform linear motion through the ambient gravitational potential. We will be using the wave equations for the scalar superpotential:

$$\frac{1}{\beta}\varphi = \nabla \cdot \vec{A} = \nabla^2 \chi = \frac{1}{c^2}\frac{\partial^2 \chi}{\partial t^2}$$

The wave equation links motion through the ambient gravitational potential with the alteration of potential for that mass.

Consider a mass moving with constant speed and direction through the ambient gravitational potential of the universe. This field fundamentally consists of scalar superpotential varying over space, and may be written out mathematically as a function of position x:

$$\nabla \cdot \vec{A} = \frac{d^2\chi}{dx^2} = \frac{\varphi_a}{\beta}$$

Solving for χ:

$$\chi(x) = \frac{1}{2}\frac{\varphi_a}{\beta}x^2 + C_1 x + C_2$$

We may set the constants to zero.

$$\chi(x) = \frac{1}{2}\frac{\varphi_a}{\beta}x^2$$

With this in mind, consider how motion through space causes the superpotential to vary over time for the traveling mass. It is like mile markers showing different values at different distances, and thus the observed marker showing different values at different times on a road trip. To find this rate of change, we differentiate the above equation twice with respect to time:

$$\frac{d\chi}{dt} = \frac{1}{2}\frac{\varphi_a}{\beta}(2x\frac{dx}{dt})$$

$$\frac{d^2\chi}{dt^2} = \frac{\varphi_a}{\beta}[x\frac{d^2x}{dt^2} + (\frac{dx}{dt})^2]$$

$$\frac{d^2\chi}{dt^2} = \frac{\varphi_a}{\beta}(x\,a) + \frac{\varphi_a}{\beta}v^2$$

Since the velocity is steady, there is no acceleration and the first term on the right is zero. Then we are left with:

$$\frac{d^2\chi}{dt^2} = \frac{\varphi_a}{\beta}v^2$$

This is a wave equation representing a newly generated gravitational potential due to velocity. Because this new potential is in the frame of reference of the moving mass itself, a minus sign must be affixed to switch back to the stationary reference frame where the ambient potential φ_a resides so that the new potential φ_l can be properly compared to it:

$$\varphi_l = \frac{1}{\beta}\frac{d^2\chi_l}{dx^2} = -\frac{1}{\beta}\frac{d^2\chi}{dx^2}$$

Combining this with the previous equation, we find that:

$$\varphi_l = (-\frac{v^2}{c^2})\varphi_a$$

What an interesting result! The new gravitational potential is a function of velocity. It is simply the ambient potential times the squared ratio between velocity and speed of light. For the moving mass, the total potential φ_T at any point would be the sum of local and ambient values:

$$\varphi_T = \varphi_l + \varphi_a$$

$$\varphi_T = \varphi_a(1 - \frac{v^2}{c^2})$$

At zero velocity, the total potential just equals the ambient. For two moving masses, if both have the same velocity then there will be zero difference in potential between them and each will appear to the other as being situated in the same ambient potential, thus the same reference frame. This is in accordance with Special Relativity where all that counts is the relative velocity between two observers.

The new potential may be written more simply if we substitute the actual value of ambient potential into the equation:

$$\varphi_l = -\frac{v^2}{c^2}(\frac{1}{2}c^2) = -\frac{1}{2}v^2$$

Except for the minus sign, which is a matter of convention and perspective, this is the kinetic energy equation without the mass variable. It is a kind of "kinetic potential" structurally identical to gravitational potential at the superpotential level. Kinetic energy E_K is therefore a gravitational potential energy induced via motion through the ambient potential.

$$E_K = \frac{1}{2}mv^2 = -\frac{mv^2}{c^2}\varphi_a$$

Einstein's famous equation could then read $E = 2m\varphi_a$ to indicate the intrinsic energy of matter is twice the ambient gravitational potential energy.

7.5 Time Dilation and Scale Contraction

Time dilation and length contraction of Special Relativity then come down to the ratio between local and ambient gravitational potentials:

$$t = \frac{t_o}{\sqrt{1 - \frac{v^2}{c^2}}} = \frac{t_o}{\sqrt{1 + \frac{\varphi_l}{\varphi_a}}}$$

$$l = l_o\sqrt{1 - \frac{v^2}{c^2}} = l_o\sqrt{1 + \frac{\varphi_l}{\varphi_a}}$$

Due to uniform linear motion, here $\nabla \cdot \vec{A}$ creates a linear compression or rarefaction in the superpotential, hence length contracts in only one dimension. However, since $\nabla \cdot \vec{A}$ can just as well compress in a radial manner, it is possible to have scale contraction as well. It would theoretically be possible to shrink objects and spaces, even pack more volume into a container than is apparent from the outside.

7.6 Acceleration and Inertia

For mass accelerating in a straight line, each moment in time and position in space comes with its own velocity, and thus its own gravitational potential. So there will be a different φ_l for different values of x. This comprises a gradient, which in turn generates a gravitational force field.

We can take the "kinetic potential" equation and rewrite the velocity variable in terms of acceleration and position:

$$\varphi_l = -\frac{1}{2}v^2$$

$$\varphi_l = -\frac{1}{2}(\sqrt{2xa})^2$$

$$\varphi_l = -xa$$

Then to get the gravitational field experienced by a moving mass due to its acceleration, we change signs (multiply by -1) to switch reference frames back to the moving mass and take the gradient or spatial derivative of this local gravitational potential:

$$\vec{g} = -\nabla \cdot [(-1)\varphi_l] = -\frac{d}{dx}(xa)\hat{x}$$

$$\vec{g} = -\vec{a}$$

As you can see, the induced gravitational field is equal and opposite the acceleration. An accelerating mass will experience a backward pull proportional to the rate of acceleration, which is identically the property of inertia. The force of this pull is equal to the gravitational force field times the mass, per Newton's Second Law, whereby the force needed to accelerate an object is:

$$\vec{F} = ma$$

Gravity and acceleration produce identical local scalar superpotential distortions, and that is the reason behind Einstein's Equivalence Principle. Note, however, that altering φ_l electromagnetically would break the equivalence.

7.7 Circular Motion

In the case of rotation or mass moving around a circular path, each point along the radius of curvature has a different tangential velocity and thus a different local gravitational potential.

Tangential velocity is a function of angular velocity ω and radius r, and these can be plugged into the kinetic potential equation and differentiated with respect to radial position to get the gravitational field produced by circular motion:

$$v = \omega r$$

$$\varphi_l = -\frac{1}{2}\omega^2 r^2$$

$$\vec{g} = -\nabla \cdot [(-1)\varphi_l] = \frac{1}{2}\frac{d}{dr}(\omega^2 r^2)$$

$$\vec{g} = \omega^2 r = (\frac{v^2}{r^2})r = \frac{v^2}{r}$$

$$\vec{F} = \frac{mv^2}{r}$$

This indicates that the force needed to keep a mass moving along a curved path is a function of its mass, tangential velocity, and radius. This is the standard physics equation for centripetal or centrifugal force, except I have derived it by examining the consequences of motion through an ambient gravitational potential field, which exists only because matter elsewhere in the universe is generating it, as per Mach's Principle. Centripetal force appears to be a gravitational force exerted on a mass due to kinetic potentials arising along its motion's radius of curvature.

7.8 Conclusion

Every mass has a gravitational field, but whereas the force fields from all masses in the universe cancel each other out, the gravitational potentials do not. So the combined potential fields from all masses in the universe create an ambient potential throughout the universe. Therefore all masses are immersed in the gravitational potential of all other masses. The interaction between a mass and this ambient field is what leads to inertial effects.

Moving with constant speed and direction does nothing but change the locally experienced value of total gravitational potential. Each velocity comes with its own value of potential. This has the effect of dilating time and contracting length relative to slower moving or stationary observers, as predicted by Special Relativity.

Accelerating through this field creates a compression of the field in front of the mass and expansion in the back. The accelerating mass then exists within a field gradient, meaning a gravitational potential that is no longer uniform. This creates a gravitational force field pointing opposite the direction of motion. That causes the mass to resist acceleration, which is the basic inertial property of mass.

As for circular movement and centrifugal force, note that each distance from the center of curvature has a different velocity. Consider a spinning disk: the edge is moving faster than points closer to the center. Since with each velocity comes a different gravitational potential, a gradient in the gravitational potential exists between center and edge of the disk. Therefore, circular motion creates a local gravitational force field pulling outward and away from the center. And that is centrifugal force, another byproduct of inertial resistance to changes in motion.

All these inertial phenomena ultimately depend on masses in the rest of the universe, as stated in Mach's Principle, because it is the combined gravitational potential of these that leads to resistance to changes of motion by individual masses.

With the postulate that the gravitational potential is the divergence in the vector potential, that all masses in the universe create an ambient potential, and the wave equation for the scalar superpotential, in the end I have derived the Equivalence Principle, Mach's Principle, and Newton's First and Second Laws.

END