International Journal of Advanced Research in Chemical Science (IJARCS)
Volume 2, Issue 4, April 2015, PP 6-12
ISSN 2349-039X (Print) & ISSN 2349-0403 (Online)
www.arcjournals.org

Panta Rei Function and Light Diversity (Exercise at Seventy-Two Decimal Places)

Janez Špringer

Cankarjeva cesta, Gornja Radgona, Slovenia, EU.
info@lekarna-springer.si

In this paper one investigates the meaning ofthe constant $c$intheE = mc^{2}equivalenceand of it dependent panta-rei-function$m^2v^2 = e^{\frac{m_0^2c^2+m^2(v^2-c^2)}{k}}$as well as extends the validity of the model to the speed beyond c.The maximal speed ofthe infinite self-mass c_∞equals the concerned constant c. On the other hand the maximal speed of the zero self-mass$c_0$equals the maximal possible speed of the real self-masses in spacev_{max}.The difference$c_0 - c_\infty$ is expected to be tiny: on the 72^{th} decimal or more. The extended model also provides imaginaryself-massesof photons whichcould explain the diversity in the speed of light $c_{light} = c\sqrt{1+\frac{k}{m_{photon}^2c^2}}$and the beam divergence being proportional to the wavelength λ.

Keywords: *Panta rei function, energy-mass equivalence,self-mass, mass equivalent, dynamic constant, base of natural logarithm, speed of light, gamma rays, beam divergence, Heracletean world*

1. THEORETICAL BACKGROUND

Mass equivalent m and speed v (or relative speed $a = \frac{v}{c}$) of the mass body with the self-mass $m_0$are in the pantarei function [1]related as:

$$m^2v^2 = e^{\frac{m_0^2c^2+m^2(v^2-c^2)}{k}} \quad or \quad m^2c^2a^2 = e^{\frac{m_0^2c^2+m^2c^2(a^2-1)}{k}}. \tag{1}$$

Two constants determine the relation between the mass equivalent m and speed v (or relative speed a). The dynamic constant k mirrors the flowing nature of physical bodies and constant c reflects the energy-mass equivalence $E = mc^2$. At the zero dynamic constant $k$the panta rei function (1) (except for $v = 0$) transforms into the known relation of the classic relativistic dynamicsin the non-Heracletean world where c means the speed of lightwhich in the same time plays the role of the maximal possible speed of mass bodies in space:

$$m_0^2c^2 + m^2(v^2-c^2) = 0 \quad or \quad m_0^2c^2 + m^2c^2(a^2-1) = 0. \tag{2}$$

The question is raised if the equality between the energy-mass equivalence constant, denoted c, and the speed of light as the maximal possible speed in space, also denoted c, holds true in the Heracletean world determined with the dynamic constant $k \geq 0$. The matter of fact, our concernin this paper is to find out thedifference between both values, if at all there is any.

Tofacilitatethe mathematicalmanipulationthe panta rei function(1)is preferred to be written in the substituted form.For the dependant variable$y = m^2c^2$and independent variable$x = a^2$we have:

$$yx = e^{\frac{m_0^2c^2+y(x-1)}{k}}. \tag{3}$$

With the help of derivationof the panta rei function the maximal value at the infinite tangentof that functioncan be found.

2. THE DERIVATION OF THE PANTA REI FUNCTION

Making ln ofboth sides of the equation (3)gives:

$$lny + lnx = \frac{m_0^2c^2+yx-y}{k}. \tag{4}$$

The derivation $\frac{dy}{dx}$ gives:

$$\frac{y'}{y} + \frac{1}{x} = y'x/k + y/k - y'/k. \quad (5)$$

Rearranging gives:

$$\frac{y'}{y} - \frac{y'}{k}(x-1) = \frac{y}{k} - \frac{1}{x},$$

$$y'\left(\frac{1}{y} - \frac{x-1}{k}\right) = \frac{y}{k} - \frac{1}{x},$$

$$y' = \frac{\frac{y}{k} - \frac{1}{x}}{\frac{1}{y} - \frac{x-1}{k}}. \quad (6)$$

3. The Infinite-Tangent of the Panta Rei Function

The infinite tangent is found when the nominator of the fraction(6)is zero.

$$y' = \infty \rightarrow \frac{1}{y} - \frac{x-1}{k} = 0 \rightarrow y(x-1) = k. \quad (7)$$

The result is valid since at the same time the numerator is positive independently of the value of the dynamic constant k:

$$\frac{y}{k} - \frac{1}{x} = \frac{1}{x-1} - \frac{1}{x} > 0 \; for \;\; 0 \le k \le 1. \quad (8)$$

The values of y and x are found with the help of relations (7) and (3) as follows:

$$yx = y + k \;\; and \;\; x = 1 + \frac{k}{y},$$

$$yx = e^{\frac{m_0^2c^2 + y(x-1)}{k}},$$

$$y + k = e^{\frac{m_0^2c^2 + k}{k}},$$

$$y = e^{\frac{m_0^2c^2}{k}+1} - k \;\; and \;\; x = 1 + \frac{k}{e^{\frac{m_0^2c^2}{k}+1} - k}. \quad (9)$$

4. The Maximal Mass Equivalent

Expressing the relation (7)with the help of the origin variables the maximalvalue at the infinite-tangent of the panta rei function is given:

$$m^2c^2(a^2-1) = m^2(v^2-c^2) = k. \quad (10)$$

Expressing the relations (9) with the help of origin variables the maximal relative speed a_{max} and maximal mass equivalent m_{max} are given as:

$$a_{max}^2 = \frac{v_{max}^2}{c^2} = 1 + \frac{1}{\frac{e^{\frac{m_0^2c^2}{k}+1}}{k} - 1}. \quad (11)$$

$$m_{max}^2c^2 = e^{\frac{m_0^2c^2}{k}+1} - k. \quad (12)$$

Combining equations (11),(12) the maximal momentum $p_{max} = m_{max}v_{max}$ is given as:

$$p_{max}^2 = m_{max}^2v_{max}^2 = e^{\frac{m_0^2c^2}{k}+1}. \quad (13)$$

The maximal value of speed v_{max}(11), mass equivalent m_{max}(12) as well as momentum $p_{max} = m_{max}v_{max}$(13) is not unique but is at the given dynamic constant $k$ofthe self-mass m_0 dependent.

5. THE WINDOW OF MAXIMAL SPEEDS

The window of maximal speeds of mass bodies is given with the help of the relation(11) which can be written in the explicit form as:

$$v_{max} = c\sqrt{1 + \frac{1}{\frac{e^{\frac{m_0^2c^2}{k}+1}}{k} - 1}}. \tag{14}$$

The lowest maximal speed v_{max}^{min} is achieved at the infinite self-mass of the mass body$m_0 = \infty$:

$$v_{max}^{min} = v_{max}(m_0 = \infty) = c_\infty = c\sqrt{1 + \frac{1}{\infty}} = c. \tag{15}$$

On the other hand the highest maximal speed v_{max}^{max} is achieved at the zero self-mass of the mass body$m_0 = 0$:

$$v_{max}^{max} = v_{max}(m_0 = 0) = c_0 = c\sqrt{1 + \frac{1}{\frac{e}{k} - 1}}. \tag{16}$$

The window of maximal speeds of mass bodies v_{max} extends from the maximal speed of the infinite self-mass of the mass bodyc_∞ to maximal speed of the zero self-mass of the mass bodyc_0:

$$c_\infty < v_{max} < c_0 = c_\infty\sqrt{\left(1 - \frac{k}{e}\right)^{-1}}. \tag{17}$$

The window (17) is open in the Heracletean world determined with the positive dynamic constant $k > 0$. The lower limit of the above window, denoted c_∞, represents the energy-mass equivalence constant c. On the other hand the upper limit, denotedc_0, represents the maximal possible speed of mass bodies in spacev_{max}^{max} which could equal the speed of light. If so – to escape the confusion - the speed of light should be denoted c_{light} instead of c.

The window of maximal speeds of mass bodies is detained in the downsizing Heracletean world determined by the zero dynamic constant $k = 0$ since there the maximal speed v_{max} is independent ofthe self-massm_0(14):

$$c_\infty = v_{max} = c_0. \tag{18}$$

The concerned window is also detained in the non-Heracletean world where the dynamic constant is absent(2)since there no real self-mass can exceed the maximal speed $v_{max} = c$ (2):

$$m = \frac{m_0}{\sqrt{\left(1 - \frac{v^2}{c^2}\right)}}\ for\ v \le c. \tag{19}$$

At the detained window of maximal speeds of mass bodies the speed of light could equal the energy-mass equivalence constant c as well as represent the maximal possible speed of mass bodies in space $v_{max}^{max}$and could be denotedon$c$as before.

Let us resume. The maximal possible value of speedv_{max}^{max}equals the constant $c$only exceptionally. First, in the downsizing Heracletean world where k is zero(11). Secondly, in the non-Heracletean world where k is absent(2). In the Heracletean world with $k > 0$ the maximal speed of mass body with the finite self-mass $m_0$always exceeds the constant c. The same is true with the speed of lightc_{light},if it should subordinate the greatest possible speed in space.

6. THE SELF-MASS AND THE SPEED OF LIGHT

Assuming the Panta rei function is valid also for the electro-magnetic wave energy particles (photons) the equation (12) bringing the relation between the maximal mass equivalent$m_{max}$and the self-massm_0 can be applied also for them. Let it be written in the inverse form:

$$m_0 = \frac{\sqrt{k(ln(m_{max}^2c^2 + k) - 1)}}{c}. \tag{20}$$

The next question is raised. If the speed of light should equal the greatest possible speed in space, the self-mass of the photon $m_0$may not be non-zero since according to the window of maximal speeds the speed of non-zero self- masses is lower(11). To resolve the problem let us analyse the equation (20) first.

The self-mass m_0 of the photon is real only when the expression under the square root(20) is positive or zero. It can be examined that it happens for the next values of the maximal mass equivalent of photon:

$$m_{max} \geq \frac{\sqrt{e-k}}{c} \approx \frac{\sqrt{e}}{c} \;\; then\, m_0 \in \mathbb{R}^+. \tag{21}$$

Real maximal mass equivalent m_{max} and real self-mass m_0 are in direct proportion to each other(20).Greater real self-mass$m_0$corresponds to the greater real maximal mass equivalentm_{max} and vice versa.

On the contrary, the self-mass m_0 of the photon is imaginary when the expression under the square root(20) is negative.It happens for the next values of the maximal mass equivalent of photon:

$$m_{max} \leq \frac{\sqrt{e-k}}{c} \approx \frac{\sqrt{e}}{c} \;\; then\, m_0 \in \mathbb{R}^+ x\, i. \tag{22}$$

Real maximal mass equivalent $m_{max}$and imaginary self-massm_0 areinversely proportionalto each other$(20)(12)$.Greater imaginary self-mass $m_0$corresponds to the smaller real maximal mass equivalent m_{max} and vice versa. This can be easily seen if the formula(12) is rewritten for the imaginary self-masses $m_{0,i} = im_0$ since the exponent changes the sign:

$$m_{max}^2 c^2 = e^{-\frac{m_{0,i}^2 c^2}{k}+1} - k. \tag{23}$$

Even the heaviest photons of gamma-rays possess mass equivalents of the magnitude far less than$\frac{\sqrt{e}}{c}$so we can assume that self-masses of the light are imaginary. But their speed(11) is real:

$$v_{max} = c\sqrt{1 + \frac{1}{\frac{e^{-\frac{m_{0,i}^2 c^2}{k}+1}}{k} - 1}}. \tag{24}$$

And their momentum is real, too:

$$p_{max}^2 = m_{max}^2 v_{max}^2 = e^{-\frac{m_{0,i}^2 c^2}{k}+1}. \tag{25}$$

7. The Type of the Mass Body Particle

Some extreme characteristics of mass bodies regarding the type of mass body particle are collected in the Table1.

Table1. *Some characteristics of the real, zero and imaginary self-mass particles*

Type of Particle	Real Particle	Zero Particle	Imaginary Particle
Self-mass $m_0(kg)$	$\infty > m_0 > 0$	0	$0 < m_0 < \frac{\sqrt{k(lnk-1)}}{c}$
Maximal mass equivalent $m_{max}(kg)$	$\infty > m_{max} > \frac{\sqrt{e-k}}{c}$	$m_{max} = \frac{\sqrt{e-k}}{c}$	$\frac{\sqrt{e-k}}{c} > m_{max} > 0$
Maximal speed $v_{max}\left(\frac{m}{s}\right)$	$c < v_{max} < c\sqrt{\left(1-\frac{k}{e}\right)^{-1}}$	$v_{max} = c\sqrt{\left(1-\frac{k}{e}\right)^{-1}}$	$c\sqrt{\left(1-\frac{k}{e}\right)^{-1}} < v_{max} < \infty$
Maximal momentum $\left(\frac{kg^2m^2}{s^2}\right)$	$\infty > p_{max} > \sqrt{e}$	$p_{max} = \sqrt{e}$	$\sqrt{e} > p_{max} > \sqrt{k}$
Maximalenergy$E_{max}(J)$	$\infty > E_{max} > c\sqrt{e-k}$	$E_{max} = c\sqrt{e-k}$	$c\sqrt{e-k} > E_{max} > 0$
$k = dynamic\ constant,\ e = base\ of\ natural\ logarithm, c = energy - mass\ equivalence\ constant$			

In the above table is evident, for instance, that the maximal speed of the imaginary particle (light)$v_{max} = c_{light}$spreads regarding the value of its self-mass m_0 from the maximal speed of the zero self-mass $c_0 = c\sqrt{\left(1-\frac{k}{e}\right)^{-1}}$ to the infinite speed $c_{light} = \infty$:

$$c_{light} \geq c_0 = c\sqrt{\left(1-\frac{k}{e}\right)^{-1}}. \tag{26}$$

The slowest speed of light $v_{max} = c_0(26)$ belongingto the self-mass $m_0 = 0$ and mass equivalent$m_{max} = \frac{\sqrt{e-k}}{c}$is the upper limit of the speed of real mass bodies in the Heracletean world.

8. THE FASTEST LIGHT AND THE GROUND CIRCUMSTANCES

Further it is evident from the Table 1that the fastest speed of light $v_{max} = \infty$belongingto the self-mass $m_0 = \frac{\sqrt{k(lnk-1)}}{c}$andmass equivalent $m_{max} = 0$ can be considered to bring instantly the maximal momentum $p_{max} = \sqrt{k}$ as a ground momentum $p_{ground}[1]$ to every bit of the Heracletean world. Since recalling the characteristics of the dynamic constant k [1]as a product of extreme momenta p_{min} *and* p_{max}holds:

$$k = p_{min} x\, p_{max} = \sqrt{k}\, x\, \sqrt{k}. \tag{27a}$$

So:

$$p_{min} = p_{max} = p_{ground}. \tag{27b}$$

It looks like the fastest light maintains the ground circumstances[1] for which no outer impulse or work is needed.Further, taking the relation$(27b)$as the rotational momentum p_{min}being equal the translational momentum p_{max}one can explain the ground momentum in no direction is preferable.

9. THE PHOTON MASS EQUIVALENT AND THE SPEED OF LIGHT

Combining the equations $(12), (14)$ the relation between the maximal speed $v_{max} = c_{light}$ and the maximal mass equivalent $m_{max} = m_{photon}$ is given:

$$c_{light} = c\sqrt{1+\frac{k}{m_{photon}^2 c^2}}\,. \tag{28}$$

From the above equation(28) follows that heavier photons (with more mass equivalent) should be slower than lighter photons (with less mass equivalent). The difference is tiny according to the expected extremely low dynamic constant k [2]. However, it could explain why astronomers studying radiation coming from a distant galaxy found that the high energy gamma rays arrived a few minutes after the lower-energy photons, even though they were emitted at the same time[3].

10. THE DISTRACTIVE FORCES BETWEEN PHOTONS

Gravitational law rules the mass bodies possessing the self-massm_0:

$$F = G\frac{(m_0)_1\, x\, (m_0)_2}{r^2}. \tag{29}$$

Inserting some imaginary self-masses of photons in the above equation we see that the gravitational force between photons becomes distractive ($i\, x\, i = -1$). This feature could explain why the beam of photons is cone-shaped[4].Further the fact that lighter photons are more imaginary and consequently more distractive(22) can explain the divergence of the light beam. Indeed, the angular spread of the beam is proportional to the wavelength $\lambda = \frac{h}{mc}$[4] which is in direct proportion to the imaginaries of photons(23).

11. From the Energy-Mass Equivalence Constant c to the Diverse Speed of Light c_{light}

The equations(17), (26) can be rewritten in the explicit form for the energy-mass equivalence constant c as follows:

$$c = c_{\infty} = \sqrt{1 - \frac{k}{e} c_0} \leq c_0 \leq c_{light}. \quad (30a)$$

$c = \text{energy} - \text{mass equivalence constant}$

$c_{\infty} = the\ maximal\ speed\ of\ the\ infinite\ self - mass$

$c_0 = the\ maximal\ speed\ of\ the\ zero\ self - mass\ as\ well\ as\ the\ minimal\ speed\ of\ light$

$k = dynamic\ constant$

$e = base\ of\ natural\ logarithm$

As already mentioned the dynamic constant k is expected to be extremely smallyielding $\frac{k}{e} \leq 2\,x\,10^{-72} kg^2 m^2 s^{-2}$ [2], (34) so according to the equation $(30a)$ the difference between the concerned values is hardly detectable:

$$c = c_{\infty} \leq \sqrt{1 - 2\,x\,10^{-72}} c_0 \leq (1 - 10^{-72}) c_0. \quad (30b)$$

All values $-\,c, c_{\infty,} c_0 -$ of course, equal the official speed of light$c_{light}^{official} = 2.99792458\,x\,10^8 \frac{m}{s}$ [5] since they differ at most on the$72^{th} - decimal$. But in the Heracletean world of the non-zero dynamic constant k lighter photons can significantly exceed this value all the way to the infinite one(28).

12. The Wavelength and Frequency of Photons

Applying Planck relation $E = \frac{hc_{light}}{\lambda}$, equation (28) and the energy-mass equivalence $E = m_{photon}c^2$ the relation between the mass equivalent of photon$m_{photon}$and its wavelength λ is given:

$$m_{photon}c^2 = \frac{hc_{light}}{\lambda} = \frac{hc}{\lambda}\sqrt{1 + \frac{k}{m_{photon}^2 c^2}},$$

$$\lambda = \frac{h}{m_{photon}\,c}\sqrt{1 + \frac{k}{m_{photon}^2 c^2}}. \quad (31)$$

The mass equivalent of photon m_{photon} and its wavelength λ are in inverse proportion independently of the value of the dynamic constant k. For instance, thewavelength λ of the zero mass equivalentof photon$m_{photon} = 0$ is infinite.This means that the fastest light brings the ground momentum $p_{ground} = \sqrt{k}(27b)$from infinity to everywhere.

Applying the relation $c_{light} = \lambda\upsilon$ the relation between the mass equivalent of photon m_{photon} and its frequency ν is given:

$$\upsilon = \frac{c_{light}}{\lambda} = \frac{m_{photon}c^2}{h}. \quad (32)$$

The mass equivalent of photon m_{photon} and itsfrequency ν are in direct proportion independently of the value of the dynamic constant k.For instance, thefrequency $\nu$of the zero mass equivalentof photon$m_{photon} = 0$ is zero.This means that the fastest light brings the ground momentum $p_{ground} = \sqrt{k}(27b)$from infinity all the time.

13. Conclusion Remarks

In the previous presentation of the Panta rei force model[1] the speed of light being ad hoc the upper limit of the domain of the panta rei function$v_{max} = c$ determines the upper limit of its range at$m_{max} = \frac{1}{c}\sqrt{e^{\frac{m_0^2 c^2}{k}}}$. On the contrary, in the present article the upper limit of both intervals is determined by the panta rei function itself. Forreal self-masses the upper limit of range

$m_{max} = \frac{1}{c}\sqrt{e^{\frac{m_0^2 c^2}{k}+1} - k}$ is achieved at the upper limit of the domain$v_{max} = c\sqrt{1 + \frac{k}{e^{\frac{m_0^2 c^2}{k}+1} - k}}$.

The domain beyond this limit is reserved for imaginary self-masses (photons of light) characterised by lower mass equivalents than$\frac{\sqrt{e-k}}{c}$ becoming zero at the infinite speed. The present interpretation of the Panta rei force model takes precedence over the previous one since it can explain some (new) characteristics of light. Under the assumption and in hope, of course, we have been looking for the needle in the right haystack lately.

14. The Addendum

The new upper limit of the domain of the panta rei function leads to the prediction of the $\sqrt{e}$-times smaller value of the size of the point s_{point} as previously predicted[1]:

$$s_{point} = \frac{h}{\sqrt{e}}. \quad (33)$$

The new predicted size of the pointss_{point}(33)leads to the prediction of the $\sqrt{e}$-times smaller value of the dynamic constant $k$as previously predicted[2]:

$$k = \frac{m_e^3 \alpha^3 c^3}{\sqrt{e}} kg^{-1} m^2 s^{-2} = \frac{7.9145\ x\ 10^{-72}}{\sqrt{e}} kg^2 m^2 s^{-2} = 4.8004\ x 10^{-72} kg^2 m^2 s^{-2}. \quad (34)$$

The new predicted value of the dynamic constant k(34)leads to the prediction of the e-times greater value of the size of the entire universe $s_{universe}$ as previously predicted[2]:

$$s_{universe} = \frac{h}{k}\sqrt{e} = 2.276\ x\ 10^{38} m. \quad (35)$$

Respecting the present theory the sub-point and super-universe sizes are reserved for the imaginary self-mass particles, i.e. photons of light.

Acknowledgment

Gratitude to the editors for the fruitful cooperation.

Dedication

This fragment is dedicated to pharmacy as a profession and art.

References

[1] *Špringer J. Panta rei as $F = dp/dt + d(k/p)/dt$ and Possible Geometric Consequences.International Journal of Advanced Research in Chemical Science (IJARCS), Volume 1, Issue 6, August 2014, 36-46.*

[2] *Špringer J. From Dynamic Constant to Inner Energy and Size of Universe. International Journal of Advanced Research in Chemical Science (IJARCS), Volume 1, Issue 10, December 2014, 9-12.*

[3] Gamma Ray Delay May be Sign of "New Physics". http://news.ucdavis.edu/search/news detail.lasso?id=8364, Retrieved February 2015

[4] *Svelto O. Principles of Lasers.5th Edition. Springer, 2009, 153-155.*

[5] CODATA, Values of the Fundamental Constants. http://physics.nist.gov/cgi-bin/cuu/Value?c|search_for=universal_in!. Retrieved February 2015