

Natural Unity

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Introduction: Natural Unity is fundamental unity gained by maintaining strict dependence upon direct empirical evidence and learn from it how to define properties and their units. At the time of the introduction of $f=ma$, when mass was not defined, it was made the third indefinable property of mechanics. That act caused the immediate loss of fundamental unity from all of physics that has since followed. The only remedy for the return of fundamental unity is for physicists to go back to $f=ma$ and formally define mass.

There are just two physics properties that are permanently indefinable. They are length and what physicists call 'time'. All other physics properties must receive formal physics definitions in the strict historical manner of expressing the property as equal to a combination of other properties that have been previously introduced to us by their direct empirical evidence. This must be done at the time that they are introduced. The units of defined physics properties must be defined in the same manner.

All properties are represented in physics equations solely by their units. It is the units that tell us what it is that physicists are really measuring. The return of fundamental unity will return the science of physics to the science of measurements.

Comparing Natural Unity with Theoretical Physics: Only a naturally unified Universe can exist. Any disunity, lack of control, or lack of meaning would prevent the Universe from existing. The Universe operates in an orderly manner. Natural unity leaves no opportunity for theoretical physicists to add *emergent physics miracles* into their analysis of the nature of the Universe. Natural unity tolerates just one cause for all effects.

Mainstream physics teaches that there are separate fundamental forces. It is not because they ignore unity. An expectation is that sometime in the future, they may discover a *super-force* from which the individual fundamental forces emerge. Mainstream physics is designing physics without first establishing fundamental unity. Mainstream's unity is something to be added to the end of theory. Mainstream's approach is contradictory to direct empirical evidence.

The view presented in this paper is that: Theoretical physics is itself a product of the lack of establishing the presence of fundamental unity at the beginning of physics. Unity must be present at the beginning of deriving physics equations. It is postulated that direct empirical evidence will reveal the single cause for all physics effects before all else is learned. Once fundamental unity is established it will be present in all physics equations.

Mainstream physics accepts indirect empirical evidence for establishing orthodoxy. Indirect empirical evidence cannot be the source for learning the physical basis of unity. The lack of unity in mainstream physics is an obstacle to correctly modeling the nature of the universe.

Two additional flaws in Mainstream's physics are the beliefs that the fundamental properties of the universe are mechanical, i.e., the cause of physics effects is 'force'; and, the practice of

leaving definable physics properties undefined. The mechanical view cannot predict nor explain the presence of intelligent life. We are offered explanations like: *Given a sufficiently long time, and a google of variations, there can arise a foggy state of logically impenetrable complexity wherein dumbness can become intelligence*. Examples of undefined definable physics properties are: Mass; Temperature; and, Electric Charge.

Each of these undefined properties is a cause of the failure of theoretical physics to show fundamental unity in its presentation of its physics equations. This paper presents the stand that: *It is a certainty that the Universe is fundamentally unified; and that, all equations must show its presence*. The presence of unity is necessary to preclude theoretical physics from deriving its equations while leaving gaps in the meanings of those equations.

Any missing meaning or lack of control would have ended the existence of the Universe. There were no gaps in meaning during its evolutionary development, and, there are none now. Mainstream physics has gaps. The first gap is the lack of a formal physics definition for the property of mass. There was reason to know that the property of mass represents special fundamental meaning that must be learned. The reason was that: *Mass* is one of just two properties, the other is force, that are introduced to us first by direct empirical evidence alone. Only the properties of direct empirical evidence, i.e., length and time, precede their introduction.

The letter *f* in $f=ma$ represents cause and was given the mechanical identity called force. The letter *a* represents direct empirical evidence in the form of change of object velocity with respect to '*time*'. (Mainstream physics believes that the count of an object's activity can measure fundamental *time*.) All other properties are defined in terms that include mass. Mass is the only property that must receive its formal physics definition solely in terms of the properties of length and '*time*'. Force cannot be first because it represents cause. All direct empirical evidence consists entirely of effects. We learn what cause does but not what cause is.

We must begin the formal definitions of physics with a property that's definition must be learned from its direct empirical evidence. Mass is the only property that receives its formal physics definition from following the lead provided by its direct empirical evidence. This makes mass unique among and before all other physics properties. Mass is the single link between direct empirical evidence and all the rest of physics.

The equation $f=ma$ does not show us everything. There is another property made known to us by direct empirical evidence. We do not learn about it from the information that informs us about mass. We learn about its presence because it is the means by which information about direct empirical evidence is delivered to us. It is photons. We receive all direct empirical evidence via the delivery system of photons. Light informs us about acceleration.

Photons carry information about '*electrically-charged*' particles that had their velocities changed sometime in the past elsewhere. Photons deliver information about measures of '*time*' and *length*. This information is what direct empirical evidence consists of. The units of direct empirical evidence are solely units of *length* and *time*. The unit of mass, i.e., the kilogram, must receive its formal physics definition in the form of an equation that expresses the kilogram in terms of a combination of meters and seconds only.

The lack of a definition for mass forced mainstream physics to develop physics without a physical link to physics direct empirical evidence. The link is needed for us to learn that which

direct empirical evidence is attempting to reveal to us. Mass could have been and can be defined in terms of length and 'time'. This was not understood and was not done.

Mainstream physics teaches the view that mass is a defined property. Students were taught the opposite until around 1970. Then unscientific change pushed itself onto physics. Today's mainstream physics considers mass to be defined by its *operational definition*. *Operational definition* is the new name of 'a *rule of measurement*'.

Its new name reduced scientific learning. It had clearly been the case taught to physics students, up until around 1970, that a defined property did not get a *rule of measurement* assigned to it. Its procedure for measurement was established by the measurements of the properties contained in its definition. Only undefined properties needed to be assigned *rules of measurement*.

A defined property must be defined when it is introduced to us by its direct empirical evidence. Its unit is defined at that same time and in the same manner. We can learn that which direct empirical evidence is attempting to reveal to us, by maintaining direct dependence upon direct empirical evidence. Knowledge of physics properties must be supported by direct empirical evidence. Physics direct empirical evidence is the observation of patterns in changes of velocities of objects.

A failure of mainstream physics is that there are still undefined definable properties with undefined definable units being used regularly in physics equations without recognizing that their presence guarantees that theoretical physics teaches a doctrine of disunity.

Defining mass: It was and remains possible to define mass in terms of length and duration, then its direct empirical evidence had to have given us guidance on how to proceed. It did and does provide that guidance. Solving $f=ma$ for $f/m=a$ shows that the ratio of the units of force to the units of mass must reduce to the units of acceleration. The reason for moving directly to units for the guidance on how to define mass is: All physics properties are represented in physics equations solely by their units. It is the units that tell us what it is that the physicists are counting.

The requirement that the units of force divided by the units of mass must reduce to the units of acceleration leaves us a few possible combinations to try. The one that works to successfully reformulate the equations of physics with fundamental unity restored right from the beginning, is for mass to have the units of acceleration but inverted.

Mass becomes defined, in the same historical manner that all defined physics properties were made defined, as the inverse representation of a property that is the very most fundamental physics property. Also, that property is something that experiences acceleration. I can say that because its units are those of acceleration. The units of force are a ratio of units of two accelerations. One is the acceleration of this most fundamental property and the other is the acceleration of the object that is host to this most fundamental property.

The identity of this most fundamental property must be learned from what is known empirically at the time that mass is introduced to us. We know that the physics properties of length and duration exist because they are the properties for which their measurements tell us about the existence of mass. There is a third property involved. The information delivered to us about

measurements of distance and 'time' is delivered by photons. Light is introduced by itself as the most fundamental property.

It is the acceleration of light that is reported to us by direct empirical evidence. We experience it, in reverse as the acceleration of objects. **Conservation of Acceleration** waits to be recognized by physicists. An example is gravity. The speed of light slows as it approaches the Earth. Its negative acceleration becomes a positive acceleration for freely falling objects.

The definition of mass and its units leads to all properties of physics having units defined in terms of some combination of meters and seconds. This is what the return of fundamental unity looks like. *All units of physics properties should be defined in a way that establishes the path that connects them to the units of direct empirical evidence. This procedure requires that all units of physics must ultimately be expressible as a combination of meters and seconds only.*

There are only two properties that are permanently indefinable, i.e., length and *time*. They are the properties of direct empirical evidence. There are no properties that pre-exist them. The undefined definable fundamental properties and their undefined definable units are: Mass and kilograms; Temperature and Kelvins; Electric charge and coulombs. The undefined status of each of these properties causes the loss of fundamental unity from physics equations.

The first step to bringing fundamental unity back to physics equations, with its presence being seen right from the beginning and every step along the way, is for physics to go back to the equation $f=ma$ and define mass. Force is then automatically defined by $f=ma$. Undefined definable properties receive their formal definitions as the equations of physics are reformulated alongside the continued presence of fundamental unity. The restoration of fundamental unity changes physics back into the science of measurements. That is its natural state. What happens to other properties when this is done?

Defining units of other properties: What happens to the units of other properties due to mass being defined? Mass is the inverse representation of the acceleration of a different fundamental property

$$1) \quad m = \frac{1}{a_c}$$

That property is the property that delivers the information about a charged particle accelerating. The letter a_c represents the acceleration of light. The variation of the speed of light, measured remotely, will be shown to be the single cause for all effects. The local measurement of the speed of light remains C . Measured locally means that the equipment used to measure the speed of light experiences the same environmental conditions as does the light. Force immediately becomes defined as a ratio of two accelerations.

$$2) \quad f = ma = a/a_c$$

The numerator is the object's acceleration. The denominator is the local acceleration of light due to the control over the speed of light caused by the object. Our concept of mass is a representation of the effect each particle has upon the acceleration of light. The units of energy and momentum must also change. The definition of kinetic energy is:

$$3) \quad E_K = \frac{1}{2}mv_p^2$$

Due to the velocity of light being fixed according to distance from the Earth, the definition of gravitational potential energy becomes:

$$4) \quad E_p = \frac{1}{2}mv_c^2$$

If the mass in these equations is given the units of inverse acceleration, then it follows that the units of energy reduce to meters. In its simplest form energy is a measure of a distance:

$$5) \quad E_{units} = \frac{1}{\frac{m}{sec^2}} \frac{m^2}{sec^2} = meters$$

An expression of momentum is:

$$6) \quad P = mv_p$$

Substituting the new units of mass:

$$7) \quad P_{units} = \frac{1}{\frac{m}{sec^2}} \frac{m}{sec} = seconds$$

The new unit of measurement for momentum is seconds. All other units can now be derived from those given above. For example, the electric field is defined as:

$$8) \quad \xi = \frac{d^2E}{dx_p dt_c}$$

The new units of electric field are:

$$9) \quad \xi_{units} = \frac{m}{m \cdot sec} = seconds^{-1}$$

For the magnetic field:

$$10) \quad H = \frac{d^2P}{dx_p dt_c}$$

The new units of magnetic field are:

$$11) \quad H_{units} = \frac{sec}{m \cdot sec} = meters^{-1}$$

Electric current has the units of:

$$12) \quad I_{units} = \frac{coul}{sec} = \frac{sec}{sec}$$

Planck's constant has the units of:

$$13) \quad Planck_{units} = joule \cdot seconds = meters \cdot seconds$$

The common units of the universal gravitational constant are:

$$14) \quad G_{units} = \frac{newtons \cdot meters^2}{kilogram^2}$$

Since force is dimensionless, then newtons no longer exist. The units of kilograms are now the inverse of acceleration. Making these substitutions:

$$15) \quad G_{units} = \left(\frac{meters}{second}\right)^4$$

The implementation of empirically based units for physics gives us the opportunity to discover empirically based meaning.

Relativity theory: Mass inversely represents the acceleration of light. This precludes the possibility of relativity theory being introduced into physics equations. Claims that time and space could affect objects and vice versa was never justified by direct empirical evidence. There has never been a physics equation written by anyone that included representation of either the fundamental property of time or of space. Both have always been substituted for by object related *rules of measurement* which are not and cannot be definitions. What takes the place of relativity theory?

Maxwell's prediction was that the speed of light is a local phenomenon. The specific equation giving this prediction is:

$$16) \quad C = \frac{1}{(\mu\varepsilon)^{\frac{1}{2}}}$$

The speed of light depends only upon the local permeability and permittivity of the medium through which the light is passing.

The Pound-Rebka experiment result can be predicted by treating light as if it accelerates due to gravity. (The variation of the speed of light does not conflict with the recognition that the local measurement of the speed of light is the constant C. A local measurement is one where the equipment used to make the measurement experiences the same environmental conditions as is experienced by the light whose speed is being measured.) I represent the speed of light as the variable v_c .

$$17) \quad g = \frac{dv_c}{dt} = a_{ct}$$

Where, a_{ct} represents the acceleration of light due to gravity. The subscript t represents that acceleration is defined as a change of velocity with respect to time. The definition of mass reveals that there is conservation of acceleration between light and objects. The magnitudes of their accelerations are equal but opposite in sign:

$$18) \quad \frac{dv_p}{dt} = \frac{-dv_c}{dt}$$

The velocity also changes with respect to distance. For equal distances:

$$19) \quad \frac{v_p dv_p}{dx} = \frac{-v_c dv_c}{dx}$$

An important aspect of these equations is, *until proven otherwise, they can be read both forward and backward with equal theoretical validity*. This introduces the need to test for both possibilities. Reading them forward, they say that gravity causes the speed of light to change. In reverse they say: The acceleration due to gravity is caused by the change in the speed of light. In other words, if the speed of light is controlled by matter, then the effect we call gravity follows automatically without the introduction of a fundamental gravitational field. Multiplying by dx :

$$20) \quad v_p dv_p = -v_c dv_c$$

Light slows as it approaches the Earth. The speed that it loses is gained by the falling object. There is a *Principle of Conservation of Acceleration* that waits for mainstream physics to see it. Setting up the indicated integral and solving yields:

$$21) \quad v_p^2 = v_{c1}^2 - v_{c2}^2$$

Next, I solve for momentum:

$$22) \quad P = \frac{dE}{dv_p}$$

I set up the increment of energy:

$$23) \quad dE = mv_p dv_p = m(-v_{c1} dv_c)$$

Since a change of v_c can cause a change of v_p , then can the reverse also be true? Can the motion of matter through a background, where mass governs the speed of light, cause a decrease in the local speed of light? Equation 21 can be solved to express the reversed effect:

$$24) \quad v_{c2} = (v_{c1}^2 - v_p^2)^{\frac{1}{2}}$$

Taking the differential:

$$25) \quad dv_{c2} = \frac{-v_p dv_p}{(v_{c1}^2 - v_p^2)^{\frac{1}{2}}}$$

Substituting this into equation 23:

$$26) \quad dE = \frac{mv_{c1} v_p dv_p}{(v_{c1}^2 - v_p^2)^{\frac{1}{2}}} = \frac{mv_p dv_p}{\left(1 - \frac{v_p^2}{v_{c1}^2}\right)^{\frac{1}{2}}}$$

$$27) \quad P = \frac{dE}{dv_p} = \frac{mv_p}{\left(1 - \frac{v_p^2}{v_{c1}^2}\right)^{\frac{1}{2}}}$$

$$28) \quad f = \frac{dP}{dt} = \frac{d}{dt} \frac{mv_p}{\left(1 - \frac{v_p^2}{v_{c1}^2}\right)^{\frac{1}{2}}}$$

Solving for energy by the Calculus integration of the product of a constant force f and a variable distance yields the equation:

$$29) \quad E_K = \frac{mv_{c1}^2}{\left(1 - \frac{v_p^2}{v_{c1}^2}\right)^{\frac{1}{2}}} - mv_{c1}^2$$

This is the energy equation replacing Einstein's kinetic energy equation. Defining the energy of a photon to be:

$$30) \quad E_{Kc} = \Delta E_K = mv_{c1}^2 \left(\frac{v_{c1} - v_{c2}}{v_{c2}} \right)$$

$$31) \quad E_K + \Delta E_K = mv_{c1}^2 \left[\frac{v_{c1} - (v_{c2} + \Delta v_{c2})}{v_{c2} + \Delta v_{c2}} \right]$$

Solving for ΔE_K yields photon energy:

$$32) \quad E_{Kc} = mv_{c1} \Delta v_{c2}$$

The expression for photon wavelength is:

$$33) \quad \lambda_c = \frac{hv_c}{E_{Kc}}$$

Substituting 32 into 33:

$$34) \quad \lambda_c = \frac{hv_c}{mv_c \Delta v_{c2}} = \frac{h}{m \Delta v_{c2}} = \frac{h}{P_c}$$

Where photon momentum is:

$$35) \quad P_c = m \Delta v_{c2}$$

Instead of Einstein's:

$$36) \quad P = E/C .$$

The wave nature? The existence of frequency led to the adoption of a wave nature. The idea of wave-particle duality has become a cornerstone of theoretical physics. The concept of a wave nature is accepted by mainstream physics as a fundamental property of photons and matter. This essay presents a different perspective on this concept.

The form of my energy equation was chosen to show its analogy to Einstein's energy equation; however, it has another useful form. I proceed through the following mathematical manipulative steps for the purpose of presenting my energy equation in a form where the origin of our concept of frequency can be seen. I multiply the first term on the right side by unity:

$$37) \quad E_K = \frac{v_{c1}}{v_{c1}} \frac{mv_{c1}^2}{\left(1 - \frac{v_p^2}{v_{c1}^2}\right)^{\frac{1}{2}}} - mv_{c1}^2$$

$$38) \quad E_K = \frac{mv_{c1}^3}{(v_{c1}^2 - v_p^2)^{\frac{1}{2}}} - mv_{c1}^2$$

Since:

$$39) \quad v_{c2} = (v_{c1}^2 - v_p^2)^{\frac{1}{2}}$$

$$40) \quad E_K = m \frac{v_{c1}^3}{v_{c2}} - mv_{c1}^2$$

$$41) \quad E_K = mv_{c1}^2 \left(\frac{v_{c1} - v_{c2}}{v_{c2}} \right)$$

The form of the energy equation given above contains an expression within the parenthesis representing the physical origin of our concept of frequency.

$$42) \quad \omega_0 = \frac{mv_{c1}^2}{h}$$

I refer to this as the rest frequency of a particle:

$$43) \quad \omega_K = \omega_0 \left(\frac{v_{c1} - v_{c2}}{v_{c2}} \right) = \omega_0 \left(\frac{v_{c1}}{v_{c2}} - 1 \right) = \omega_0 \frac{v_{c1}}{v_{c2}} - \omega_0$$

Kinetic frequency is equal to total frequency minus rest frequency. No wave nature is needed!

Conclusion: Mainstream physics teaches a physics that embraces disunity. The evidence that this is the case consists of its continued use of undefined properties with their undefined units. Undefined properties occur because mainstream physics fails to maintain dependence upon direct empirical evidence.

The equation $f=ma$ presented us with the earliest opportunity to adopt the finding that the Universe is fundamentally unified. That finding requires that we define mass at the time of its introduction to us by its direct empirical evidence. We would have learned at that same time that Relativity Theory has no place in the study of physics. We would have learned new physics equations that are not possible for mainstream physics. We would have learned that fundamental unity requires combinations of only two units, i.e., meters and seconds, for all properties.

$$44) \quad h = keC = k\Delta x_c$$

The equation shows that Planck's constant equals the product of Boltzmann's constant, electric charge, and the speed of light. It is derivable in Naturally Unified physics. It is impossible in mainstream physics because the units of mainstream physics do not match. The units of Natural Unity do match for the equation. This relationship between h and k allows for investigating further relationships such as combining their expressions having to do with energy.

$$45) \quad G = a_{pL}^2 \Delta x_c^2$$

The equation says that the Universal Gravitational Constant is equal to the square of the locally measured acceleration due to gravity of one proton toward another proton multiplied by the square of the distance between them, where the distance is the radius of the hydrogen atom. Each physics expression having units of the product of newtons, meters, and seconds can benefit from investigating new possibilities resulting from trying:

$$46) \quad f = f^2$$

This equation was used to learn the physical origin of the Universal Gravitational Constant which was given in equation 45.

Theoretical physics began when the decision was made that mass would be the third indefinable property of mechanics. This decision caused the immediate loss of fundamental natural unity from $f=ma$ and all physics equations that would follow. The one link, i.e., mass, to dependence upon direct empirical evidence was lost. Thereafter, physicists would often have to guess about the nature of the universe. Some guesses were entered into physics equations and became staples of theoretical physics.

The lack of fundamental unity made certain that many guesses would lack direct empirical evidence. The cure for this ailment was to accept indirect empirical evidence as support. The real cure for physics is to go back to $f=ma$ and formally define mass as set forth in this essay. That act will lead to learning how to define temperature and electric charge. Then, natural unity will be restored to the equations of physics.

References: There is the use of significant introductory textbook knowledge. However, the bulk of the text and the equations is original work by the author.