High energy dimensioning the quantum space-time of the electron

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Abstract

The photon-electron interaction allows to describe a relativistic dynamics of the quantum absorption-emission of the electron, which could provide a description of the primordial universe and the arrow of time, applied to quantum computers, electron microscope and other technologies. The alternatives descriptions for the wave–particle duality have variable interpretations, when came to describe how with a single constitutive mechanism, the photon shows changes on the relationship between electric and magnetic phases, which in the space-time are structured as differentiable responses when acting on a target, manifesting properties of particles (photoelectric), or a wave (in the double-slit experiment). By analyzing the quantum absorption-emission of the electron, quantum properties emerge at the high and low energy extremes. The image sequence of the topographic projection of the unidirectional wave function, suggest that within the particle the incorporated energy, produce orderly patterns conforming energy convection cells of quasi-fractal periodicity. This patterns, in the direction of absorption shows increasing energy levels, decreasing the contour that could be related by the relationship that decreasing entropy increase curvatures, until the Planck limit. If the sequence is examined in reverse, or emission, also shows a proportional correlation between relativistic mass or potential-energy and the curvature of space. Emission increasing entropy, eventually leads to decreasing curvature of the particle, which is revealed by the tendency of internal contour force-lines to become parallel. Scale extrapolation allows postulating, that increasing entropy by decreasing curvature, allows relating space expansion to the universe flatness.

Introduction

The two alternatives descriptions for the wave–particle duality have not been properly applied, when came to describe how with a single constitutive mechanism, the photon become adapted through dephase or changes of phase, to offer alternative responses when acting on a differentiable target, like an electron or a double-slit experiment.
The photon has been described as the mutual perpendicular electric and magnetic fluctuation resulting in the vectorial product or field propagation.

For example, photons of blue light had sufficient energy to free an electron from the metal, but photons of red light did not. This could be explained because the space-time of localization allows the blue photon have the inside of the electron for its coupling manifesting the momentum as resonance a vibration inside the electron whereas the red photon instead is out of the electron because involve a longer space-time. Hence, a circle around like a diffraction interaction the embracing of the electron prevents its delocalization. Hence, only the small photons of higher energy are able to enter the electron orbital within the coincidence of their respective space-time. As a consequence a less energetic photon or their summation of several, would not reach a total to produce the photoelectric response. Therefore, the analyzed experiment is a quantum dimensional phenomenon.

Physical parameters for an electromagnetic propagation on differentiable target and their resultant:

1. The photon (boson) upon impact with the electron (fermion) then receives an electric vector that reconfigures the electrical phase of the wave, coupling for angular momentums that conform to a resulting particle function.

2. The coupling for angular momentums allows for Schrödinger dissociation, when the photon interacts in a double-slit experiment. A boson-slit interaction conforms to a resulting wave function.

The Schrödinger box, relates coulomb walls, generating resonance locus, the latter expression allows assigning oscillatory values to probability density. As well as describing a wave function as fluctuations of the values of energy density in relationship to its locus, either when propagating as wave (λ) or being confined as a particle ($r = \lambda/2\pi$) within the spacetime [1, 2, 3, 4, 5, 6, 7, 8, 9].

The obtained results demonstrate a parallelism between the oscillating properties of density of probability and frequency. The last one is restricted by space to: $c/\lambda=\nu$, this relationship can also be applied to probability density, which is a manifestation of probability, related to evolution of the space dimensions.

Results

Photon-electron interaction

The photon interacts through the coupling of its wavelength with the internal space-time of the electron; increasing its relativistic mass and contracting its associated de Broglie wavelength. For low energy photons the Thompson effect predominates and for high energy photons the Compton scattering [10]. With the use of light pulses at terahertz frequencies, characteristics of the electron's internal quantum space-time emerge, according to new scientific achievements [11].

When an electron moves through a potential difference ΔV, acquires kinetic energy according to: $\frac{1}{2}m\,\mathrm{v}^2 = q\Delta V$. Where, m=[mass]=Kg, v=[velocity]=m/s, q=charge=1.602×10^{-19} C y ΔV =[potential difference]=Volt.

$$\frac{1}{2}m\,\mathrm{v}^2 = q\Delta V \Rightarrow \mathrm{v} = \left(2q\Delta V / m\right)^{1/2}$$

The wavelength associated with the particle is: $\lambda = \frac{h}{p}$, where h is Planck's constant and p is the linear momentum. Entonces, $\lambda = \frac{h}{p} = \frac{h}{\sqrt{2mqV}}$.

The relativistic correction: $\lambda = \frac{h}{\sqrt{2m_0 qV}} \frac{1}{\sqrt{1 + \frac{qV}{2m_0 c^2}}}$

Analyzing access to forbidden light through the simulation of emission-absorption quantum-relativity

If a high energy photon interacts with an electron, the interaction can be described by the Compton scattering relationship or by the 4-vector formulation of relativistic momentum. The wavelength of the photon is coupled to the internal quantum space-time of the electron, increasing its relativistic mass.

In the high-energy Planck limit, when the electron acquires relativistic velocities, extreme quantum properties emerge. The Planck particle contains the maximum energy in the smallest possible space called the Planck wavelength. Therefore, the Planck particle cannot absorb energy (photons).

In extremely low energy quantum systems, quantum properties also emerge. The zero-point energy (ZPE) is the lowest possible energy that a quantum mechanical system may have. Hence, ZPE system is incapable of emitting energy (photons).

Table 1. Emerging quantum properties at high and low energy extremes.

Planck units	**Zero-point energy**
Are a set of units of measurement defined exclusively in terms of five universal physical constants	Is the lowest possible energy that a quantum mechanical system may have
Planck particle cannot absorb energy (photons)	ZPE system (and/or Cooper pair) cannot emit energy (photons)
Analogous conditions at the primordial Universe	Bose-Einstein Condensation conditions

The table 1 shows symmetric properties between the Planck particle and the zero-point energy.

New scientific achievements show use of light pulses at terahertz frequencies (trillions of pulses per second) to accelerate electron pairs, known as Cooper pairs, within supercurrents. This allows access the unique properties of the quantum world, including forbidden light emissions that one day could be applied to high-speed, quantum computers, communications and other technologies.

The study of the Inverse Compton Scattering shows an analogy to the use of light pulses at terahertz frequencies applied to Cooper pairs.

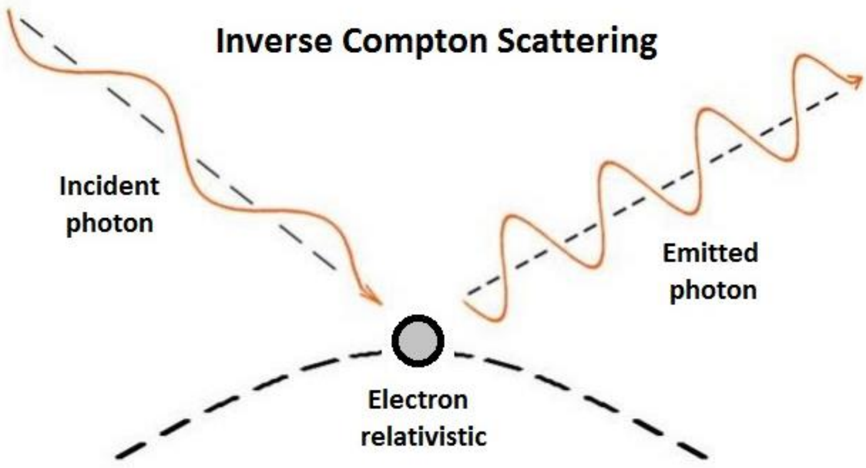


Figure 1. *Inverse Compton Scattering shows that an electron with relativistic energy emits a high-energy photon, greater than the incident photon.*

An electron with very high relativistic velocity acquires a bosonic character unable to absorb photons. Its thermodynamic tendency is dissipative because its quantum space-time cannot accommodate the wavelength of the incident photon. On the other hand, the copper pair and its bosonic character, prevent it from internally accommodating the photons of terahertz frequencies, analogous to what happens with the relativistic electron.

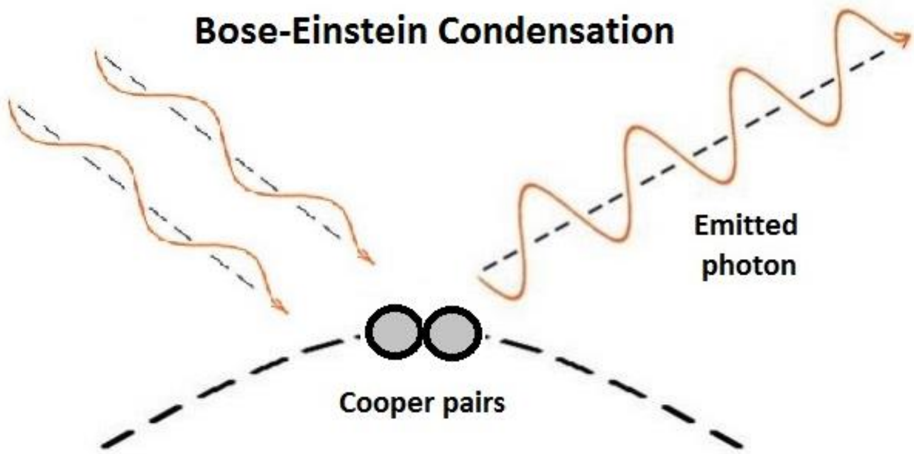


Figure 2. *Bose-Einstein Condensation shows that a Cooper Pairs emits a high-energy photon, greater than the incident photons. The condensation of Cooper pairs is the foundation of the Bardeen–Cooper–Schrieffer theory of superconductivity, which describes superconductivity as a microscopic effect.*

Parameterization of Relativistic mass as a function of a Planck limit

The formula of restricted relativity theory $E_{\mathrm{T}} = \sqrt{p^2c^2 + m^2c^4} = \gamma \times mc^2$ describe the term for absorption of kinetic energy $p \times c$ with lineal momentum p, as the inertial mass $\gamma \times m$, were: dilatation coefficient $\gamma = (1 - \mathrm{v}^2 / c^2)^{-1/2}$, v is the particle velocity and c the velocity of light. Mathematically, if the value of v, becomes close to c, γ will tend to infinity.

However, if the concept that absorption of kinetic energy results in the increment of inertial mass the theoretically limit is the Planck energy: $E_{Pl} = \sqrt{\hbar c^5 / G}$, as a result $E_{Pl} = E_T$. Relativity as well as Quantum Mechanics, established the concept of a maximum reachable limit for a particle, which does not allow that the value **v** could equal to ***c***. If a Planck limit is accepted it allows evaluating the thermodynamic evolution of a particle.

Replacing in the Einstein formula total energy E_T by the Planck energy limit E_{Pl} equivalent, it is obtain the expression:

$$\boxed{\sqrt{\frac{\hbar c^5}{G}} = \sqrt{(m\,\mathrm{v})^2 c^2 + (m)^2 c^4} = \gamma \times mc^2} \quad [1]$$

The limit imposed to the formula, does not contradict the Relativistic interpretation of the increase of inertial mass and the shortening of the particle's length, in the direction of its movement.

However, if the energy transference does not only affect one dimension, could be implied a change of angular frequency given by the expression $E_{Pl} = \omega \times \hbar$, and therefore a shortening of its radius [12, 13]. The electron could be experimentally shown as a particle in rotation. Electron microscopy allows increasing resolution by contraction of the diameter of the particle.

Incorporation of mass

In terms of the hypothesis of De Broglie [14] all mass m, has associate a wavelength λ, by the equation $m\,\mathrm{v} = 2\pi\hbar / \lambda \vee \; m\,\mathrm{v} = h/\lambda$. Consequently this relationship introduce in the expression [1].

1st Evaluation

$$\sqrt{\frac{\hbar c^5}{G}} = \sqrt{(m\,\mathrm{v})^2 c^2 + (m)^2 c^4} = \gamma \times mc^2 \Rightarrow \sqrt{\frac{\hbar c^5}{G}} = mc\sqrt{\mathrm{v}^2 + c^2}$$

$$\sqrt{\frac{\hbar c^5}{G}} = \frac{2\pi\hbar c}{\lambda}\frac{\sqrt{\mathrm{v}^2 + c^2}}{\mathrm{v}}$$ Clearing v it is obtained: $$\boxed{\mathrm{v} = \frac{2\pi c\sqrt{G\hbar}}{\sqrt{c^3\lambda^2 - 4\pi^2 G\hbar}}}$$

Fulfilling the condition: $c^3\lambda^2 - 4\pi^2 G\hbar > 0 \therefore \lambda > 2\pi\sqrt{\frac{G\hbar}{c^3}}$ $\boxed{\lambda > 2\pi \times l_{Pl}}$

The formula shows the relationship between diameter of the particle and the corresponding wavelength.

2nd Evaluation

$$E_{Pl} = \sqrt{(m\,\mathrm{v})^2 c^2 + (m)^2 c^4} = \gamma \times mc^2$$

$$E_{Pl} = mc\sqrt{\mathrm{v}^2 + c^2}$$

$$E_{Pl} = \frac{hc}{\lambda}\frac{\sqrt{\mathrm{v}^2 + c^2}}{\mathrm{v}} \text{ Where: } \boxed{\mathrm{v} = \frac{hc^2}{\sqrt{E_{Pl}{}^2\,\lambda^2 - c^2h^2}}}$$

It must fulfill the following thing: $E^2\lambda^2 - c^2h^2 > 0 \therefore \boxed{\lambda > \frac{ch}{E_{Pl}}}$

Numerically

$$\lambda > \frac{2.9979\times 10^{10}\ \text{cm/s} \times 4.1357\times 10^{-21}\ \text{MeV.s}}{1.221\times 10^{22}\,\text{MeV}} \Rightarrow \boxed{\lambda > 1.015\times 10^{-32}\,\text{cm}}$$

Relation between linear moment and resting mass

$$\sqrt{\frac{\hbar c^5}{G}} = \sqrt{p^2c^2 + m^2c^4} = \gamma \times mc^2 \Rightarrow \frac{\hbar c^5}{G} = p^2c^2 + m^2c^4 = \gamma^2 \times m^2c^4 \Rightarrow$$

$$1 = \frac{p^2c^2G}{\hbar c^5} + \frac{m^2c^4G}{\hbar c^5} = \frac{\gamma^2 \times m^2c^4G}{\hbar c^5} \Rightarrow 1 = \frac{p^2}{p_{Pl}{}^2} + \frac{m^2}{m_{Pl}{}^2} = \gamma^2\frac{m^2}{m_{Pl}{}^2} \Rightarrow$$

$$\boxed{1 = \frac{p^2}{p_{Pl}{}^2} + \frac{E^2}{E_{Pl}{}^2} = \gamma^2\frac{m^2}{m_{Pl}{}^2}}$$

$$p_{Pl} = m_{Pl} \times c \Rightarrow p_{Pl} = 2.17645\times 10^{-8}\ \text{Kg} \times 2.9979258\text{m/s} \ \ p_{Pl} = 6.525\,\text{Kg}\times\text{m/s}$$

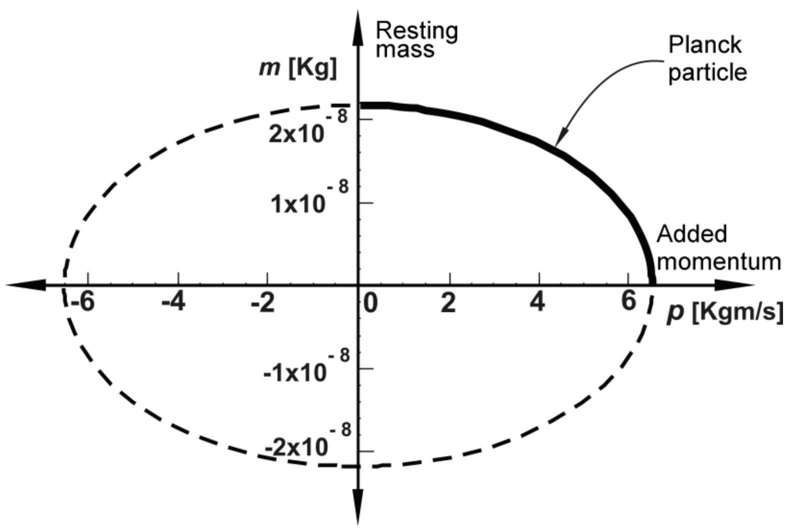


Figure 3. Relation between mass and moment. *In the y-axis, for each value of resting mass, corresponds a complement value for the particle's moment, on the x-axis, to reach the Planck's dimensions, with moment:* $p_{Pl} = m_{Pl} \times c \Rightarrow p_{Pl} = 2.18 \times 10^{-8}\,\mathrm{Kg} \times c \therefore p_{Pl} = 6.525\,\mathrm{Kg} \times \mathrm{m/s}$. *Dark line: physical values; broken-line: mathematical values.*

Quantum parameterization of the Relativistic mass variation by means of the Schrödinger's box

The relativistic treatment can be homologated to the quantum one, by assuming that an electron inside the Schrödinger box (S-box), relate its spatial coordinates to the increase of kinetic energy. Thus, when apply a force able to re-dimension the box, also re-dimensions the electron. Thus, transformation of kinetic energy into mass and contraction width, by means of the γ-coefficient of relativistic dilation: $m = \gamma \times m_0 \wedge l = \frac{l_0}{\gamma}$.

Starting from this relativistic conjecture, it was quantum-assayed the particle's space-time locus as a function of the absorption of energy dimensioned by the γ-parameter.

Within the box the particle has the energy quantified in levels n, where width length of the box "a": $E_n = \frac{n^2 h^2}{8m a^2}$. Assuming, that "a" equals the diameter of the particle ∅, then: $E_n = \frac{n^2 \cdot h^2}{8m \cdot \emptyset^2}$. Applying a work in the x-axis direction which and the relativistic considerations, it is obtained: $E_n = \frac{n^2 h^2}{8(\gamma m_0)\left(\frac{\emptyset}{\gamma}\right)^2} \therefore E_n = \gamma \frac{n^2 h^2}{8m_0 \emptyset^2}$

Hence, acceleration a = dv/dt relates the final and initial energy as follows: $\frac{E_{n-f}}{E_{n-i}} = \gamma$

Particle in a box: an infinite potential well (V(x))

[1] $V(x) = \begin{cases} \infty & \text{si} \quad x < 0 \text{ ó } x > a \\ 0 & \text{si} \quad 0 < x < a \end{cases}$

Applying the Schrödinger equation

1) External region to the well

[2] $\nabla^2 \psi + \frac{2m}{\hbar^2}(E - \infty)\psi = 0$ whose trivial solution is $\psi = 0$

2) Internal region to the well

[3] $\frac{d^2\psi}{dx^2} + \frac{2m}{\hbar^2} E\psi(x) = 0 \wedge 0 < x < a$, making [4] $k^2 = \frac{2mE}{\hbar^2} \Rightarrow \frac{d^2\psi}{dx^2} + \frac{2m}{\hbar^2} E\psi(x) = 0$

The solution is the expression: $\psi(x) = \mathrm{A}\,\mathrm{sen}[kx] + \mathrm{B}\cos[kx]$

As the electron is defined within interval 0 < x <a, must fulfill the conditions of contour: $\psi(0)=0 \wedge \psi(a)=0$. Therefore, $\mathrm{B}=0$ and $\psi(x)=\mathrm{A}\,\mathrm{sen}[k\cdot a]=0$.

Accordingly, $\mathrm{A}\neq 0$, hence $k\cdot a=n\cdot\pi$, or: [5] $k=\dfrac{n\,\pi}{a}$.

From the expression [4] is obtained $k^2=\dfrac{n^2\pi^2}{a^2}=\dfrac{2mE}{\hbar^2}$, with $n=1,2,3\ldots$ the electron cannot have any intermediate value of energy [5] $E=\dfrac{n^2\pi^2\hbar^2}{2ma^2}=\dfrac{n^2h^2}{8ma^2}$.

The wave function $\Psi_{\mathrm{n}}(x,t)=\mathrm{A}\,\mathrm{sen}[\dfrac{n\pi}{a}x]e^{-i\frac{E}{\hbar}t}$ with $0\le x\le a$ and $\Psi_{\mathrm{n}}(x,t)=0$ in $x<0$ or $a<x$.

Renormalizing the wave function: $\int_{-a/2}^{a/2}\Psi_{\mathrm{n}}^{*}(x,t)\Psi_{\mathrm{n}}(x,t)\,dx=1$,

becomes $\int_{-a/2}^{a/2}\mathrm{A}^2\mathrm{sen}^2(\dfrac{n\pi}{a}x)\,dx=1$, then $\mathrm{sen}^2\theta=\dfrac{1}{2}(1-\cos 2\theta)$, whose solution equals: $\dfrac{a\,\mathrm{A}^2}{2}=1\therefore \mathrm{A}=\sqrt{\dfrac{2}{a}}$. Replacing in [5] $\Psi_{\mathrm{n}}(x,t)=\sqrt{\dfrac{2}{a}}\,\mathrm{sen}[\dfrac{n\,\pi}{a}x]e^{-i\frac{E}{\hbar}t}$.

Imposing time independence: [6] $\boxed{\Psi_{\mathrm{n}}(x)=\sqrt{\dfrac{2}{a}}\,\mathrm{sen}[\dfrac{n\pi}{a}x]}$

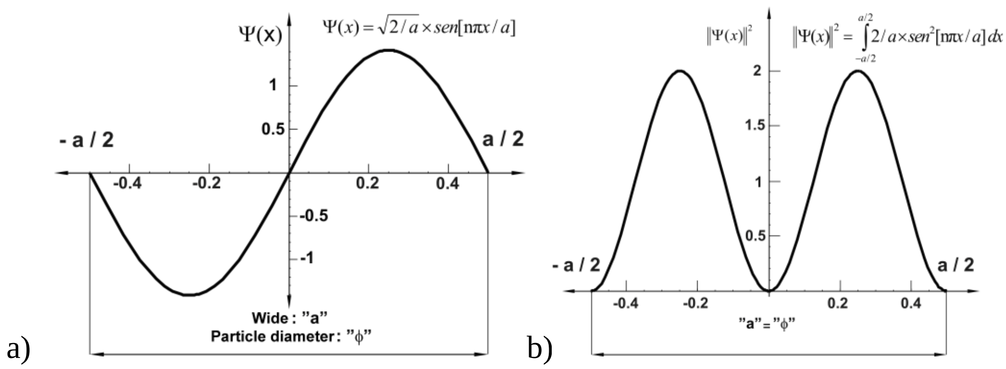


Figure 4: a) Function of wave of the particle. *The equation of Schrödinger is applied so that "a" represents diameter of the particle between -a/2 and a/2, and renormalized amplitude* $\sqrt{2/a}$. ***b) The associate Probability Density.*** *The probability density for the total of energy E of the particle was evaluated between - a/2 and a/2, where it is observed that the distribution is concentrated in the periphery or contour.*

If we considered that an idealized electron could be contained in a one-dimensional of infinite potential-box, moving throughout box interval: $0\le x\le a$, assuming that the width length "a" became as small as the diameter of the electron $\varnothing_{\mathrm{e}}$.

$$\boxed{\Psi_{\mathrm{n}}(x,t)=\sqrt{\frac{2}{\varnothing_{\mathrm{e}}}}\,\mathrm{sen}[\frac{n\pi}{\varnothing_{\mathrm{e}}}x]}$$

\

In the initial condition [1], can be supposed that to "a" varies as does the γ-parameter, by the relativistic relation $a=\frac{a_0}{\gamma}$. Reformulating by means of this idea, the condition [1] results:

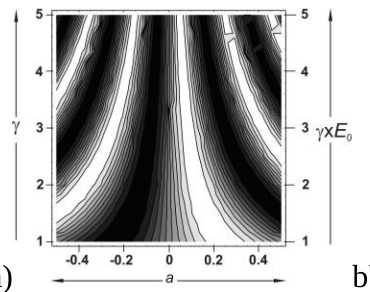
$$V(x)=\begin{cases}\infty & \text{si} \quad x<0 \ \text{ó} \ x>\frac{a_0}{\gamma}\\ 0 & \text{si} \quad 0<x<\frac{a_0}{\gamma}\end{cases}$$ Operating: $$V(x\gamma)=\begin{cases}\infty & \text{si} \quad x<0 \ \text{ó} \ x\gamma>a_0\\ 0 & \text{si} \quad 0<x\gamma<a_0\end{cases}$$

Making a change of variable $x\gamma=u$, it is reached the same conclusion [6]:

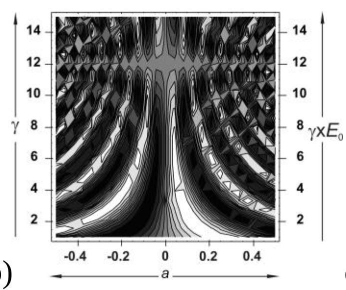
$$\Psi_{\mathrm{n}}(u,t)=\sqrt{\frac{2}{a}}\,\mathrm{sen}[\frac{n\pi}{a}u]$$ That is to say: $$\boxed{\Psi_{\mathrm{n}}(x\gamma,t)=\sqrt{\frac{2}{a_0}}\,\mathrm{sen}[\frac{n\pi}{a_0}x\gamma]}$$

The wave function dependence of parameters x and γ, was described by the constant *n*. Nevertheless, this function describes the evolution of the energy level, as if determined by the changes of frequency. That is to say, without being able to distinguish between the value of n and the one of γ [fig. 3.a)].

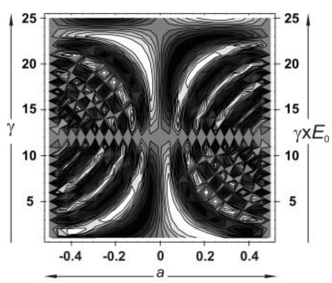
The Parameter $\gamma=(1-\mathrm{v}^2/c^2)^{-1/2}$ is a function of the velocity of the electron in relation to *c*, which causes that its mathematic dominion varies between $1<\gamma<\infty$, but does not reach the infinite value, by the restriction that imposes the energy limit Planck. The variation of parameter γ from 1 to very great values generates in its aspect a characteristic fractal.



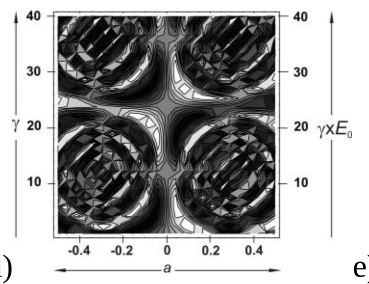
a)



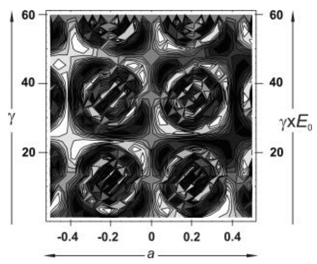
b)



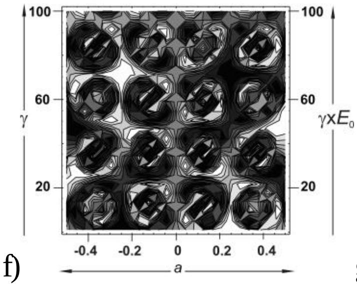
c)



d)



e)

f) 

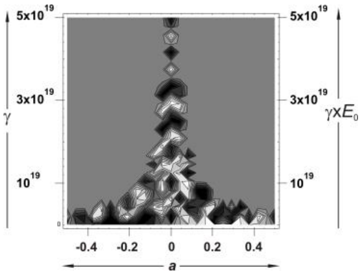
g) 

Figure 5. .a), b), c), d), e), f), g). Topographic projections of the sequence of one-directional wave function. *Applying on the plane $a\times\gamma$, where density is represented by dark zones for valleys and the clear ones for the tops of the wave. The energy either the relativistic* $\boldsymbol{E=\gamma\times E_0}$ *ó* $\boldsymbol{m=\gamma\times m_0}$ *is directly proportional to* $\boldsymbol{\gamma}$*-parameter: a)* $\boldsymbol{m=5\times m_0}$ ***;*** *b)* $\boldsymbol{m=15\times m_0}$ ***;*** *c)* $\boldsymbol{m=25\times m_0}$ ***;*** *d)* $\boldsymbol{m=40\times m_0}$ ***;*** *e)* $\boldsymbol{m=60\times m_0}$ *; f)* $\boldsymbol{m=100\times m_0}$***.***

The figure 5: d), e), g), suggest a continuous reproduction at a different scale, which could be interpreted as pseudo-fractal [15, 16]. The latter, with the characteristic of a feed-back, allows the assumption that the thermodynamics of the particle's structure could be escalated through a large number of energy changes. The E_1-substrate generates E_2-product, which then becomes substrate for the next turnover, allowing an iterative function for energy, $E_2= f(E_1)$ [17], interrupted in the Planck limit [18, 19, 20, 21, 22].

The thermodynamic system, particle plus incoming energy, configure an up-hill staircase increasing enthalpy more than entropy, which inside the particle under the Planck constant would escalate quantum-separated energy potentials. By analogy, could be inferred that the energy became stratified, not too differently from the atomic level, by understanding an orbital as an energy potential. This quantification process, with retention of configuration, at a lower scale, relates increment of the curvature with increment the inertial mass.

Consequently, it is observed that when the S-box it contracted, to reach the Planck values of space-time, leads to a mini black hole. In which since physical laws collapse, it is possible to assume that probability density would disappear dimensionally.

This parallel fate may result as shown in the S-box by a Planck constant-dependent of a quantization process, relating density of energy with probability. Hence, probability density shifts between two values of the space-time, could be regarded as resultant of multiple energy levels within the same space (example: atom) or as a cosmic chronology of probability within expanding space.

The persistence of the angular moment and gravity subsequently to collapse imply a relationship, between increasing mass and angular momentum. The information required to reproduce in pseudo-fractal form the thermodynamic structure, could be a gravitational property to which the S-box shapes as quantum.

This structure collapses gravitationally, because the attraction between the quantum expressions of the internal energy increases as function of their decreasing distance.

The collapse in the Planck horizon, allows that gravity, charge and angular momentum remain as observable [23, 24, 25] within the physical spacetime.

The conjecture of a Quantum Universe could be developed [26] from the assumption of a Planck horizon, from which emerge particles of maximum curvature. Their emission energy, conform a downhill dissipative potential, allowing that the internal structure evolve into a decreasing curvature, as function increasing entropy, by reverting direction from g) to a) in figure 3.

Hawking's formula: $S = \frac{\pi c^3 k}{2hG}\mathrm{A}$ or $S = \frac{c^3 k}{4\hbar G}\mathrm{A}$, correlates entropy S with A the horizon area of the black hole, from where the energy could not escape (alternatively from the universe itself). This also, could be described as a proportional relationship to curvature α, or $\mathrm{A} \propto \alpha$.

This area could only increase by increment of mass or by Hawking's radiation emission, coupled to a decrease of angular momentum. If the big black hole does not absorbed energy, assuming a stable mass, then the Hawking radiation increases entropy and area.

Accordingly, the area could growth by aggregation of black holes, but also at the Big-Bang primordial conditions, would be chain of emerging Planck particles equivalent to mini-black holes. These, could be integrated within inflationary space, allowing their individual dissipation by black body emission from the 5×10^{-44} seconds on. The latter, could be comparable to Hawking's radiation, but one processes could be consider explosive, when referred within our time scale. But, the primordial event within a Planck to inflation scale would proceed gradually, with diminution of angular momentum along the increase of entropy and area of the energy locus. Therefore, the process of primordial particle aggregation and dissipation, as well as the generation of spacetime would manifest a flatness tendency.

Hence, the emission sequence leading to cosmic expansion also can be characterized as correlation between dissipating energy potential levels, decreasing the space curvature [27, 28, 29, 30, 31, 32]. The thermodynamic evolution illustrated by figure 3.a), shows lines of force tending to became parallel. The S-box can be dimensioned to cover not only local locus of energy but also could be applied to the matter-radiation system. In other words, allowing correlating expansion with increasing entropy of the universe itself and its tendency to flatness.

Evolution of the Planck particle as a function of energy emission

Following an argument similar to the deduction of the function of a relativistic wave, a priori, a wave function could be obtained that includes the particle Planck, configured within a time independent but one-dimensional increasing S-box.

$$\Psi_{\mathrm{n}}(x) = \sqrt{\frac{2}{a_0}}\,\mathrm{sen}[\frac{n\pi}{a_0}\frac{x}{\mathbf{y}}]$$

Renormalization: The probability density P(x) function for the interval is obtained $-a/2 < x < a/2$ that must be equal to the value P (x) = 1, with **y** as its proportional factor.

$$P_{(x)} = \int_{-\infty}^{\infty} \Psi(x)^{*}\Psi_{\mathrm{n}}(x)\,dx = \int_{-a/2}^{a/2} \sqrt{\frac{2}{a_0}}\,\mathrm{sen}[\frac{\pi}{a_0}\frac{x}{\mathbf{y}}]\,dx \Rightarrow$$

$$P_{(x)} = \frac{1}{a_0}\int_{-a/2}^{a/2} (1-\cos[\frac{2\pi}{a_0}\frac{x}{\mathbf{y}}])\,dx \Rightarrow P_{(x)} = 1 - \frac{\mathbf{y}\,\mathrm{sen}[\frac{\pi}{\mathbf{y}}]}{\pi} = 1 \quad P_{(x)} = 1 - \frac{\mathbf{y}\,\mathrm{sen}[\frac{\pi}{\mathbf{y}}]}{\pi}$$

Of the condition P (x) = 1, is deduced that, $\mathbf{y}\times\sin[\pi/\mathbf{y}] = 0$. Therefore, and it takes values 1/1, 1/2, 1/3,… , 1/n, redefining in the quantizing by $\mathbf{y}_{(\mathrm{n})}$.

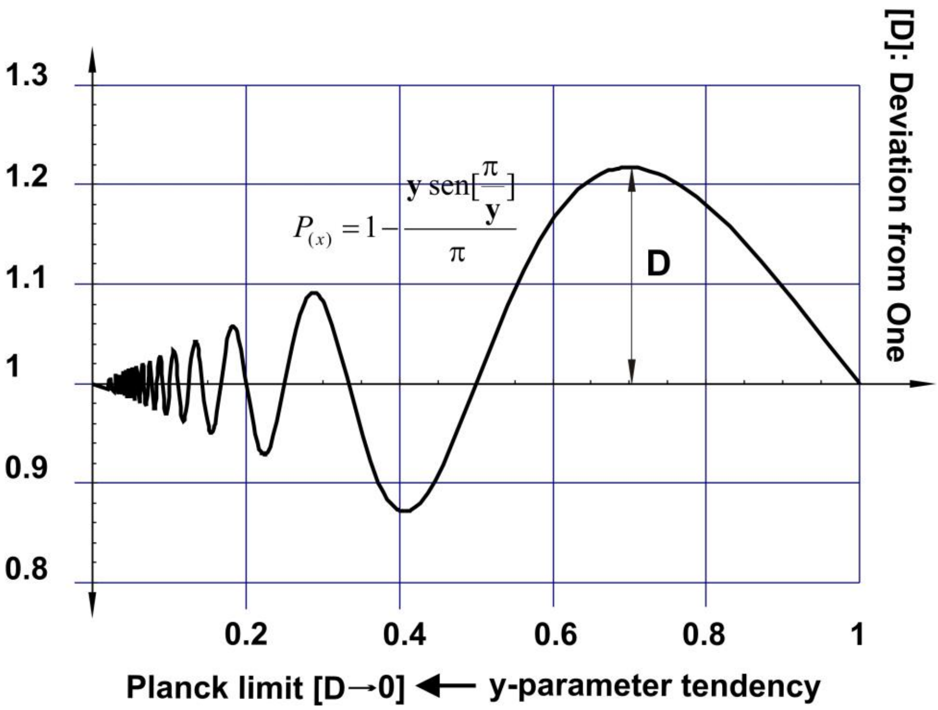


Figure 6. *Graphics of probability density for emission, as function of the **y**-parameter. The probability density for the interval - a/2 < x < a/2, must be equal to the value P (x) = 1. Of the probability condition P (x) = 1, is deduced that,* $\mathbf{y}\times\sin[\pi/\mathbf{y}] = 0$. *Therefore, n values 1/1, 1/2, 1/3,… , 1/n, redefining the quantizing values by* $\mathbf{y}_{(n)}$.

Discussion

Thermodynamics defines as an open system, the one which allows the input and output of matter and energy [33]. To distinguish between both, could make sense in Biology but not in Physics, because of the mass to energy equivalence. It was decided to examine energy absorption, in a different context than that of emission, because the first one is a quasi-open system to the input of energy. The second one emission is a graded relationship between temperatures and the generated spectra, the outcome of quantification at the primordial Planck horizon.

The Einstein formula was applied as a theoretical description of a particle evolutionary state as a function of energy input, within a particle accelerator of unlimited potential. In this one, the velocity of a particle could be related to the input energy level, but could not surpass cither c or acquire inertial mass beyond the Planck limit. In this case, the Einstein formulation could be applied, like a process of quantum accumulation of energy as mass and momentum.

Independently of the structure of the initial primordial particle, at the Planck limit could be assumed, that gravity could pull the particle to join larger black holes, and the resulting entities become defined only by the parameter of mass, angular and momentum. This collapse process relates entropy with the area of the horizon.

Emission or the transformation of mass in energy is quantified by temperature: $T = \frac{hc^3}{16\pi^2 Gmk}$, which also may play the role of activation energy. This process, in term of temperature, becomes spontaneous, and allows an equivalence of Planck mass to Planck temperature 10^{32} K. Dissipating mass by black body spectrum stretches-out space. These, creates a thermodynamic arrow of time, strengthened by the difference of scales between temperature-spectra, which by decreasing tendency to superposition, adds to the arrow irreversibility.

The wave function associated to a particle in movement, could be conceptually analyzable by a Schrödinger box (S-box). The latter, by its widening could simulate emission of energy, and by width contraction absorption, with respectively a decrease and an increase in enthalpy. These changes are scalable like energy levels or potentials, linked to the respective decrease and increase of the particle-box tendency of curving space.

The thermodynamic openness, allows a laser by continuous injection of energy, to support a potential with photon-emission at constant wavelength. The results support the idea of a particle as a thermodynamic system, open to input of kinetic energy and temperature dependent output. Hence, absorption appears to allow the generation of subjacent levels of energy, within the simplest system, an electron, accelerated up to the Planck limit.

The inertial mass tends to resting mass, by decreasing speed, allowing dissipation of potential through radiation. This effect, by the mass-energy equivalence, allows considering radiation as a resulting from potentials dissipating by temperature the energy gradient.

Hence, to idealize the Big-Bang as an explosion [34] should not be regarded as incompatible with a black body emission generating a spectrum, because the scale is a determinant of abruptness of the thermodynamic events [35, 36]. Accordingly the progression of the gradual dissipation of the energy potential between temperatures levels could therefore be coupled to expansion.

Hence, by decreasing frequency a wavelength-spectrum it's generated with a λ-peak incrementing proportionally to the decreasing potential between energy levels. The universe as a close system with the summation of entropy and enthalpy as constant total energy could decrease potential-temperature. The Inflationary Era could be explained by a simultaneous and cooperative incoming of Planck particles into ordinary space plus their black body emissions; where the Expansion Era depends only from emission itself.

Conclusions

The absorption of kinetic energy into inertial mass was studied as a wave function by application of Einstein's TTR restricted by quantum mechanics. The relativistic γ-parameter, was shown as subject to quantification, and capable to induced a particle contraction. Moreover, it was revealed to absorbed energy into differentiate potential levels. Hence, providing a factor *n*, which relates energy as a functional stages of Ψ, restructuring the particles into concentrically layers of energy.

The photon interacts through the coupling of its wavelength with the internal space-time of the electron; increasing its relativistic mass and contracting its associated de Broglie wavelength.

The conclusion is that the electron has most of the energy after the collision involves transforming the momenta to the zero-momentum frame, which diminishes the momentum of the photon while increasing that of the electron. Then the momenta exchange upon collision in the zero momentum frame. Then you make the reverse transformation which further transference of the magnitude of the photon momentum to increase the electron momentum. For the example used here, the electron gets most of the energy.

This idealization was obtained by simulation that the particle was enclosed in Schrödinger box (S-box). The absorption of kinetic energy was shown along the wide direction of the S-box, which represented the particle's diameter. Hence, increments of energy within the particle became stabilized like inertial mass, which correspond to potential-energy levels. Hence, the S-box could be used to simulate the contraction of the particle, as a function of the supply of energy by a particle accelerator or potential amplifier.

An electron with very high relativistic velocity acquires a bosonic character unable to absorb photons. Its thermodynamic tendency is dissipative because its quantum space-time cannot accommodate the wavelength of the incident photon. On the other hand, the copper pair and its bosonic character, prevent it from internally accommodating the photons of terahertz frequencies, analogous to what happens with the relativistic electron.

This process of inertial mass accumulation and its reverse energy emission, simulate respectively, the increase and decrease of the quantum states of a particle's endogenous energy-potential. Both, directional states could be spontaneous, but are asymmetric pathways, since absorption requires coupling to a source of energy. Emission would be a downhill generation of black body radiation. The direction for a potential increment, has to be associated with the net increment of enthalpy by the increment in total energy, $\Delta E=\Delta H+T\Delta S$. The latter, allows that enthalpy, could increase more than a simultaneous increase of entropy. However, for a decreasing potential, entropy could increase at the expense of decreasing enthalpy.

The Planck energy limit of absorption, leads the particle to collapse into a mini black hole, decreasing its complexity trough the relationship between area and entropy. Hence, the Hawking's radiation should be regarded as a downhill black body emission. To differentiate primordial energy from a mini black hole should be emphasized required contour considerations. In the present universe, the latter would have the tendency by mutual gravitational attraction to join other black holes.

However, within the primordial Inflationary event, contour flatness prevents implosion by gravitational attraction, accordingly to the following:

1. Critical mass could not be reach instantaneously and accumulation of Planck particles becomes a simultaneous function of their evaporation rate 5×10^{-44} seconds. This is a very short period, in term of inflation lasting 10^{-33} seconds, the large exponential time difference, allows their accumulation of 1.4×10^{60} Planck particles.
2. The time span of Inflation has been described, as resulting of the cooperative interaction which allows reaching primordial critical mass, but as an array of escalated spectra between sequence influxes of Planck particles, which are also decaying by black body emission [37].

The velocity resulting from this joint cooperative interactions, that jointly generates spacetime, if were consider as a single phenomenon, would exceed by much the velocity of light, but only because have not been separately computed. The spacetime required for gravitational effects is insufficient, to allow two Planck particles or mini black holes to join each other. Therefore, a sequentially influx, allows the first particle to become evaporated, before the second one enters into the ordinary space generated by radiation. Hence, the Planck radiation allows the coupling summation of spacetime avoiding a gravitational collapse.

Flatness could be maintained during expansion, because the temperature dissipative quantum potential, allows spectra of longer and longer wavelength. This is a process, which by itself is not subject to gravitation, even if photons are. Hence, the intergalactic recession, could be explained by the space increment, as a function of the increasing number-elongation of CMB-photons [38]. Thus, determining the size of voids and decreasing gravitational effect. The latter, even decreasing with distance, still was strong enough to form cumulus and super-cumulus.

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