

On Causality and Impossibility

Roger Ellman

Abstract

Much of contemporary science treats description and quantification of what happens but fails to treat the causality of the events – how, why, through what mechanism they happen. For example, gas pressure is causally explained by the kinetic theory of gases but the cause of gravitation is not investigated nor presented; only the description and quantification of gravitation is addressed. But, without understanding of the causality of physical processes it cannot be said that they are well understood.

Understanding of causality cannot be addressed solely by mathematical analysis and manipulations. It requires insight into the actual physical processes.

Related is the issue of impossibility. Sometimes clearly impossible hypotheses or interpretations of observations are seriously proffered. Some examples are contended instantaneous action at a distance involving "entangled" particles' quantum states and contended universe accelerating expansion, which raises problems of conservation of energy and thermodynamic principles of increasing entropy let alone that of anti-gravity.

Addressing issues solely by mathematical analysis and manipulations facilitates neglecting the practical possibility or impossibility of the interpretation.

These issues apply to the Einstein-Hubble concept of space, the Einstein general relativity treatment of gravitation, quantum mechanics in general, and general uncertainty as compared to the original per Heisenberg.

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Without an understanding of the specific real causes of a physical process it simply is not really understood. Understanding of causality cannot be addressed solely by mathematical analysis and manipulations. It requires insight into the actual physical processes. It is not addressed by giving new names to things that are not really understood nor explained such as "field" to explain action at a distance or "quantized angular momentum" to account for atomic stable orbits.

Furthermore, when a process and its interactions are treated with mathematical models and descriptions without correct, sufficient treatment of causality it becomes possible to neglect issues of whether the mathematically contended behavior is actually physically impossible in the real world. That it is not impossible in the mathematics can disguise that it actually is impossible, or may not be really possible, in material reality. For example, that because a process equation is mathematically valid whether its time variable moves forward into the future or back toward the past does not mean that the actual physical process can operate in both time directions.

Still furthermore, excepting only the very beginning of the universe, causes have their own causes, they are caused by prior existing causes. Then, physics is confronted with an unbroken chain of cause back to the origin of the universe, and a correct understanding of the physics of today's universe requires first a return to that very beginning and a developing of understanding of it and of how the train of causes then proceeded to the present [not necessarily in a time-line sense but in a cause-effect-cause ... sense, which has been done in¹ *The Origin and Its Meaning*].

The following analyses are a series of "case studies" of various instances where these problems have defeated full understanding of the scientific process treated, and have usually defeated even partially correct understanding of it. Such defeats are impediments to the proper advance of science – they wrongly create the perceived circumstance that the subject is fully resolved and so defeat further investigation, or investigation of alternatives, that could arrive at a truly valid understanding.

These "case studies" are not of minor, relatively unimportant instances. Rather, they are studies of some of the principle fundamental components of contemporary physics' understanding of nature and the universe.

CASE #1 - EINSTEIN: ALL IS RELATIVE AND THERE IS NO PRIME REFERENCE SYSTEM.

a. The Established Concept Deficient in Causality

"What is motion, motion relative to what?" After all, the Earth and anything on its surface rotate about the Earth's axis, revolve around the sun, participate in the sun's motion in the galaxy and in the galaxy's motion through space. Thus use on the Earth's surface of the terms "static" or "in motion" requires clarification.

This is the fundamental problem underlying relativity, and it became a major issue upon the development of physics' treatment of electro-magnetic waves: is there a medium in which the electro-magnetic waves exist, and if so is it a "stationary" all-pervasive "aether", a prime reference system to which everything else is relative? If not, what is the meaning of "static" or "in motion" and what of the motion of things relative to each other?

The problem and its significance can be further appreciated by means of an example. We take a straight wire in which positive charge flows at constant velocity

[constant speed and direction along the wire relative to the wire]. Classically, in terms of magnetic field behavior, there is a magnetic field circumferential to the wire. This field will exert a force on a charge moving in the field. Now, we, the observers, take on a velocity identical to the charge moving in the wire, the charge causing the magnetic field. In this case, to us, the charge in the wire is static. It is not moving and there should be no field. [It is true that to us in this case the wire appears to be traveling "rearward", but moving wires are not, in themselves, a cause of magnetic field.] Is there, now, as we view it, a magnetic field? That is, from the "static", as we view it, charge?

How do we reconcile this: a charge "at rest" relative to the Earth exhibits to us only static effects even though moving through space at a speed of at least 66,600 miles per hour [the Earth's speed around the sun] and a charge at rest relative to us [the above example of the wire] exhibits magnetic effects?

RELATIVITY AND INVARIANCE

By the time of Newton and the development of his laws of motion it was well understood that all motion is relative to some frame of reference. One cannot say that something is moving at a stated velocity except by defining what the velocity is relative to. Newtonian mechanics dealt with this problem, successfully for "Newtonian systems". Direct linear relationships transfer Newtonian motion descriptions from one frame of reference to another.

In the second half of the 19th century Maxwell developed his equations describing electro-magnetic field, the equations being an outgrowth of the then developing understanding of electricity, charge, magnetic effects, and so forth. Substantially before the first actual detection of electro-magnetic waves by Herz toward the end of the century, it was recognized that Maxwell's equations described a wave propagating in space at a velocity, c , determined by two constants in the equations, ϵ and μ , the dielectric constant and the permeability of space, such that $c^2 = 1/\epsilon \cdot \mu$.

This result presented two problems.

First

At the time it seemed inconceivable that these [or any] waves could propagate other than in some medium. Since the waves could and do propagate throughout free space as well as through the air and through other substances some kind of all-pervading medium, called in those days an "aether", was postulated.

Second

Maxwell's equations would not correctly transform from one frame of reference to another at different velocity using the Newtonian transformations. Therefore it was thought that Maxwell's equations applied only to one, prime, frame of reference, that of the "aether", which also defined μ , ϵ , and, therefore, c .

[The Newtonian transform between two systems at different velocities is to merely subtract the velocity difference. For example, to a passenger in a train going forward at 30 miles per hour the train is a stationary reference system and the landscape out the window is traveling backwards at 30 miles per hour. To do a Newtonian transform from the train-as-reference to the landscape-as-reference one subtracts the landscape's 30 miles per hour backward from the landscape (making it stationary) and also from the train (making it to be going 30 miles per hour forward).

[If one attempts such a Newtonian transform on Maxwell's equations and the speed of light wrong results are obtained because of non-linearity. In addition, one cannot subtract a velocity difference between two systems from the speed of light, c , because c is an absolute constant given by $c^2 = 1/\epsilon \cdot \mu$ and cannot vary with some other velocity.]

The problem in the assumption that there is an "aether" that serves as the electro-magnetic wave medium is that all attempts to define and detect the "aether" led to contradictions or further problems. The most famous of those attempts was the Michaelson-Moreley experiment, which, expecting to find two different measured results for the speed of light because of the motion of the earth in its orbit relative to the "aether", obtained the "negative" result that the speed of light always measured to be the same regardless of the motion of the observers, Michaelson and Morely and the Earth.

The Michaelson-Moreley experiment and the Newtonian transformation inadequacy required that a new transformation system be developed. That was done by Lorentz. Lorentz retained the existence of an "aether" which had to be the prime frame of reference. His transformations and their consequent "contractions" resolved the "aether" problems. The Lorentz transforms and the Lorentz contractions are familiar to all physicists and are fundamental to the Theory of Relativity.

EINSTEIN'S ARBITRARY [NON-CAUSALLY BASED] ASSUMPTION

In the early 1900's Einstein took the further step of denying that any "aether" or medium was necessary for electro-magnetic waves and that there was no prime frame of reference. Those assumptions were embodied in his Theory of Relativity for which, there being no "aether", everything is relative. The repeated failure to successfully define and detect an "aether", coupled with Einstein's formulation that dealt with the problem by denying the "aether's" existence, resulted in the complete acceptance of Einstein's theories and the abandonment of the "aether" problem. However, Einstein had no proof, only his opinion, to justify his aether denial.

Excepting only the issue of whether an "aether" exists and is the prime frame of reference, the Lorentz and the Einstein formulations are equally valid descriptions of physical reality. However, the Theory of Relativity and other developments in physics that came from Einstein [his explanation of the photoelectric effect and his famous $E = m \cdot c^2$] were tremendously successful. Relativistic effects could be observed and measured experimentally. The mass-energy equivalence was dramatically confirmed.

Just as Einstein had his doubts about some of the then accepted aspects of traditional 20th Century physics [in referring to some aspects of uncertainty and quantum mechanics he is reputed to have said that he "... did not believe that God plays with dice ..."] so Lorentz still clung to the necessity of an "aether" and the prime frame of reference that it implied.

But the relativity "bandwagon" was rolling and relativity carried the day.

b. The Causality-Based Correct Conception

New developments in space research long after the death of Lorentz and Einstein now make it necessary to reverse that outcome and conclusion. It can now be shown that Lorentz was essentially correct and Einstein incorrect with regard to a prime frame of reference and a medium in which electro-magnetic waves propagate. That is, there is a universal absolute frame of reference to which all motion is relative and it is the prime frame of reference.

It is now necessary to restate relativity more correctly. There is nothing inherent in Einstein's Theory of Relativity requiring his comprehensive relativity, the absence of a prime frame of reference. The concept "relative" does not necessarily enter into the mathematical derivations and "theory of relativity" is a misnomer. The theory-system called the Theory of Relativity should be correctly referred to as the "Principle of Invariance". Einstein's fundamental postulate was invariance.

"Invariance" means that the laws of physics, the behavior of all physical reality, is the same in any coordinate system or frame of reference. Invariance requires that the

form of the mathematical statements describing reality and the constants appearing in those statements be invariant under any transformation of coordinates, which means that they must be unchanged by any change of frame of reference regardless of its motion so long as it is at constant velocity with no acceleration involved. Since all universal constants appearing in equations describing physical reality are invariant, the speed of light, one of those constants, is invariant.

The principle of invariance is not magical or mysterious, but obvious. When one walks down the street, breathes, throws a stone or rides in a space ship one is doing a thing. The thing is not changed by changing the frame of reference from which someone observes it. The act is invariant therefore its description must be so. Einstein's principal mistake was that while he recognized that invariance was essential he did not look for a mechanism to cause that to be so, and the only possible such mechanism is a universe-wide single absolute frame of reference.

To be perfectly clear about this replacement of relativity with "absolutivity" the pertinent factors are as follows.

(a) All motion is absolute, that is, it is relative to an absolute, prime frame of reference.

In normal human experience the absolute frame of reference cannot be detected so that motion seems to be relative, but that is only an appearance.

(b) The absolute frame of reference is not a "preferred" frame of reference in the sense of having special or different physical laws. It is a "prime" reference system in that all physical reality is relative to it.

That is why the universe is invariant. For physical reality there is only one grand system of reference for everything. The universe does not "know" about our frames of reference; it simply is in its natural frame of reference, everywhere. It would be ridiculous for it not to be invariant.

This goes counter to some of the most basic accepted concepts of 20th Century physics. Consequently, it requires substantial justification, which is as follows.

(1) A medium is required for electro-magnetic waves. They either propagate in a medium or are themselves propagation of the wave "substance" or else they have no existence. Since they exist, and since their propagation is a transverse wave, not longitudinal, and since there has never been a contention that electro-magnetic waves involve motion of anything in the direction of wave propagation other than that of the wave's energy and momentum, the medium must exist.

One cannot say that there is no electro-magnetic wave medium just "field". "Field" is merely a code-word for "action at a distance", an inability to actually explain the mechanism and actions involved.

A medium is also required to define and set the propagation velocity of the waves to c , the speed of light. Without a medium there is no cause of a universal fixed value of c nor μ and ϵ , the dielectric constant and permeability of free space.

(2) As described in the General Theory of Relativity, Einstein's "curved" space-time, due to the variation of gravitation with the distribution of mass in the universe, and the gravitational field pervading the universe

with its shape due to that variation, is itself a frame of reference. Since in that point of view space-time is not uniformly "flat", the shape variations make possible detection not only of acceleration but also of absolute velocity relative to the total mass as distributed in the universe.

But, that reference frame is identical to the reference frame of the singularity at which the universe started with the "Big Bang".

(3) There exists throughout the universe a background radiation which is the residual radiation from the immense energy of the "Big Bang", the start of the universe. The temperature has now cooled down from the extremely high levels at the beginning to only about 2.7° Kelvin. That radiation is, of course, relative to the beginning, relative to "where the "Big Bang" took place. Measurements of Doppler frequency shift of this radiation due to the motion of the Earth give an absolute velocity for the Earth relative to the medium of about 370 km/sec . The absolute direction of the Earth's motion as indicated by those measurements is off in the direction from Earth of the constellation Leo.

The absolute velocity of the Earth is sufficiently low that observations from Earth are equivalent (within the accuracy involved) to observations from at rest in the absolute frame of reference.

$$v_{\text{Earth}} \sim 370 \text{ km/sec}$$

$$\left[1 - \frac{v_E^2}{c^2} \right]^{1/2} = 0.99999992 \dots$$

(4) The Lorentz contractions must actually occur, not be mere observational effects. According to the theory of relativity, an object in motion experiences slower time. If two identical clocks agree and one clock is then moved away and returned while the other is motionless [in relativistic terminology if one is moved away and then returned relative to the other from which observations are made] the moved clock must read an earlier time than the unmoved clock even when both are again at rest in the same frame of reference. When both are so again together and at rest there can be no observational quirk to cause them to read different times. The moved clock must have actually run slower.

It could be argued that the moved clock had to be accelerated to be moved so that the overall process was not a constant velocity situation. That is not the contention of relativity, however, which states that the moved clock does run slower and relies on the fact of acceleration to make the distinction as to which clock was moved and which stayed at rest.

(5) Consider three clocks, #1, #2, and #3, at constant velocities v_1 , v_2 , and v_3 . According to relativity the time of clock #3 is contracted by some amount relative to Clock #1. Likewise Clock #3 is time contracted relative to Clock #2, but by some different amount. But, Clock #3, with a time contraction relative to Clock #1 in an amount based on the velocity difference between Clock #1 and Clock #3, and with a time contraction relative to Clock #2 based on the velocity difference between Clock #2 and Clock #3, cannot be actually contracted

two different amounts at the same moment. Since the contraction must be actual, not solely observational, an absurdity results.

The solution to this problem is simple. All clocks are actually, as observed from the prime frame of reference, contracted according to their absolute velocity relative to that frame, not according to their velocity relative to another moving clock. In addition, an observer at a moving clock observes somewhat different results than those actual absolute contractions because his standards of measurement have also been contracted by his own motion [even though they appear unchanged to him]. This produces an observed, but not actual modification of the absolute, actual contraction.

[Of course, if one of the moving clocks is moving at a modest velocity the difference between its at rest dimensions and its actual contracted ones is so small that the observations from that slow-moving clock would be essentially equivalent to from at rest, the very case set out for planet Earth in (3) above.]

In his original paper on relativity Einstein contended that there was no way that an observer experiencing acceleration could distinguish between whether his system was actually accelerating in a region free from gravitation or was actually at rest in a gravitational field. In fact, that contention is incorrect and the distinction can be made by local measurement, as is now known. The distinction occurs because gravitation follows an inverse square law in practice in the real universe and gravitation is inherently radial relative to the gravitating mass.

One could say that Einstein was largely correct but for partially incorrect reasons. The same can be said of the effect of absolutivity on cosmology and space-time physics. The results obtained by traditional 20th Century physics and the theories leading to them are largely correct. Absolutivity only restores the medium and the prime [but not "preferred", special, nor having different physical laws] frame of reference.

The fact that until recently we could detect no absolute velocity and that even now it is only detectable with special scientific effort does not mean that all motion is relative, it only means that we have not developed the means for ready detection of absolutivity. There have been many other things that were undetectable in the past but that are not so now: germs, distant stars, x-rays, atoms, etc.

The Theory of Relativity has required mind-twisting adjustments to way of thinking, adjustments away from the reasonable and "apparent" to a mass of paradoxes and their proposed resolutions. Absolutivity retains contact with reality both in describing physical reality accurately and by doing so in a fashion much more consistent with reasonableness.

With absolutivity the principle of invariance becomes simple, practical and apparent in addition to being necessary as it always was. There is only one "system", the universe with some parts moving in various ways and some parts at rest and that one system has, of course, one overall set of physical laws throughout. Before absolutivity, invariance was necessary but was crying for an explanation, a cause. One can see no particular reason why invariance should be necessarily automatically true in the universe of the Theory of Relativity. Absolutivity solves the problem by showing the natural inevitability of invariance.

Why does this new medium succeed when all prior attempts to define an "aether" without contradictions failed? The reason is the nature of the electro-magnetic wave medium, as follows.

Electro-magnetic field is cyclically changing electric and magnetic field. It is caused by changing motion of electric charge. The changes are changes in the always-present static field of electric charge. The variations in the static field are relative to its

average value, the static field amount in the absence of motion of charge. The magnetic field is a further variation in the static field, a distortion of it due to the effect of charge motion.

Static electric field is normally thought of as just that, static. But, if electromagnetic waves are merely variations in that field and yet they propagate at the speed of light, then the static electric field must be a propagation of some thing at the speed of light, c . Such a propagation model of static electric field is essential. Otherwise communication at speeds in excess of the speed of light could take place by making static field changes. See² *Inertial Mass, Its Mechanics - What It Is; How It Operates*.

That propagation, the static electric field, is the medium, the "aether", and it is relative to the universe' prime frame of reference, that of the "Big Bang", that of where its source charges originated, where they were before motion carried them elsewhere. That propagation emanates from each charge, originally from the origin of the "Big Bang" and now from wherever each charge is. It, itself carries the controlling parameters μ and ϵ . See³ *Gravitational Mass, Its Mechanics - What It Is; How It Operates*.

It is now time to address the apparent paradox that was left as a question at the beginning of this discussion. The apparent paradox had two elements.

First

A charge at rest relative to the Earth's surface exhibits to us, who are also at rest relative to the Earth's surface, no magnetic field even though the charge is clearly in motion with the Earth's surface rotating about the planet's axis, revolving about the sun and moving relative to and with the galaxy.

Second

A charge in motion in an electric wire [as a current] does exhibit a magnetic field to us, who are [in this problem] moving with the same velocity as the charge even though the charge is at rest relative to us.

Although there are these two elements to the problem, they are one overall problem, an apparent inconsistency in physical laws. The inconsistency results directly from relativity and resolves when absolutivity is applied.

Considering first the problem of the wire, absolutivity answers with the solution,

"Since the current in the wire is in absolute motion, it exhibits the usual magnetic field regardless of the motion of the observer. The only effect of the observer's motion is to change his standards of measurement [per his absolute velocity and the Lorentz transforms] and, therefore, the magnitude of the magnetic field as he measures it."

Relativity responds,

"No, the explanation is that, although the current of the charge moving relative to the wire is zero relative to the observer moving at the same velocity, the overall wire including the charge is electrically neutral so that the wire moving 'rearward' without the charge [as the observer sees it] is an opposite charged wire moving in the opposite direction and produces the same magnetic field to the observer as he would see if he were at rest relative to the wire and he were observing the charge moving 'forward'. In other words, a wire moving 'rearward' while its current stands still gives the same magnetic field as the wire standing still and its current moving 'forward'."

Absolutivity then closes the discussion with,

"If relativity were valid that would be a true and good analysis, but the same problem as that of the wire can be stated for a beam of charged particles in empty space without the wire. In such a case the magnetic field behavior is the same, the paradox for relativity is the same, but there is no 'wire' to travel 'rearward'. Thus, only the explanation of absolutivity will resolve the problem."

[This also illustrates the simplicity of absolutivity compared to relativity.]

The first part of the paradox, that of the charge at rest on the Earth's surface, is simply a case of magnitudes. In fact the charge at rest relative to the moving Earth is in absolute motion and does exhibit the expected magnetic field. However, the field is too small to be noticed. The magnitude of magnetic field is less than the corresponding electric field magnitude by a factor of $[v^2/c^2]$, the v being the velocity of the charges whose motion, as electric current, produces the magnetic field. The velocity of Earth [presented earlier above] is less than 10^{-3} of the speed of light so that $[v^2/c^2] < 10^{-6}$. In addition, of course, the Earth is overall electrically neutral and the magnetic field due to its motion in space consists largely of a pair of equal and opposite such fields.

CASE #2 - EINSTEIN – HUBBLE: THE EXPANSION OF THE UNIVERSE IS EXPANSION OF SPACE ITSELF.

a. The Established Concept Deficient in Causality

The Hubble - Einstein theory, thoroughly and extensively elaborated in numerous books and scientific papers, is that a result of the beginning of the universe was the creation of space, itself, and that it is space, itself, that is expanding, and in the process carrying the universe's matter and energy along with it -- an expanding universe such that the velocity, v , of recession of any distant astral object from us, the observers, is directly proportional to the object's distance from us, $v = H_0 \cdot d$, where H_0 is the "Hubble Constant", the value of which has been not well determined beyond being in the range of $50 - 100 \text{ km/sec per megaparsec}$, but has been recently reported per analysis of a Hubble Space Telescope survey as $72 \text{ km/sec per megaparsec}$ ³.

In spite of the long term acceptance of the Hubble - Einstein cosmological concept there are fundamental questions about it that are unanswered. The concept is a direct result of Einstein's General Theory of Relativity for which space, itself, is some kind of "substance" [not Einstein's terminology] capable of expanding. That concept leaves the problem, "... relative to what" ? If space is expanding then the expansion must be relative to some static, non-expanding reference. One cannot have relativity without relativity. Any change or effect must be relative to a previous unchanged reference or previous unaffected state. Otherwise the change or effect would be undetectable.

So, what do we call that "static, non-expanding reference" ? It is space itself; and it is the framework that expansion of the universe is relative to. And that space must have always existed unoccupied [and, therefore actually "nothing"] until the "Big Bang" introduced matter and energy into it.

Furthermore, were space, itself, to be expanding as in the Hubble - Einstein theory, then it would be expanding everywhere including the expansion of the space containing and within all of our measurement standards and instrumentation [and selves]. But, an expanding ruler used to measure an expanding universe would report only a static state, not an expansion. The expansion would not be detectable by us if it were space, itself, that is expanding. Since we detect the expansion, then it must be, and is, the objects within space that are moving away from each other [away from the "Big Bang" location]. And, therefore, space itself is passive and static.

b. The Causality-Based Correct Conception

See⁴, *Analysis of the "Big Bang" and the Resulting Outward Cosmic Expansion: Hubble - Einstein Cosmology vs. the Universal Exponential Decay.*

CASE #3 - EINSTEIN: GRAVITATION IS THE BENDING OF SPACE BY THE GRAVITATING MASS.

a. The Established Concept Deficient in Causality

The behavior of gravitational mass is well known as described by Newton's Law of Gravitation. But just what mass is, how those behaviors come about, what in material reality produces the effects of gravitational mass, is little understood and has been less addressed.

The current physics concept is a product of Einstein's General Theory of Relativity for which space, itself, is some kind of "substance" [not Einstein's terminology] capable of being "curved" by the effect on it of gravitating masses in it. That concept leaves the problem, "... relative to what" ? If space is curved than the curvature must be relative to some flat, uncurved reference. One cannot have relativity without relativity. Any change or effect must be relative to a previous unchanged reference or previous unaffected state. Otherwise the change or effect would be undetectable.

So, what do we call that "flat, uncurved reference"? It is space itself; and that flat, uncurved rectilinear space is the framework that curved motion due to gravitation is relative to. Furthermore, Einstein's contention that space is curved by gravitation is his assumption, his opinion, without any basis in fact, just as was his contention that there is no prime reference system and no aether.

b. The Causality-Based Correct Conception

A complete thorough analysis and understanding have been developed. See³, *Gravitational Mass, Its Mechanics - What It Is; How It Operates.*

CASE #4 - QUANTIZED ORBITAL ELECTRON ANGULAR MOMENTUM IS THE CAUSE OF ATOMIC STABLE ORBITS.

a. The Established Concept Deficient in Causality

The statement that the orbital electron's angular momentum is quantized, as in

$$m \cdot v \cdot R = n \cdot \frac{h}{2\pi} \quad [n = 1, 2, \dots]$$

is merely a mis-arrangement of

$$2\pi \cdot R = n \cdot \frac{h}{m \cdot v} = n \cdot \lambda_{mw} \quad [n = 1, 2, \dots]$$

the statement that the orbital path, $2\pi \cdot R$, must be an integral number of matter wavelengths, λ_{mw} , long. And, that may have resulted from a lack of confidence in the fundamental significance of matter waves because of the failure to develop theory that produced acceptable, valid, matter wave frequencies, frequencies such that $f_{mw} \cdot \lambda_{mw} = \text{particle velocity}$ which is an obvious necessity.

There is no causal basis for quantization of orbital angular momentum and none has ever been proffered. The contention that atomic orbital angular momentum is quantized is an opinion / hypothesis without basis.

b. The Causality-Based Correct Conception

The problem of theory that produces acceptable, valid, matter wave frequencies, such that $f_{mw} \cdot \lambda_{mw} = \text{particle velocity}$ is fully resolved in⁵ *A Reconsideration of Matter Waves*.

The causality of matter waves determining atomic orbital structures is presented in⁶ *Matter Waves and Orbital Quantum Numbers* and fully developed in¹ *The Origin and Its Meaning*.

CASE #5 - FIELD AS AN EXPLANATION OF VARIOUS ACTIONS-AT-A-DISTANCE.

a. The Established Concept Deficient in Causality

The behavior of inertial mass is well known as described by Newton's Laws, the Lorentz Contractions, and Einstein's mass – energy equivalence. But just what mass is, how those behaviors come about, what in material reality produces the effects of inertial mass, is little understood and has been less addressed.

The only extant hypothesis is the "Higgs Field" and its related particle, the Higgs Boson. Neither has been detected in spite of significant efforts. Further, their hypothesis is not a description of the mechanics of mass but an abstraction away from the problem, substituting another "field" to explain that not understood.

b. The Causality-Based Correct Conception

A complete thorough analysis and understanding have been developed. See², *Inertial Mass, Its Mechanics - What It Is; How It Operates;* ³, *Gravitational Mass, Its Mechanics - What It Is; How It Operates;* and the full development in¹ *The Origin and Its Meaning*.

CASE #6 - HEISENBERG'S MEASUREMENT UNCERTAINTY EXTENDED TO CONTENTED ABSOLUTE GENERAL UNCERTAINTY.

a. The Established Concept Deficient in Causality

Heisenberg observed that the very act of observation changes that which is observed because observation requires energy to depart from the observed object to travel to the observer to deliver the information of the observation. If this effect of measuring is relatively small, the observed measurements will be reasonably accurate as in everyday "macro" observing. For atomic level size particles, however, the perturbation due to the act of observing is large relative to the information parameters of the particle.

This means that it is not possible to observe the position and momentum of an individual such particle, nor to observe changes in those characteristics of the particle, because of unacceptable inaccuracy. The information received in the observation can be correct, but only for as the observed particle was before the observation energy departed the particle leaving question as to its state at the time the observer receives the information. This consideration led to the Principal of Uncertainty, formulated by Heisenberg, which quantitatively defines the theoretical limit on measurement accuracy relative to the object being observed.

It should be noted that Heisenberg's analysis was fully causally based.

Those considerations then further led to the contention that, since the motions cannot be measured they are not in the purview of science, "which deals only in observable, measurable facts". The line of thought was then extended to the point of conceiving particles as not having specific positions or motions at any given instant of time, having rather only statistical probabilities of being in various locations with various velocities.

The equations of the probability distribution in space of such particles are wave-like in form, as developed by Schrödinger. Those considerations led to development of

wave mechanics, which is the description of the physical laws of particles' behavior in terms of statistical or probabilistic statements, and quantum mechanics, which is an abstract mathematical model.

However, there is no causality in the post-Heisenberg development. Justification for wave mechanics and quantum mechanics is proffered in pointing out that it has produced largely correct results or subsequently validated predictions. The same was true for over 1,000 years of the astronomy of Ptolemy; it produced correct results and valid accurate predictions. However Ptolemaic theory was not a valid description of material reality because it lacked causal underpinning.

The same is true of wave mechanics, quantum mechanics, and the extension of Heisenberg's measurement uncertainty to material reality being conceived of as overall uncertain and statistical.

b. The Causality-Based Correct Conception

Until the above-described deviations of 20th Century physics, material reality had been found to be and was known to be "hard" and specific. The fundamental laws of physics [Newton's Laws of Motion, Coulomb's Law of electrostatic behavior, Ampere's Law of electric and magnetic behavior, Newton's Law of Gravitation] and the myriad developments and extrapolations derived from them all dealt in and all produced specific determinable processes and results.

A detailed development and extension of those into addressing the data of post 19th Century physics exists, and does so without the deviations of mis-developed uncertainty, wave mechanics, and quantum mechanics. It fully resolves the wave / particle difficulties that contributed to those deviations. See¹ *The Origin and Its Meaning*.

CASE #7 - QUANTUM "ENTANGLED INSTANT TELEPORTATION".

a. The Established – Impossible Concept also Deficient in Causality

In quantum mechanics, if two particles "are in a state such that there is a matching correlation between two 'canonically conjugate' dynamical quantities", quantities like position and momentum, whose values suffice to specify all the properties of a classical system [Schrödinger's definition], they are termed as being "entangled". Experiments have been conducted the results of which have been interpreted as instantaneous communication of a such 'canonically conjugate' dynamical quantity from one particle to the other, the communication exhibited as a responsive change in one particle due to an introduced change in the other particle.

That interpretation is contended in spite of the material impossibility of instantaneous communication no matter what the circumstances.

b. The Causality-Based Correct Conception

No causality for the contended action has been proffered.

There is a simple, direct, physical reason why nothing in material reality can be infinite: any infinity in material reality would produce impossible contradictions and violations of conservation. Consequently, instant communication is impossible no matter how short the distance involved and no matter how closely involved the source and target are. Acceptance and comprehension of that would prevent the proffering of contended instantaneous communication and other impossible interpretations of data.

If the data that are interpreted as "quantum entanglement" and instantaneous communication are analyzed independently of *a priori* quantum mechanics assumptions then correct alternative explanation can be found. Case #4, above, has already presented

the earliest cause of the deviation into quantum overemphasis and Case #6, above has presented its fundamental invalidity.

CASE #8 - TYPE IA SUPERNOVAE DATA AND ACCELERATING UNIVERSE EXPANSION.

a. The Established Concept Deficient in Causality

The, for years generally accepted, Hubble astronomical model of the universe is of a uniformly expanding cosmos in which all galaxies are moving apart so that their speed away from us is proportional to their distance from us, the constant of proportionality being called the Hubble Constant, H . Until recently the distance to far distant such bodies has been determined by measuring the redshift, deemed a Doppler effect. From that one obtains the speed of recession, v , and then the distance v/H .

Recently it has become possible to determine the distance to far distant galaxies by an alternative independent means based on observations of Type Ia Supernovae in those galaxies. It has been concluded that the intrinsic brightness [luminosity] of such supernovae is related to the pattern [light curve] of their flare up and back down, a process taking weeks overall. By comparing the intrinsic brightness, as determined from that pattern, to the observed brightness the distance can be determined from the inverse square law.

Those new distance determinations indicate distances exceeding the Hubble model distance by 10 - 15%. The interpretation of that result proposed by the researchers who developed the data and others is that some "antigravity effect" is accelerating the universe's expansion, which expansion had hitherto been thought to be slowing down because of gravitation. That "antigravity effect", by default, would have to be a property of the empty space, the vacuum, of the universe since it is certainly not a property of the matter.

Those implications are so unsettling to theory and to reasonableness that the data had been initially deemed in error. As a result there have been extensive analyses of sources of error and measurements have been taken on a sufficiently large number of Type Ia Supernovae to be statistically significant, all with the conclusion that the new distance measurements are valid and that theory must be adjusted accordingly.

That line of thought has led to acceptance of the concept that space is filled with "dark [i.e. undetected] energy", also referred to as "quintessence" [the ancients' fifth essence] and to the reinstatement of Einstein's "cosmological constant" a term in his equations that he introduced to account for the universe not promptly collapsing due to gravitation and which he later disavowed as his "greatest error" upon Hubble's discovery of the expansion of the universe.

As with the earlier cases above causality is a problem. The inventing of new, undetected, unexplained "anti-gravity effect" and "dark energy" is not treatment of causality any more than "field" handles the causality of action at a distance.

In addition, those contended causes are impossible. The "anti-gravity effect" and general acceleration of cosmic expansion directly contradict the contended existence of "dark matter", which is hypothesized to provide missing gravitation not anti-gravitation. One cannot have both simultaneously.

The "Hubble Constant", H_0 , would better be referred to as the "Hubble Parameter". Not even the first digit of its numerical value is securely determined and its value has been taken to be over a range of from less than $H_0 = 50$ to nearly $H_0 = 100$ for various calculations and estimates by various researchers. Unfortunately, the currently more favored value for the parameter, $H_0 = 72$ fails to correspond well to the currently favored age of the universe of about 13.7 Gyrs for which the Hubble parameter would need to be about $H_0 = 62$.

Consequently, the "extensive analyses of sources of error and measurements" referred to above would seem to be open to question. After all, the report is that the observed SNIa distances were "10-15% greater" than the "Hubble" distances – that with a Hubble parameter the value of which is indeterminate to more than 16% of its lower value, 62.

b. The Causality-Based Correct Conception

The correct analysis of the situation shows that the data indicating distance excesses are due to calibration errors which themselves are due to an effect of which the researchers were completely unaware. That correct analysis, causally based [the cause is related to the "Pioneer Anomaly"] and not requiring impossible behavior nor posited but unknown "dark energy" or "anti-gravity effects" is presented in⁷ *A Comprehensive Resolution of the Pioneer 10 and 11 "Anomalous Acceleration" Problem Presented in the Comprehensive Report "Study of the Anomalous Acceleration of Pioneer 10 and 11" and the Relationship of that Issue to "Dark Matter", "Dark Energy", and the Cosmological Model.*

References

- [1] This paper is based on development in R. Ellman, *The Origin and Its Meaning*, The-Origin Foundation, Inc., <http://www.The-Origin.org>, 1997, in which there is more extensive development and the collateral issues are developed.
- [2] R. Ellman, *Inertial Mass, Its Mechanics - What It Is; How It Operates*, Los Alamos National Laboratory Eprint Archive at <http://arxiv.org>, physics/9910027.
- [3] R. Ellman, *Gravitational Mass, Its Mechanics - What It Is; How It Operates*, Los Alamos National Laboratory Eprint Archive at <http://arxiv.org>, physics/9903035.
- [4] R. Ellman, *Analysis of the "Big Bang" and the Resulting Outward Cosmic Expansion: Hubble – Einstein Cosmology vs. the Universal Exponential Decay*, Los Alamos National Laboratory Eprint Archive at <http://arxiv.org>, physics/0004053.
- [5] R. Ellman, *A Reconsideration of Matter Waves*, Los Alamos National Laboratory Eprint Archive at <http://arxiv.org>, physics/9808043.
- [6] R. Ellman, *Matter Waves and Orbital Quantum Numbers*, Los Alamos National Laboratory Eprint Archive at <http://arxiv.org>, physics/8909003
- [7] R. Ellman, *A Comprehensive Resolution of the Pioneer 10 and 11 "Anomalous Acceleration" Problem Presented in the Comprehensive Report "Study of the Anomalous Acceleration of Pioneer 10 and 11" and the Relationship of that Issue to "Dark Matter", "Dark Energy", and the Cosmological Model*, Los Alamos National Laboratory Eprint Archive at <http://arxiv.org>, physics/9906031