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The constancy of the speed of light in vacuo.

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Abstract

All electromagnetic radiation including the visible light moves at a constant velocity in vacuum. The velocity of electromagnetic radiation in a vacuum does not depend on the velocity of the object that is emitting the radiation. The velocity of electromagnetic radiation in a vacuum is a physical constant and commonly known as the speed of light. The speed of light is denoted as *c* (Latin: celeritas).

The constancy of the speed of light in a vacuum has consequences. This publication will proof, that Heisenberg's uncertainty principle is determined by

the constancy of the as the speed of light in a vacuum.

Key words: Anti h, Planck's constant h, General Contradiction Law, Barukčić.

1. Background

According to the theory of special relativity the velocity of light in a vacuum will be measured by all observers as being the same, regardless of the reference frame of the observer or the velocity of the source emitting the light. The speed of light in a vacuum is by definition and not by measurement exactly 299,792,458 metres per second. The metre has been defined as the distance light travels in a vacuum in 1/299,792,458 of a second.

Light can be slowed to less than *c* by passing through materials. Further, times and distances are dilated at large velocities in accordance with the Lorentz transforms in such a way that the speed of light remains constant.

Something that could travel faster than *c* in one reference frame could be observed in some other reference frames before it happened. In so far, an effect as the other side of a cause that is observed in time before its cause would violate causality since it would presuppose something that is faster than *c*. It is worth noting that such a violation of causality in our world has not been observed so far.

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2. Material and Methods

The constancy of the velocity of light in a vacuum is part of Einstein's field equation too, the one cannot without its own other. In so far, may be, the velocity of light in a vacuum can be defined by Einstein's basic field equation too.

2.1. Einstein's field equation.

Einstein's theory of general relativity, especially **Einstein's field equation** describes how energy, time and space are interrelated, how the one changes into its own other and vice versa.

Einstein's basic field equation (EFE).

Let

R_{ab} denote the Ricci tensor,
R denote the Ricci scalar,
g_{ab} denote the metric tensor,
T_{ab} denote the stress-energy tensor,
h denote Planck's constant, h ≈ **$(6.626\ 0693\ (11)) * 10^{-34}$ [J * s],**
π denote the mathematical constant π, also known as **Archimedes' constant.** The numerical value of π truncated to 50 decimal places is known to be about

π ≈ 3.14159 26535 89793 23846 26433 83279 50288 41971 69399 37510,

c denote the speed of all electromagnetic radiation in a vacuum, the speed of light, where

$$c = 299\ 792\ 458\ [m / s],$$

γ denote Newton's gravitational 'constant', where

$$\gamma \approx (6.6742 \pm 0.0010) * 10^{-11} [m^3 / (s^2 * kg)],$$

Einstein's field equation describes how a field or energy (or matter) and time changes space and vice versa. Einstein's basic field equation (EFE) is usually written in the form

$$(((4 * 2 * \pi * \gamma) * T_{ab}) / (c^4)) = (R_{ab}) - ((R* g_{ab}) / 2) .$$

The stress-energy-momentum tensor as the source of space-time curvature, describes the density and flux of **energy** and momentum in space-time in Einstein's theory of gravitation. The stress-energy-momentum tensor is the source of the gravitational field, a source of space-time curvature.

According to general relativity, the metric of space-time is determined by the matter and energy content of space-time. The Ricci scalar/metric tensor completely determines the curvature of space-time and defines such notions as **future, past**, distance, volume, angle and ...

The Ricci tensor, named after Gregorio Ricci-Curbastro, is a key term in the Einstein field equations and more or less a measure of **volume distortion**.

3. Results

3.1. Planck’s constant h and Heisenberg's uncertainty principle

Planck’s constant h and Heisenberg’s uncertainty principle.

Let

E denote the kinetic energy,

h denote Planck's constant, h **≈ (6.626 0693 (11)) * 10 $^{-34}$ [J * s],**

t denote the time,

T denote the period, **the time** for one complete cycle for an oscillation of a wave, the time between two consecutive occurrences of an event. Let $t_2 > t_1$. Thus, let $T = \Delta t = t_2 - t_1$.

f denote the frequency (of a wave),

1 = f * T, thus T = 1 / f. Let

λ denote the wave length (of a electromagnetic wave),

p denote the momentum,

ω denote the angular frequency,

ω = 2 * π * f,

ω = ((2 * π) / T),

h = λ * p,

then

$$\mathbf{h = (E_{kin}) * T = constant.}$$

Proof.

$$\omega = 2 * \pi * f \quad (1)$$

$$h * \omega = 2 * \pi * f * h \quad (2)$$

$$h * \omega = 2 * \pi * E_{kin} \quad (3)$$

$$h = (2 * \pi * E_{kin}) / \omega \quad (4)$$

$$h / (2 * \pi) = (E_{kin}) / \omega \quad (5)$$

$$h / (4 * \pi) = (E_{kin}) / (2 * \omega) \quad (6)$$

$$\text{Recall, } f * T = 1. \ \omega = (2 * \pi) / T. \quad (7)$$

$$h / (4 * \pi) = (E_{kin}) / (2 * ((2 * \pi) / T)) \quad (8)$$

$$h / (4 * \pi) = (E_{kin}) * T / (4 * \pi) \quad (9)$$

$$h = (E_{kin}) * T = constant. \quad (10)$$

Q. e. d.

Planck's constant h as an area of a square in plane (Euclidean) geometry.

Let us assume that **Planck's constant h** is organised as an area of a square A in plane (Euclidean) geometry.
Let

E denote the uncertainty of measurement of energy,

t denote the uncertainty of the simultaneous measurement of time,

h denote Planck's constant, h ≈ **(6.626 0693 (11)) * 10 $^{-34}$ [J * s],**

π denote the mathematical constant π, also known as **Archimedes' constant,**

r denote the radius of a circle/sphere in plane (Euclidean) geometry,

(Anti r) denote the anti radius of a circle/sphere in plane (Euclidean) geometry,

d denote the diameter of a circle in plane (Euclidean) geometry. Let d = r + (Anti r). Let

A(□) denote the area of a square A in plane (Euclidean) geometry,

A(□) = E * t = r * (Anti r),

A_o denote the area enclosed by a circle in plane (Euclidean) geometry,

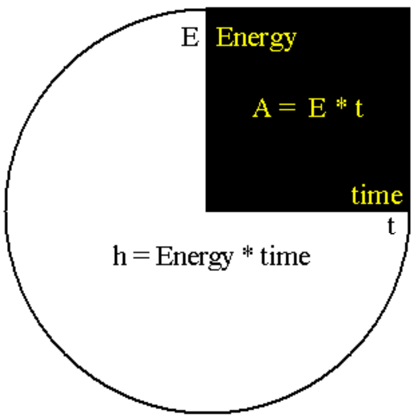
A_o = π * r²,

A_{Sphere} denote the area of a sphere in plane (Euclidean) geometry,

A_{Sphere} = 4 * π * r²,

then

Energy * time = E * t = h = A(□). (11)



Planck’s constant h as an area of a sphere in plane (Euclidean) geometry.

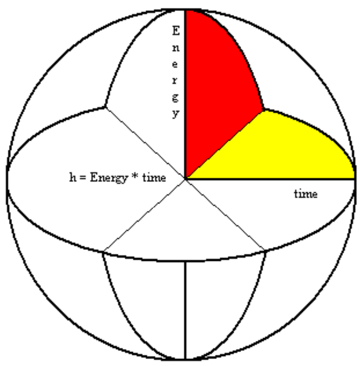
Let us assume that **Planck’s constant h** is organised as an area of a sphere in plane (Euclidean) geometry.

Let

E	denote the uncertainty of measurement of energy,
t	denote the uncertainty of the simultaneous measurement of time,
h	denote Planck's constant, h ≈ **(6.626 0693 (11)) * 10^{-34} [J * s],**
π	denote the mathematical constant π, also known as **Archimedes' constant,**
r	denote the radius of a circle/sphere in plane (Euclidean) geometry,
(Anti r)	denote the anti radius of a circle/sphere in plane (Euclidean) geometry,
d	denote the diameter of a circle in plane (Euclidean) geometry. Let d = 2 * r = r + r,
A(□)	denote the area of a square A in plane (Euclidean) geometry,
A(□) =	E * t,
A_o	denote the area enclosed by a circle in plane (Euclidean) geometry,
A_o =	$\pi * r^2$,
A_{Sphere}	denote the area of a sphere in plane (Euclidean) geometry,
A_{Sphere} =	$4 * \pi * r^2$,

Then

$$\textbf{Energy * time = E * t = h} = 4 * \pi * r^2 = A_{Sphere} \,. \qquad (12)$$



$A_{Sphere} = 4 * \pi * (\text{Energy * time}) = 4 * \pi * r^2$

The variance of X.

Let

X denote something existing independently of human mind and consciousness,

Anti X denote the otherness of X that is existing independently of human mind and consciousness, the negation of X, the local hidden variable of X,

C = X + (Anti X),

$\sigma(X)^2$ denote the variance of X,

$\sigma(X)^2 = ((C * X) - (X)^2)/C^2$,

then

$$X*(\text{Anti } X) = (C * X) - (X^2).$$

Proof.

$$\mathbf{+ X = + X} \quad (13)$$

$$+ X + (\text{Anti } X) = + X + (\text{Anti } X) \quad (14)$$

$$\mathbf{+ X + (\text{Anti } X) = + C} \quad (15)$$

$$+ X = + C - (\text{Anti } X) \quad (16)$$

$$+ X * X = + X * (C - (\text{Anti } X)) \quad (17)$$

$$+ X^2 = + (C*X) - (X*(\text{Anti } X)) \quad (18)$$

$$\mathbf{(X*(\text{Anti } X)) = + (C * X) - (X)^2} \quad (19)$$

Let us assume that **X = (Anti X)**. According to the general contradiction law (Barukčić 2006e) it is equally true that $(X*(\text{Anti } X)) = C^2/4$. We obtain the next Equation.

$$(X*(\text{Anti } X)) = C^2/4 \qquad + (C * X) - (X)^2 = C^2 /4 \quad (20)$$

Let us assume that the division by C is allowed and possible.

$$(X*(\text{Anti } X)) / C^2 = 1/4 \qquad (+ (C * X) - (X)^2)/C^2 = 1/4 \quad (21)$$

It is not that much possible to analyse a world where (C = 0) with the tools of a variance, since we are not allowed to divide by 0. We obtain the next equation.

$$(\sigma(X)^2 = (X*(\text{Anti } X)) / C^2) = 1/4 \qquad (\sigma(X)^2 = ((C * X) - (X)^2)/C^2) = 1/4 \quad (22)$$

Let us assume that $X \neq (\text{Anti } X)$. According to the general contradiction law (Barukčić 2006e) it is equally true that $(X*(\text{Anti } X)) \leq C^2/4$. We obtain the next equation.

$$(\sigma(X)^2 = (X*(\text{Anti } X)) / C^2) \leq 1/4 \qquad (\sigma(X)^2 = ((C * X) - (X)^2)/C^2) \leq 1/4 \quad (23)$$

Q. e. d.

Let us assume according to classical logic that C = 1 and that $\mathbf{(X*(\text{Anti } X)) = 0.}$ In a world that is governed only by the laws of classical logic has to be equally that $\mathbf{(C * X) - (X)^2} = 0$. At the end it has to be that $(C*X) = (X)^2$ or that C = X or that C = X + 0 or that C = X + ((Anti X) = 0). In so far, every time when we find that $\mathbf{(X*(\text{Anti } X)) = (C * X) - (X)^2 = 0,}$ we have found equally that there is no local hidden variable, there is no Anti X inside an X, we have only the pure X. On the other hand, every time when (C * X) – (X)² ≠ 0 we have equally found that **(X*(Anti X))** ≠ 0, X is itself and equally X is another too. According to classical logic, it is not possible that **(X*(Anti X))** ≠ 0. In so far, the variance of X is more then only a statistical measure. The variance of X denotes the interior struggle within C between X and Anti X. "***The variance*** *in this sense* ***is a measure of the inner contradictions of a random variable, of changes, of struggle within this random variable itself.*** Thus, ***the greater σ^2(X) of a random variable X, the greater the inner contradictions of this random variable***." (Barukčić 2006a1, p. 57).

The variance of a radius.

Let

r		denote the radius of a circle in Euclidean geometry,
Anti r		denote the otherness of the radius, the anti radius of a circle in Euclidean geometry,
d		denote the diameter of a circle in Euclidean geometry,
d	=	r + (Anti r),
C		denote the circumference of a circle in Euclidean geometry,
C	=	π * d,
$\sigma(r)^2$		denote the variance of the radius of a circle in Euclidean geometry,
$\sigma(r)^2$	=	$((d * r) - (r)^2) / d^2$,

then

$$r*(\text{Anti } r) = (d * r) - (r^2).$$

Proof.

$$\mathbf{+ r = + r} \qquad (24)$$

$$+ r + (\text{Anti } r) = + r + (\text{Anti } r) \qquad (25)$$

$$\mathbf{+ r + (Anti\ r) = + d} \qquad (26)$$

$$+ r = + d - (\text{Anti } r) \qquad (27)$$

$$+ r * r = + r * (d - (\text{Anti } r)) \qquad (28)$$

$$+ r^2 = + (d*r) - (r*(\text{Anti } r)) \qquad (29)$$

$$\mathbf{(r*(Anti\ r)) = + (d * r) - (d)^2} \qquad (30)$$

According to the general contradiction law (Barukčić 2006e) it is equally true that (r*(Anti r)) = $d^2/4$, if r = anti r. We obtain the next Equation.

$$(r*(\text{Anti } r)) = d^2/4 \qquad + (d * r) - (r)^2 = d^2 /4 \qquad (31)$$

$$(r*(\text{Anti } r)) / d^2 = 1/4 \qquad (+ (d * r) - (r)^2)/d^2 = 1/4 \qquad (32)$$

$$(\sigma(r)^2 = (r*(\text{Anti } r)) / d^2) = 1/4 \qquad (\sigma(r)^2 = ((d * r) - (r)^2)/d^2) = 1/4 \qquad (33)$$

Q. e. d.

As long as r = Anti r it is equally true that $\sigma(r)^2 = (1/4)$.

3.2. The constancy of the speed of light and Heisenberg's uncertainty principle

Werner Heisenberg discovered 1927 a basic relationship between energy and time. **Heisenberg uncertainty principle** states in general that the simultaneous determination of X and its other, the Anti X, the local hidden variable of X if you like, has an unavoidable uncertainty. Under certain experimental conditions something can exhibit **X-like** behaviour (e. g. electrons can exhibit **particle**-like **(= X)** behaviour such as **scattering**). Under other conditions, the same something can exhibit **Anti X-like** behaviour (e. g. electrons can exhibit **wave**-like **(= Anti X)** behaviour such as **interference**). We can observe only either X or Anti X at a time, never both at the same time, although the same something has both X and Anti X nature. A fundamental consequence of the basic relationship between X and Anti X is in accordance with Heisenberg's uncertainty principle that increasing the accuracy of the measurement of X (e. g. energy) increases the uncertainty of the simultaneous measurement of its Anti X, its complement, its negation (e. g. time).

Heisenberg's uncertainty principle is based on (Variance(X) * Variance(Anti X)) $^{1/2}$, the basic relationship between X and Anti X, too. The first mathematically exact derivation of Heisenberg's uncertainty principle was provided by Kennard (Kennard 1930) as

$$h / (4 * \pi) \leq (\Delta_{\Psi} X) * (\Delta_{\Psi} (\text{Anti } X)) \qquad (34)$$

where

$\Delta_{\Psi} X$	denote the standard deviation of X (e. g. position) in the state vector $\mid \Psi >$,
Δ_{Ψ} (Anti X)	denote the standard deviation of Anti X (e. g. momentum) in the state vector $\mid \Psi >$,
$\mid \Psi >$	denote a normalised state vector,
h	denote Planck's constant, h **≈ (6.626 0693 (11)) * 10^{-34} [J * s],**
π	denote the mathematical constant π.

Heisenberg's uncertainty principle is known to be according to the proof provided by Kennard (Kennard 1930)

$$\mathbf{E * t \geq h / (4 * \pi),} \qquad (35)$$

where E denotes energy, t denotes time. Heisenberg's uncertainty principle has thus two absolutely equivalent meanings/sides.

Either

$$(E * t) > h / (4 * \pi) \qquad (36)$$

or

$$E * t = h / (4 * \pi), \qquad (37)$$

but not both at the same space-time.

What are the consequences if $E * t = h / (4 * \pi)$?

Heisenberg's uncertainty relation.

Let

$E_{Kinetic}$	denote the kinetic energy. Recall, $E_{Kinetic}$ = h * f. Let
t	denote the uncertainty of the simultaneous measurement of time,
h	denote Planck's constant, h ≈ **(6.626 0693 (11)) * 10^{-34} [J * s],**
c	denote the speed of light in vacuum,
f	denote the frequency,
λ	denote the wave length. Recall, c = λ * f . Let
π	denote the mathematical constant π,

E*t = h/(4 * π),

then

$$\pi = (1 / 4).$$

Proof.

$$E * t = h / (4 * \pi) \quad (38)$$

$$\text{Recall, } (E * t) = h \quad (39)$$

$$h = h / (4 * \pi) \quad (40)$$

$$1 = 1 / (4 * \pi) \quad (41)$$

$$\pi = (1 / 4) \quad (42)$$

Q. e. d.

Only we know that π is not (1 / 4). In so far, there is a problem. Heisenberg's uncertainty relation appears to be correct and is already experimentally confirmed. Thus, it appears to me that it doesn't make sense to try to refuted the same. In so far, **either** the formula **Energy*time = h** is not correct **or π** as such is not a constant, π must have the ability to change and the minimum value of π according to Heisenberg's uncertainty relation has to be (1 / 4). In so far, based on Einstein's field equation and according to Barukčić (Barukčić 2007b) π as a natural process is not a constant and can be defined as

$$\pi = (c^4)*((R_{ab}) - ((R* g_{ab}) / 2)) / (4 * 2 * \gamma * T_{ab}), \quad (43)$$

where R_{ab} denote the Ricci tensor, R denote the Ricci scalar, g_{ab} denote the metric tensor, T_{ab} denote the stress-energy tensor, c denote the speed of all electromagnetic radiation in a vacuum, γ denote Newton's gravitational 'constant' (assumed that the division by T_{ab} is allowed). Thus, if Heisenberg's uncertainty principle is correct and as long as the equation **energy * time = h** is true, it has equally to be true that

$$\pi = ((c^4)*((R_{ab}) - ((R* g_{ab}) / 2)) / (4 * 2 * \gamma * T_{ab})) \geq (1 / 4), \quad (44)$$

$$\mathbf{h}*((c^4)*((R_{ab}) - ((R* g_{ab}) / 2)) / (4 * 2 * \gamma * \boldsymbol{\pi} * T_{ab})) \geq (\mathbf{h} / (4 * \boldsymbol{\pi})). \quad (45)$$

$$\text{Recall, } c = \lambda * f. \ E_{Kinetic} = h * f. \quad (46)$$

$$h*(f*\lambda *(c^3)*((R_{ab}) - ((R* g_{ab}) / 2)) / (4 * 2 * \gamma * \pi * T_{ab})) \geq (h / (4 * \pi)) \quad (47)$$

$$E_{Kinetic} * (\lambda *(c^3)*((R_{ab}) - ((R* g_{ab}) / 2)) / (4 * 2 * \gamma * \pi * T_{ab})) \geq (h / (4 * \pi)) \quad (48)$$

$$\text{Set time = Period} = (\lambda *(c^3)*((R_{ab}) - ((R* g_{ab}) / 2)) / (4 * 2 * \gamma * \pi * T_{ab})) \quad (49)$$

$$\mathbf{E_{Kinetic} * time \geq (h / (4 * \pi))} \quad (50)$$

It appears to me that Heisenberg's uncertainty relation can be expressed in terms of tensors too.

It is claimed that Planck's constant h is a constant but equally it appears to be that Planck's constant h is something that is full of life, Planck's constant h is changing too, it is changing at least its shape. If the energy content of Planck's constant h is not changing while Planck's constant h is changing at least in shape, there are some questions that have to be answered. Let us assume that h can change from an area of a square A in plane (Euclidean) geometry to an area of a sphere in plane (Euclidean) geometry and vice versa. Further, let us assume, that the **energy*time** content of Planck's constant h doesn't change as such. Thus, let it be true that **energy*time = h**. What would be the consequences?

Planck's constant h changes and is a constant too.

Let

E	denote the uncertainty of measurement of energy,
t	denote the uncertainty of the simultaneous measurement of time,
h	denote Planck's constant, h ≈ **(6.626 0693 (11)) * 10^{-34} [J * s],**
π	denote the mathematical constant π, also known as **Archimedes' constant,**
r	denote the radius of a circle/sphere in plane (Euclidean) geometry,
(Anti r)	denote the anti radius of a circle/sphere in plane (Euclidean) geometry,
d	denote the diameter of a circle in plane (Euclidean) geometry. Let d = 2 * r = r + r,
A_{Square}	denote the area of a square A in plane (Euclidean) geometry,
A_{Square} =	E * t = r * (Anti r) = r^2. Let **r = Anti r**. Let **energy = time**. Let
A_{Sphere}	denote the area of a sphere in plane (Euclidean) geometry,
A_{Sphere} =	$4 * \pi * r^2$,

then

$$\pi = (1 / 4).$$

Proof

$$\textbf{Energy * time = E * t = h} = 4 * \pi * r^2 = A_{Sphere} = A_{Square} . \quad (51)$$

$$A_{Sphere} = A_{Square} \quad (52)$$

$$4 * \pi * r^2 = = A_{Square} \quad (53)$$

$$4 * \pi * r^2 = h \quad (54)$$

$$r^2 = h / (4 * \pi) \quad (55)$$

$$(E * t) = h / (4 * \pi) \quad (56)$$

$$h = h / (4 * \pi) \quad (57)$$

$$1 = 1 / (4 * \pi) \quad (58)$$

$$\pi = (1 / 4) \quad (59)$$

Q. e. d.

If Planck's constant h has the ability too change in shape, is energy needed for this change or is the shape of Planck's constant h nothing other then energy that is on the way to its own self, energy trying to catch the other of itself, to become the other of itself, energy on the way too united with the other of itself? Is space that in what energy and time are united by Planck's constant h, where the opposition, the unity and the struggle between energy and time finds its own solution?

Heisenberg's uncertainty relation and the velocity of light.

Let

$\sigma(s)$	denote the standard deviation of the measurement of the position of something existing independently of human mind and consciousness,
$\sigma(p)$	denote the standard deviation of the measurement of the momentum of something existing independently of human mind and consciousness. Let $\sigma(p) = m * v$. Let
$\sigma(E)$	denote the standard deviation of the measurement of the energy of something existing independently of human mind and consciousness. Let $\sigma(E) / m = c^2$. Let
$\sigma(t)$	denote the standard deviation of the measurement of the time of something existing independently of human mind and consciousness,
t	denote the (space) time.
m	denote the mass,
v	denote the velocity. Let $v = \sigma(s) / \sigma(t)$,
h	denote Planck's constant, h ≈ **(6.626 0693 (11)) $* 10^{-34}$ [J * s],**
π	denote the mathematical constant π, also known as **Archimedes' constant.** The numerical value of π truncated to 50 decimal places is known to be about **π ≈ 3.14159 26535 89793 23846 26433 83279 50288 41971 69399 37510,**
$\hbar = h/(2 * \pi)$	denote **Dirac's constant,** the reduced Planck constant, pronounced "h-bar",

then

$$\mathbf{v^2 \leq c^2.}$$

Proof.

$$h / (4 * \pi) \leq \sigma(E) * \sigma(t) \tag{60}$$

$$\sigma(p) * \sigma(s) \leq \sigma(E) * \sigma(t) \tag{61}$$

$$m * v * \sigma(s) \leq \sigma(E) * \sigma(t) \tag{62}$$

$$m * (\sigma(s) / \sigma(t)) * \sigma(s) \leq \sigma(E) * \sigma(t) \tag{63}$$

$$m * (\sigma(s) / \sigma(t)) * (\sigma(s) / \sigma(t)) \leq \sigma(E) \tag{64}$$

$$m * (\sigma(s) / \sigma(t)) * (\sigma(s) / \sigma(t)) \leq \sigma(E) \tag{65}$$

$$m * v * v \leq \sigma(E) \tag{66}$$

$$v^2 \leq \sigma(E) / m \tag{67}$$

$$\mathbf{v^2 \leq c^2} \tag{68}$$

Q. e. d.

As long as Heisenberg's uncertainty principle is valid, it is equally assured that there is no velocity greater in value then the speed of the light. On the other hand, it is equally true that Heisenberg's uncertainty principle is one consequence of the special relativity and the fact that

$$\mathbf{v^2 \leq c^2.}$$

The velocity of the interaction between X and Anti X inside something may happen at large velocities, thus even if this relationship between X and Anti X inside something is somehow manipulated, this cannot happen , move, ... faster than light.

This is the foundation of Heisenberg's uncertainty principle. In so far, the proof above can be reversed.

Heisenberg uncertainty principle and microphysics.

Let

$\sigma(s)$	denote the standard deviation of the measurement of the position of something existing independently of human mind and consciousness,
$\sigma(p)$	denote the standard deviation of the measurement of the momentum of something existing independently of human mind and consciousness. Let $\sigma(p) = m * v$. Let
$\sigma(E)$	denote the standard deviation of the measurement of the energy of something existing independently of human mind and consciousness. Let $\sigma(E) / m = c^2$. Let
$\sigma(t)$	denote the standard deviation of the measurement of the time of something existing independently of human mind and consciousness,
t	denote the (space) time.
m	denote the mass,
v	denote the velocity. Let $v = \sigma(s) / \sigma(t)$,
h	denote Planck's constant, $h \approx$ **(6.626 0693 (11)) * 10^{-34} [J * s],**
π	denote the mathematical constant π, also known as **Archimedes' constant.** The numerical value of π truncated to 50 decimal places is known to be about **π ≈ 3.14159 26535 89793 23846 26433 83279 50288 41971 69399 37510,**
$\hbar = h/(2 * \pi)$	denote **Dirac's constant,** the reduced Planck constant, pronounced "h-bar",

then

$$h / (4 * \pi) \leq \sigma(E) * \sigma(t).$$

Proof.

$$\mathbf{v^2 \leq c^2} \qquad (69)$$

$$v^2 \leq \sigma(E) / m \qquad (70)$$

$$m * v * v \leq \sigma(E) \qquad (71)$$

$$m * (\sigma(s) / \sigma(t)) * (\sigma(s) / \sigma(t)) \leq \sigma(E) \qquad (72)$$

$$m * (\sigma(s) / \sigma(t)) * (\sigma(s) / \sigma(t)) \leq \sigma(E) \qquad (73)$$

$$m * (\sigma(s) / \sigma(t)) * \sigma(s) \leq \sigma(E) * \sigma(t) \qquad (74)$$

$$m * v * \sigma(s) \leq \sigma(E) * \sigma(t) \qquad (75)$$

$$\sigma(p) * \sigma(s) \leq \sigma(E) * \sigma(t) \qquad (76)$$

$$\mathbf{h / (4 * \pi) \leq \sigma(E) * \sigma(t)} \qquad (77)$$

Q. e. d.

We started with the position $\mathbf{v^2 \leq c^2}$ and were able to derive Heisenberg uncertainty principle! If Heisenberg's uncertainty principle is based on the relationship $\mathbf{v^2 \leq c^2}$ then the same should be valid in macrophysics to.

Heisenberg uncertainty principle and the path to macrophysics.

Let

Δs	denote the change in position of something existing independently of human mind and consciousness. Let $\Delta s = s_2 - s_1$. Let
Δp	denote the change in momentum of something existing independently of human mind and consciousness. Let $\Delta p = p_2 - p_1$. Let $\Delta p = \Delta m * v$. Let
ΔE	denote the change in energy of something existing independently of human mind and consciousness. Let $\Delta E = E_2 - E_1$. Let. Let $\Delta E / \Delta m = c^2$. Let
Δt	denote the change in time of something existing independently of human mind and consciousness. Let $\Delta t = t_2 - t_1$. Let
t	denote the (space) time.
Δm	denote change in mass,
v	denote the velocity. Let $v = \Delta s / \Delta t$,
h	denote Planck's constant, $h \approx$ **(6.626 0693 (11)) * 10^{-34} [J * s],**
π	denote the mathematical constant π, also known as **Archimedes' constant.** The numerical value of π truncated to 50 decimal places is known to be about **$\pi \approx$ 3.14159 26535 89793 23846 26433 83279 50288 41971 69399 37510,**
$\hbar = h/(2 * \pi)$	denote **Dirac's constant,** the reduced Planck constant, pronounced "h-bar",

then

$$h / (4 * \pi) \leq \Delta E * \Delta t .$$

Proof.

$$\mathbf{v^2 \leq c^2} \qquad (78)$$

$$v^2 \leq \Delta E / \Delta m \qquad (79)$$

$$\Delta m * v * v \leq \Delta E \qquad (80)$$

$$\Delta m * (\Delta s / \Delta t) * (\Delta s / \Delta t) \leq \Delta E \qquad (81)$$

$$\Delta m * (\Delta s / \Delta t) * (\Delta s) \leq \Delta E * \Delta t \qquad (82)$$

$$\Delta m * (v) * (\Delta s) \leq \Delta E * \Delta t \qquad (83)$$

$$\Delta p * \Delta s \leq \Delta E * \Delta t \qquad (84)$$

Let it be true that according to Heisenberg it is $(\Delta p * \Delta s) \geq (h / (4 * \pi))$. (85)

$$h / (4 * \pi) \leq \Delta E * \Delta t. \qquad (86)$$

Q. e. d.

We started with the position $\mathbf{v^2 \leq c^2}$ in macrophysics and were able to derive Heisenberg uncertainty principle! The same is valid in macrophysics too.

3.2. The constancy of the speed of light and Einstein's field equation

The constancy of the speed of light determined by Einstein's field equation.

Let

R_{ab} denote the Ricci tensor,

R denote the Ricci scalar,

g_{ab} denote the metric tensor,

T_{ab} denote the stress-energy tensor,

G_{ab} denote the Einstein tensor, where $G_{ab} = (R_{ab} - ((R*g_{ab})/2))$,

Λ denote the cosmological constant,

ρ_{Vac} denote the vacuum energy,

π denote the mathematical constant π, also known as **Archimedes' constant.** The numerical value of π truncated to 50 decimal places is known to be about

$\pi \approx$ 3.14159 26535 89793 23846 26433 83279 50288 41971 69399 37510 ... ,

Anti π denote the negation of π,

γ denote Newton's gravitational 'constant', where

$$\gamma \approx (6.6742 ... \pm 0.0010) * 10^{-11} [m^3 / (s^2 * kg)],$$

Anti γ denote the negation of γ,

f denote the frequency (of a wave),

ω denote the angular frequency, where $\omega = 2 * \pi * f$,

λ denote the wavelength (of a electromagnetic wave),

μ_0 denote the permeability constant, the magnetic constant, the permeability of free space or of vacuum,

ε_0 denote the permittivity of vacuum, the electric constant. Recall, $(\mu_0 * \varepsilon_0 * (c^2)) = 1$.

c denote the speed of all electromagnetic radiation in a vacuum, the speed of light, where

$$c = \lambda * f = 299\,792\,458 \ [m / s],$$

Einstein's field equation describes how a field or energy (or matter) and time changes space and vice versa. Einstein's basic field equation (EFE) is usually written in the form

$$\underbrace{(((4 * 2 * \pi * \gamma) * T_{ab}) / (c^4))}_{\textbf{Energy/matter content} \text{ of space-time}} = \underbrace{(R_{ab}) - ((R* g_{ab}) / 2)).}_{\textbf{Curvature} \text{ of space-time.}}$$

Recall,

$$+ T_{ab}^{(Vac)} = - (\Lambda / (8 \pi)) * g_{ab}$$

$$\rho_{Vac} = (\Lambda / (8 \pi)).$$

Then

$$c = ((4 * \pi * 2 * \gamma) * (T_{ab} / ((R_{ab}) - ((R* g_{ab}) / 2))))^{1/4}. \qquad (87)$$

Proof.

$$(((4*2*\pi*\gamma)*T_{ab})/(c^{4})) + ((R*g_{ab})/2) = (R_{ab}). \quad (88)$$

$$(((4*2*\pi*\gamma)*T_{ab})/(c^{4})) = ((R_{ab}) - ((R*g_{ab})/2)) \quad (89)$$

$$(((4*2*\pi*\gamma)*T_{ab})) = (c^{4})*((R_{ab}) - ((R*g_{ab})/2)) \quad (90)$$

Let us assume that it is allowed to divide by $((R_{ab}) - ((R*g_{ab})/2))$.

Otherwise set $((R_{ab}) - ((R*g_{ab})/2)) = 1$.

$$(c^{4}) = (((4*2*\pi*\gamma)*T_{ab}))/((R_{ab}) - ((R*g_{ab})/2)) \quad (91)$$

$$(c^{4}) = (4*\pi*2*\gamma)*(T_{ab}/((R_{ab}) - ((R*g_{ab})/2))) \quad (92)$$

$$\mathbf{c} = ((4*\pi*2*\gamma)*(T_{ab}/((R_{ab}) - ((R*g_{ab})/2))))^{1/4} \mathbf{= constant!} \quad (93)$$

Q. e. d.

Since $c^2*\varepsilon*\mu = 1$ = constant we obtain $((4*2*\pi*\gamma*\varepsilon^2*\mu^2) * (T_{ab}/((R_{ab})-((R*g_{ab})/2))))^{1/4} = 1$, which denotes the universe according to George Boole. It is $((4*\pi*2*\gamma) * (T_{ab}/((R_{ab})-((R*g_{ab})/2))))^{1/4}$ = constant but does this mean that every part this equation is everywhere around us and in space-time constant too?

3.2.1. The constancy of the speed of the light c under the condition that π and γ are constant

Under the condition that γ = constant and that π = constant and that c, the speed of the light is constant too (assumed that it is allowed to divide by $((R_{ab}) - ((R*g_{ab})/2))$), we obtain

c = constant 1 = $((\text{constant } 2)*(T_{ab}/((R_{ab}) - ((R*g_{ab})/2))))^{1/4}$ **= constant or**
$(c^{4}) = (\text{constant } 1)^{4} = (\text{constant } 2)*(T_{ab}/((R_{ab}) - ((R*g_{ab})/2)))$ or
$(c^{4}) = (\text{constant } 1)^{4}/(\text{constant } 2) = (T_{ab}/((R_{ab}) - ((R*g_{ab})/2)))$ = constant.

Under this circumstances (γ = constant, π = constant and c = constant)

$$(T_{ab}/((R_{ab}) - ((R*g_{ab})/2))) = (\text{constant } 3) \text{ too.}$$

In this case, it has to be (G_{ab} is known to denote Einstein's tensor) that

$T_{ab} = (\text{constant } 3)*((R_{ab}) - ((R*g_{ab})/2))$ or

$T_{ab} = (\text{constant } 3)*G_{ab}$.

In this case (**constant 3**) = $c^{4}/(4*2*\pi*\gamma) = ((\text{Anti } \gamma)*c^2)/2*\pi$.

Only, π is not a constant. A constant value of π is still not known.

3.2.2. The constancy of the speed of the light c under the condition that $R_{ab} = 0$.

Exact solutions of Einstein's field equations are useful for the investigation of different models of evolution of our universe too. Let us investigate the constancy of light under the condition that $R_{ab} = 0$. Recall, manifolds with a vanishing Ricci tensor or $R_{ab} = 0$ are referred to as Ricci-flat manifolds. The Ricci tensor, a key term in Einstein's field equation, is more or less a measure of *volume distortion*.

The constancy of the speed of the light under the condition that $R_{ab} = 0$.

Let

R_{ab}	denote the Ricci tensor,
R	denote the Ricci scalar,
g_{ab}	denote the metric tensor,
T_{ab}	denote the stress-energy tensor,
G_{ab}	denote the Einstein tensor, where $G_{ab} = (R_{ab} - ((R*g_{ab})/2))$,
Λ	denote the cosmological constant,
ρ_{Vac}	denote the vacuum energy,
π	denote the mathematical constant π, also known as **Archimedes' constant.** The numerical value of π truncated to 50 decimal places is known to be about **$\pi \approx$ 3.14159 26535 89793 23846 26433 83279 50288 41971 69399 37510 ... ,**
Anti π	denote the negation of π,
γ	denote Newton's gravitational 'constant', where $\gamma \approx (6.6742 ... \pm 0.0010) * 10^{-11} [m^3 / (s^2 * kg)]$,
Anti γ	denote the negation of γ,
c	denote the speed of all electromagnetic radiation in a vacuum, the speed of light, where $c = 299\,792\,458 [m / s]$,

then

$$T_{ab} = - ((\text{Anti } \pi) * (\text{Anti } \gamma) * R) * g_{ab} . \qquad (94)$$

Proof

$$c = ((4 * \pi * 2 * \gamma) * (T_{ab} / ((R_{ab}) - ((R* g_{ab}) / 2))))^{1/4} = \text{constant!} \qquad (95)$$

$$(c^4)* ((R_{ab}) - ((R* g_{ab}) / 2)) = ((4 * \pi * 2 * \gamma) * (T_{ab})) \qquad (96)$$

Let us assume that $(R_{ab}) = 0$. Let us assume that T_{ab} and $R*g_{ab}$ doesn't vanish. (97)

$$(c^4)* ((0) - ((R* g_{ab}) / 2)) = ((4 * \pi * 2 * \gamma) * (T_{ab})) \qquad (98)$$

$$(c^4)* (- ((R* g_{ab}) / 2)) = (4 * \pi * 2 * \gamma) * (T_{ab}) \qquad (99)$$

$$(- ((R* g_{ab}) / 2)) = ((4 * \pi * 2 * \gamma) /(c^4)) * (T_{ab}) \qquad (100)$$

$$- (R^* g_{ab}) = ((4 * \pi * 2 * 2 * \gamma) / (c^4)) * (T_{ab}) \quad (101)$$

$$- (R^* g_{ab}) = ((4 * \pi / c^2) * (2 * 2 * \gamma / c^2)) * (T_{ab}) \quad (102)$$

$$- (R^* g_{ab}) = (1 / (\text{Anti } \pi)) * (2 * 2 * \gamma / c^2)) * (T_{ab}) \quad (103)$$

$$- (R^* g_{ab}) = (1 / (\text{Anti } \pi)) * (1 / (\text{Anti } \gamma)) * (T_{ab}) \quad (104)$$

$$- ((\text{Anti } \pi)^* (\text{Anti } \gamma))^* (R^* g_{ab}) = (T_{ab}) \quad (105)$$

$$T_{ab} = - ((\text{Anti } \pi)^* (\text{Anti } \gamma))^* (R^* g_{ab}) \quad (106)$$

$$+ T_{ab} = - ((\text{Anti } \pi)^* (\text{Anti } \gamma)^* R) * g_{ab} \quad (107)$$

Q. e. d.

Einstein's introduced the term cosmological constant as an independent parameter in the field equation to allow a static universe. Observations of distant galaxies by Hubble confirmed that our universe is not static but expanding. Where is the energy needed for this expansion of our universe taken from? Recent astronomical observations have found that the existence of a cosmological constant denote the existence of a non-zero vacuum energy.

Dark energy as a hypothetical form of energy has strong negative pressure and permeates all of space (Peebles 2003). Recent observations of the type Ia supernovae as the best known standard candles for cosmological observation provide very strong evidence for dark energy. The expansion of the universe is accelerating (Riess *et al.* 1998, Permutter *et al.* 1999). Where is the energy for the expansion of the universe taken from? Is dark energy the empty negative, the nothing philosophers are talking from, is it the energy density of empty vacuum?

4. Discussion

Heisenberg's uncertainty principle is based on the relationship between X and Anti X and is determined by Einstein's constancy of the light in vacuum and the fact that there is nothing that is faster then light. It appears possible, that the same can be expressed in terms of tensors too.

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