

# Energy Electromagnetic Force Equivalence, $E = F_e \times r$

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## Abstract

By combining the mass energy equivalence formula,  $E = mc^2$ , with the speed of light and gravity formula,  $g = \frac{c^2}{r}$ , a new equation for energy is derived.

The Energy Electromagnetic Force Equivalence is used to explain the rotational torque of the stars, planets, and galaxy. A greater understanding of the universe is achieved with a simple mathematical expression. Nuclear energy from the Sun is converted to an electrical force which pervades the universe and gives the bodies within it, rotational motion. It is a macro equation for action at a distance. The equation suggests that nuclear energy and electromagnetic force is one of the most basic equations of the universe. It is proposed that there is only one all-encompassing force of the universe, the electromagnetic force.

## Keywords

$c^2$ , Centripetal Acceleration, Energy, Force, Mass Energy Equivalence, Light

## 1. Introduction

My insight into the nature of light has led to the possible merging of electromagnetism and special relativity. In his 1905 *Annus Mirabilis* paper “Does the Inertia of an Object Depend Upon Its Energy Content?”, Albert Einstein states that if a body gives off energy  $E$  in the form of radiation, its mass diminishes by  $E/c^2$  [1]. Radiation means electromagnetic radiation, or light, and mass means the ordinary Newtonian mass of a slow-moving object. By combining Einstein’s work with my own equation  $g = \frac{c^2}{r}$ , a greater understanding of the force of the universe is achieved.

To pull off such a feat of Theoretical Engineering, which is the merging of the dreamy world of Theoretical Physics with the hands-on practical world of Electrical Engineering, we must first analyze the genesis of General Relativity in Einstein's own words:

*“The centrifugal force, which acts under given conditions of a body is determined precisely by the same natural constant that also gives its action in a gravitational field. In fact, we have no means to distinguish a centrifugal field from a gravitational field. We thus, always measure, as the weight of the body on the surface of the Earth the superposed action of both fields, named above, and we cannot separate their actions. In this manner the point of view to interpret the rotating system  $K'$  as at rest, and the centrifugal field as a gravitational field, gains justification by all means. This interpretation is reminiscent of the original (more special) relativity where the ponderomotively acting force, upon an electrically charged mass which moves in a magnetic field, is the action of the electric field, which is found at the location of the mass as seen by the reference system at rest with the moving mass” [2].*

This is one of the most insightful statements in scientific history as Dr. Einstein looks back to explain his approach to general relativity. From his description of the happiest thought in his life, we learned that gravity was an acceleration [3]; and then later he explains that from his equivalency principle he makes a leap and concludes that acceleration is a gravitational field. General relativity was a huge turning point in science and set a course that has directed us for the past one hundred years. After a century of rote learning and application of the theory, we have an opportunity to review and add to his body of work.

According to Einstein's equivalency principle there is a centrifugal field to mirror his gravitational field and space time theory. To put this in Newtonian perspective  $C_f = G_f$ , and equivalency works both ways. From my previous work we know that centrifugal acceleration and centripetal acceleration are fraternal twins birthed from an electromagnetic force. Einstein spent many of his last years unsuccessfully bogged down on his unification theory involving Maxwell's equations. There is an opportunity to help bring this complex physics conundrum into focus by continued focus on the centrifugal and centripetal fields.

## 2. Mass Energy Equivalence

Albert Einstein was able to derive a law that we still use today, governed by one of the simplest but most powerful equations ever to be written down,  $E = mc^2$ . There are only three parts to Einstein's most famous statement.  $E$ , or energy, represents the total energy of the system;  $m$ , or mass, is related to energy by a conversion factor; and  $c^2$ , which is the speed of light squared, a seemingly incomprehensible factor we need to make mass and energy equivalent. Energy can be an abstract concept, but we use it in some form every day. Mass of course is something that each of us is familiar with, but what is  $c^2$ ? Where does the squaring of light come from and how does it relate to energy?

### 3. Speed of Light and Gravity

By simple substitution of the speed of light, or  $c$ , in the centripetal acceleration equation

$$g = \frac{c^2}{r}$$

where  $g$  is the gravitational force,  $c$  is the speed of light and  $r$ , is the radius of the arc of light.

This equation gives us a clue as to how energy is created in the universe, for we can now see that light is bending and curving around celestial bodies such as stars and planets. The bending of light by the magnetic fields of the celestial bodies creates a centripetal acceleration inward. We call this inward acceleration gravity, but it is derived from an electromagnetic force that is bending the light. It is the same phenomena of a Ferris wheel or a bucket of water on a rope. Gravity is a simple centripetal acceleration. We can now discern that light squared is merely velocity squared which is Newton's mathematical model of centripetal acceleration.  $c^2$  is then the cross product of  $g \times r$ , or  $c^2 = g \times r$ . And, since light, or  $c$ , according to Maxwell is an electromagnetic radiation, we can deduce that gravity is the result of an electromagnetic force. The four forces of nature have thus been consolidated into three forces of nature; strong nuclear, weak nuclear and electromagnetic. The gravitational force no longer exists.

### 4. Calculating Energy Electromagnetic Force Equivalence

$$E = m \times c^2$$

$$\text{Substituting } c^2 = g \times r$$

$$E = m \times g \times r$$

$$\text{Substituting } F = m \times a, \text{ or } F = m \times g \quad [4]$$

$$E = F \times r$$

Since our equation is derived from light, or  $c$ , and light is derived from electromagnetic radiation according to Maxwell, I add a subscript denoting electromagnetic force. The final equation for a rotational electrical system is then:

$$E = F_e \times r$$

The formula says that nuclear energy is equivalent to the cross product of rotational electromagnetic force and radius.

I have taken the liberty of inserting a Newtonian equation into what is considered an Einstein relativity equation and some explanation is required. To do so will require some background into relativity. Although, in many cases, Einstein gets credit for relativity, it was first proposed by Hendrik Lorentz in 1895, published by Joseph Larmor in 1897 and eventually modified by Henri Poincare in 1905, but accredited to Lorentz by Poincare. Einstein is credited with tying it all together in his Special Relativity paper [5]. Looking back at the original Lorentz Transformation and using time as our variable:

$$t' = \frac{t}{\sqrt{1 - \frac{v^2}{c^2}}}$$

In this equation, we see that time and velocity are variables because neither of them has a constant physical value, like the speed of light “ $c$ ”. But we know that the speed of light in a vacuum must be constant in the universe. Newton viewed space-time as being flat, unchanging, but that is not at all the case in Einstein’s four dimensional covariant world. To Einstein, space-time is very dynamic, changing depending on gravity and velocity.

In everyday cosmic life, both Newton’s and Einstein’s views coexist, but the speeds at which planets and stars travel are relatively slow compared to the speed of light. My equation has cancelled out light entirely and there is no velocity function. I do acknowledge that although the equation is developed in the world of relativity, its application for slow moving stars and planets is chiefly Newtonian. If the equation was to be considered for application at near light speed, then more research and revision would have to be made.

## 5. Work and Energy

Work is the product of force and distance. A force is said to do work if, when acting, there is a movement of the point of application in the direction of the force. When the force is constant and the angle between the force and the displacement is  $\theta$ , then the work done is given by  $W = F_s \cos \theta$ . Work transfers energy from one place to another, or one form to another. The SI unit of work is the joule (J).

## 6. Cosmic Tangential Acceleration

Tangential acceleration is a measure of how the tangential velocity of a point at a certain radius changes with time. Tangential acceleration is just like linear acceleration, but it is specific to the tangential direction, which is relevant to circular motion.

Tangential acceleration results from the change of the speed of the object along the curved path and at a particular point on the curved path it is equal to the instantaneous velocity at that particular point.

$$a_t = \frac{d|v|}{dt} \quad [6]$$

Radial acceleration is because of the change in the direction of the velocity. Its magnitude is equal to the tangential acceleration equation, which is given by,

$$|ar| = v^2 r$$

$r$  = radius of curvature

Acceleration at any point on the circular path is not always in the direction of the tangent to that particular point. That is why the acceleration at any point on the circular path has two components. These two components are perpendicular

to each other. One component is the tangential component of acceleration and the other component is the radial component of acceleration. Direction of the tangential component of acceleration at any particular point on the curved path is in the direction of the tangent at that particular point.

The radial component of acceleration is due to the centripetal force, which is acting towards the center of the curved path. The resultant acceleration vector at any point on the curved path is the vector sum of the tangential vector and the radial component of the vector.

We thus conclude that in the case of cosmic tangential acceleration, we can conceive of accelerated motion of the planetary bodies out and away from their starting point. This supports an accelerating and expanding universe [7].

## 7. Conclusions

I have shown that the new electrical equation,  $E = F_e \times r$ , has a mechanical equivalent  $W = F \times s$ . This implies that a rotational electromagnetic field is similar to a linear Newtonian expression of work or a change in energy. This is initial confirmation that the new Energy equation is valid and rooted in Newton's law of motion. An even closer analogy is the expression for Torque, or  $T = F_m \times r$ , where  $F_m$  is the mechanical force rotating a lever arm [8]. We have similar electrical engineering equations for electrostatic and magnetostatic torque, which may be related [9].

It is deduced that nuclear energy ( $E$ ) of the universe is what creates the electromagnetic force that bends particles and light, and also rotates the stars and the planets.  $E = F_e \times r$  is the electrical analogy for galactic torque. We experience it every day when the Sun rises and sets. It is one of the most basic laws of the universe.

We have known about all types of energies, including mechanical energy, chemical energy, and electrical energy. These are all energies inherent to moving objects, and these forms of energy can be used to do work, such as run a car engine or power an electric light bulb. But mass at rest has energy inherent to it: a tremendous amount of energy. Electromagnetic attraction, or gravitation, which works between any two masses in the universe also does work based on a change in energy, which is equivalent to mass via  $E = mc^2$ . Mass can be converted into energy, but I have now shown that it is also converted into electrical forces,  $E = F_e \times r$ . Energy is transferred from a Sun to a planet via rotational electrical force. Torque is what turns the planetary motors and solar generators, which cuts across magnetic field lines, to produce voltages and currents. The solar system experiences what can only be described as an electrical activity created by nuclear energy from the Sun.

In nuclear fission or fusion reactions, the mass of what we started with is greater than the mass we end up with. The amount of the difference is how much energy is released. This is true for everything from decaying uranium to fission bombs to nuclear fusion in the Sun [10]. It is also true for electromagnet-

ic force. Energy released from the Sun is converted into electromagnetic force at ever increasing distances.

There is only one conclusion, nuclear energy is proportional to electromagnetic force. We know that  $E = mc^2$  is a nuclear equation. The conclusion of this paper suggests that there may be only one true all-pervasive force of the universe; electromagnetism which creates light and gravity. The four forces of nature may according to this hypothesis be combined into one universal electromagnetic force.

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## Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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